

**MINISTRY OF HEALTHCARE OF UKRAINE  
BOGOMOLETS NATIONAL MEDICAL UNIVERSITY**

“Approved”  
at the Department №2 of  
Hygiene and Ecology  
meeting  
from \_\_\_\_\_ 20\_\_.

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“ \_\_\_\_\_ ” \_\_\_\_\_ 20\_\_ .

## **STUDY GUIDE**

<i>Discipline</i>	Occupational (Labor) hygiene
<i>Module № 1</i>	Occupational health in the field
<i>Module № 2</i>	Occupational health issues in the medical field
<i>Topic</i>	ANALYSIS OF ACCIDENTS IN THE MEDICAL FIELD
<i>Course</i>	II, III
<i>Faculties</i>	Medical №1-4, FTDAFU, dentistry, medical-psychology.

MINISTRY OF HEALTHCARE OF UKRAINE  
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DEPARTMENT №2 OF HYGIENE AND ECOLOGY

METHODOLOGICAL RECOMMENDATIONS

**ANALYSIS OF ACCIDENTS IN THE MEDICAL FIELD**

Kyiv-2020

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## 1. Relevance of the topic:

Occupational diseases are unique in the sense that the hazards that cause them are known even before exposure of the workers takes place. This fact characterizes occupational diseases as being entirely preventable: exposure can be controlled or prevented. 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 minimize the damage 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 or other tests that have been developed to detect these early changes, each exposure having its specific test.

Unfortunately, there are other occupational diseases, which cannot be detected at a reversible stage. These include acute reactions to irritant gases, e.g. ammonia, asphyxiants, e.g. CO and hydrocyanic acid, and corrosive materials, e.g. acids and alkalis; collagenous pneumoconiosis, e.g. silicosis and asbestosis; occupational cancer, and many other conditions.

Occupational health and safety (OHS) covers staff health, safety and welfare in the workplace. OHS is particularly important in public hospitals because major hazards exist—such as exposure to infectious and chemical agents, manual handling of patients and materials, slips, trips, falls, and occupational violence. These hazards can lead to musculoskeletal injuries, acute traumatic injury, infections such as hepatitis and potentially even death. The impact of poor OHS is felt not just by affected staff, but also by the patients they are treating.

A health care facility is a workplace as well as a place for receiving and giving care. Health care facilities around the world employ over 59 million workers who are exposed to a complex variety of health and safety hazards everyday including:

- biological hazards, such as TB, Hepatitis, HIV/AIDS, SARS;
  - chemical hazards, such as, glutaraldehyde, ethylene oxide;
  - physical hazards, such as noise, radiation, slips trips and falls;
  - ergonomic hazards, such as heavy lifting;
  - psychosocial hazards, such as shiftwork, violence and stress;
  - fire and explosion hazards, such as using oxygen, alcohol sanitizing gels;
- and
- electrical hazards, such as frayed electrical cords.

Health-care workers (HCWs) need protection from these workplace hazards. Yet, because their job is to care for the sick and injured, HCWs are

often viewed as “immune” to injury or illness. Their patients come first. They are often expected to sacrifice their own well-being for the sake of their patients. Indeed health protecting health-care workers has the added benefit to contributing to quality patient care and health system strengthening. Some of the same measures to protect patients from infections, such as adequate staffing, protect health-care workers from injury.

**2. Objective:**

1. To identify causes of accidents in the workplace and their classification.
2. To identify occupational diseases and traumas among healthcare workers and their remedies. Differentiate between occupational diseases and work-related diseases.
3. Learn about modern approach to analysis of accidents in the workplace and their prevention.

**3. Basic knowledge, abilities, and skills needed in order to study the topic (interdisciplinary integration).**

Names of previous disciplines	Skills acquired
1. Human Anatomy	<p>To analyze information on the organization of the human body, as well as the systems, organs, and tissues that that comprise it.</p> <p>To identify the topographic-anatomical relationships of human organs and systems.</p>
2. Medical and Biological Physics	<p>To explain the physical principles and biophysical mechanisms of the influence of external factors on human body systems.</p> <p>To evaluate the general physical and biophysical regularities that form the basis of human vital activities.</p>
3. Medical Chemistry	<p>To interpret types of chemical equilibrium in order to formulate an integral physicochemical approach to the study of the body’s vital processes.</p> <p>To use chemical quantitative and qualitative analysis techniques.</p> <p>To classify the chemical properties and transformations of bioinorganic substances over the course of human vital activities.</p> <p>To evaluate the general physicochemical regularities that form</p>

	the basis of human vital activities.
4. Microbiology, Virology, and Immunology	To interpret the biological properties of pathogenic and nonpathogenic microorganisms and viruses, as well as the regularities of their interaction with macroorganisms, the human population, and the external environment.
5. Normal Physiology	To analyze the state of human health under different conditions based on physiological criteria.
6. Biological Chemistry	To interpret the importance of biochemical metabolic processes and their regulation in ensuring the functioning of organs, systems, and the human body as a whole.
7. General Hygiene and Human Ecology	To analyze the status of the environment and the effect of its factors on the health of different segments of the populace. To interpret the basic laws of health science, as well as the general regularities of the interrelationship of health with vital environmental factors and conditions.

#### 4. Assignments for unsupervised work when preparing for the lesson.

##### 4.1. List of basic terms, parameters, and characteristics that a student must master when preparing for the lesson:

Term	Definition
Occupational accident	An occupational accident is a sudden and unexpected accident caused by external factors due to which the employee suffers injuries. As an occupational accident is considered an accident occurring in the workplace or on the way home from work or vice versa or while the employee is away on a business trip or running an errand ordered by the employer.
Acute occupational disease	Intoxication: intoxication happens suddenly, after a one time impact of relatively high concentration of chemicals (for not more than one shift) caused by contamination of the work zone.
Occupational disease (chronic)	An “occupational disease” is any disease contracted primarily as a result of an exposure to risk factors arising from work activity.
Work-related disease	“Work-related diseases” have multiple causes, where factors in the work environment may play a role, together with other risk factors, in the development of such diseases.
Fatigue	Fatigue is physical and/or mental exhaustion that can be triggered by stress, medication, overwork, or mental and physical illness or disease.
Napping	Sleep lightly or briefly, especially during the day
Biological	A biological rhythm is any cyclic change in the level of a bodily

rhythm	chemical or function.
Circadian rhythm (clock)	The cyclical 24-hour period of human biological activity. Disruption of the clock or its synchronization occurs during jet-lag, shift work and old-age. It affects our well-being and mental and physical performance.
MSD	Musculoskeletal disorder: if you've injured your neck or back on the job, you've likely experienced a musculoskeletal disorder. A musculoskeletal disorder, often called MSD for short, is defined as a problem that occurs at work — even if it takes a while to develop — that affects your nerves, muscles and/or tendons.
LBP	Lower back pain is a common disorder involving the muscles, nerves, and bones of the back.
Blood-borne pathogens	Pathogenic microorganisms that are transmitted via human blood and cause disease in humans. They include, but are not limited to, Hepatitis B virus (HBV) and human immunodeficiency virus (HIV)
Seroconversion	The time period during which a specific antibody develops and becomes detectable in the blood
Ergonomics	An applied science concerned with designing and arranging things people use so that the people and things interact most efficiently and safely.

#### **4.2. Theoretical questions for the lesson:**

1. Relevance of OHS
2. Causes of accidents and results.
3. List source causes of accidents.
4. Classification of accidents.
5. Test yourself on the knowledge and understanding of the terms (see 4.1).
6. Fatigue: types, causes and remedies (napping)
7. Occupational diseases and traumas among healthcare workers. Lower back pain (LBP).
8. Infectious diseases: bloodborne and airborne.
9. Work-related diseases.
10. Prevention of occupational and work-related diseases.
11. OHS in public hospitals.

#### **4.3. Tasks to be completed during the lesson:**

Task 1. Study the table above on the cause-result accident sequence.

Read the definitions of terms presented in the table (personal factor, source causes, unsafe act, unsafe conditions, etc.)

Task 2. Using your experience or imagination, come up with examples of situations/actions that arise in the workplace based on the following categories

listed above: conflicting motivations, basic types of direct causes, and basic types of unsafe conditions. *For example, an illustration of “conflicting motivations: avoiding discomfort” may be a nurse that may not wear a mask when working with patients, who are contagious and becomes contaminated (tuberculosis, ebola, the flu).*

### **5. Topic content:**

A healthy workforce is vital for sustainable social and economic development on global, national, and local level. Occupational health problems have gradually increased in type and magnitude and have led to or aggravated diseases resulting from exposure to several risk factors, one of which is the work environment. Examples include chronic obstructive pulmonary disease, which is mainly caused by smoking, but may be aggravated by irritant gasses or dusts in the workplace. Low back pain syndrome has several risk factors including rheumatic disorders, scoliosis and inappropriate posture at work. Work-related musculoskeletal system diseases are commonly observed among nurses, physiotherapists, dentists, and dieticians.

Hand washing is a mandatory requirement to prevent transmission of disease. On the other hand, hand washing exposes a person to an extraordinary amount of contact with water and soap/cleansing agents. This chronic exposure can result in irritant hand dermatitis. Healthcare workers are at risk of allergic diseases such as occupational asthma and allergic rhinitis.



Fig. 1. The case-result accident sequence ( J. Stranks. 2005)

<b>INDIRECT CAUSES</b> <i>PERSONAL FACTOR</i> Definition: Any condition or characteristic of a man that causes or influences him to act unsafely.	<b>DIRECT CAUSES</b> <i>UNSAFE ACT</i> Definition: Any act that deviates from a generally recognised safe way of doing a job and increases the likelihood of an accident.	<b>THE ACCIDENT</b> Definition: An unexpected occurrence that interrupts work and usually takes this form of an abrupt contact.	<b>DIRECT RESULTS</b> Definition: The immediate results of an accident.	<b>INDIRECT RESULTS</b> Definition: The consequences for all concerned that flow from the direct result of accident.
1) Knowledge and skill deficiencies (a) Lack of hazard awareness (b) Lack of job knowledge (c) Lack of job skill 2) Conflicting motivations (a) Saving time and effort (b) Avoiding discomfort (c) Attracting attention (d) Seeking group approval (e) Expressing resentment 3) Physical and mental incapacities	<b>BASIC TYPES</b> 1) Operating without authority 2) Failure to warn or signal 3) Using defective equipment 4) Hourseplay 5) Failure to use protection <b>UNSAFE CONDITIONS</b> Definition: Any environmental condition that may cause or contribute to an accident.	<b>BASIC TYPES</b> 1) Struck by 2) Contact by 3) Struck against 4) Contact with 5) Caught in 6) Caught on 7) Caught between 8) Fall on same level 9) Exposure 10) Overexertion/strain	<b>BASIC TYPES</b> 1) 'No results' or near miss 2) Minor injury 3) Major injury 4) Property damage	<b>FOR THE INJURED</b> 1) Loss of earnings 2) Disrupted family life 3) Disrupted personal life 4) And other consequences <b>FOR THE COMPANY</b> 1) Injury costs 2) Production loss costs 3) Property damage costs 4) Lowered employee morale 5) Poor reputation 6) Poor customer relations 7) Lost supervisor time 8) Product damage costs
(a) Saving time and effort (b) Avoiding discomfort (c) Attracting attention (d) Seeking group approval (e) Expressing resentment 3) Physical and mental incapacities	<b>BASIC TYPES</b> 1) Inadequate guards and safety devices 2) Inadequate warning systems 3) Fire and explosion hazards 4) Unexpected movement hazards 5) Poor housekeeping 6) Protruding hazards 7) Congestion, close clearance 8) Hazardous atmospheric conditions 9) Hazardous placement or shortage 10) Unsafe equipment defects 11) Inadequate illumination, noise 12) Hazardous personal attire			

Although it is possible to prevent or reduce healthcare worker exposure to these hazards, healthcare workers continue to experience injuries and illnesses in the workplace. Cases of nonfatal occupational injury and illness with healthcare workers are among the highest of any industry sector. That is why there has always been the need for understanding actual causes of accidents. Research into this topic has shown that mostly two factors are most relevant:

- unsafe working environment and/or equipment
- human factor.

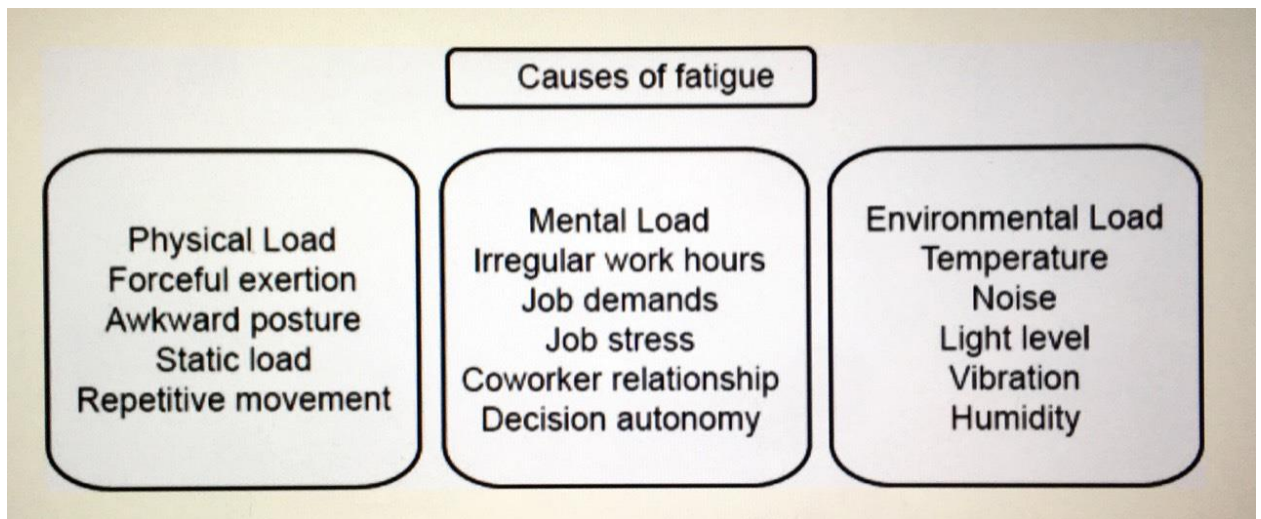
Essentially, all accidents are caused by one or more events, which lead to the accident and result in injury. Unsafe acts and /or not following safety rules and guidelines as well as unsafe conditions directly cause accidents. However, indirect causes of accidents are people related and have to do with inadequate knowledge or poor safety specification and design of work equipment ( **Fig. 1.** J. Stranks. 2005).

The accident, such as a slip, trip or fall, is the cause of the injury and the direct result of the accident. The indirect results of the accident can be significant for both the injured person and the organization in terms of loss of earnings and earning capacity for the injured and, for the organization, poor reputation as a result of bad publicity.

**Source causes** are any circumstances that may cause or contribute to the development of an unsafe condition. Major sources include:

- **Management:** failure by management and supervision to inform, instruct, maintain and lead in safety procedures
- **Employees:** failure to follow a specific safety procedure
- **Maintenance employees:** inadequate or careless maintenance of the medical facility/equipment
- **Design and engineering:** ineffective safety devices on equipment
- **Wear and tear:** of protective gear and equipment
- **Lack of preventive maintenance**

*Fatigue.* Fatigue is a work place hazard and can be associated with safety and health of the worker. It affects the health and safety of both the employee and his/her colleagues. The term “fatigue” had a widespread usage in occupational medicine. Workers’ fatigue is a significant problem in modern industry, largely because of high demand jobs, long duty periods, disruption of circadian rhythms, and accumulative sleep debt that are common in many industries.



**Fig. 2.** K. Sadeghniaat-Haghighi, Z. Yazdi. 2015.

Fatigue affects all workers regardless of skill, knowledge, and training. It directly influences their physical and mental abilities necessary for carrying out even simple tasks. Fatigue causes decreased task motivation, longer reaction time, reduction of alertness, impaired concentration, poorer psychometric coordination, problems with memory and information processing, and poor judgment. It is estimated that fatigue in the workplace is costing more than 18 billion dollars a year in the USA alone.

A study has shown that among physicians and nurses accumulation of sleep loss and fatigue during successive (overtime) work shifts gave a rise to accident rates and errors.

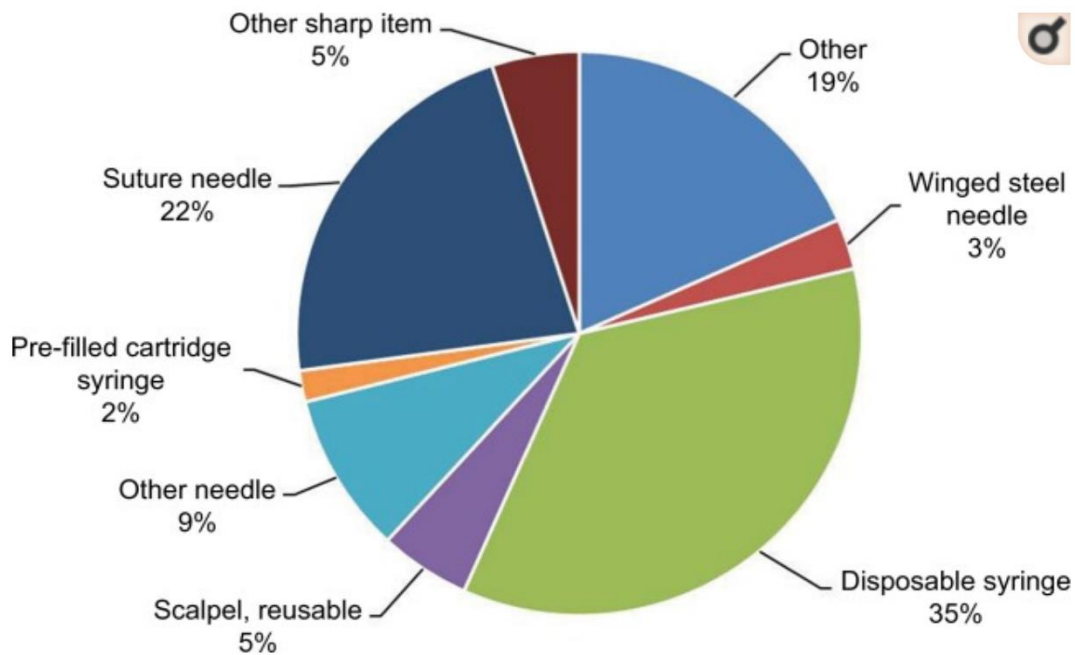
*Fatigue management.* It is necessary to consider ranges of strategies to address the different types and causes of fatigue. Since circadian disruption is the most important cause of fatigue, preventive strategies are designed to decrease the impact of circadian disruption and sleep loss on performance and alertness during the job. Some of these strategies including minimize sleep loss, naps during night shifts, education of good sleeping habits to workers, stimulators, and acceleration in circadian adaptation to different shift types.

Napping as a fatigue countermeasure has been found to be effective for shift workers. Many researches showed that short naps improved both the mood and performance. Also it was found that a 30 min nap in subjects decreased sleepiness and increased alertness.

*Common accidents which cause infectious occupational diseases.*

Needlestick injuries (NSIs) from a contaminated needle put healthcare workers (HCWs) at risk of becoming infected with a blood-borne virus and suffering serious short- and long-term medical consequences. Hypodermic injections using disposable syringes and needles are the most frequent cause of NSIs. The use of safety devices that cover the needle-tip after hypodermic injection lowers the risk of NSI per HCW by 43.4%-100% compared to conventional

devices. The economic value of converting to safety injective devices shows net savings, favorable budget impact, and overall cost-effectiveness.



**Fig. 3.** Cooke CE, Stephens JM, 2017

While less than 10% of the HIV positive persons among healthcare workers are the result of exposure at work (needlestick injuries) 95% of the HIV occupational seroconversions are preventable with practical, low-cost measures and have the co-benefit of preventing exposure to other bloodborne viruses and bacteria.

#### *Occupational and work-related diseases.*

Occupational diseases are at one end of the spectrum of work-relatedness 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 vary.

#### *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, a work-related disease or aggravation of a concurrent disease, eg.

- 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 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 center. Of course

infection can also occur in the general population under non-occupational conditions.

- Work-related diseases occur much more frequently than occupational diseases. Occupational 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.
- Individual susceptibility to the effects of some occupational exposures varies. Genetic factors are important determinants of individual susceptibility.

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. heat, noise, radiation
- Chemical: e.g. solvents, pesticides, heavy metals, dust
- Biological: e.g. tuberculosis, hepatitis B virus, HIV
- Ergonomic: e.g. improperly designed tools or work areas, repetitive motions, lifting heavy objects (patients)
- 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 disease may occur after the termination of exposure. An extreme example would be asbestos-related mesothelioma (a cancer affecting the lung and abdomen) which can occur 30 to 40 years after the exposure.

The clinical manifestations of occupational disease 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.

### **Prevention of occupational diseases.**

Prevention is most commonly achieved 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 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 airborne hazards. These are known as engineering controls.

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

Work-related diseases affect the worker in a number of ways: they may be partially caused by bad working conditions and aggravated, accelerated or enhanced by workplace exposures, all of which in turn worsens the person's working capacity. Work-related diseases are often more common than occupational diseases and therefore deserve close attention by the health service infrastructure.

The work-related diseases which deserve particular attention are:

Behavioral and psychosomatic disorders

### **Locomotor disorders**

Rates of musculoskeletal injuries from overexertion in healthcare occupations are among the highest of all U.S. industries. Data from the Bureau of Labor Statistics (BLS) show that in 2014, the rate of overexertion injuries averaged across all industries was 33 per 10,000 full time workers. By comparison, the overexertion injury rate for hospital workers was twice the average (68 per 10,000), the rate for nursing home workers was over three times the average (107 per 10,000), and the rate for ambulance workers was over five times the average (174 per 10,000).<sup>1</sup> The single greatest risk factor for overexertion injuries in healthcare workers is the manual lifting, moving and repositioning of patients, residents or clients, i.e., manual patient handling.

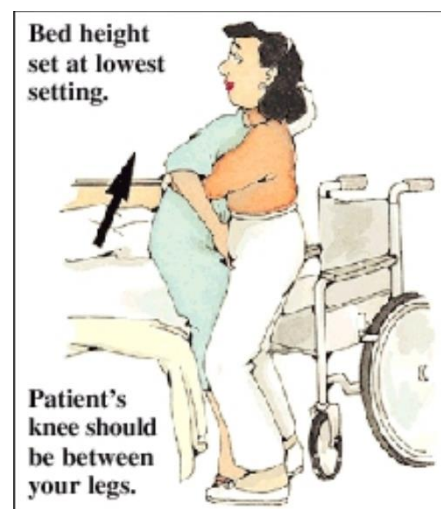
Two examples of locomotor disorders are lower back pain (LBP) syndrome and shoulder-neck pain syndrome. LBP is most commonly diagnosed in persons between the ages of 25 and 64. It affects over half the working population at some time during their active working life. The most common type of occupational LBP

is nonspecific, of indeterminate pathology and often associated with posture, lifting of heavy objects and injurious (twisting) movements. Certain medical professions carry a higher risk of developing low back pain. These include ... These occupations require proper selection, physical training, proper placement and adoption of safe criteria for load lifting.

Disorders associated with general muscle weakness and general malaise, such as infections, may also result in an increased susceptibility to shoulder and neck complaints from loads on the shoulder which a worker can normally tolerate. Further proof of the work-relatedness of shoulder and neck pain is presented by the fact that application of ergonomic principles to improve methods of work reduces the pain.

Evidence-based research has shown that safe patient handling can significantly reduce overexertion injuries by replacing manual patient handling with safer methods guided by the principles of "Ergonomics." Ergonomics refers to the design of work tasks to best suit the capabilities of workers. In the case of patient handling, it involves the use of mechanical equipment and safety procedures to lift and move patients so that health care workers can avoid using manual exertions and thereby reduce their risk of injury.

The National Institute for Occupational Safety and Health (NIOSH, USA) researchers developed guidelines to determine weight limits for preventing back injuries caused by manually lifting objects on the job. Research studies have validated the equation's usefulness for computing safe weight limits when lifting inanimate objects such as boxes and other packages. As a matter of policy, NIOSH recommends its use for that purpose.





Public hospitals present hazardous challenges that demand OHS management of the highest standard. It has been found that while there are instances of better practices among audited public hospitals, there are also significant shortcomings, which put staff at unnecessary risk. Unfortunately, insufficient priority is often given to OHS in public hospitals. Staff safety needs to be given a higher priority by senior management and the department, and managers within public hospitals should be held to account for the OHS performance of areas under their control. Sustained improvement in the public hospital safety culture is not likely to occur without greater priority and clear accountability.

## **6. Test yourself:**

1. Classification of occupational accidents among healthcare workers.



2. Main causes of accidents.
3. Prevention of accidents and traumas.
4. Solving the task

Task:

In small groups, discuss the following questions:

- 1) In your opinion, what are the occupational diseases you expect to find among workers in your profession?
- 2) Do you think it is important to prevent occupational diseases? Why?
- 3) What are social and economic effects of occupational diseases?

## 7. Recommended Literature

1. John Doyle, auditor general. Victorian Auditor-General's Report. Occupational Health and Safety Risk in Public Hospitals. November 2013, Melbourne, p. ix – 32.
2. J. Stranks. The Handbook of Health and Safety Practice. Dorset Press, Great Britain, Part Fire, 2005, p.173 -192.
3. I.Kostyuk and V.Kapustnyk. Occupational Diseases: Manual. Osnova, 2005, p.57-63
4. R. Mehrdad, N. S. Shams-Hosseini, S. Aghdaei, M. Yousefian. Prevalence of Low Back Pain in Health Care Workers and Comparison with Other Occupational Categories in Iran: A Systematic Review J Med Sci, 2016 Nov; 41(6): 467–478.
5. GMH Swaen, LGPM van Amelsvoort, U Bültmann, IJ Kant. Fatigue as a risk factor for being injured in an occupational accident: results from the Maastricht Cohort Study. Occup Environ Med 2003;60(Suppl I):i88–i92
6. Pasupathy KS, Barker LM. Impact of fatigue on performance in registered nurses: Data mining and implications for practice. J Healthcare Quality. 2012;34:22–30. [PubMed]
7. K. Sadeghniaat-Haghighi, Z. Yazdi. Fatigue management in the workplace. Ind Psychiatry, 2015 Jan-Jun; 24(1): 12–17.
8. J.F. Duffy, C.A. Czeisler. Effect of Light on Human Circadian Physiology. Sleep Med Clin. 2009 Jun; 4(2): 165-177.
9. Cooke CE, Stephens JM. Clinical, economic, and humanistic burden of needlestick injuries in healthcare workers. Med Devices (Auckl). 2017 Sept 29; 10:225-235.
10. [http://www.who.int/occupational\\_health/topics/hcworkers/en/](http://www.who.int/occupational_health/topics/hcworkers/en/)
11. [http://www.who.int/occupational\\_health/regions/en/oehemhealthcareworkers.pdf?ua=1](http://www.who.int/occupational_health/regions/en/oehemhealthcareworkers.pdf?ua=1); p. 63-
12. <https://www.mounnittany.org/articles/healthsheets/5114>