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Intensive Care Unit Workforce: Occupational Health and Safety

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Abstract

There are many different work tasks and workplace hazards related to the ICU setting. The workplace hazards include the physical environment of the ICU, working conditions, psychosocial factors, ergonomic factors, biological factors and chemical factors that cause ICU workers to have health problems. The occurrence of occupational health problems in ICU workers not only leads to decreased job satisfaction and productivity but also increases absenteeism and burnout. Moreover, this situation adversely affects patient care and increases the cost of treatment. Recognising occupational hazards and risks arising from the work environment will assist in planning strategies to protect and promote health programmes for ICU workers. Understanding the importance of occupational health and safety practices by all institutions is a key factor to improve quality of life, work efficiency and work satisfaction of ICU workers.

Keywords: intensive care unit, ICU workforce, workplace hazards, occupational health, occupational safety

1. Introduction

This chapter presents information about occupational health and safety in the intensive care unit (ICU) settings. The reader is cautioned that ICU workers face many workplace hazards due to the complex nature of their work environment. Furthermore, this chapter aims to describe the occupational risks of ICU workers related to personal factors and to discuss prevention strategies related to this issue. Although traditional prevention strategies for occupational health and safety in the ICU are given, personal measures such as risk management and health promotion programmes for ICU workforce will also be provided.

2. Intensive care unit workforce

The health services provided in ICUs are carried out by a multidisciplinary team. The members of this team are intensivists, ICU nurses, pharmacists, dieticians, respiratory therapists, physiotherapists, occupational therapists, healthcare assistants and members of other professions [1, 2]. Other staff in secretarial and transportation services are in a position to support the ICU team [2].

The nursing staff in some countries may comprise distinct occupations such as nurses and nurse aids/assistants or technicians [3]. Nurses are the workforce in the ICU and are mostly involved in complex work tasks, such as medication management, organising the ICU environment, coordinating the work tasks between nursing staff and direct contact with patients while providing care, as well [3]. The working experience of the ICU nursing staff may vary with the hospital type and location. In the study done by Sevinç et al. [5], 30% of the ICU nurses had working experience of less than 1 year. In another study setting done in the United States, the mean age of ICU nurses was 46.5 [7]. Healthcare assistants are responsible for tasks related to patient care directly, inasmuch as they are the members of the ICU team that are most exposed to the physical workloads [3].

The work environment in the ICU setting poses many occupational hazards, especially for the female workforce. In recent years, the number of female intensive care medicine (ICM) specialists has increased. Studies show that the proportion of female ICM specialists in the United Kingdom and New Zealand in 2012 was 17% and 18%, respectively. On the other hand, majority of the nursing workforce in the ICUs consists of women. Although the nursing profession has become more popular for men in the recent years, female nurses in the clinical setting still have a slightly higher percentage than male nurses. Thus, the occupational hazards and challenges for female members of the ICU team must be considered during the risk assessment, hazard prevention and training processes as they might face higher risks due to pregnancy, motherhood and other conditions) [4].

Due to the fact that working conditions are hazardous in the ICU setting, nurses and other ICU workers transfer to other units in the hospitals after working there for a certain period. As in many other units in the hospitals, there are also shortages of staff in the ICU setting. Many studies show that inadequate numbers of the ICU staff have a negative impact on patient outcomes [5, 6]. However, not only the number of staff will prevent unexpected negative conditions of the patients, but also the work environment will improve patient outcomes [7].

The models advocating the improvement of patient outcomes and cost-effectiveness support having an intensivist present in the ICU setting, creating accurate job descriptions for all team members, developing procedures and providing continuous education to the staff [2].

3. The work environment in the ICU and the occupational hazards

The work environment is considered an important factor that affects the motivation and work satisfaction of employees. A productive and satisfying work environment is described

as “a multi-dimensional, integrated phenomenon” and the importance of having all dimensions present in the work setting is stated by Schmalenberg and Kramer as “an excellent work environment doesn’t evolve from the presence of only a few desired processes. None of them optional, all are required.” [8].

The workplace environment must be considered carefully because of the fact that it can affect the motivation and capability of ICU workers to perform the tasks [9]. There is evidence about the impact of poor work environments on healthcare professionals and patient outcomes [7]. Negative outcomes for the ICU workforce can be related to job satisfaction and burnout. However, there are some other negative outcomes for the patients such as inadequate safety, impaired quality of care, medical errors and increased mortality [7].

The work environment in ICU is not only related to the physical environment, but also related to psychosocial settings [7]. The nature of a poor work environment is associated with a number of hazards and risks [10]. The terms “hazard” and “risk” are often used interchangeably which leads to confusion. Despite this, hazards in the workplace are described as “a potential source of harm or adverse health effect on a person or persons” [11, 12]. Additionally, the risks which arise from identified hazards are graded by combinations of severity and likelihood of harm [11, 13].

The ICU environment may cause a number of health risks in relation to occupational hazards. The workplace hazards include the **physical environment** of the ICU (*lighting, conditioning, noise, equipment, work space*), **working conditions** (*daily workload, working in shifts, standing for long hours, caring for patients with co-morbidities, inadequate income*), **psychosocial factors** (*dissatisfaction with work, workplace stress, frequently encountered deaths, interaction with families of patients, workplace violence*), **ergonomic factors** (*repositioning the patients and repeating movements such as pushing, pulling, elevating and bending*), **biological factors** (*being exposed to infectious organisms during invasive and non-invasive procedures*) and **chemical factors** (*being exposed to antiseptic and disinfectants or inhaling their gases*).

3.1. Physical environment

The physical environment of the ICU may contain various hazards likely to cause injuries to ICU workers. Those hazards are associated with mechanical factors, equipment, noise, light, heat and humidity. In the conditions where the physical characteristics of the workplace were not designed considering the needs and expectations of employees, it will result in decreased work performance of the employees and increased number of lost work days [14].

Mechanical hazards in the ICU include mobile equipment which is used to transfer patients, transported objects i.e. emergency trolleys, moving parts of objects, sharp edges of surfaces, falling objects, slippery surfaces, high pressure fluids and other items. ICU staff are more likely to sustain injuries caused by mechanical hazards inasmuch as they give care to patients in unstable conditions. A suitable workplace design, safety signs and risk measures should be applied to eliminate risks related to mechanical hazards in the ICU [15].

Intensive care units are one of the departments with the most advanced equipment in the hospital settings. With the aim of using that equipment effectively, it is important to design

the bed spaces, monitor heights and drainage systems considering the architectural principles for the ICU standards so that healthcare personnel can have sufficient space to care for their patients [16, 17]. The environment of the ICU requires appropriate physical layout and workstation design. On the other hand, an inadequate patient room or bed space will make it difficult to interact effectively with the patient and provided equipment [9]. The architectural design of the ICU affects job satisfaction, the level of stress and well-being of the healthcare professionals working in the ICU setting. The ICU team members' experiences and opinions should be asked for before the architectural design of the ICU is made [17].

The equipment to improve the physical conditions might not have been developed yet for the specific needs in the ICU; on the other hand, it might be developed but not obtained by the facility (the hospital) or provided in some ICU setting [9]. The studies show that although in some ICU setting the staff are provided high technological equipment to prevent them from physical injuries and protect them from musculoskeletal disorders, they do not make use of the equipment reporting reasons such as the equipment being difficult to use (requiring complex work tasks or disinfection of the parts for every use) or being time-consuming [16].

The design of the ICU should prevent the distraction caused by the high level of noise in the ICU. It is also shown that noise may cause an increased stress level for the ICU staff [18, 38]. Moreover, it is also stated by the Occupational Health and Safety Administration that 20% of the workers may have a significant change in hearing if they are exposed to 90dBA noise for 8 h per day for 40 years [18].

Poor lighting in the ICU can cause discomfort while ICU workers are performing their daily tasks. Suitable lighting must consider the ideal level of lighting in different parts of the ICUs. Suitable lighting in the ICU varies as the lighting in the entrance and the waiting area is recommended to be 150 lx, circulation areas to be between 100 and 150 lx, and offices to be 750 lx. A direct interference with vision must be prevented and glare must be minimised. The nurse desks and monitoring areas should be located where light can be received in a 90° angle [12].

Heating and air conditioning in the ICUs are important physical conditions that affect the body temperature and cause heat stress in the ICU workers. Changes in the body temperature and heart rate along with sweating are known as the symptoms of the heat strain. This type of physiological strain indicates a cardiovascular response to the blood flow need. In the conditions where heat and ventilation in the ICU environment are not within ideal limits, the body starts to remove heat primarily by evaporation by sweating, the rate of which varies with air motion, humidity and type of clothing. The heat strain may primarily cause discomfort, but also induces heat-related disorders and acute musculoskeletal injuries [19]. The ideal temperature for workplaces is recommended as between 19° and 23°C but may vary in different settings [13].

Humidity is another factor in the working environment that affects workers' health. In conditions when humidity is low, it means the air is dry and can cause stuffy nose, dry and itchy skin, sore eyes, sore throat and flu-like symptoms in further cases. The relative humidity is stated as to be maintained between 40 and 70% [13].

3.2. Working conditions

Patients in ICUs receive continuous medical care 24 h a day from the ICU team. There are many different work tasks and related workload in the ICU setting. The influence of excessive workload in the ICU setting may result in a high level of stress, job dissatisfaction and physical injuries [20]. There is a direct correlation between the length of the shifts and the burnout due to excessive workload and fatigue. There are evidence and standards that consider the number of patients to be assigned to the ICU workforce. The evidence for the intensivist-to-patient ratios is ideally no higher than 1:14 inasmuch as it affects the staff well-being and patient care [21]. In a study investigating the clinical intensive care service, it was claimed that the paediatricians-to-patient ratio was 1:13, median working hours of the paediatricians were 60 h in a week, and indicated night shifts were 60 nights in a year [22]. The recommended nurse-to-patient rate is 1:1 for the critical patients with mechanical ventilation, and the maximum number of the patients to be assigned to a nurse is two according to the American College of Critical Care Medicine [23]. Those standards may vary with the national regulations in different countries. For example, the nurse-to-patient standard in Turkey is 1:4 for ICUs, not considering the dependency levels of the patients [5].

Studies in the literature show that there is a correlation between increased workload and increased medical errors and hospital infections [24]. Moreover, there is a relation between increased workload and death rates of the patients in the ICU. The excessive workload in the ICU setting is the main risk factor for hospital infections such as pneumonia, urinary tract infections, bloodstream infections, and surgical-site infections [25]. It is stated in the literature that when the ICU nurses give care to one patient above the recommended number, there is an increased risk for pulmonary failure by 53%, for nosocomial pneumonia by 7%, for unplanned extubation by 45% and for mortality rates by 9% [24]. In this context, the workload of the healthcare professionals in the ICU has crucial importance not only for causing occupational health problems, but also for patient safety issues [5, 24, 26].

The working characteristics in the ICU which require long work schedules lead to physical and mental fatigue [3]. Moreover, the long shifts (12 h and above) increase the errors and near misses, and decrease staff vigilance. As a further matter, the negative effects of shift work have been discussed for a long time, and are accepted as detrimental. It has a negative impact on individuals' health, such as disrupting the circadian rhythms, causing sleep disorders, causing increased risk of gastrointestinal tract disorders, increasing stress levels, altering activity and rest patterns and affecting the social and domestic life [27, 28]. Moreover, it disturbs the body's chemical and hormonal functions because of the fact that individuals working during the night are not able to benefit from the daylight. In many studies, it is discussed that working in night shifts for a long term increases the risk of breast cancer [29].

Nevertheless, the low salaries for healthcare professionals working in the ICU are not satisfying compared to the required working conditions [3].

3.3. Psychosocial factors

There are various psychosocial risk factors in ICU settings, such as high qualitative and quantitative demands, emotional demands, low job control, role conflicts, ambiguity, mobbing and physical violence, which affect ICU workers' well-being [30].

Intensive care units are stressful settings inasmuch as they require communicating with patients and their families facing the death and loss processes, coping with complex work tasks and adapting to busy work conditions [26]. The psychological hazards in the ICU may cause psychosocial burden, shifts in the mood, sadness, negative outlook towards life in general, irritation, loss of confidence and negative self-image [3]. Those negative conditions are related to symptoms of a high level of stress. Consequences of high levels of stress in the ICU can cause increased absence, lowered productivity, more accidents and physical injuries, higher job turnover and increased costs [30].

The ICU team members may encounter uncertainties, varied situations that require immediate action, high level of knowledge, psychomotor and cognitive skills and competences which may cause fatigue [3]. Lack of equipment and resources in the ICU may result in job dissatisfaction for the healthcare professionals working there [20]. In the studies done with anaesthesiologists and ICU nurses, it is found that overall nurses and the female anaesthesiologists consider the lack of resources as a cause for job dissatisfaction [2, 20].

Intensive care unit workers are responsible for many complex work processes in acute and chronic settings. There might be some role conflicts and ambiguity that result in decreased job control, misunderstanding and increased stress. However, in some cases, it is reported that physical aggression and physiological violence occur due to working in intense work conditions. Negative behaviours such as yelling, offending, ignoring, threatening or hiding important information can mean mobbing which are inadmissible for members of the ICU team. Being a victim of mobbing leads to physical and mental problems such as high level of stress, depression, eating disorders, addiction and suicide attempts [30].

The social hazards in the ICU setting are usually generated by working long shifts which require working at night and weekends. They may cause isolation from family relationships, social life difficulties, overall disinterest towards others, uncontrolled aggressiveness and difficulty in making decisions regarding personal life [3].

3.4. Ergonomic factors

Ergonomics are defined as the "laws of the work" and it primarily focuses on the physical aspects of the work. There are many force and energy requirements for work tasks in the ICU setting and there must be considerations of biomechanical rules and workplace adjustments to prevent ICU workers from musculoskeletal disorders [31].

Occupational musculoskeletal disorders not only occur in acute conditions but also may develop on account of cumulative micro traumas usually in relation to lack of *balance* of the body for tissue repair and adaptation to physical stress [32, 33].

Intensive care unit settings require physical loads on ICU workers during patient care [34, 35]. The physical hazards may cause ergonomic risks, which lead to musculoskeletal symptoms and disorders. Several conditions such as excessive and repetitive traumas while pushing and pulling heavy equipment, standing for long periods of time, not having adequate rest, manually lifting and moving partially or fully dependent patients in awkward, twisted or extremely bent positions requiring extreme muscular exertions must be considered as the major factors for musculoskeletal disorders [31, 34, 35]. The symptoms are mostly seen as pain in the leg, back, shoulder, neck and other parts of the body [3, 16].

In ICUs where the physical characteristics were not designed properly, healthcare professionals have a higher risk of musculoskeletal injuries due to repeated physical loads during patient care [34]. The ICU members with musculoskeletal symptoms are less productive because of pain and limited mobility, and they are likely to make consistent safety mistakes. Hence, they may also affect the health or endanger the safety of other members of ICU [31].

3.5. Biological factors

The ICU workers have increased risk related to biological hazards since they are exposed to infectious organisms during invasive and non-invasive procedures. Transmission of infectious agents can occur through blood and body fluids on equipment or their droplets' absorption by skin or mucosa through direct or indirect contact or lung penetration through the air. Intensive care unit work tasks and processes require direct or indirect contact with biological materials that results in illness and disease [13]. As in many other healthcare units, ICUs have the highest rate of needle stick injuries in the nursing workforce that can result in transmission of most common blood-borne infections such as Hepatitis B and C, other Hepatitis infections and HIV. Other infections can transmit to ICU workers by spreading through close contact and by droplets, such as tuberculosis and meningococcal meningitis [12, 36].

There are standard and transmission-based regulations in healthcare facilities to prevent infections occurring in the ICU workforce. Standard precautions include hand washing, respiratory hygiene and cough etiquette, waste management and decontamination, and appropriate use of personal protective equipment. Transmission-based interventions include airborne, contact and droplet precautions [13].

3.6. Chemical factors

The ICU workers face chemical hazards such as being exposed to antiseptic and disinfectants or inhaling their gases. During the work tasks and processes in the ICU settings, ICU workers can be exposed to surface cleaners, antiseptic solutions and anaesthetic gases such as formaldehyde. The exposure can occur through many routes, which commonly happens by penetration after lung inhalation, absorption by skin or mucosa contact through eyes or nose. They can cause inflammation or irritation on the part where contact occurred. Moreover, it can lead to dermatitis, allergic reactions (i.e. sneezing and rhinitis), asthma and cancer [13].

The effect of chemicals in the workplace can vary depending on some factors such as age, sex, ethnicity, genetics, immune system, nutrition, disease history, occupational history, previous exposures, other exposures to synergistic or antagonistic chemicals and recently used medications [12]. The occupational health and safety team in the hospital should keep records of all chemical agents which are being used in the ICU, and prepare emergency action plans in acute and chronic exposure cases.

4. Risks related to the ICU workers

4.1. Personal factors

There are some personal factors related to occupational diseases acquired by ICU workers. These factors can be summarised as ageing, inadequate physical condition, smoking and obesity.

The workforce in the ICU is ageing since the healthcare industry workforce is getting older in accordance with an increase in the retirement age requirements in all industries (around the world). In the United States, the average age of registered nurses is 46.8 [9]. The ageing workforce in the ICU might face increased risks for physical injuries and musculoskeletal disorders due to decreased muscular endurance and physical strength by age 50 and above [31]. Moreover, the workforce in the ICU is likely to have more chronic diseases with the ageing population [37].

The demographic characteristics of the society have changed in recent years. The body weight in certain populations is increasing rapidly. People's lifestyle is changing and it is leading to less healthy eating and having a more sedentary life. Obesity may cause many health problems such as back pain, osteoarthritis, diabetes mellitus, hyperlipidaemia, coronary heart diseases and other health conditions [37]. Considering the population trends, it has been shown that the body weight of ICU workers has also changed, and they are more likely to have obesity-related health problems and are at an increased risk of musculoskeletal injuries. Similarly, patients in the ICU have become heavier. Thus, this situation increases the risk of physical injuries of the ICU workforce while lifting or moving or transferring heavy patients [31].

4.2. Personal habits

The work tasks in the ICU setting require intense physical activity during the shift, even without lunch breaks or other breaks in some cases. Healthcare professionals who work in the ICU get fatigued after working for long hours. There are some personal habits that affect the level of physical or mental tiredness of the ICU workforce.

Studies have shown that regular physical activity prevents musculoskeletal disorders by maintaining flexibility of muscles and ligaments. According to this, ICU workers with a habit of regular physical activity have a decreased risk of physical injuries and musculoskeletal disorders [16, 38].

Intensive care unit workers might face sleeping disorders due to working night shifts. The high level of stress and physical tiredness after working for long hours might cause sleep disturbances in ICU workers [3]. Moreover, having inadequate sleep and rest increases the risk of unsafe practices and occupational accidents. It is shown in the studies that, there is a direct relation between sleep and level of attention [28].

Negative stress and poor balance between work and social life can cause careless dietary habits. A poor lifestyle implies a poor diet, which is not only related to eating too much or little, but also eating low-quality foods such as fast food and frozen food [13].

There is evidence about the correlation between an unhealthy lifestyle and decreased physical and mental abilities for work tasks [39]. Positive lifestyle such as having adequate sleep/rest, healthy eating habits and regular physical exercise affects job security and occupational quality [40].

4.3. Cognitive features

The cognitive features include individual differences, perceptions and decision making and human error. Individuals differ from each other by personality, reliability, perceptions and self-awareness. Moreover, some people are more likely to make errors [41]. It is shown in the literature that there is a correlation between cognitive failures and accidents [40].

The ICU setting has many different hazards, and the perceptions, decisions, and capabilities of the ICU workers are crucial to avoid the risks related to them. Decision making is an important factor that affects the level of risks and prevents accidents when an ICU worker makes the right decision at the right time. Individuals' competence is also important. Although some people are very capable of avoiding errors, their physical ability and willingness impact dealing with hazards [41]. However, cognitive features are directly related to occupational stressors so they can easily be changed [40].

There are some workplace interventions recommended to control and manage risks in the ICU setting, and most of these interventions are focused on behaviour change processes [16]. However, there are some individual factors affecting staff's behaviour change. Self-efficacy is the ability of individuals to accomplish tasks with barriers to change that they encounter during the process of behaviour change. It is related to the level of control of individuals over situations that affect their health [42].

In the conditions when the perceived self-efficacy level is high, the individual will realise the priority of the occupational health and safety principles to prevent work-related injuries or disorders while managing their work tasks [42].

There are some factors related to self-efficacy that affect the individual's behaviour change process negatively, such as decreased awareness of the benefits of the change and loss of interest or having a high level of perceived barriers to change (i.e. claiming to not have proper facilities for physical activity or complaining about time pressure while doing their work tasks) [42].

4.4. Occupational and health history

Risks arising from the previous workplace affect ICU workers' current health conditions. Some biological and chemical agents require a long period of time before causing any signs and symptoms while they are affecting the body functions. A detailed employment history provides information about the current occupational diseases and future health problems which might occur while performing in the ICU [10, 41].

Illnesses might have many causes such as ageing, lifestyle or genetic characteristics or viruses. Intensive care unit workers lose work days due to common illnesses i.e. symptoms of musculoskeletal disorders, headaches, dental issues, infectious diseases, gastric problems, among others. The health history of the ICU workers needs be recorded and comorbidities should be considered in relation to risk factors in the ICU [13].

5. Occupational health and safety practices in the ICU

The work tasks and processes in the ICUs are identified in a variety of guidelines prepared by the ILO (International Labour Organisation) and OSHA (Occupational Health and Safety Administration). The measures and practices related to protecting the ICU workers' health are identified in these guidelines. The measures and practices can be divided into two main topics such as workplace interventions and personal measures. Workplace interventions can be summarised as reducing the working hours and workload, designing and organising the work environment properly. Personal measures include staff training, providing risk management and health promotion programmes and other measures.

5.1. Workplace interventions

5.1.1. *Reducing the working hours and workload*

Changing work patterns and improving control strategies will result in decreased risks and reduced health deficits among ICU workers. Evidence shows that re-arranging working hours and workload results in reduced occupational health symptoms of the ICU workers. Improved working conditions, material and moral support, properly managed work shifts provide a safe environment in the ICU setting [40]. The occupational and safety team members have responsibilities to recognise workplace hazards and identify risks in the ICU setting that impact workplace practices and the workers' health status [10].

5.1.2. *Designing and organising the work environment*

A positive work environment is linked to improved patient and staff outcomes such as decreased hospital infections, death rates, and increased motivation and job satisfaction [43, 44].

The occupational health and safety team are involved in designing work equipment and ICU work process. Moreover, studies show that in situations where ICU workers' opinions were

asked on the process of redesigning the unit, there was a significant increase in job satisfaction of staff and a dramatic reduction in turnover and absenteeism [10, 30].

5.1.3. Other interventions

Workplace interventions designed to prevent hazards and reduce related risks allow the occupational and safety team to implement strategies to improve safety culture in the ICU [44]. Safety culture is described as “*the product of individual and group values, attitudes, perceptions, competencies, and patterns of behaviour that determine the commitment of an organisation’s health and safety management*” [45]. There is a direct connection between safety culture and trusted communication in the organisation. Moreover, increased perception of the importance of safe practices and sufficient confidence in preventive measures are remarked as the fundamentals of the safety culture [44]. Studies in this area show that perceptions of ICU safety are influenced by factors such as opinions of the management, working conditions, job satisfaction, team work climate, stress recognition, and safety climate [46]. Thus, workplace interventions to manage occupational risk factors should be focused on improving the safety culture of the ICU setting. After being established, the safety culture can be improved by initiating different intervention strategies [44]. The safety culture is known as a two-way system between the management’s responsibilities and employees’ commitment to their duties, which can only be established by key strategies: control, cooperation, communication and professional competence [13].

Designing safety checklists is another intervention that results in improved patient and workforce outcomes. A safety checklist aims to monitor safety performance and make improvements to work systems [38]. There are different aspects to creating safety criteria since they may be related to organisational, personal or professional characteristics. The safety hazards that threaten patient safety as well as health, well-being and safety of the ICU workforce must be stated on the checklists [38].

5.2. Personal measures

5.2.1. Staff training

Staff training interventions include prevention programmes related to physical, psychological, chemical, biological, ergonomic and other hazards in the ICU setting. In recent years, the importance of health promotion programmes is becoming more recognised as workplaces provide occupational health and safety (OHS) team members with access to a large group of people, who have good inter-communication and facilities to exchange information. Workplace health promotion activities enable OHS team members to participate in continuous assessment of the healthy lifestyle behaviours of ICU workers and to develop specific training interventions for them [10].

Occupational and safety practices should appreciate the biological, psychological, and social characteristics of individuals considering that interventions in the workplace will be integrated into adult life and health. The ability of the staff to participate in the training productively is an important factor that contributes to the effectiveness of the intervention. There are studies

showing the benefits of on-work training programmes [16]. In this case, ICU professionals would not be requested to participate in staff training sessions when they need to rest after working long hours. Additionally, it is discussed in the literature that the on-work training sessions are more successful when they are model based or combined with multiple interventions [47–49].

Training should include different time periods such as orientation programmes when workers start working in the ICU (pre-employment examinations); periodical training; condition-based training where ICU workers need information about an unexpected or unusual situation (e.g. when they were caring for patients with an epidemic disease); return to work programmes for staff who have been absent after having a workplace accident or long-term leave from the ICU; and other programmes [10, 41].

5.2.2. Risk management

Risk management programmes comprise planning, applying and evaluating personal, physical and organisational interventions that aim to assess and decrease occupational risks to employees [50–52]. In recent years, many studies have been done with the aim of identifying high-risk tasks; creating and implementing solutions to reduce these risks in the workplace. There is legislation in many countries, for different work areas as well as ICUs to implement risk analysis and management programmes. Risk assessment involves the assessment of the severity and likelihood of harm which arises from identified hazards [11, 13]. Risk assessment can be made by using both qualitative and quantitative methods. However, in relation to legislations in many countries, a written risk assessment should be done including the risk control measures such as elimination of hazards, engineering controls, administrative controls and distribution of personal protective equipment [13]. Risk assessment and management interventions in the ICU should be performed as general and job-specific controls [31]. Therefore, safety hazards affecting the ICU workforce should be assessed individually, considering the work task-specific hazards that they might face. For example, in relation to biological risks, hazardous materials and wastes must be disposed safely. Continuous monitoring should be performed for persons who come into contact with biological materials by handling, manufacturing or storing them [13].

Work-related musculoskeletal disorders are one of the most common occupational health problems seen in ICU workers. The literature shows that evidence-based interventions used in ergonomic risk management programmes such as body mechanics training, ergonomic guidelines, exercise programmes, cognitive-behavioural interventions, social support programmes and workplace adjustments were found to be effective in terms of reducing the ergonomic risks to ICU workers [33, 47, 48, 50, 51, 53–57].

5.2.3. Health screening

Health screenings of ICU workers should be done regularly. A detailed history of previous employment and a comprehensive assessment of the current occupational diseases should be performed when the staff start working in the ICU setting (pre-employment examinations). Eventually, it should be followed by periodical screenings, condition-based screenings (e.g. when they were caring for patients with an epidemic disease) and return to work screenings for workers who had a workplace accident or a long-term leave from the ICU [10, 41].

5.2.4. Health promotion programmes

Occupational hazards and risk factors in the ICU are not only associated with the workplace setting, but are also related to personal habits such as smoking, not having a healthy diet or inadequate physical activity. Therefore, risks related to personal factors can only be managed by conducting health promotion programmes in their workplace. Health promotion programmes in the ICU are valuable interventions when they are used proactively, developed, and managed/monitored by experienced health professionals [9]. Health promotion activities (i.e. programmes aimed at diet management, weight control, physical activity or coping with stress) in the ICU should be developed considering the needs of ICU workers. For example, conditions related to high level of stress can be managed by improving coping skills. Those skills can be improved through stress management, problem solving, relaxation, and self-awareness trainings [13, 30]. However, a good health promotion intervention should be based on a model (i.e. Pender's Health Promotion Model; Prochaska's Trans-theoretic Model; Green's PRECEDE-PROCEED Model) [58]. According to these models, there are some factors such as past experiences, unsuccessful attempts to change, self-efficacy, social support, self-awareness and readiness to change that affect the positive results that may be achieved by workplace health promotion programmes [58–60].

5.2.5. Other measures

There are other monitoring and prevention programmes in relation to risks arising from hazards in the ICU setting. Different forms of prevention can be applied for varied risks as follows:

- Limitation of risk sources
- Limitation of ICU workers' reactions towards hazardous conditions
- Treatment of injuries and harm caused by hazards, including monitoring the long-term effects [30]

The aim of the preventative measures and interventions is to strengthen how ICU workers deal with physical, chemical, biological, psychosocial and ergonomic hazards. Another form of risk prevention is the optimisation of task content in connection with job rotation, job enlargement, job enrichment and creation of autonomous work groups (**Table 1**) [30].

Optimisation	Main focus/action
Job rotation	Move workers to different stations regularly
Job enlargement	Merge similar jobs into larger modules
Job enrichment	Group basic tasks and control elements together and assign workers to higher tasks
Creation of autonomous work groups	Create independent worker groups and give them the responsibilities of larger job fragments

Table 1. Optimisation of task content.

6. Conclusion

The ICU environment may cause a number of health risks in relation to occupational hazards. The workplace hazards include the physical environment of the ICU, working conditions, psychosocial factors, ergonomic factors, biological factors and chemical factors. The occurrence of occupational health problems in ICU workers not only leads to burnout and decreased job satisfaction, but also affects patient care and increases the cost of treatment. Workplace interventions and personal measures should be done in terms of reducing hazards and related risks in the ICU setting. Increased employee participation should be considered in all risk management, monitoring, and prevention programmes. The contribution of ICU workers in these programmes will improve the effectiveness of the interventions associated with reducing health risks in the ICU settings.

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