Developing an Occupational Work-related Safety Guideline for Nurses Working at General Intensive Care Units

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Abstract

Abstract: It is becoming increasingly recognized that HCWs, especially nurses, who are critical to the delivery of safe and effective care in Intensive Care Units (ICUs), are exposed to a variety of occupational work-related safety hazards, as well as strategies to avoid these hazards, to maintain their health and wellbeing. **Aim:** to develop an occupational work-related safety guideline at general ICUs at EL-Beheira governorate. **Methods:** a methodological qualitative research design was utilized at all general ICUs affiliated to the Ministry of Health and Population (MOHP), at El-Beheira Governorate (n=13). **Subjects:** two groups: nurses (n=539) divided into head nurses (n=26) and nurses (n=513); and panel of experts (n=40), who were divided into academic experts (n=10) and professional experts (n=30). **Tools:** two tools were used Occupational Work-related Hazards Questionnaire (OWHQ) developed by the researcher and used by nurses to identify OWSH at general ICUs, and Appraisal of Guidelines for Research & Evaluation (AGREE II) Questionnaire, developed by Brouwers et al. and completed by academic and professional/clinical to validate the developed guideline. **Results:** more than one- half of nurses got moderate level of total OWSH mean percent score. Biological hazards was the first; followed by ergonomic, chemical, psychosocial and; lastly, physical hazards. However, the majority of strategies or recommendations to deal with these hazards got moderate scores. **Conclusion:** both academic and professional experts agreed upon the content and face validity, clarity, and quality of the developed occupational work-related safety guideline to be used by nurses at general ICUs. **Recommendations:** implementing the developed Occupational Work-related Safety guideline for nurses working at general ICUs to enhance their safety and conduct training programs and awareness sessions for the developed guideline.

Keywords: Intensive Care Units (ICUs), occupational work-related safety hazards, guideline, Health Care Worker (HCWs).

I.Introduction

The complexity of the health care system, which is fueled by scientific and technological advancements, emphasizes the importance of creating healthy work environments. In this context, the need for systematic approach capable of recognizing, analyzing, eliminating, and dealing with a variety of hazards to establish a healthy workplace has emerged **(Faris et al, 2018)**.This enhances the workplace long-term viability through creating a healthy, supportive, and safe work environment; ensuring health promotion and protection as an integral part of management practices; fostering health-promoting work and lifestyles; ensuring overall organizational participation; and extending positive impacts to the local and surrounding community and environment **(Arcanjo et al, 2018)**. Healthy and safe work culture require collaboration between several dimensions as leadership commitments to safety, open communication founded on trust, organizational learning, a non-punitive approach to event reporting and analysis, teamwork, and a shared belief in the importance of safety **(Gül, 2021)**.In the world of occupational health and safety, an incident is the negative outcome of an uncontrolled hazard. An occupational health hazard is a dangerous phenomenon, substance, human activity, or condition that may cause loss of life, injury, or other health impacts at the workplace **(Manuel et al, 2015; WHO, 2012)**. Occupational Safety and Health (OSH) is defined as:

"the promotion and maintenance of the highest degree of physical, mental, and social well-being of workers in all occupations" **(Awan et al, 2017)**. Occupational Safety and Health is an area concerned with protecting the safety, health, and welfare of Health Care Workers (HCWs) **(Lunn, 2015)**. Occupational safety and health is a multi-disciplinary activity targeting four basic aspects, namely: protection and promotion of nurses' health by preventing and controlling occupational diseases and accidents; development and promotion of safe and healthy work environments and work organizations; enhancement of physical, mental and social well-being of nurses; and enabling them to conduct socially and economically productive lives and to contribute positively to sustainable development **(Shinde et al, 2016)**. Working conditions have a strong impact on nurses' health and well-being, so, a non-supportive working environment can cause harm if not controlled, and can lead to occupational health hazards, and thus, hospitals like other high-risk workplaces are characterized by exposure to a high-level of hazardous agents that significantly endangers the health status and life of nurses **(El-Molla, 2013)**. Health care workers, especially nurses, are on the frontlines of various occupational hazards and are the most vulnerable to occupational health risks in the workplace **(Edorisiagbon, 2015)**.Occupational hazards can cause various forms of disabilities; loss of manpower, leading to decrease productivity and, in serious cases, may lead to inevitable deaths, which consequently lead to loss of skilled personnel among physicians and nurses **(Zaybak and Çevik, 2015)**. In hospitals, Intensive Care Units (ICUs) are highly stressful environments because of continuous emergency expectations, complex technology, and sudden changes in patients' general health status, such stressful work environments pose multiple risks to their wellbeing **(Shimizu et al, 2010)**. Intensive care nurses encounter difficult work conditions, sleeplessness, fatigue, and uncertainty about tasks and duties, and provide care to patients, who are in pain and sometimes about to die; also it affects nurses' burnout, work satisfaction, and job retention **(Giurgiu et al, 2016)**. The ICUs' environment may cause Occupational Work-related Safety Hazards (OWSH), which may be encountered by ICUs nurses and it is classified into five categories, including: biological hazards; physical hazards; chemical hazards; psychosocial hazards; and ergonomic hazards **(Amosun et al, 2011)**. The factors that contribute to occupational injuries and illnesses in health care facilities include: lack of awareness by nurses; lack of adequate protective aids and equipment; shortage of staff; excessive workload; failure to observe basic safety and hygiene guidelines; and inadequate operational knowledge of modern health care equipment **(Aroop et al, 2019)**. National Institute of Occupational Safety and Health (NIOSH) develops guidelines to minimize the risk of exposure to hazardous agents for nurses. These guidelines highlight the aspects that must be present to ensure effective workplace procedures, such as: the use of Personal Protective Equipment (PPE) during the preparation, administration, and disposal of hazardous drugs, the provision of a biological safety cabinet, and training of all personnel involved in any aspect of the handling of hazardous agents or materials **(NOISH, 2016)**.

Significance of the study

Among all occupations, nursing was ranked highest for musculoskeletal disorders ranging from 40-80% among all populations. The most common part of the body to be affected is the lower back region with a prevalence rate of 29- 64%, neck with a prevalence rate of 34%- 54% and shoulders with a prevalence rate of 35-60 **(WHO, 2022)**. A study on biological hazards revealed that 97.4% of HCWs were subject to injuries caused by sharp and perforating objects and that 1.9% of the injured developed HBV infections **(U.S. Bureau, 2022)**.

Aim of the study

The study aimed to develop an occupational work-related safety guideline at general ICUs at EL-Beheira governorate, through:

- Assessing the occupational work-related safety hazards at all general ICUs, in EL-Beheira Hospitals .
- Developing an occupational work-related safety guideline for nurses working in ICUs.
- Disseminating the developed guideline.

Research Question:

1. What are the occupational work-related safety hazards encountered by staff nurses in general intensive care units?
2. What are the controlling measures/ strategies to handle the occupational work-related safety hazards encountered by staff nurses in intensive care units?

II. Materials and methods

1. Research design:

Methodological, qualitative research design was utilized.

2. Setting:

This study was carried out at all general ICUs that are affiliated to the Ministry of Health and Population (MOHP), at El-Beheira Governorate (n=13). It included: Kafr El-Dawar General Hospital, Abo-Homos Central Hospital, Damanhour Fever Hospital, Itay El-Baroud central Hospital, Damanhour Chest Hospital, El-Mahmoudya Central Hospital, Idko Central Hospital, Rasheed Central Hospital, El-Delengat Central Hospital, Housh Essa Central Hospital, Abo El-Matamer Central Hospital, El-Rahmaneya Central Hospital, and Shoubrakhet Central Hospital.

3. Subjects

They were composed of two groups; as followed; 1) All nurses, who were working in the previously mentioned settings with at least one year of work experience, and who were available during the time of data collection, were included in the study (n=539). They were divided into two groups: head nurses (n=26); and staff nurses (n=513); 2) Panel of experts: (n=40), divided into two categories: a) Academic experts (n=10), and b) Professional/clinical experts, (n=30), who were working at the previously mentioned settings.

4. Tools of the study

Two tools were used in this study:

Tool (I): Occupational Work-related Hazards Questionnaire (OWHQ)

It was developed by the researcher after thorough review of related literature **(Dhahir and Al Mayahi, 2021; Sadaf and Yaqoob, 2011)**. It was used to identify occupational work-related safety hazards and strategies/recommendations used by hospital management to overcome those hazards at general ICUs. It consisted of two parts (54 items), namely: **First part,** Occupational Work-related Hazards (OWH) (39 items), that was divided into five categories, namely: physical hazards (11 items); biological hazards (3 items); chemical hazards (8 items); psychosocial hazards (10 items); and finally, ergonomic hazards (7 items), and **Second part,** strategies/recommendations to overcome OWSH (15 items) that represent common measures to control hazards. Responses were measured on 5-point Likert scale ranging from (1) not at all; (2) rarely; (3) sometimes; (4) fairly often; and (5) frequently, if not always. The highest scores indicate higher exposure to the occupational work-related safety hazards and application of strategies/recommendations. The score was ranged from (54 - 270), where low (54 - <135); moderate (≥135 - <202); and high (202≥ - 270).

Tool (II): Appraisal of Guidelines for Research & Evaluation (AGREE II) Questionnaire

It was developed by **Brouwers et al. (2010),** to evaluate the quality and methodical strategy of the guideline development process. It was completed by the academic and professional/clinical experts chosen to evaluate the guideline development. It consists of 23 items organized under six domains, as followed: a) scope and purpose (3 items); b) stakeholder involvement (3 items); c) rigour of development (8 items); d) clarity of presentation, structure, and format (3 items); e) applicability (4 items); and f) editorial independence (2 items). Responses were measured on 5 point Likert scale ranging from (1) strongly disagrees to (5) strongly agree (**Makarski and Brouwers, 2014**), **(Brouwers et al, 2013)**. The highest scores indicate approval of the content of the Occupational Work-related Safety Guideline

and inform whether a guideline should be recommended for use or not. The score ranged from (23- 115); where low (23 – < 57); where moderate (≥57 - < 86); high (≥ 87 - 115). In addition, a demographic characteristics data sheet of the study subjects was developed by the researcher, for nurses, it included: gender, age, educational qualification, working unit, years of nursing and unit experiences, and marital status. Panel of experts, it included: age, educational qualification, gender, academic or professional years of experience, current job positions.

II- Methods

1. An official approval was obtained from the ethical committee- Faculty of Nursing- Damanhour University and the Dean of Faculty of Nursing- Damanhour University and the responsible authorities of the study settings, after explanation of the study purpose.
2. Tool I: Occupational Work-related Hazards Questionnaire (OWHQ) was developed according to the following steps: a) reviewing hospital risk assessment performed by occupational health and safety committee; and the Egyptian laws and regulations of occupational health and safety; followed by b) reviewing the related literature to identify occupational work-related hazards in general intensive care units; and c) interviewing professional/clinical experts in the field of the study, such as: occupational health and safety coordinators, quality specialists, nursing directors or supervisors, ICUs head nurses, physicians, training coordinator.
3. The developed tool was translated into Arabic and was tested for its content validity by academic experts from related field of the study (n=5), accordingly, some modifications were done.
4. The Occupational Work-related Hazards Questionnaire (OWHQ) was developed; then was tested for its content validity using Content Validity Index (CVI) = 0.98.
5. A pilot study was carried out on 10% of total sample size (n= 54), where head nurses (n=3); and staff nurses (n=51), rather than the study sample; in order to check and to ensure the clarity and feasibility of the developed tool and to identify obstacles and problems that may be encountered during data collection. Then, no modifications were done.
6. The two tools were tested for its reliability using Cronbach's alpha coefficient, to measure internal consistency of the items. Tool (I) Occupational Work-related Hazards Questionnaire (α= 0.908), indicating excellent reliability, and tool (II) Appraisal of Guideline for Research & Evaluation (AGREE II) (α= 0.790), indicating acceptable reliability.
7. The developed guideline was executed based on the following methodological steps: **(Vermeulen et al, 2017; Breejen et al, 2016; Darzi et al, 2017; Higgins et al, 2022).**

Phase1: Determination of Needs and Scope of the Guideline:

The purpose of this phase was to determine the context of the guideline. It consists of three steps as followed:

1.1. Assess the need for guideline development:

The need for developing occupational work-related safety guideline is based on the responses of nurses who are working at general ICUs to the Occupational Work-related Hazards Questionnaire (OWHQ).

1.2. Determining the scope of the Guideline

The guideline designed to handle occupational work-related safety hazards in general ICUs, through providing strategies/recommendations for dealing with work-related safety hazards, including: biological, physiological, chemical, psychosocial, and ergonomic **(Hilbink et al, 2014; Yan et al, 2013)**.

1.3. Composition of the Guideline Development Group (GDG):

The guideline was developed by the researcher after thorough review of related literature. Then, it was reviewed and revised by academic supervisors and panel of experts, including: academic and professional/clinical experts in the guideline field of practice throughout the development process.

Phase2: Occupational Work-related Safety Guideline Development:

2.1. Determining the Objectives, Target Population of the Guideline:

The main goals and objectives of the developed guideline is to increase nurses' orientation of their occupational work-related safety hazards and strategies/recommendations for the prevention of these hazards. Target population; the developed guideline is beneficial for nurses and other HCWs

members who are working at general ICUs and come in contact with occupational work-related safety hazards **(Shea et al, 2007; Institute of Medicine, 2011)**.

Grades Of Recommendation	
A	At least one meta-analysis, systematic review of RCT, or RCT rated as 1++, and directly applicable to the target population; or A systematic review of RCTs or a body of evidence consisting principally of studies rated as 1+, directly applicable to the target population, and demonstrating overall consistency of results.
B	A body of evidence including studies rated as 2++, directly applicable to the target population, and demonstrating overall consistency of results; or extrapolated evidence from studies rated as 1++ or 1+.
C	A body of evidence including studies rated as 2+, directly applicable to the target population and demonstrating overall consistency of results; or Extrapolated evidence from studies rated as 2++.
D	Evidence level 3 or 4; or Extrapolated evidence from studies rated as 2+.

2.2. Establishing research questions

The research questions were constructed in order to help in targeting the evidence as followed:

1. What are the occupational work-related safety hazards encountered by nurses at general intensive care units?
2. What are the controlling measures and strategies/recommendations to handle the occupational work-related safety hazards encountered by nurses at ICUs?

2.3. Systematic literature review

- Systematic literature review was undertaken to establish a comprehensive guideline including the benefits and harms of the possible strategies based on scientific evidence using electronic bibliographic data bases as follow; PubMed, Science Direct, Cochrane Database of Systematic Reviews, and Scottish Intercollegiate Guideline Network.
- Once studies have been identified, they were assessed for relevance to the clinical questions of interest and for bias, as followed: screening for relevance to current guideline; summarizing evidence data are extracted from the relevant studies on the benefits, and the harms of the interventions being considered; and finally, translating evidence into a clinical practice guideline **(Burda et al, 2014; Lytras et al, 2011; Polus et al, 2012; Brosseau et al, 2014; Yan , Min ,and Zhou, 2013).**

2.4. Grading the evidence- based recommendations

The quality of each individual study used in the guideline development was assessed using the Scottish Intercollegiate Guideline Network (SIGN), coding system through three steps; study validity rating, determination level of evidence, and finally grade of recommendation **(Scottish Intercollegiate Guidelines Network, 2015)**.

SIGN's grading research evidence and recommendation system.

2.5. Drafting and Developing the Guideline

The guideline was written into English form, in clearly defined, actionable, and easy to translate into clinical practice.

<u>Phase 3:</u> Reviewing and Evaluating the Guideline Development Process

3.1. Evaluating the Guideline:

The content of the guideline was reviewed by panel of experts in the field of the developed guideline (n=40), divided into two categories, academic expert (n=10), and professional/clinical experts (n=30), using AGREE II to assess accuracy, comprehensiveness and balance of the scientific evidence and validity, clarity and feasibility of the recommendations. Modifications were done to the guideline in accordance with experts' comments **(Atefi et al, 2015; Ali et al, 2010)**.

3.2. Finalizing the Guideline

The final copy of the developed guideline was performed after completion of experts' modifications, and got approval from guideline development group.

<u>Phase 4</u>: Dissemination, and Updating the Guideline

4.1. Dissemination of the Guideline:

The aim of this step is making this guideline accessible, available, and distributed widely, through raising awareness sessions that were conducted for the study subjects, who were available at time of these scheduled sessions.

Afterwards, a hardcopy was delivered to the administration of the study settings **(Basiri et al, 2015; Bhargava et al, 2013)**.

4.3. Updating the Guideline

It is an essential step to ensure that the guideline will remain current and their quality will be maintained. The standards and full guideline are valid a minimum of two years and a maximum of five years, unless new evidence supporting or contradicting the current recommendations then updating the guide is a necessity.

1. Data collection was conducted by the researcher, from the study subjects through hand-delivered questionnaires to nurses at their work settings through individualized interview. It took about 15 minutes for each questionnaire to be completed. Moreover, data collection from the panel of experts (academic and clinical) was done through individualized interview and took approximately an hour to review the tool and the guideline. Data collection took a period of 5 months from the beginning of April to the end of August 2021.
2. Data obtained was analyzed using the appropriate statistical

Ethical Considerations

- The research approval was obtained from the ethical committee at the Faculty of Nursing-Damanhour University, prior to the start of the study.
- An informed consent was obtained from ICUs nurses after explanation of the aim of the study.
- Privacy and right to refuse to participate or withdraw from the study were assured during the study.
- Confidentiality and anonymity regarding data collected were maintained.

Statistical analysis

The collected data was revised, categorized, coded, computerized, tabulated and analyzed using Statistical Package for Social Sciences (SPSS) version 25.0. It was divided as: (1) Descriptive statistics: frequency, percent and mean with standard deviation. (2) Analytic statistics: Chi-square test, Pearson correlation coefficient test, Multiple Linear regression analysis and ANOVA. P value ≤ 0.05 was significant, and P value ≤ 0.01 was highly significant.

III. Results

Table (1) illustrates the mean ± SD of age for head nurses was (31.5 ± 7.65); compared to (30 ± 8.16) for staff nurses. Above three quarters of head nurses (77%) had from 30 to less than 40 years old; whereas (76.5%) of staff nurses had from 20 to less than 30 years old. Pertaining to gender, all head nurses (100%), and more than three quarters of staff nurses (77.4%) were females. Concerning educational qualification, the majority of head nurses (88.5%) hold Bachelor degree of Nursing Sciences; compared to above half of staff nurses (56.7 %) hold Diploma of Technical Institute of Nursing. The mean ± SD of years of nursing experience was 11.15± 3.79 for head nurses; and 5.33±3.86 for staff nurses. As regard to years of ICUs experience, the majority of head nurses (92.3%) had from 5 years to less than 10 years; however, more than three quarters of staff nurses (75.6%) had from 1 year to less than 5 years of ICUs experience. Concerning marital status, the majority of head nurses (92.3%) and above two thirds (69.7%) of staff nurses were married.

Table (2) reveals that three quarters of the panel of experts (75%) were professional/ clinical experts. Moreover, their mean age was 40±5.0 and three quarters of them (75%) had from 40 to less than 50 years old. Additionally, above half of them (55%) had Bachelor degree of Nursing Sciences and one quarter of them (25%) had Doctorate degree of Nursing Sciences. In relation to, years of academic/ clinical experience, their mean was 19.25±4.11 and the majority of them (82.5%) had from 20 to less than 30 years of this experience.

Table (3) shows that nurses got moderate mean percent scores of total occupational work-related safety hazards (62.24%). The first was biological hazards, which got high mean percent score (76%); compared to moderate mean percent scores of

ergonomic, chemical, psychosocial and physical (64.86%, 63.43%, 62.90%, and 55.38%), respectively.

Table (4) reveal that the total and the majority of strategies/recommendations got moderate mean percent scores; except for: appropriate disposal of sharp instruments; biomedical and chemical waste is safely disposed; compliance with wearing and disposing Personal Protective Equipment (PPE); and infection control guideline is available and complied all times, which got high mean percent scores (84.60%, 80.93%, 80.30%, 75.81%), respectively. On the other hand, periodic medical examination performed annually was the only item that got low mean percent score (35.36%).

Table (5) shows that there were positive highly statistically significant correlation between nurses' perceptions and strategies/recommendations to overcome Occupational Work-related Safety Hazards (OWSH), where (r= 0.264, P= 0.000). Moreover, there were positive highly statistical significant correlations between physical, chemical, psychosocial, ergonomic, biological hazards and strategies/recommendations to overcome these hazards, where (P= 0.000), for each one.

Table (6) presents the results of multivariate regression analysis between nurses' perceptions of strategies/recommendations to overcome occupational hazards as independent variables and occupational work-related safety hazards as a dependent variable. It was found that approximately 19.1% of the explained variance of occupational work-related safety hazards was related to strategies/recommendations to overcome these hazards, where the model is significant (F = 6.822, P = 0.000). However, coefficients table of regression analysis displayed that only the variables of emergency exits marked, and dispose sharp instruments in unbreakable containers tended to be highly statistically significant predictors of occupational work-related safety hazards, where (β=0.126, P=0.000; β=0.341, P=0.000), respectively; compared to receive orientation and continuing training, which was statistically significant, where (β= 0.128, P =0.046).

Table (7) shows that total OWSH guideline got high mean percent scores (75.9%) as perceived by academic and professional/
clinical experts. All dimensions got high scores, the first one is scope and purpose; then stakeholder involvement; applicability of the guideline; clarity of presentation; rigour of development; and finally, editorial independence (99.58%, 98.54%, 96.56 %, 95.0 %, 93.98 %, 82.5 %), respectively.

Table (8) shows that there were positive highly statistically significant correlations between total AGREE II and both rigour of development and editorial independence dimensions; and also, between scope and purpose dimension and stakeholder involvement dimension, where (P=0.000). Furthermore, positive statistically significant correlations were found between total AGREE II and scope and purpose; stakeholder involvement; clarity of presentation and applicability of the guideline dimensions, where (P= 0.011, 0.015, 0.034, 0.045), respectively.

Table (1): Demographic characteristics of head nurses and staff nurses working at El-Beheira general ICUs.

Demographic characteristics	Head nurses (n= 26)		Staff nurses (n= 513)	
	No.	%	No.	%
Age				
20 -	0	0.0	394	76.5
30 -	20	77.0	113	22.0
40 +	6	23.0	6	1.5
Mean ±SD	31.5 ± 7.65		30 ± 8.16	
Gender				
Male	0	0.0	116	22.6
Female	26	100	397	77.4
Educational qualification				
Diploma of Secondary Nursing School	0	0.0	37	7.2
Diploma of Technical Institute of Nursing	0	0.0	291	56.7
Bachelor degree of Nursing Sciences	23	88.5	183	35.7
Post graduate degree	3	11.5	2	0.4
Years of nursing experience				
1-	0	0.0	288	56.2
5-	15	57.7	151	29.4
10 +	11	42.3	74	14.4
Mean ±SD	11.15± 3.79		5.33±3.86	
Years of ICUs experience				
1-	0	0.0	388	75.6
5-	24	92.3	89	17.4
10 +	2	7.7	36	7.0
Mean ±SD	5.11± 3.32		5.21± 4.49	
Marital status				
Single	1	3.8	145	28.3
Married	24	92.4	358	69.7
Widow	0	0.0	7	1.4
Divorced	1	3.8	3	0.6

Table (2): Demographic characteristics of panel of experts (academic and professional/ clinical). (n=40)

Demographic characteristics	Panel of experts (n=40)	
	No.	%
Experts group		
Academic	10	25.0
Professional/ clinical	30	75.0
Age		
30-	5	12.5
40-	30	75.0
≥ 50	5	12.5
Mean ±SD	40±5.0	
Educational qualification		
Bachelor degree of Nursing Sciences	22	55.0
Master degree of Nursing Sciences	8	20.0
Doctorate degree of Nursing Sciences	10	25.0
Years of academic/ clinical experience		
10-	5	12.5
20-	33	82.5
≥ 30	2	5.0
Mean ±SD	19.25±4.11	

Table (3): Mean percent score of Occupational Work-related Safety Hazards (OWSH) as perceived by nurses, working at El-Beheira general ICUs.

Occupational Work-related Safety Hazards (OWSH)	Min.	Max.	Mean	SD	Mean % score
Physical	11	46	30.46	5.630	55.38
Chemical	8	40	25.37	5.272	63.43
Psychosocial	10	50	31.45	7.301	62.90
Ergonomic	7	33	22.70	4.627	64.86
Biological	3	15	11.40	2.923	76.00
Total Occupational Work-related Safety Hazards	39	163	121.37	19.766	62.24

High mean percent score: ≥ 75 %, Moderate mean percent score: ≥ 50 – <75 %, Low mean percent score: <50 %

Table (4): Mean percent score of strategies/recommendations to overcome Occupational Work-related Safety Hazards (OWSH) as perceived by nurses working at El-Beheira general ICUs.

Strategies / recommendations to overcome OWSH	Min.	Max.	Mean	SD	Mean % Score
Orientation and training on actual or potential occupational hazards.	1	5	3.47	1.024	69.46
Training on fire fighting and evacuation during emergency.	1	5	3.24	1.076	64.82
Firefighting means and equipment available and suitable for all kind of fire.	1	5	3.35	1.084	66.94
Emergency exits are marked and free of obstacles.	1	5	2.91	1.353	58.18
Chemical substance is properly labeled and stored.	1	5	2.88	1.069	57.59
Awareness of containing measures for chemical spill.	1	5	2.87	1.221	57.48
Personal Protective Equipment (PPE) is available all the time.	1	5	3.44	1.064	68.79
Compliance with wearing and disposing PPE.	1	5	4.01	1.026	80.30
Biomedical and chemical waste is safely disposed.	1	5	4.05	1.002	80.93
Appropriate disposal of sharp instruments.	1	5	4.23	0.992	84.60
An infection control guideline is available and complied all times.	1	5	3.79	1.003	75.81
Vaccination against infectious disease and epidemic.	1	5	3.33	1.258	66.57
Periodic medical examination is performed annually.	1	5	1.77	0.904	35.36
Incidents of occupational hazards are reported to hospital management immediately.	1	5	2.96	1.046	59.22
Routine maintenance is performed to electrical system and all equipment.	1	5	3.21	0.976	64.12
Total strategies or recommendations to overcome OWSH.	15	73	49.51	9.487	66.01

High mean percent score: ≥ 75 %

Moderate mean percent score: ≥ 50 – <75 %, Low mean percent score: <50 %

Table (5): Correlation matrix between nurses' perceptions and OWSH and its strategies/ recommendations to overcome at El-Beheira general ICUs.

OWSH / strategies/ recommendations		1	2	3	4	5	6	7
1.Physical Hazards	r	1	0.547	0.419	0.522	0.368	0.762	0.258
	P(2-tailed)		0.000**	0.000**	0.000**	0.000**	0.000**	0.000**
2.Chemical hazards	r		1	0.38	0.517	0.391	0.742	0.22
	P(2-tailed)			0.000**	0.000**	0.000**	0.000**	0.000**
3.Psychosocial hazards	r			1	0.599	0.477	0.801	0.152
	P(2-tailed)				0.000**	0.000**	0.000**	0.000**
4.Ergonomic Hazards	r				1	0.53	0.82	0.183
	P(2-tailed)					0.000**	0.000**	0.000**
5.Biological hazards	r					1	0.657	0.225
	P(2-tailed)						0.000**	0.000**
6. Total OWSH	r						1	0.264
	P(2-tailed)							0.000**
7. Total strategies/ recommendations	r							1
	P(2-tailed)							

Interpretation of r: Weak (0.1-0.24), intermediate (0.25-0.74), strong (0.75-0.99), Perfect (1)
* Significant $P \leq 0.05$, ** highly- significant $P \leq 0.01$

Table (6): Multiple linear regression analysis of Occupational Work-related Safety Hazards (OWSH) among nurses' working at El-Beheira general ICUs.

OWSH	Unstandardized Coefficients	Standardized Coefficients	T	P
	B	B		
(Constant)	92.950		8.511	0.000**
Age (years)	0.002	0.001	0.005	0.996
Years of nursing experience	0.187	0.044	0.397	0.691
Years of ICUs working experience	0.106	0.018	0.319	0.750
Receive orientation and continuing training.	2.473	0.128	1.997	0.046*
Receive appropriate training on fire fighting.	0.586	0.032	0.543	0.587
Firefighting means and equipment available.	1.230	0.067	1.157	0.248
Emergency exits are marked at ICU.	1.845	0.126	2.623	0.000**
Use and handle chemical substance.	0.356	0.019	0.374	0.708
Aware of containing measures.	0.013	0.001	0.016	0.987
Personal protective equipment is available.	0.616	0.033	0.660	0.509
Compliance with wearing and disposing PPE.	1.558	0.081	1.256	0.210
Biomedical and chemical waste is safely.	1.290	0.065	0.985	0.325
Dispose sharp instruments in unbreakable containers.	6.787	0.341	5.216	0.000**
An infection control guidelines effective all times.	0.245	0.012	0.232	0.817
Receive vaccination against infectious diseases	0.502	0.032	0.682	0.496
Periodic medical examination is performed for all staff.	1.776	0.081	1.761	0.079
Incidents that involve occupational hazards are reported.	0.414	0.022	0.434	0.664
Hospital management promotes routine maintenance.	1.167	0.058	1.141	0.255
ANOVA[a]				
Model	df	F	P	R^2
Regression	18	6.822	0.000**	0.191

a: Dependent Variable: Nurses' total occupational work-related hazards.
b: predictors: (Constant), strategies/recommendations, and demographic characteristics.
*P value (significant) ≤ 0.05 **P value (highly- significant) ≤ 0.01
df= degree of freedom
F= One Way Anova T=Independent samples t- test
R^2= Coefficient of multiple determination.

Table (7): Mean percent score of Occupational Work-related Safety Hazards (OWSH) guideline evaluation as perceived by experts using Appraisal of Guidelines for Research and Evaluation (AGREE II).

AGREE II dimensions	Min.	Max.	Mean	SD	Mean % Score
1. Scope and purpose	10	12	11.95	0.316	99.6
2. Stakeholder involvement	10	12	11.83	0.446	98.5
3. Rigour of development	26	32	30.08	1.439	93.9
4. Clarity of presentation	8	12	11.4	0.841	95.0
5. Applicability of guideline	14	16	15.45	0.677	96.6
6. Editorial independence	4	8	6.6	1.105	82.5
Total of AGREE II	**80**	**90**	**87.3**	**2.564**	**75.9**

High mean percent score: ≥ 75 %, Moderate mean percent score: ≥ 50 – <75 %, Low mean percent score: <50 %

Table (8): Correlation matrix between experts' Appraisal of Guidelines for Research and Evaluation (AGREE II) dimensions (scope and purpose, stakeholder involvement, rigour of development, clarity of presentation, applicability of the guideline, and editorial independence).

AGREE II dimensions		1	2	3	4	5	6	7
Scope and purpose	r	1	0.663	0.121	0.116	0.347	0.088	0.398
	P(2-tailed)		0.000**	0.457	0.477	0.028*	0.589	0.011*
Stakeholder involvement	r		1	0.101	-0.218	0.352	0.114	0.383
	P(2-tailed)			0.536	0.176	0.026*	0.482	0.015*
Rigour of development	r			1	0.186	0.009	0.277	0.772
	P(2-tailed)				0.250	0.955	0.083	0.000**
Clarity of presentation	r				1	0.099	0.044	0.335
	P(2-tailed)					0.543	0.787	0.034*
Applicability of the guideline	r					1	0.027	0.319
	P(2-tailed)						0.867	0.045*
Editorial independence	r						1	0.596
	P(2-tailed)							0.000**
TOTAL AGREE II	r							1
	P(2-tailed)							

Interpretation of r =Weak (0.1-0.24), intermediate (0.25-0.74), strong (0.75-0.99), Perfect (1)

*P value (significant) ≤ 0.05 **P value (highly- significant) ≤ 0.01

IV. Discussion

Nurses are an integral component of the health care delivery system, who encounters a variety of Occupational Work-related Health and Safety Hazards (OWSH) that are categorized into biological, chemical, physical, ergonomic, and psychosocial hazards which threaten their lives, safety and well-being **(Imam et al, 2013)**. Therefore, this study was constructed to develop an occupational work-related safety guideline that would be beneficial for nurses, in order to address these hazards that are prevalent in the general ICUs working environment and offer a rational approach for managing and preventing these hazards.

Occupational Work-related Safety Hazards (OWSH)

The findings of the current study revealed that nurses got moderate level of total OWSH mean percent score. The first OWSH was biological hazards; followed by ergonomic, chemical,

psychosocial and physical hazards. Additionally, there were no statistical significant differences between head nurses and staff nurses' perceptions regarding total OWSH and all its types at ICUs.

This may be due to the fact that ICUs represent the most complex and critical environment dealing with critically ill patients to provide patient care and treatment to face life-threatening conditions with the goal of maintaining vital functions in order to prevent further physiological deterioration, reduce mortality, and avoid morbidity; thus, leading to high level of stress in ICUs, which affect the hazard exposure level. Moreover, head nurses and staff nurses' were mastering the same clinical skills, to cope with the nature of ICU, that necessitate high level of professional and clinical competency, and needs persistence from all staff due to nursing shortage and life-threatening situations.

Additionally, both groups receive the same training programs and awareness workshops on occupational health policies, rules, and regulations form their working settings, and head nurses also work in collaborative way with their staff. Furthermore, all MOHP hospitals follow the national guideline for infection control, which involves the protection and prevention of nurses from biological hazards. This is in the same line with **Zarrini et al. (2019)**, who concluded that nurses in ICUs perceived moderate level of occupational hazards. Similarly, **Ghahremani et al. (2018)** and **Arab et al. (2015)** reported a moderate level of occupational injuries among nurses and other health care providers, working in critical care units. This is in agreement with, **Elewa and El Banan (2016)** and **Saqer (2014),** who concluded that there is no significant relationship between total occupational hazards and different nursing employment status. Moreover, **Elewa and El Banan (2016)** found that the majority of nurses were exposed to physical hazards, followed by chemical hazards; while biological hazards were ranked as the lowest occurrences. This is partially in accordance with, **Attia et al. (2018),** who revealed that the most common types of hazards, that nurses are exposed to ergonomic and psychological hazards, while the lowest was the biological hazards.

Strategies/recommendations to overcome occupational work-related safety hazards (OWSH)

The findings of the current study reveal that appropriate disposal of sharp instruments; safe disposal of biomedical and chemical waste; compliance with wearing and disposing PPE; and availability and compliance of the infection control guideline all times, got high mean percent scores whereas, the majority of strategies/recommendations got moderate mean percent scores, namely: orientation and training on actual or potential occupational hazards; training on fire fighting and evacuation during emergency; availability of firefighting means and equipment that are suitable for all kind of fire; emergency exits are marked and free of obstacles; chemical substance is properly labeled and stored; awareness of containing measures for chemical spill; PPE is available all the time; vaccination against infectious disease and epidemic; incidents of occupational hazards are reported to hospital management immediately; routine periodic maintenance is performed to electrical system and all equipment.

On the other hand, annual/periodic medical examination performed for nurses got low mean percent score. This may be due to that each hospital is obligated by Egyptian laws and civil defense regulations to have occupational health and safety committee, which is responsible for: ensuring the availability of firefighting means and equipment that includes alarm system, fire extinguishers, water fire system; each hospital must have firefighting and evacuation plan and train at least twenty five percent of HCWs on each working shift on this plan through scheduled drills; the evacuation necessitate clear pathway to assembling point through emergency exits with appropriate light and unobstructed pass. Moreover, in the different versions of Egyptian national quality standards for accreditation developed by General Authority for Healthcare Accreditation and Regulation (GAHAR), each hospital is required to develop hazardous material and waste management plans which include: safe handling, storage, usage and

transportation of hazardous material, appropriate labeling, and material safety data sheets. Furthermore, the hospital management has also obligated by law to ensure the availability of PPE that are suitable for every kind of hazards and provision of appropriate staff training and orientation. Additionally, **Heydarheydari et al. (2016)** and **Shafiee et al. (2016)** found that periodic medical examination and wearing appropriate PPE is important to protect HCWs and necessary for early detection for long term effect of OWSH. Furthermore, **Assefa et al. (2016), Leiss (2014)** and **Akintayo (2013**) concluded that the use of PPE is the most important measures to safeguard nurses that are constantly in contact with patients, making them less liable to be exposed to occupational hazards. This is in accordance with Occupational Health and Safety Administration **(OSHA) (2014),** and World Health Organization **(WHO) (2010),** which declared that HCWs encountered an increase in the risk of exposure to infections from vast pathogens at their working environment; and in order to tackle this danger, innovative ways of building the capacity of HCWs are needed to initiate with the principles of OSHA Act (2007), which include both eliminative measures, such as: simple standard hygiene practices; and technical protective measures, such as: engineering controls, organizational measures and PPE. Moreover, **Wafula (2013)** reported that continuous training on infection prevention and control has a positive impact on the reduction of sharp injuries.

Correspondingly, **Janjua et al. (2010)** concluded that an advanced knowledge of the risks of exposure to medical sharps was associated with fewer injuries; whereas a lack of professional qualification was linked to more sharps-related injuries. These finding are incongruent with **Moftah et al. (2014),** who confirmed that the majority of nurses did not carry out or perform certain procedures in relation to infection control precautions, such as: use of PPE (gloves, mask, apron), and correct labeling and disposal of needles and sharp instruments. Moreover, **Tidley and Din (2013)** added that despite wearing PPE, transmission of infection, through needle stick injury, to health care personnel via percutaneous tissues was present even with gloves protection.

Correlation matrix between nurses' perception to OWSH and its related strategies/recommendations

The findings of the current study revealed that there were positive highly statistically significant correlations between nurses' perceptions and OWSH (physical, chemical, psychosocial, ergonomic, and biological hazards) and its related strategies/recommendations. This may be attributed to hospitals; commitment to provide and to maintain reasonable and practical work environment that is safe and with minimal exposure to risk among HCWs. This is done through: compliance to occupational and safety laws and regulation; regular monitoring and assessment of work environment hazards; training, guidance and scheduled drills to deal in case of hazards exposure; and finally, national interest with adherence to Egyptian national quality standards for accreditation developed by GAHAR to improve the quality of health care services nation-wide. These findings are congruent with **Zolot (2017),** who reported that safety in the hospital care setting means the presence of measures that minimize the risk of physical, biological, chemical and psychological harm, which can be achieved for example through; safe patient handling and mobility practices, reasonable patient care assignments, and shift duration. Furthermore, **Elewa and El-Banan (2016)** stated that most of nurses perceived lack of educational and developmental programs for health care providers, regular medical examination, policies and procedures for occupational safety and ineffective supervision as more contributing factors for exposure to occupational hazards.

In the same line, **Ghosh (2013)** concluded that nurses are exposed to many occupational hazards as a result of lack of information on the causes, prevention and management of occupational injuries/or illnesses. Additionally, the findings of multivariate regression analysis between nurses' perceptions of strategies/recommendations to overcome occupational hazards as independent variables and occupational work-related safety hazards

as a dependent variable, where the model is significant. However, coefficients regression analysis displayed that only the variables of emergency exits marked, and dispose sharp instruments in unbreakable containers tended to be highly statistically significant predictors of OWSH; compared to receive orientation and continuing training, which was statistically significant. This may be attributed to that all HCWs must be aware of their role in the event of emergencies and must be trained on the safe use of fire extinguishers, that should be provided at appropriate and prominent locations, also all emergency exits should be kept clear of clutter. Moreover, reducing needle stick injuries is an important component of infection control guideline, which allowed the hospital to provide targeted interventions to increase awareness of the risks of needle stick injuries, reduce such injuries and to identify risky practices, and to design a customized improvement plan to reduce risk and injury. Furthermore, training and orientation is obligatory by Egyptian laws and GAHAR on health and safety issues to be conducted to all HCWs. This is in agreement with **Bazeyo et al. (2015)** and **Fletcher et al. (2015),** who stated that HCWs work in an environment that is deeming to be one of the common hazardous occupational settings, where they are frequently exposed to many forms of occupational hazards while doing their duties which may be preventable if they comply with appropriate precautions. This is partially in accordance with, **Saqer (2014),** who found that there is a significant linear relationship between knowledge of health care providers regarding health and safety and physical risks. On the other hand, **Jalali et al. (2016)** found that the staff knowledge about fires and its prevention measures and control has been lower than the average limit of staff awareness.

Occupational Work-related Safety Hazards Guideline

The findings of the current study show that total OWSH guideline got high mean percent scores as perceived by academic and professional/ clinical experts. All dimensions and their related items got high mean percent scores, the first one is scope and purpose; then stakeholder involvement; followed by, applicability of the guideline; then clarity of presentation; rigour of development; and finally, editorial independence. This may be due to that academic and clinical/professional experts were involved and concerned with the field of the developed guideline as they work as: quality teams members, occupational health specialists, nursing directors, and academic experts. In the same line, **Xiaoyu et al. (2022)** found that the domain scope and purpose had the highest scores, followed by the clarity of presentation, the rigor of development, stakeholder involvement, and editorial independence, and the lowest was applicability. On the other hand, **Zhou et al. (2021)** found that the domain with the highest percentage was clarity of presentation, while the domain with the lowest percentage was applicability.

Moreover, the findings revealed that there were positive highly statistically significant correlations between total AGREE II and both rigour of development and editorial independence dimensions; and also, between scope and purpose dimension and stakeholder involvement dimension. Furthermore, positive statistically significant correlations were found between total AGREE II and scope and purpose; stakeholder involvement; clarity of presentation and applicability of the guideline dimensions. Positive statistically significant correlations were found between applicability of the guideline and both scope and purpose and stakeholder involvement. On the other hand, no statistical significant correlations were found between the other dimensions. This may be due to that scope and purpose of the guideline focus on HCWs, especially nurses, working at general ICUs, and answers the question of what are the OWSH and the risk of exposure during their employment time, and the objectives of the guideline focusing on OWSH: biological; chemical; physical; ergonomic; and psychosocial hazards. Moreover, stakeholder involvement, who focuses on the extent to which the developed guideline included: appropriate stakeholders; individuals from all relevant professional groups; views and preferences of intended users. Additionally, rigour of development of the guideline, this domain assesses the process used to gather and synthesize the evidence and the methods to formulate the recommendations and to update them. Finally, the editorial

independence domain got the least score of the developed OWSH guideline. This may be attributed to lack of expert interest to disclose necessary funding to apply the guideline and there is no conflict of interest between experts, and lack of appreciation to its necessity for guideline users.

This is in line with **Zhang et al. (2014),** and **Holmer et al. (2013),** who concluded that low editorial independence occurs due to the difficulty to ensure that guideline developer interests and source of funding will not affect the quality of strategies/recommendations, included in the developed guideline. Additionally, **Vasse et al. (2012)** found that the highest quality domains were scope and purpose and clarity of presentation. However, this is not in accordance with **Smith et al. (2015),** and **Tunnicliffe et al. (2015),** who found that the applicability domain had the lowest score. This is supported by **Brosseau et al. (2014),** who reviewed seventeen Clinical Practice Guidelines (CPG), based on the AGREE II scoring, and found that the quality of CPGs are good and applicable for HCWs, and there was consensus for some recommendations.

V. Conclusion

It is concluded that the current study developed a valid and reliable Occupational Work-related Safety guideline at general ICUs. This was achieved through assessing Occupational Work-related Safety Hazards (OWSH); then, developing OWSH for nurses working at general ICUs. More than one- half of nurses got moderate level of total OWSH mean percent score. Biological hazards was the first; followed by ergonomic, chemical, psychosocial and; lastly, physical hazards. However, the majority of strategies or recommendations to deal with these hazards got moderate scores. Finally, the developed OWSH guideline got high mean percent scores to be applicable and to be used by general ICUs' nurses.

VI. Recommendations

In the light of the study findings, it is recommended that:

Hospital administrators should:

- Establish policies that describe the hospital's commitment to safety and health and pledging to establish, and maintain a safety and health program for all HCWs.
- Train nurses on Occupational Work-related Safety Hazards at job placement, annually, and whenever changes in exposure routes are introduced, training includes safe work practices and procedures.
- Ensure that regular inspections for the hospital's safety environment, accidents, and work injuries are investigated and handled, and that dealing with safety concerns and issues is effective.
- Provide vaccination and treatment for nurses at risk of blood-borne exposure should receive the HBV vaccine, to protect them from infection. In case of exposure, access to emergency services immediately because post-exposure prophylaxis against HIV is most effective within two hours of exposure; whereas, against HBV is most effective within 24 hours.
- Supply nurses with assistive technologies, such as mechanical lifting devices for transporting heavy objects to avoid strain and force exertion from manual lifting, and ergonomic-comfortable office that HCWs can be adjusted to maintain a neutral posture and avoid inappropriate body positions.
- Foster an organizational culture that promotes psychosocial health and safety through promoting a work environment that is free from psychological harm, ensuring compliance with relevant occupational health and safety laws.

Nursing management (directors, supervisors, and head nurses) should:

- Allow participation and representation of all departments and different categories of nurses in hospital performance improvement committees (occupational health and safety, infection control, quality improvement committee) and hospital board.
- Advocate for nurses' rights for working in suitable conditions, an adequate level of resources, receive assistance, safe environment (participate in design modification, training programs, and resources allocation).
- Ensure compliance with the practice requirements guidelines developed by hospital improvement committee including nursing staff committee.
- Recognize and reward nurses' good and safe job performance (such as: complying with the infection control guidelines especially in emergencies).

- Emphasis on quality of work-life improvement, for nurses through fair job assignment, flexible time schedules, monitoring nurses' absenteeism, and sick leaves.
- Create a supportive work environment and safety climate that impedes trust, respect, cooperation, incident reporting, improvement rather than punishment, and teamwork.

General ICU's nurses should:

- Follow standard precautions (universal precautions), such as: considering all body fluids as infectious; washing hands, disinfecting surfaces and equipment; and wearing gloves and other appropriate PPE to the situation.
- Follow work-practice controls for the prevention of sharps injury, such as: preparing all the needed items before using a sharp object (needle or scalpel), such as alcohol swabs, gauze, and bandages, placing the sharps disposal container at a well-known and fixed site; suitable size to fit the different sharp objects; lastly, it should not exceed more than three-quarters full.
- Participate in designing work equipment and ICUs work process, which will increase their job satisfaction and will reduce dramatically turnover and absenteeism.
- Attend training programs that cover different employment periods such as orientation, training for refreshing or updating knowledge, and condition-based training where general ICUs nurses need information about an unexpected or unusual situation (e.g. when they were caring for patients with an epidemic disease); return to work training for staff who have been absent after having a workplace accident or long-term leave from the ICUs.
- Comply with occupational safety practices and preventive measures, follow infection control guidelines and actively participate in decision-making regarding nursing work conditions rather than behaving passively and carelessly.
- Collaborate and cooperate with other HCWs through sharing skills, and experience, and deciding to handle patients safely.

Further research to be conducted

- Impact of occupational work-related safety hazards on the quality of nurses' work life.
- Developing a strategy for improving occupational work practices in nursing.
- Application of occupational work-related safety hazards guideline in different health care settings.

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