KEMAS 20 (2) (2024) 222-230

Jurnal Kesehatan Masyarakat

http://journal.unnes.ac.id/nju/index.php/kemas

Knowledge and Attitude Related to Chemical Hazards Among Employees in Dental and Oral Hospital, Indonesia

Diki Bima Prasetio[1] ✉, Tiwakron Prachaiboon[2], Shinta Dwi Surya Pramesti[1], Nasya Adelia Putri[1], Eli Sahiroh[1], Dwi Windu Kinanti Arti[3], Jipri Suyanto[4], Yuliani Setyaningsih[5]
[1]Faculty of Public Health, Universitas Muhammadiyah Semarang, Semarang, Indonesia
[2]Faculty of Public Health, Khon Kaen University, Khon Kaen, Thailand
[3]Faculty of Dentistry, Universitas Muhammadiyah Semarang, Semarang, Indonesia
[4]Faculty of Health Sciences, Dehasen University Bengkulu, Bengkulu, Indonesia
[5]Faculty of Public Health, Diponegoro University, Semarang, Indonesia

Article Info

Article History:
Submit: October 2023
Accepted: March 2023
Published: October 2024

Keywords:
Attitude; Chemical Hazards; Knowledge

DOI
https://doi.org/10.15294/kemas.v20i2.48405

Abstract

The risk of chemical exposure in hospitals is a critical issue in the field of healthcare. Exposure to hazardous chemicals can harm the health of healthcare workers operating in hospital environments. Hospitals utilize various chemicals; exposure can occur through inhalation, ingestion, and skin absorption. This research, conducted in the year 2023, aims to assess the knowledge and attitudes of hospital employees regarding chemical hazards. The study employed a cross-sectional design with a total population sampling technique, with a sample size of 154 employees including doctors, nurses, pharmacists, laboratory technicians, radiologists, and support staff divided into three units: medical services, medical support, and management. Data analysis utilized bivariate analysis and the chi-square test for relationship testing. Multivariate analysis was also employed using logistic regression. The study's results reveal that 63% of the individuals are under 30 years of age, the majority are female (67.5%), 66.2% have less than 3 years of work experience, 62.3% work in medical service units, and 77.3% have an education level of a bachelor's degree or higher. Additionally, 52.6% of the employees are unmarried. 76% of employees exhibit a positive attitude, and 89% possess good knowledge of chemical hazards. The study demonstrates a relationship between individual characteristics (age, gender, work experience, and unit) and the level of knowledge of chemical hazards among hospital employees. The multivariate analysis revealed that age and work unit are the influential variables. This research concludes that the majority of employees at the Dental and Oral Hospital possess good knowledge of chemical hazards and can recognize chemical hazard symbols following the GHS. Furthermore, most of them exhibit a positive attitude toward preventive measures and an understanding of chemical hazards. The data analysis results indicate that there is a relationship between age, length of service, and work unit with the level of chemical hazard knowledge.

INTRODUCTION

The risk of chemicals in hospitals is a growing concern faced by healthcare professionals and supervisory authorities daily (McDiarmid, 2006). Exposure to dangerous substances in the hospital setting can lead to adverse effects on the well-being and overall quality of life of healthcare professionals. The extent of this exposure can differ greatly based on the specific clinical departments and job roles, and it may stem from a variety of sources. (Chhabra, 2016). Hospitals are places where various types of chemicals, ranging from medications to cleaning agents, are extensively used for patient care, sterilization, and facility maintenance (Charlier et al., 2021; ILO, 2021; Rutala & Weber, 2015). Exposure to chemicals within the hospital environment may manifest in

✉ Correspondence Address:
Faculty of Public Health, Universitas Muhammadiyah Semarang, Semarang, Indonesia
Email: dikibimaprasetio@unimus.ac.id

pISSN 1858-1196
eISSN 2355-3596

two forms: acute poisoning or as a consequence of sustained, long-term contact with low levels of contaminants among healthcare workers. This can result in harm to the nervous system, blood-forming system, or reproductive system, and may potentially be linked to the development of cancerous conditions. (Leso et al., 2019; Stewart-Evans et al., 2013). Chemicals can enter the human body through two main mechanisms: inhalation, where substances are inhaled through the respiratory system, and ingestion, where substances are swallowed through the mouth. There are several ways for chemicals to enter the body, namely inhalation, absorption, and ingestion (ILO, 2021). Previous research explained that the prevalence of occupational respiratory symptoms of hairdressers in Palembang was 40% and they are vulnerable groups (Desheila Andarini et al, 2019). This has been attributed to their exposure to several toxic elements used in the coiffures, including sprays, hair colors, and, more importantly, bleaching agents, specifically per sulfate salts, although the mechanism of inducing occupational asthma has not been demonstrated (Desheila Andarini et al, 2019).

Ensuring the health and safety of the workplace is of paramount importance, primarily because of the elevated occurrence of illnesses and fatalities among employees exposed to workplace hazards. It's estimated that around 100,000 individuals lose their lives as a result of work-related illnesses, and approximately 400,000 new cases of occupational diseases are diagnosed annually (Amosu et al., 2011). According to the European Agency for Safety and Health at Work's 2015 report, 17% of workers in the European Union (EU) reported exposure to chemicals or substances for at least a quarter of their working time (Work, n.d.). Previous research indicates that the prevalence of exposure to asthma-inducing agents, carcinogens, and ototoxic agents reaches significant levels, namely 98.7%, 28.1%, and 7.6%, respectively. Meanwhile, exposure to anesthetic gases reaches 6.2%, and antineoplastic drugs reach 2.2%. The most prevalent exposures pertain to latex, cleaning solutions, and disinfectants within the category of asthma-inducing agents. Formaldehyde ranks as the most frequent substance responsible for exposure within the carcinogenic group, and p-xylene is commonly encountered as an ototoxic agent. Situations leading to exposure include the use of latex gloves, bleach, and chlorhexidine for cleaning, the utilization of formaldehyde as a disinfectant, both in laboratory settings and elsewhere, and the use of p-xylene within laboratory environments. (Rai et al., 2020).

Hospital employees, including doctors, nurses, laboratory technicians, and support staff, often work close to potentially hazardous chemicals (Hundhammer et al., 2023). These chemicals can pose health risks if not handled and managed properly. Therefore, it is crucial for healthcare workers to have a comprehensive understanding of the chemical hazards present in their workplaces and to be fully aware of the potential risks associated with their exposure. The objective of this study is to evaluate the comprehension and consciousness of hospital employees concerning workplace chemical hazards. By doing so, we can identify areas where additional training and safety measures may be needed to protect the health and well-being of healthcare professionals.

METHOD

In this research, a cross-sectional study design was employed to gather information through surveys conducted at a specialized dental and oral hospital, involving 154 participants with diverse roles in medical, medical support, and management. Ethical approval for this study was obtained from the ethics committee at the Faculty of Nursing and Health Sciences, University of Muhammadiyah Semarang, under reference number 228/KE/09/2023. Subsequently, interviews using a questionnaire were conducted to assess employees' knowledge and attitudes regarding chemical hazards in the workplace. The questionnaire comprised 9 questions related to chemical hazard knowledge, 11 questions assessing knowledge of chemical hazard symbols based on the Globally Harmonized System of Classification and Labeling of Chemicals (GHS), and 10 questions regarding attitudes toward chemical hazards. Employee knowledge and attitude scores were calculated, assigning equal weight (one point) to each question. The

TABLE 1. Individual Characteristics

Variable	Category	*n*	%
Age	≥ 30 years old	57	37,0
	< 30 years old	97	63,0
Gender	Female	104	67,5
	Male	50	32,5
Years of service	< 3 years	52	33,8
	≥ 3 years	102	66,2
Unit section	Medical support	20	13,0
	Medical services	96	62,3
	Management	38	24,7
Level of education	College Degree and Higher	119	77,3
	Lower than a College Degree	35	22,7
Marital status	Married	81	52,6
	Single	73	47,4
Attitudes	Positive	117	76,0
	Negative	37	24,0
Level of knowledge of chemical hazards	Good	89	57,8
	Poor	65	42,2

Source: Primary Data, 2023

data analysis in this study involved bivariate analysis to test relationships using the chi-square test. Additionally, multivariate analysis was performed using logistic regression.

RESULT AND DISCUSSION

Based on Table 1, it can be explained that the characteristics of employees in the Dental and Oral Hospital are as follows: the majority is the age of <30 years, accounting for 63%; 67.5% are female; 66.2% have worked for ≥ 3 years. The majority of Dental and Oral Hospital employees are in medical service units, accounting for 62.3%, with 77.3% holding a college degree or higher. The married status is greater at 52.6% compared to the unmarried status. The level of knowledge about chemical hazards is mostly good, at 57.8%.

Based on Table 2 it is explained that employees have a good knowledge of chemical hazards by 90.9%. Good knowledge of the effects of chemical hazards on health 82.5%, good knowledge of relevant types of PPE 74.7%, employees know. Good against hazards other than chemical hazards 72.1%, and knowing the importance of emergency exits 92.2%. In addition, employees know about Material Safety Data Sheets 51.9%, know well about workplace safety rules 79.2%, employees know well about hospitals must maintain worker health 96.8%, and employees know how to identify, handle, and address if there are leaks or chemical spills in hospitals 74.7%.

Table 2 explains that 87% of employees know the symbol of explosion risk, 90.3% know the symbol of flammable substances, 59.1% know the symbol of oxidizing agents, 58.4% know the symbol of gas under pressure, 55.2% know the symbol of toxic substances, 72.1% know the symbol of irritating the skin, 60.4% know the symbol of risk to health, 71.4% know the symbol of harmful to the environment, 64.3% know the symbol of biological hazard, and 81.8% knew the danger symbol of radioactive materials. According to ANSI Z535 and ISO 3864 signs and symbols must be understood by at least 85% and 67% of people (Jahangiri M, Omidvary F, 2018). Chemicals, as they progress through various stages from production to handling, transportation, and usage, pose a significant risk to both human health and the environment. To ensure the safe handling,

TABLE 2. Level of knowledge of chemical hazards and the symbol in the workplace

Variable	Level of knowledge of chemical hazards			
	Good		Poor	
	n	**%**	***n***	**%**
Level of knowledge of chemical hazards				
Know chemical hazards	140	90,9	14	9,1
Know the Effects of Chemical Hazards on Health	127	82,5	27	17,5
Knowing relevant personal protective equipment (PPE)	115	74,7	39	25,3
Know hazards other than chemicals	111	72,1	43	27,9
Emergency exit is important	142	92,2	12	7,8
Know the material safety data sheet	80	51,9	74	48,1
Know any safety rules in this workplace	122	79,2	32	20,8
Have information on occupational health	149	96,8	5	3,2
Knowing How to Identify, Handle, and Address Chemical Leaks or Spills in the Hospital	115	74,7	39	25,3
Level of Knowledge of Chemical Hazard Symbols				
Know Explosive Risk Symbol	134	87,0	20	13,0
Know flammable substances symbol	139	90,3	15	9,7
Know oxidizing substances symbol	91	59,1	63	40,9
Know gas under pressure symbol	90	58,4	64	41,6
Know corrosive substances symbol	85	55,2	69	44,8
Know toxic substances (acute toxicity) symbol	103	66,9	51	33,1
Know the skin irritant symbol	111	72,1	43	27,9
Know the risk to health symbol	93	60,4	61	39,6
Know harmful to the environment symbol	110	71,4	44	28,6
Know biological hazards symbol	99	64,3	55	35,7
Know the danger of radioactive materials symbol	126	81,8	28	18,2

Source: Primary Data,2023

transport, and disposal of chemicals, there is a need for global standardization in classifying these hazards. This involves categorizing chemicals based on their potential dangers and proposing uniform hazard communication elements, such as labels and safety data sheets, as outlined in the Globally Harmonized System of Classification and Labelling of Chemicals (GHS). The GHS employs consistent criteria for classifying substances and mixtures according to their health, environmental, and physical risks, as well as for communicating these hazards through labeling requirements, including hazard and prevention statements and pictograms (UNECE, 2017). The symbol is described in Figure 1.

Based on Table 3, the findings of this research reveal the patterns of employee attitudes in the Dental and Oral Hospital of Universitas Muhammadiyah Semarang regarding chemical hazards. A significant 84.4% of employees exhibit a negative attitude towards workplace statements perceived as harmful to health, and an equivalent percentage, 84.4%, holds a negative attitude regarding the utilization of Personal Protective Equipment (PPE) during chemical contact. Nevertheless, noteworthy positive attitudes are observed among the employees. Specifically, 89% express a positive attitude towards the

TABLE 3. Attitudes Towards Chemical Hazards in the Workplace

Variable	Attitudes toward chemical hazards in the workplace			
	Positive		Negative	
	n	%	*n*	%
The workplace is hazardous to health	130	15,6	24	84,4
I should use PPE during work	130	15,6	24	84,4
The employer has a responsibility to reduce exposure to hazards	137	89,0	17	11,0
All PPE has the same level of protection	129	83,8	25	16,2
I should always use PPE	145	94,2	9	5,8
PPE is relevant in the workplace	149	96,8	5	3,2
Employer provides PPE	135	87,7	19	12,3
I have undergone chemical safety training	139	90,3	15	9,7
The supervision of Personal Protective Equipment (PPE) use during contact with chemicals is in place	150	97,4	4	2,6
Feel satisfied with my work	151	98,1	3	1,9

hospital's assertion of responsibility in reducing exposure to chemical hazards. Furthermore, 83.8% maintain a positive attitude concerning the belief that all PPE provides the same level of protection. A substantial 94.2% hold a positive attitude towards compliance with work safety regulations, and an impressive 96.8% convey a positive attitude towards the appropriateness of the provided Personal Protective Equipment.

In addition, positive employee attitudes extend to various aspects, including the hospital's provision of PPE (87.7% positive attitude), employee participation in safety training related to chemicals (90.3% positive attitude), positive attitudes towards supervision regarding the use of PPE during chemical contact (97.4% positive attitude), and a remarkable 98.1% of employees expressing satisfaction with their work. These attitude patterns reflect the complex dynamics in the workplace concerning safety and the overall work environment at the Dental and Oral Hospital. While certain areas indicate noteworthy negative attitudes, the substantial positive responses underscore the effectiveness of measures taken by the hospital, such as safety training provision and regulatory compliance. These steps can be seen as indicators of awareness and commitment to creating a safe work environment and ensuring the well-being of employees.

Based on Table 4 the results of the relationship test explain that there is a relationship between age and the level of chemical hazard knowledge p = 0.001, there is a relationship between working life and the level of chemical hazard knowledge p = 0.010, and there is a relationship between the unit of work part and the level of chemical hazard knowledge p = 0.000. While the test explained that there was no relationship between sex and the level of knowledge of chemical hazards p = 0109, there was no relationship between the level of education and the level of knowledge of chemical hazards p = 1.000, and there was no relationship between marital status and the level of knowledge of chemical hazards p = 0.581. The results in Table 5 the multivariate test explained that the influential variables were age and part of the unit.

Knowledge related to chemical hazards is important for hospital employees because chemicals are commonly used in hospitals every day. Various chemicals used in the Dental and Oral Hospital include chemicals in dental casting, fixing and developing agents, chemicals used in dental health services, and chemicals used in workplace cleaning (Lajolo *et al*., 2019). The use of these chemicals can pose various

TABLE 4. Bivariate Analysis of the Relationship between Individual Characteristics and Level of Knowledge of Chemical Hazards in the Workplace

Variable	Category	Level of knowledge of chemical hazards				*p*
		Good		**Poor**		
		n	**%**	***n***	**%**	
Age	≥ 30 year	43	48,3	14	21,5	0,001*
	< 30 year	46	51,7	51	78,5	
Gender	Female	55	61,8	49	75,4	0,109
	Male	34	38,2	16	24,6	
Years of service	< 3 year	38	42,7	14	21,5	0,010*
	≥ 3 year	51	57,3	51	78,5	
Unit section	Medical support	18	20,2	2	3,1	0,000*
	Medical services	57	64,0	39	60,0	
	Management	14	15,7	24	36,9	
Level of education	College Degree and Higher	69	77,5	50	76,9	1,000
	Lower than a College Degree	20	22,5	15	23,1	
Marital status	Married	49	55,1	32	49,2	0,581
	Single	40	44,9	33	50,8	

** p<0.05 indicates a significant relationship*

Source: Primary Data, 2023

TABLE 5. The Most Related Variables

Variable	β	p
Age	1,343	0,001*
Units (2)	2,915	0,001*

Source: Primary Data, 2023

health risks. Employee knowledge regarding chemical hazards is crucial in protecting them from the chemicals used. The goal of creating the GHS is to provide the correct classification of chemicals based on their potential hazards and to convey important information about these chemicals to users through standard pictograms, signal words, hazard statements, and precautionary statements on labels and safety data sheets (Mehrifar *et al*., 2016; Rossete & Ribeiro, 2021).

RSGM has established adequate facilities for chemical management in the workplace. These facilities include secure storage areas and a controlled disposal system, equipped with standard hazard symbols. Additional amenities such as eye washers and spill kits have been introduced to provide a swift response to chemical emergencies, especially in cases involving eye contact or chemical spills. To ensure employee safety, RSUGM has implemented stringent chemical safety policies. Employees undergo regular training covering the understanding of hazard symbols, the use of personal protective equipment (PPE), and procedures for the prevention and emergency response related to chemical substances. Storage policies governing secure and locked storage areas further support the creation of a chemical-safe work environment, contributing to a better understanding of chemical risks and the necessary safety measures among employees.

Based on the research results, it is explained that 57.8% of employees have good knowledge of chemical hazards. Most workers

are aware of chemical hazard symbols that are in line with the GHS. Additionally, the majority of employees have a positive attitude towards prevention and other information related to chemical hazards. According to the relationship test results, there is a relationship between age and knowledge of chemical hazards in the hospital, with a p-value of 0.001. The employees' awareness of chemical hazards is positively influenced by the hospital's commitment to enhancing workplace safety. This commitment is reflected in the hospital's proactive measures, including the formulation of policies governing the use of chemicals and the implementation of regular training sessions, conducted at least annually, to prevent accidents in the workplace. The older a person is, the more likely they are to have a greater willingness to learn and acquire information compared to younger individuals (Tsitsimpikou *et al*., 2021). Previous research has also indicated that laboratory workers aged 31-40 years, constituting 51.7%, have good knowledge of chemical hazards compared to those under 30 years old (Papadopoli *et al*., 2020).

Research has linked exposure to hazardous chemicals in the workplace to both mild and severe acute effects, such as skin rashes, eye irritation, or burns, as well as severe impacts, including adverse reproductive outcomes (including infertility, spontaneous abortion, and congenital malformations), and possibly leukemia and other cancers (Fransman *et al*., 2014; Lawson *et al*., 2012). Whereas in research or healthcare laboratories, attention has been particularly devoted to biological hazards (Papadopoli *et al*., 2019). Gender does not show a relationship with knowledge of chemical hazards, with a p-value of 0.109. Of those, 61.8% of female employees have good knowledge of chemical hazards. Women may be more vulnerable to pesticides than men due to their greater sensitivity related to physical characteristics, such as a higher percentage of body fat that allows for the accumulation of pesticides, hormonal-sensitive tissues, and their productive age (Chen *et al*., 2018; Silvia *et al*., 2020). Despite the theory, both men and women need to acquire this knowledge. Therefore, knowledge about chemical hazards is essential for both genders. The relationship test results explain that there is a relationship between length of employment and knowledge of chemical hazards, with a p-value of 0.010. Workers with more than 3 years of experience are more likely to have good knowledge of chemical hazards, with a rate of 57.3%. The longer a person works, the longer their exposure to a chemical hazard accumulates. Health risks from chemicals depend on several factors, including the intrinsic characteristics of the substance and the duration of exposure (Videnros *et al*., 2020). Regular training and knowledge enhancement are important to improve and refresh employee knowledge regarding chemical hazards.

There is a relationship between the unit department and knowledge of chemical hazards, with a p-value of 0.000*. The hospital departments in this study are divided into three categories: medical services, medical support, and management. Employees in hospitals have varying levels of exposure to chemical hazards, whether in medical services, medical support, or management. In hospitals, not all employees are exposed to the same level of chemical hazards. There are differences in exposure levels, and often, the most exposed employees are doctors, nurses, laboratory technicians, and pharmacists (Papadopoli *et al*., 2020; Rai *et al*., 2021; Zhang *et al*., 2016). This is due to their primary roles in providing healthcare to patients and performing medical procedures that involve the use of specific chemicals. For example, doctors and nurses often deal with medications and medical procedures that use various types of chemicals. Laboratory technicians and pharmacists also routinely interact with chemicals for laboratory analysis and medication preparation.

This study is not consistent with previous research that found a significant relationship between the level of education of nurses and their overall knowledge of health and safety measures (Ahmed & Shareef, 2019). There is no relationship between education level and knowledge of chemical hazards in this study, which does not align with previous research that showed a relationship between education level and knowledge of workplace hazards (Usman N O, 2021). This is due to other factors, such as a higher percentage of

employees with a bachelor's degree or higher (77.3%) compared to those with an education level below a bachelor's degree (22.7%). Marital status does not show a relationship with employee knowledge of chemical hazards. This result is in line with previous research conducted on janitorial staff measuring their knowledge of physical environmental hazards in hospitals (Ilesanmi et al., 2015). Marital status is a personal condition that indicates whether someone is married or unmarried. On the other hand, knowledge of chemical hazards in hospitals among employees relates to an individual's understanding of potential hazards in their workplace, particularly those related to the chemicals used in medical treatment or hospital care.

Conclusion

This study explains that as many as 57.8% of employees have good knowledge related to chemical hazards. Most workers are aware of chemical hazards and chemical hazard symbols that comply with GHS. Most employee attitudes lead to a 76% positive attitude regarding prevention and other information related to chemical hazards. The results of the relationship test explained that there was a relationship between age, length of service, and part units with knowledge of chemical hazards in Dental and Oral Hospital employees. The importance of training related to chemical hazard knowledge is provided to all employees regularly.

REFERENCES

Ahmed, S.A., & Shareef, O.H., 2019. Assessment of Occupational Health and Safety Measures' Knowledge and Experienced Types of Hazards among Nursing Staff in Rania Hospital. *Erbil Journal of Nursing and Midwifery*, 2(2), pp.85–92.

Amosu, A.M., Degun, A.M., Olanrewju, M.F., Aderibigbe, K.A., Health, A., & Centre, I.S., 2011. The Level of Knowledge Regarding Occupational Hazards among Nurses in Abeokuta, Ogun State, Nigeria. *Current Research Journal of Biological Sciences*, 3(6), pp.586–590.

Andarini, D., Camelia, A., & Listianti, A.N., 2019. Occupational Respiratory Symptoms Caused by Chemical Hazard on Hairdresser Workers in Palembang. *Journal KEMAS (Jurnal Kesehatan Masyarakat)*, 15(1), pp.6-14.

Charlier, B., Coglianese, A., Rosa, F.D., Caro, F.D., Piazza, O., Motta, O., Borrelli, A., Capunzo, M., Filippelli, A., & Izzo, V., 2021. Chemical Risk in Hospital Settings: Overview on Monitoring Strategies and International Regulatory Aspects. *Journal of Public Health Research*, 10(1).

Chen, M.-W., Santos, H.M., Que, D.E., Gou, Y.-Y., Tayo, L.L., Hsu, Y.-C., Chen, Y.-B., Chen, F.-A., Chao, H.-R., & Huang, K.-L., 2018. Association between Organochlorine Pesticide Levels in Breast Milk and Their Effects on Female Reproduction in a Taiwanese Population. *International Journal of Environmental Research and Public Health*, 15(5).

Chhabra, S., 2016. Health Hazards Among Health Care Personnel. *Journal of Mahatma Gandhi Institute of Medical Sciences*, 21(1), pp.19.

EU-OSHA - European Agency for Safety and Health at Work., 2018. *Dangerous substances*.

Fransman, W., Kager, H., Meijster, T., Heederik, D., Kromhout, H., Portengen, L., & Blaauboer, B.J., 2014. Leukemia from Dermal Exposure to Cyclophosphamide Among Nurses in The Netherlands: Quantitative Assessment of the Risk. *The Annals of Occupational Hygiene*, 58(3), pp.271–282.

Hundhammer, T., Lindner, R., Caccia, L., Langbehn, H., Petermichl, W., Dittmar, M., & Gruber, M., 2023. Management of Decontamination in Chemical Accidents: A Laboratory Model. *Scientific Reports*, 13(1), pp.1–12.

Ilesanmi, O.S., Omotoso, B., & Falana, D., 2015. Hazards of Hospital Cleaners in a Tertiary Health Facility in Southwest Nigeria. *International Journal of Occupational Safety and Health*, 4(1), pp.5–10.

International Labour Organization., 2022. *The Globally Harmonized System of Classification and Labelling of Chemicals (GHS)*.

ILO., 2021. Exposure to Hazardous Chemicals at Work and Resulting Health Impacts: A Global Review.

Jahangiri, M., & Omidvary, F.M.A., 2018. A Comparison Study of Perception Towards Chemical Hazard Warning Signs in Old and Globally Harmonized System (GHS) Among Chemical Workers in Shiraz. *Iran Iran Occupational Health.*, 15(5), pp.1–9.

Lajolo, C., Leso, V., Gioco, G., Patini, R., & Fedele, M., 2019. *Chemical Hazard for Dental Hygienists : A Systematic Review*. *European Review for Medical and Pharmacological*

Sciences, 23(18), pp.7713-7721.

Lawson, C.C., Rocheleau, C.M., Whelan, E.A., Lividoti Hibert, E.N., Grajewski, B., Spiegelman, D., & Rich-Edwards, J.W., 2012. Occupational Exposures Among Nurses and Risk of Spontaneous Abortion. *American Journal of Obstetrics and Gynecology*, 206(4), pp.327.

Leso, V., Ercolano, M.L., Cio, D. L., & Iavicoli, I., 2019. Occupational Chemical Exposure and Breast Cancer Risk According to Hormone Receptor Status: A Systematic Review. *Cancers*, 11(12).

McDiarmid, M.A., 2006. Chemical Hazards in Health Care: High Hazard, High Risk, but Low Protection. *Annals of the New York Academy of Sciences*, 1076, pp.601–606.

Mehrifar, Y., Eskandarnia, A., Pirami, H., & Mardanparvar, H., 2016. Assessment of Awareness and Comprehension of Chemical Hazard Symbols Among Chemistry Students. *Journal of Occupational Health and Epidemiology*, 5, pp.20–25.

Papadopoli, R., Bianco, A., Pepe, D., Pileggi, C., & Pavia, M., 2019. Sharps and Needle-Stick Injuries Among Medical Residents and Healthcare Professional Students: Pattern and Reporting in Italy- a Cross-Sectional Analytical Study. *Occupational and Environmental Medicine*, 76(10), pp.739–745.

Papadopoli, R., Nobile, C.G.A., Trovato, A., Pileggi, C., Pavia, M., & Pavia, M., 2020. Chemical Risk and Safety Awareness, Perception, and Practices Among Research Laboratories Workers in Italy. *Journal of Occupational Medicine and Toxicology*, 15(1), pp.1–11.

Rai, R., El-Zaemey, S., Dorji, N., & Fritschi, L., 2020. Occupational Exposures to Hazardous Chemicals and Agents Among Healthcare Workers in Bhutan. *American Journal of Industrial Medicine*, 63(12), pp.1109–1115.

Rai, R., El-Zaemey, S., Dorji, N., Rai, B.D., & Fritschi, L., 2021. Exposure to Occupational Hazards Among Health Care Workers in Low-and Middle-Income Countries: A Scoping Review. *International Journal of Environmental Research and Public Health*, 18(5), pp.1–41.

Rossete, C., & Ribeiro, M., 2021. Laboratory Technicians' Use and Interpretation of Hazard Communication Elements on Chemical Labels. *ACS Chemical Health & Safety*, 28, pp.211–223.

Rutala, W.A., & Weber, D.J., 2015. Disinfection, Sterilization, and Control of Hospital Waste. *Mandell, Douglas, And Bennett'S Principles And Practice Of Infectious Diseases*, January 2015, pp.3294–3309.

Silvia, S.C., Magnarelli, G., & Rovedatti, M.G., 2020. Evaluation of Endocrine Disruption and Gestational Disorders in Women Residing in Areas with Intensive Pesticide Application: An Exploratory Study. *Environmental Toxicology and Pharmacology*, 73, pp.103280.

Stewart-Evans, J.L., Sharman, A., & Isaac, J., 2013. A Narrative Review of Secondary Hazards in Hospitals from Cases of Chemical Self-Poisoning and Chemical Exposure. *European Journal of Emergency Medicine*, 20(5), pp.304–309.

Tsitsimpikou, C., Georgiadis, N., Tsarouhas, K., Kartsidis, P., Foufa, E., Bacopoulou, F., Choursalas, A., Kouretas, D., Nikolaidis, A.K., & Koulaouzidou, E.A., 2021. Children and Parents' Awareness Regarding Potential Hazards Derived from the Use of Chemical Products in Greece. *International Journal of Environmental Research and Public Health*, 18(24).

Usman, N.O., Bello, K., Nwankwo, B., Abdullahi, H.M., Omole, N.V., Ibrahim, M.J., 2021. Knowledge of Occupational Hazards and Practice of Occupational Health and Safety a mong Mortuary Workers in Health Facilities in Kaduna Metropolis, Nigeria. *Journal of Epidemiological Society of Nigeria,* 4(2), pp.39–48.

Videnros, C., Selander, J., Wiebert, P., Albin, M., Plato, N., Borgquist, S., Manjer, J., & Gustavsson, P., 2020. Investigating the Risk of Breast Cancer Among Women Exposed to Chemicals: A Nested Case–Control Study Using Improved Exposure Estimates. *International Archives of Occupational and Environmental Health*, 93(2), pp.261–269.

Zhang, X., Zheng, Q., Lv, Y., An, M., Zhang, Y., Wei, Y., & Feng, W., 2016. Evaluation of Adverse Health Risks Associated with Antineoplastic Drug Exposure in Nurses at Two Chinese Hospitals: The effects of Implementing a Pharmacy Intravenous Admixture Service. *American Journal of Industrial Medicine*, 59(4), pp.264–273.