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The awareness of healthcare workers about hazardous substances used in a tertiary hospital

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ABSTRACT

Objectives: Potentially hazardous materials are commonly used during health practices in the hospital environments. Management of hazardous substances is of great importance. Inadequate training of personnel for use and disposal of hazardous materials were reported by some studies. The aim of present study was to create awareness among healthcare workers for hazardous substances.

Methods: A survey was carried out on 204 healthcare workers (125 females and 79 males; mean age: 33.8 ± 12.9 years) to measure their level of knowledge about hazardous substances used in hospitals.

Results: Hospital departments were investigated and it was found that listing of dangerous substances were missing, their locations were not fixed, and they were not stored in isolated areas. Sixty percent of the participants considered themselves not having enough knowledge about hazardous materials. Ninety percent of the respondents thought that warning signs and symbols placed on hazardous material storage cabinets are useful. It was determined that warning signs for flammable, hazardous for environment, corrosive and explosive were significantly less known compared to symbols ($p = 0.037$, $p = 0.018$, $p < 0.001$ and $p < 0.001$, respectively).

Conclusions: It was concluded that healthcare workers did not have sufficient information about hazardous substances. Healthcare workers should be trained effectively on hazardous substances issue.

Keywords: hazardous substance, healthcare workers, hospital environment

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Hospitals play a significant role in health sector as institutions providing treatment, rehabilitation and care for sick and wounded people as well as for people who want to have their health status checked or who want to have health information on a 7/24 basis. These institutions are also important because they employ considerable number of medical, administration and support personnel. Hospital sector has highest risk for occupational hazards. Individuals who work in a hospital are required to be adequately informed about the physical and health hazards present in the hospital, the known risks, and what is to be done if an accident occurs [1].

Potentially hazardous materials are used during implementation of health care services. Explosive, oxidizing, flammable, irritant, harmful, toxic, carcinogenic, corrosive, infectious, teratogenic, mutagenic and environmentally hazardous materials are considered dangerous materials, and their wastes are referred to as hazardous waste. Costa and Felli [2]

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showed that healthcare workers detected 145 chemical substances and the most frequent health problems were related to skin problems. Hazardous materials used in hospitals are halogenated and non-halogenated organic compounds, inorganic compounds, corrosive materials, some prescription drugs, disinfectants, and other compounds containing carcinogenic or mutagenic toxins. Occupational exposure to hazardous drugs can cause harmful effects on health professionals and several protective measures must be taken [3]. These materials are frequently used for works in operation rooms, in-room services, laboratories and sterilization units. Use of hazardous materials and production of hazardous wastes are inevitable for hospitals and their management is crucial. A study by Terekli *et al*. [4] showed that education of personnel for use and disposal of hazardous materials is insufficient both in amount and scope.

The aims of the presents study were to determine and take under control hazardous materials used in hospital environment, to create awareness for them among healthcare workers, to set rules to minimize possible injuries that could arise from use of hazardous materials and to ensure safety for the healthcare workers, the hospital working environment.

METHODS

Data collection tool / questionnaire form of the study was conducted on a total of 204 health workers (125 females, 79 males, mean age: 33.8 ± 12.9 years) in clinics, intensive care services, emergency rooms, laboratories, hospital storages, pathology, radiology, nuclear medicine and radiation oncology departments of the a tertiary hospital in order to determine what they know about hazardous materials in hospital environment. Questionnaire forms included questions categorized in six main groups about what the hazardous materials are and what care must be observed about them.

Formal request was made to Gaziosmanpaşa University Health Research and Practice Hospital. Administration for visits to departments before the study, and permission was granted. Health workers to participate in the study were informed in advance and interviews were made with ones willing to participate. Data were collected by a single investigator through face-to-face interviews and observation techniques. This study was carried out by the safety committee and the quality committee. The Tertiary Hospital management was informed about the study results.

Statistical Analysis

Statistical analysis was performed using IBM-SPSS 20 program. The results were expressed as mean ± standard deviation (SD). The differences among groups were analyzed by one-way analysis of variance (ANOVA), and Tukey test was used as post-hoc test. $p < 0.05$ was considered statistically significant.

RESULTS

Survey of departments of Gaziosmanpaşa University, Health Research and Practice Hospital by Worker's Safety Committee and Quality Committee started with inspection of hospital storage which supplies all material needs of the hospital. Hazardous materials that could be found in hospital environment were determined. Hazardous symbol and signs to be used for labeling of hazardous materials and products given in Table 1 were distributed to all departments. A list of dangerous materials that could be found in hospital environment was prepared. List of hazardous materials by different hospital departments were given in Table 2.

Two hundred four health workers employed in clinics, intensive care service, emergency room, laboratories, hospital storage, pathology, radiology, nuclear medicine and radiation oncology departments participated in the questionnaire study. Occupations of the participants were as follows: nurse (n = 95, 46%), cleaning staff (n = 43, 21%), radiology and surgery technicians (n = 32, 16%), physician (n = 18, 9%), assistant health personnel (secretaries and other administrative personnel) (n = 16, 8%). Distribution of participants in questionnaire study by occupation was given in Figure 1.

The first question of the awareness questionnaire was "In your opinion, what are the hazardous materials used in hospital?" Sixty percent of the participants could name 3, 4 and 5 materials, which was significantly higher than those who could name 0, 1 and 2 materials (p = 0.03). There was significant

Table 1. Symbols and signs to be used for labeling of hazardous materials and preparations

HAZARD FEATURE	SIGN	SYMBOL
EXPLOSIVE	E	
OXIDİZING	O	
FLAMMABLE	F	
TOXIC	T	
HARMFUL	Xn	
CORROSIVE	C	
IRRITANT	Xi	
ALLERGIC	Xn Xi	
CARCINOGENIC	T Xn	
MUTAGEN	M Xn	
TOXIC FOR REPRODUCTION	T Xn	
HAZARDOUS FOR ENVIRONMENT	N	

difference between people who could name 3, 4 and 5 materials and people who could name 0, 1 and 2 materials in both nurse and assistant health personnel groups ($p < 0.001$). Data for this question was given in Figure 2.

When the meanings of hazardous material signs of Flammable (F), Irritant (Xi), Hazardous for Environment (N), Corrosive (C) and Explosive(E) participants were asked to participants, it was revealed that C and E signs were less known compared to other signs ($p < 0.001$) (Figure 3).

C was known only by 26% of the health workers. When the analysis was repeated after the participants were grouped by their profession, C was the sign least known by all professions. Percentages of knowing E in physician and assistant personnel groups were similar to percentages of knowing all other signs (Figure 4).

When the participants were asked to match the symbols and meanings of warning signs, success rate of 70% for Xi was much lower than those of other signs ($p < 0.001$) (Figure 5).

Analysis after grouping the participants by their profession revealed that Xi was again the least known symbol (Figure 6).

Answers of participants given to questions about signs and symbols of hazardous materials were compared. It was determined that warning signs for F, N, C and E were significantly less known compared to other symbols ($p = 0.037$, $p = 0.018$, $p < 0.001$ and $p < 0.001$, respectively). Sign and symbol of Xi, on the other hand, was known at the same rate ($p = 0.798$) (Figure 7).

Answers given by the participants to the question of "Dou you consider yourself knowledgeable enough about hazardous materials used in hospital?" were studied. Sixty per cent of them considered themselves to have enough knowledge about hazardous materials. Analysis of participants by their professions showed that percentages of workers who considered

Table 2. List and warning signs of the hazardous materials

department	NAME OF HAZARDOUS MATERİAL	WARNING SING
HOSPITAL WAREHOUSE	TOOL DISINFECTANT	Xi
	SKIN DISINFECTANT	F
	SURFACE DISINFECTANT	Xi, N
	ETHYL ALCOHOL 96%	
BIOCHEMISTRY AND MICROBIOLOGY LABORATORY	ANALYTIC MACHINE SOLUTION	C, Xi
	HAND DISINFECTANT	F
	LPG TANK	E
PATHOLOGY LABORATORY	FORMALDEHYDE 37-40%	Xn, T
	XYLENE	F, Xn, Xi, T, M
	ETHYL ALCOHOL 96%	F
	METHANOL	F, T, M
	TISSUE STAINS	F, T, M
	HAND DISINFECTANT	F
INSERVICE	HAND DISINFECTANT	F
	SKIN DISINFECTANT	XI
	TOOL DISINFECTANT	XI
	SURFACE DISINFECTANT	Xi, N
	ETHYL ALCOHOL 96%	F
	OXYGEN TANK	E
LAUNDRY	ALKALINE WASHING MATERIAL	C

themselves not having enough knowledge were significantly higher in cleaning staff, physician and assistant personnel ($p = 0.046$, $p < 0.001$ and $p < 0.001$, respectively) (Figure 8).

Answers given by the participants to the question of "Would you like to get information about the hazardous materials used in hospital?" were examined. Seventy five per cent of the participants told they

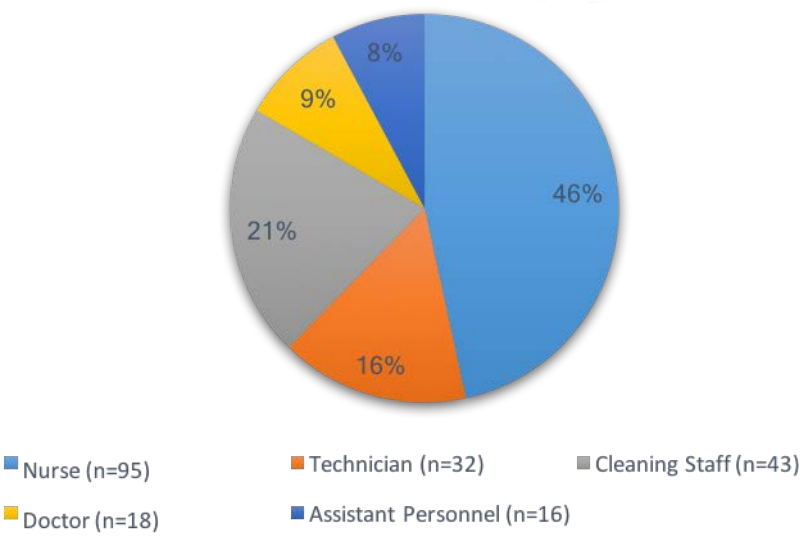

Figure 1. Distribution of 204 health personnels by profession who participated in the questionnaire conducted for awareness of hazardous materials in hospital environment.

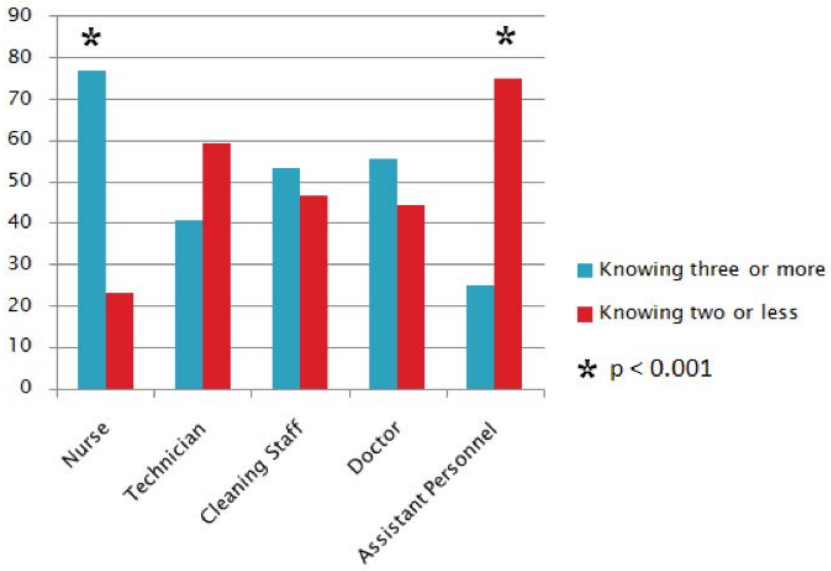

Figure 2. Distribution of health personnel based on knowing hazardous materials.

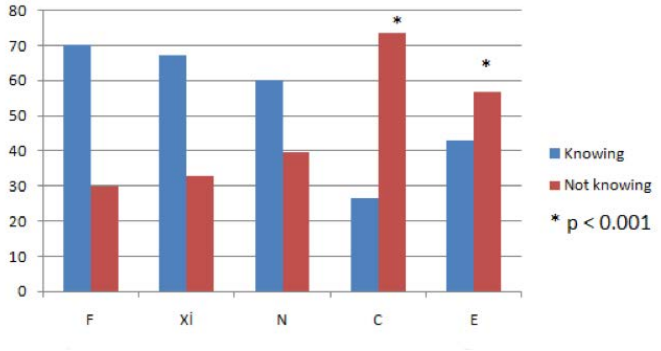

Figure 3. Percentages of questionnaire participants knowing hazardous material warning signs [Flammable (F), Irritant (Xi), Hazardous for Environment (N), Corrosive (C) and Explosive (E)].

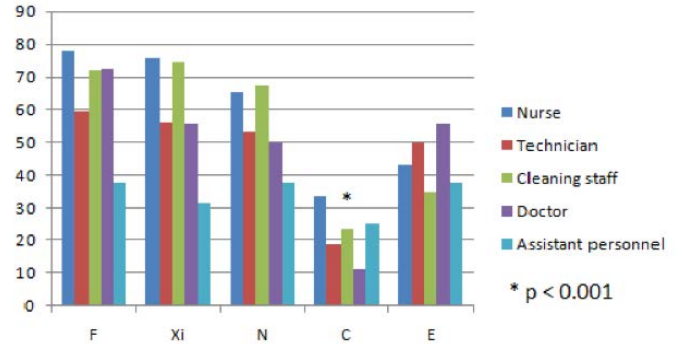

Figure 4. Percentage of knowing hazardous material warning signs by professions [Flammable (F), Irritant (Xi), Hazardous for Environment (N), Corrosive (C) and Explosive (E)].

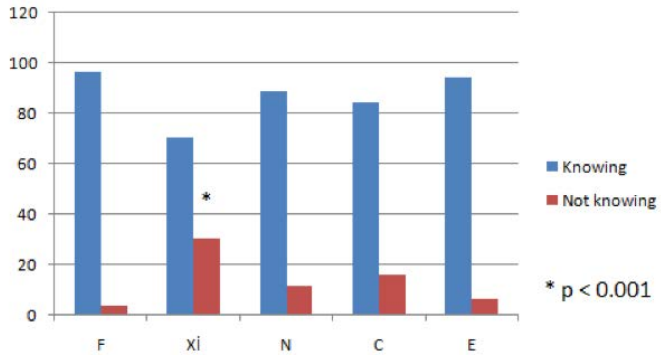

Figure 5. Percentages of questionnaire participants knowing symbols and meaning of hazardous material warning signs [Flammable (F), Irritant (Xi), Hazardous for Environment (N), Corrosive (C) and Explosive (E)].

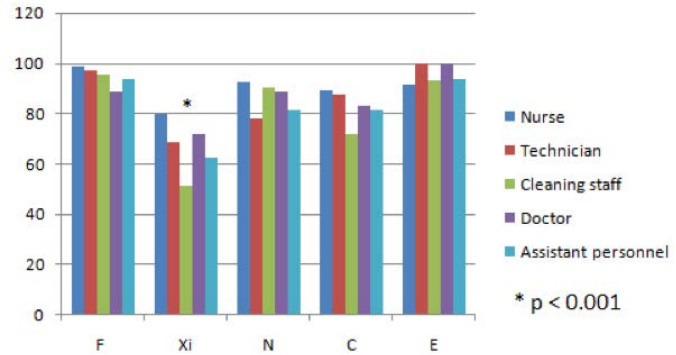

Figure 6. Percentage of knowing symbols of hazardous material warning signs by professions [Flammable (F), Irritant (Xi), Hazardous for Environment (N), Corrosive (C) and Explosive (E)].

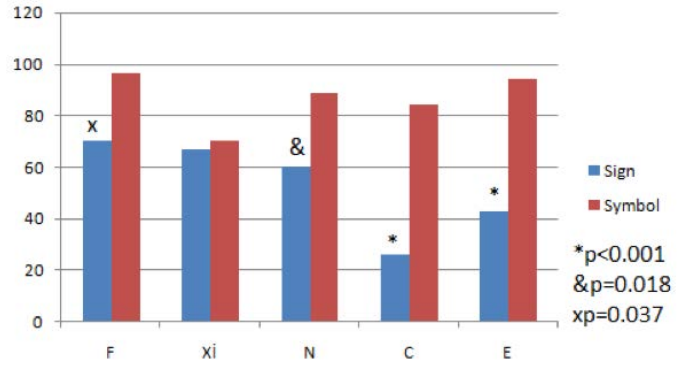

Figure 7. Percentages of knowing the warning signs and symbols of hazardous materials [Flammable (F), Irritant (Xi), Hazardous for Environment (N), Corrosive (C) and Explosive (E)].

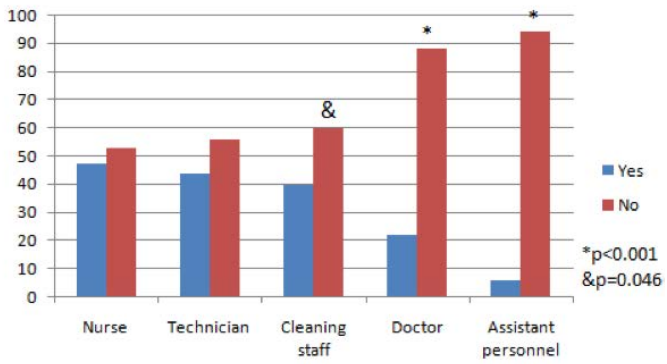

Figure 8. Percentages of questionnaire participants considering themselves knowledgeable enough about hazardous materials used in hospital.

wanted to get detailed information about hazardous materials. An analysis of participants after grouping by their profession showed that workers demanding detailed information for hazardous materials were high in all professions (Figure 9).

Finally, participants were asked to mention whether the signs put on hazardous material cabinets in hospital were useful. Ninety per cent of them thought that the warning signs and symbols put on cabinets were useful. Analysis after grouping participants by their professions revealed that workers who considered the signs were useful were clearly high in all groups ($p < 0.001$) (Figure 10).

All departments of the Tertiary Hospital were surveyed and hazardous materials in working environments were determined. Areas where hazardous materials were kept and stored in the hospital were re-organized according to the current regulations.

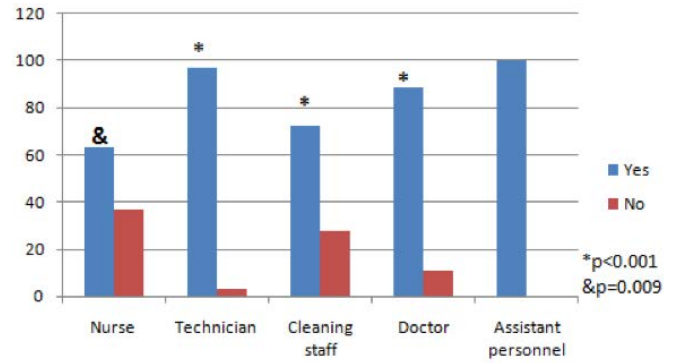

Figure 9. Distribution of answers given by questionnaire participants from different professions to the question of "Would you like to have detailed information about hazardous materials used in hospital?"

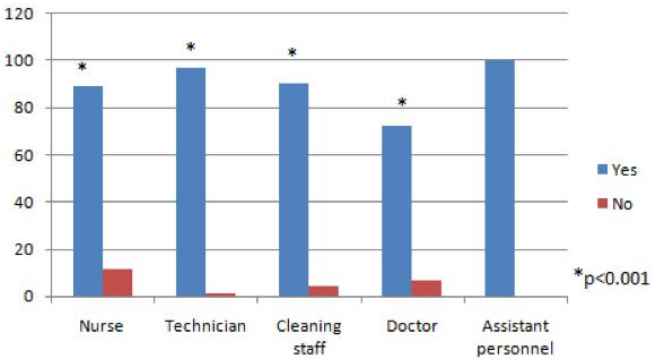

Figure 10. Figure 10. Comparison of answers given by questionnaire participants from different professions to the question of "Whether warning signs and symbols put on hazardous material cabinets in hospital are effective?"

DISCUSSION

The health care industry is one of the largest employers, and hospital workers face safety risks comparable to some of most dangerous jobs in the worldwide. Health and safety risks in a healthcare environment not only put at risk the health of workers. They also impose significant costs on healthcare institutions, increasing the cost of medical care for everyone and compromising the quality of patient care. Awareness of occupational health and safety among the employees is important in the hospital. The work environment must be free from hazards and all employees should be aware of their health and safety.

There are thousands of chemicals and other toxic substances which nurses are exposed in practice. Hazardous chemical exposures can occur in a variety of forms including aerosols, gases, and skin contaminants from medications used in practice. Materials which have one or more of the features of explosive, oxidizing, very easily flammable, easily flammable, flammable, genotoxic, toxic, harmful, corrosive, irritant, allergic, carcinogenic, mutagenic and dangerous for environment are considered hazardous since they can pose risk for health and safety of workers. Management of these materials is crucial for hospitals because the process from release to destroying them is a part of daily hospital activity [5-9].

From the various reviews available on occupational health hazards and their precautions, various problems of physical, chemical, biological, and psychological nature were identified [10-12]. Hazardous material management, also an inseparable part of environment management, should have strict standards to be observed. These standards should include monitoring through written procedures of obtaining, transporting, storing and disposal of hazardous materials. Potentially hazardous materials should be evaluated and approved before use. Product safety and information forms containing the potential dangers of hazardous materials used in hospital should be obtained from producers and sellers. For an appropriate management of hazardous materials, a written procedure should be produced which carries information about the name, explanation, synonyms, area of use, risks for human and environment, directions for use, protective precautions, emergency and first aid directions and appropriate disposal methods. Elimination or decrease of hazardous materials could be facilitated through establishment of hazardous material management systems in hospitals; thus, impacts of materials dangerous for human health could be lowered both inside and outside hospital. Hospitals can also prevent potential dangers through replacing hazardous materials with less hazardous ones to be used during hospital operations. Hazardous materials should be transported with care not to leak, spill or scatter around. Their transport should be carried out based on product safety information form and hazardous materials inventory list. Workers in all hospital departments should be trained about the presence and use of hazardous materials [13]. In this study, knowledge of healthcare workers was investigated about on hazardous materials. Participants expressed their inadequacy in this regard. The tertiary hospital workers in the present study demanded detailed information about hazardous materials. The self-report survey was conducted in a tertiary hospital research hospital and cannot be generalized without replication to other settings.

Most of the hazardous materials used in laboratory studies are harmful for health. Ensuring a safe working environment through establishment of proper recording and using procedures and organizing training programs for the use of these materials mean prevention of potential dangers for workers, patients and environment. Many chemicals used have the potential to be dangerous and they carry various signs on their packages showing this feature. The present study showed that health workers did not know characteristics of dangerous materials used in hospital and were not aware of the dangers posed to them. Efforts to reduce health and safety risks in the healthcare workplace may have positive impact on workers, patients and communities. Institutions that focus on developing and maintaining a culture of safety could effectively reduce most of the risks. A safety culture can also lead to significant process improvements, creating greater operational efficiencies and increasing profitability [14].

Storages in hospitals designated for hazardous materials should be kept locked and access of unauthorized people to them should be prohibited. Chemicals in stores should be kept in their original packages. Temperature of storages should be 18-20 °C. Storage areas for harmful chemical materials and products should be equipped with necessary heating, isolation, aeration, warning and fire extinguishing systems considering the possible harms caused by the materials stored. Conditions suggested by the supplier should be taken into account in storing the material [15]. Therefore, we designated a separate part for hazardous materials in hospital storage within the context of the present study based on safety considerations.

Flammable and combustible liquids should be stored in places such as cabinets or shelves with

protection against fire. If chemical material to be used is hazardous, amount of purchase should be suitable for anticipated duration of use. In places where storing facilities are limited frequent purchasing should not be made. Hazardous materials should be stored based on their expiration date. Shelves should be labeled specifying class symbols of hazardous material. Storage and cabinets should be labeled according to danger posed by the materials they contain. Cabinets where hazardous materials were stored were labeled using danger warning signs in the present study. The questionnaire study showed that workers found the danger warning signs placed on hazardous material cabinets useful.

Healthcare workers have a significant role in provision of a safe and quality service in health institutions. It is necessary for health workers to know what the hazardous materials and their risks are, where they are located, in what stage of the study they are used, what are the contact and entrance ways into the body and the way they affect the worker. Awareness of occupational safety plays an important role in the prevention of occupational diseases [16]. Number of studies aiming to determine the dangers and risks of hospital environment is quite limited [17]. Healthcare workers must receive adequate information and training about the risks derived of the presence of any hazardous chemical agent present in their working place, as well as about the prevention and protection measures to be adopted [18]. The present study revealed that health workers did not consider themselves having enough knowledge about hazardous materials used in hospital and demanded detailed information on this issue. Aspects such as periodical training and evaluation are key factors in order to achieve the objective in a satisfactory way.

Limitations

The self-report survey was conducted in a tertiary hospital research hospital and cannot be generalized without replication to other settings. Results of the present study should not be generalized for all health workers since it was carried out only on workers in Gaziosmanpaşa University Health Research and Practice Hospital. It should also be kept in mind that results could be subjective since evaluations were made solely based on the responses by workers.

CONCLUSION

The present study was conducted in a tertiary hospital. Hospital workers did not have enough information about hazardous materials. Nevertheless, meaning of warning signs of hazardous materials were not known well by health workers. Warning signs and symbols of hazardous materials should be known for all workers. Nevertheless, meaning of warning signs of hazardous materials were not known well by health workers in the present study. Interestingly, symbols of hazardous materials were known more than warning signs. It was concluded that, in order to clearly indicate the cabinets containing hazardous materials, they need to be labeled using hazardous material warning signs and symbols. Health workers need effective trainings for these materials. Warning signs and symbols of hazardous materials should be known for all workers. In order to clearly indicate the cabinets containing hazardous materials, they need to be labeled using hazardous material warning signs and symbols.

Authorship declaration

All authors listed meet the authorship criteria according to the latest guidelines of the International Committee of Medical Journal Editors, and all authors are in agreement with the manuscript.

Conflict of interest

The authors disclosed no conflict of interest during the preparation or publication of this manuscript.

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