Open Access Library Journal
2023, Volume 10, e10526
ISSN Online: 2333-9721
ISSN Print: 2333-9705

Medical Waste Management in Lebanese Hospitals

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How to cite this paper: Sawli, N. and Salameh, P. (2023) Medical Waste Management in Lebanese Hospitals. *Open Access Library Journal*, **10**: e10526.
https://doi.org/10.4236/oalib.1110526

Received: July 19, 2023
Accepted: November 7, 2023
Published: November 10, 2023

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Abstract

Problem: In Lebanon, health authorities have not set regulations to guide the process of medical waste management in hospitals. **Objective:** To assess the situation of medical waste management in Lebanese hospitals and determine the factors that affect its application. **Methods:** An observational cross-sectional study was carried involving random private and public hospitals. Thirty hospitals were recruited, and they were surveyed using a validated questionnaire to collect responses from hospitals. SPSS version 24 was used to perform the descriptive and bivariate analysis by chi-square test ($p < 0.05$). A score was constructed to be the dependent variable of the linear regression which involved a group of predictors. **Results:** According to the used score, 70% of the hospitals showed high waste management. Their locations showed significant association with the type of waste transport chosen ($p = 0.072$) and disposal of chemical wastes ($p = 0.012$). Different practices showed positive correlation with good waste management. Some confounders had strong association such as segregation at site, staff training and budget allocation, while others showed weak positive association such as having proper containers and sufficient equipment. **Conclusion:** Due to the lack of local guidelines, hospitals obey international guidelines for proper waste management in which pharmacists might play a major role by controlling their stocks and preparing medications especially cytotoxic ones correctly.

Subject Areas

Epidemiology

Keywords

Medical Wastes, Waste Management, Segregation, Waste Disposal, Training,

Education

1. Introduction

Wastes include all unused items that people tend to get rid of or discard. Wastes include sewage, household garbage, packages and medical wastes from hospitals or chemicals from industries [1]. At present, around 1.47 billion tons of solid wastes are produced globally, and this figure has increased each year [2]. Among them, 5.9 million are estimated to be a result of medical wastes [2]. Over the last few decades, progress in medical science and technology and expansion in the number of health institutions worldwide has been accompanied by increasing quantities of potentially hazardous medical waste [3]. The World Health Organization (WHO) reported that underdeveloped countries suffer the greatest burden of risk from medical waste due to the high costs of proper disposal procedures. The spread of bloodborne pathogens in health care waste motivated the WHO in 2004 to call for the development of national policies, guidance and plans for health care waste management [3]. In developing countries, poor sanitation practices might result in the mixing of such hazardous waste with general waste, which may exacerbate the problem of waste management. Hence a proper management of healthcare waste is vital for public health and safety [4]. Medical wastes are defined by the World Health Organization (WHO) as wastes generated by healthcare activities in any sort of health facility such as hospitals, centres and pharmaceutical shops [5]. They include broad range of wastes with different properties. First, medical wastes have medicinal properties which are contaminated with a pharmaceutically active or hazardous medicine. Hazardous properties include toxicity, carcinogenicity, reprotoxicity or mutagenicity [6]. Second, wastes may have chemical properties such as laboratory reagents, photo-chemicals, disinfectants, therapeutic chemicals, and their contaminated package. Third, wastes may be infectious when they compromise the viable of a person who is known or suspected to have an infection. Also, they can be in the form of wastes contaminated with a culture of pathogenic microorganisms. Some infectious wastes may be life threatening by causing permanent disability or fatal disease. Thus, they should be stored for a maximum of 24 hours in a secure store with restricted access to authorized staff, then autoclaved on-site prior to removal to disposal facility [6]. Sharps also are a common type of wastes. They are items or parts of items that may cause cuts or puncture wounds including needles and their parts, scalpels, blades, ampoules, broken flacons and end of infusion sets [6]. Wastes management protocols differ between developed and developing countries. In developing countries, the main reason of mismanagement is the lack of legislative policies and control for proper practice [4]. Other reasons are financial strains such as lack of facilities, equipment, staff training and awareness [4]. As a result, poor sanitation induces mixing various

types of wastes together [7]. In contrary, developed countries have well-established regulations for proper disposal of medical wastes. In such countries, awareness of waste management in hospitals is mandatory in terms of its segregation, collection, storage, packaging, transportation and disposal. According to the "Health Technical Memorandum" for safe management of healthcare wastes, the utmost goal is not to produce waste at all for best financial and environmental outcomes [6]. The best approach is to review the volume, types of wastes and their site of production produced to identify and implement practical steps to reduce wastes [6]. Appropriate waste management involves proper segregation, colour coding, labelling, transport and disposal. Starting with segregation, its occurrence at the point of the production and packing wastes in colouring-coded packaging is a vital step since it ensures safety by reducing the risk of exposure and injury of all staff handling waste streams. Environmentally, segregation serves in minimizing, recycling and decreasing misclassification of waste as infectious wastes. In addition, financial aims are important to reduce costs by having correct classification of waste streams [6]. A case study at Margaret Hospital was conducted to realize the means of reduction, reuse and recycling of wastes in renal units. It found that there were over 18,000 euros in cost savings since improved segregation at source meant that more material went into domestic waste for recycling rather than into medical waste stream for disposal [6]. Knowing that the use of colour coding is not mandatory, producers should adopt this protocol to assist in waste identification of each type according to each national system. Its importance relies in applying good segregation to confirm that medical wastes are well-determined and not moved anonymously. Transport of wastes is the key step to start their disposal. Hospitals are responsible for transporting dangerous goods offsite by bulk transport to carry hazardous and infectious wastes in bags using equipped vehicles, closed leak-proof, non-porous and free from cracks containers and transport on road where load threshold is determined for each waste type. Additionally, on-site transport is available to which public do not have access by dedicated trucks, trolleys, tugs, or wheeled containers to transport wastes receptacles exclusively to storage areas. Lastly, wastes can be carried on ships. An "International Maritime Dangerous Goods" code regulates the transport of incompatible substances in sea [6]. The target step of waste disposal is its treatment. All treatments and disposal facilities, regardless of size or type of technology used, are required to "render safe" the waste. It is required to diminish the number of present pathogens to a level at which no additional precautions are needed to protect healthcare workers against infection or chemical contamination [6]. Treatment and disposal systems for healthcare wastes can be distinguished into two broad types: high temperature processes and non-burn low temperature alternatives. All systems of treatment use heat, chemicals, irradiation or combination of these methods. The selection of the most appropriate system depends on type and volume of wastes, support capabilities of the supplier, staffing requirements and operating costs. Despite it is not considered a

treatment, landfill disposal for offensive wastes remains an option. Most widely utilized method is incineration with landfilling. Incineration process converts wastes into ash and gases including acid gases and oxidizing nitrogen. It is an effective process, but more expensive than landfilling by a factor of 2 to 5 per unit volume [6]. Incineration produces toxic dioxin emissions which are considered carcinogenic, so strict controls are required to avoid exceeding dioxin standards [6]. Based on all mentioned branches of medical waste management, this study was conducted to assess the situation of medical waste management in Lebanon and to determine the factors that affect its application since no published studies can been found and no protocols exist for the management of medical waste in Lebanon.

2. Materials and Methods

2.1. Participants

The study was conducted among all Lebanese hospitals. Lebanese hospitals were stratified into public and private hospitals. Among a total of 129 hospitals present in Lebanon, 29 are public while 100 hospitals are private. Hospitals were randomly selected from each governorate to be part of this study. Stratification and random selection were done to reduce the existence of selection bias. The list of hospitals with their locations and phone numbers were obtained from the MOPH website. Thus, the sample size in this study was 129 hospitals. Recruitment was restricted to hospitals only. Other health sectors were excluded. For example, non-governmental medical centres that offer medical services, donating campaigns, private clinics having drug samples or diagnostic kits and laboratory and radiology centres were excluded. In addition, hospitals which refused to participate in this study or those which were unreachable were not included. Concerning respondents, ten hospitals (33.33%) responded out of 29 public hospitals. Besides, twenty private hospitals (20%) had recorded responses as follows: seven hospitals in mount Lebanon (7%), three hospitals in Tripoli (3%), two in Saida (2%), Zahle (2%), Beirut (2%) and Nabatieh (2%). One hospital in each of Hermel (1%) and Akkar (1%), while no responses were received from Kesserwen hospitals.

2.2. Data Collection

Two types of variables were considered. Qualitative variables examined the existence of several practices including segregation, collection, transport and disposal, protective equipment usage and training. On the other hand, quantitative data involved the measurement weight of produced waste, number of qualified staff in waste management committee and cost of this procedure. The mentioned outcomes associated with the hospitals demographic data were collected in a google form to obtain an organized validated questionnaire that was used to be filled and to save the results for analysis. It was prepared based on a validated tool of healthcare waste management rapid assessment from WHO [8], a check-

list, which was obtained from Environmental Protection Agency [9], in addition to the guidelines of "*Lebanon Health Resilience Project*" conducted by Lebanese MOPH in 2018. The questionnaire included 45 questions of all mentioned qualitative and quantitative variables. Data collection was performed after obtaining the list of hospitals. It required two months to be performed. Responses were collected by distributing the questionnaire via WhatsApp or phone calls with the concerned staff in the hospitals.

2.3. Statistical Analysis

Statistical package for the social sciences (SPSS) version 24 software was used to perform statistical analysis. Percentages of utilized disposal methods and other mentioned variables were obtained. Moreover, chi-square test was used in the bivariate analysis to study the association between the studied variables and the socio-demographic properties of hospitals. Concerning multivariate analysis, a linear regression was performed in order to minimize the effect of confounding bias. A score was established based on the obtained validated questionnaire. It included all practices involved in segregation, collection, storage, transport, training, equipment, and budget whose questions were yes/no questions. Then, points were counted according to the accomplishment of the practice (1 if it was totally done, 0.5 if it was partially done and zero if it was not performed). Details of the score are represented in Table 1.

After that, the total was computed to classify the waste management of the hospitals. The classification of the total score was as follows:

- $x < 50\%$ had insufficient waste management
- $50\% < x < 75\%$ had good waste management
- $x > 75\%$ had excellent waste management

Finally, the obtained score was considered the dependent variable of the linear regression, and the components of the score were the corresponding predictor whose confounding impact was to be studied with $p < 0.05$, CI of 95% and beta-coefficients.

3. Results

3.1. Descriptive Analysis

The obtained population of analysis for hospitals was 30. More than half of the hospitals (53.33%) were medium as they bear 100 - 500 beds, while 46.6% of them were considered small having less than 100 beds (Table 2). Private hospitals formed 66.7% of total number of hospitals. The locations of hospitals were distributed among distinct areas, mostly between urban and rural regions (43.33%) each. The recruited hospitals had various services. All of them had emergency and radiology departments. Medicine, gynaecology, and paediatric departments were present in 80%, 76.7% and 67.7% of hospitals respectively. Meanwhile, less than half of the hospitals involved intensive care unit (ICU) (46.7%).

Table 1. Details of the score.

Variable	Factor	Total pts
Segregation	High: 5 Good: 4 Satisfactory: 3 Insufficient: 2 Bad: 1 Segregation at Point of generation	6
Collection	Labels Leaking Emptying Filling Yellow bags for medical wastes Lids of yellow bags	8
Storage	Secured area Away from patients Away from public Clean Restricted to authorized members Conditions Chemical waste storage Incompatibility	6
Transport	Labels on sharps Sep of hazardous and non-hazardous wastes before transport	2
Training		1
Equipment		1
Budget		1
Total		25

Table 2. Result of descriptive analysis.

Demographic variable	N (%)	Percentage (%)
Size		
Medium	16	53.3
Small	14	46.6
Area		
Urban	13	43.3
Per-urban	4	13.3
Rural	13	43.3
Type		
Private	21	70.03
Public	9	29.96
Services		
Medicine		80
Gynaecology		76.7
Paediatrics		66.7
Surgery		93.3
Emergency		100
Radiology and laboratory		100
ICU		46.7

All hospitals declared that they generate general and infectious wastes including sharps. The corresponding quantities of wastes produced were remarkably variable. The majority of hospitals (43.33%) refused to give such data. Also, some hospitals lacked the presence of a specialized committee for waste management (13.3%). Whereas the majority had a committee of 3 members (23.3%). Most of them were cleaning staff (43.3) or nurses (36.7%). Training the involved staff and checking their required equipment were revealed in 93.3% and 80% of the involved hospitals respectively. Concerning practices of waste disposal, 60% of hospitals were satisfied with their segregation process. Wastes were collected in plastic, labelled and free of leaking containers. Their emptying and filling each day to the three-quarters were common in 83.3% and 76.7% respectively. Sharps were specifically collected in single-use puncture proof containers, and they were well supplied in 66.7% of hospitals. Infectious wastes were collected in yellow containers which were covered with rigid lids. After that, wastes were stored in a secured area, restricted to authorized people and cleaned regularly from spills and debris. Hospitals showed to contract with private companies to transport medical wastes offsite by closed refrigerated device for disposal, while they dealt with municipals to get rid of regular wastes. Finally, the knowledge of hospitals towards method of disposal applied by the companies was tested. Incineration was the most common response. More than half of the hospitals (56.7%) allocated a specific budget for waste management process in hospitals. All frequencies and percentages of mentioned variables are represented in Table 3.

Table 3. Frequencies and percentages of mentioned variables.

Variable	Frequency	Percentage (%)
Kind of wastes		
General	30	100
Recyclable	11	36.7
Infectious	30	100
Sharps	30	100
Chemical	13	43.3
Anatomical	10	33.3
Qualifications of staff		
Cleaning staff	13	43.3
Nurses	11	36.7
Pharmacists	3	10
Physicians	3	10
Segregation		
High	5	16.7
Insufficient	6	20
Non-existent	1	3.3
Satisfactory	18	60
At point of generation	24	80

Continued

Collection		
Labels	22	73.3
Leaking	27	90
Emptying daily	25	83.3
Filling to three-quarters	23	76.7
Yellow bags usage	27	90
Lids	30	100
Kinds of containers		
Plastic	24	80
Depending on wastes	3	9.9
No specific containers	2	6.7
Cardboards	1	3.3
Sharps containers		
Single use-puncture proof	24	80
Multiple use-puncture proof	5	16.7
Non-specific	1	3.3
Storage area		
Secured	30	100
Away from patients and public	30	100
Clean	29	96.7
Restricted access	30	100
Cleared according to guidelines	0	0
Chemical wastes storage in special facility	12	40
Incompatibility concerns	10	33.3
Transportation		
Means		
Closed	26	86.7
Open	2	6.7
Not taken	1	3.3
No idea	1	3.3
Responsible for transport		
Private company	27	90
Municipality	13	43.3
Hospital	4	13.3

Continued

Disposal		
Final site		
Off-site	26	86.7
Onsite	4	13.3
Disposal method		
Dump	1	3.3
Landfill	3	10
Burial	2	6.7
Autoclave	4	13.3
Shredding	4	13.3
Incineration	11	36.7
Others	4	13.3
No idea	8	26.7
Training	28	93.3
Equipment	24	80
Number of committee members		
Zero	4	13.33
1	6	20
2	5	16.67
3	7	23.33
6	3	10
Others	5	16.67
Budget allocation	17	56.7
USD/bed/year		
Do not know	14	46.2
Refused to answer	8	26.4
Missing	1	3.3

3.2. Bivariate Analysis

The area of the hospitals had significant correlation with the kind of produced wastes and their means of transport. First, the area was strongly associated with the generation of chemical wastes ($p = 0.012$). The majority of rural areas did not produce chemicals (84.6%), while most hospitals in urban areas had chemical wastes in their containers (69.2%). Second, the location had a significant influence on the type of transport that wastes underwent ($p = 0.027$). Ten urban hospitals (76.9%) did not depend on municipal transport, unlike peri-urban (100%) and rural hospitals (46.2%) which highly considered it. Furthermore, the size of hospitals affected the production of chemical wastes ($p = 0.015$). Medium

hospitals mainly (68.75%) produced chemical wastes in their departments, whereas 84.6% of small hospitals did not. Moreover, services present in each hospital played a vital role in affecting waste management process. Hospitals with ICU had larger amounts of chemical wastes ($p = 0.000$).

3.3. Multivariate Analysis

In the multivariable analysis, there was no involvement of socio-demographic properties of hospitals for it was performed based on a constructed score which was made up of the summation of all sides of disposal practice as mentioned before. In addition, these features showed no marked association with this dependent variable in the bivariate analysis proposing a hypothesis for the need of a larger samples size. As a result, the multivariate analysis was restricted to the disposal practices since these variables are considered the stages of a successful waste management chain according to the international guidelines. Thus, evaluating them would give an obvious image about the state of waste management in the hospitals.

Based on the classification of the calculated score mentioned previously, nine hospitals (30%) had good waste management process, while 21 (70%) had high pharmaceutical waste management. Consequently, 14 predictors showed to be strong confounders of waste management process (Table 4). All behaviours are positively associated with waste management, so their involvement leads to enhanced waste management. Some behaviours showed weak positive association (beta < 1) such as segregation, free of leaking containers, labelling and sealing sharps, sufficient equipment, separating incompatible chemicals during storage and emptying containers daily. On the other hand, several variables showed a strong correlation (beta > 1) with waste management. These are storage of chemical wastes in a specialized facility, separation of hazardous and non-hazardous wastes during transport, clearing storage area according to temperature conditions, placing medical wastes in yellow bags, training the staff, labelling containers, filling them to their three-quarters only, segregating wastes at site of production and allocating budget.

4. Discussion

The results showed that hospitals tend to apply medical waste management according to international guidelines targeting for specific accreditation since national guidelines are missing. Almost, all involved practices are considered from segregation to disposal, and training was a key step in most hospitals.

This study is the primary study in Lebanon for hospital medical wastes. Selection bias was avoided by randomization and stratification. Multivariable analysis prevents confounding bias. Also, methods of recruitment, data collection and validated questionnaire were clear. The cross-sectional study aids in the deprivation of follow-up and recall bias. On the other hand, not all invited hospitals participated in the study for they were unreachable through phones or emails,

Table 4. Result of multivariate analysis.

Model	Unstandardized Coefficients		Standardized Coefficients	Sig.	95.0% Confidence Interval for B	
	B	Std. Error	Beta		Lower Bound	Upper Bound
(Constant)	4.377	0.143		0.000	4.067	4.687
Segregation level	0.996	0.014	0.453	0.000	0.966	1.026
Segregation at point of generation	1.021	0.038	0.150	0.000	0.940	1.102
Labels on containers	1.050	0.031	0.187	0.000	0.982	1.117
Containers free of leaking	0.989	0.048	0.089	0.000	0.887	1.092
Containers emptied at the end of each day	0.940	0.048	0.111	0.000	0.836	1.045
Containers filled no more than about three-quarters	1.029	0.032	0.153	0.000	0.959	1.098
Labelling and sealing sharps	0.801	0.085	0.084	0.000	0.617	0.985
Medical waste in yellow plastic bag	1.241	0.063	0.136	0.000	1.105	1.377
Storage of chemical wastes in special facility	1.711	0.129	0.349	0.000	1.432	1.990
Separation of incompatible chemical wastes	0.303	0.133	0.059	0.040	0.016	0.589
Availability of sufficient equipment	0.987	0.030	0.156	0.000	0.922	1.052
Security and restriction of storage area	0.313	0.145	0.024	0.051	-0.001	0.626
Clearing storage area within the following periods: Max 48 hours during the cool season Max 24 hours during the hot season	1.421	0.055	0.149	0.000	1.303	1.539
Separation of hazardous and non-hazardous wastes	1.711	0.136	0.129	0.000	1.417	2.005
Yearly training of staff	1.140	0.086	0.095	0.000	0.953	1.327
Budget allocation	1.000	0.026	0.209	0.000	0.945	1.056

asked for live interviews which was a financial and logistic challenge or refused to participate. Therefore, the sample size may not be representative and not powerful enough to show all associations. Moreover, the study was not double-blinded, so differential measurement bias could be detected leading to over-estimation of waste management. Also, some factors found in literature were not studied since they were absent in the validated questionnaire such as the evolution of waste production during corona pandemic and the on-site transport of medical wastes inside hospitals.

Concerning obtained results, the quantities of generated wastes highly differ among hospitals. Since the answer to this question was opened, hospitals responded distinctly about the amount produced daily, weekly or monthly leading to random responses and difficulty to study their association with other variables. Similar studies estimate an average amount of produced wastes since it depends on variables such as number of admissions and services performed in the hospital. For example, a study in Pakistan hospitals showed that they produced an average amount of 0.667 kg/bed/day [7]. This number showed to be

affected by the hospital number of beds, location and type where greater waste production occurs in smaller hospitals. Thus, hospital waste was found to decrease with number of beds and increase with average occupancy by patients [7]. Another studied factor was the number and qualifications of the committee members. Lacking the presence of this committee is not acceptable according to Lebanese guidelines where at least one member should be assigned, and this number increases in accordance with the hospital size [10]. Besides, this study indicated that committee members are mainly cleaning staff and nurses. Meanwhile, the Lebanese guide proposed that the committee should be a link between the head of the hospital, chief pharmacists, senior nurses and waste management officers [10]. The most common chosen method of disposal is incineration. Likely, it is the most recommended method by the international guidelines. Hospitals used it with autoclaving to transform infectious wastes into domestic wastes [6]. In contrary, despite that this method is the most common method in Ethiopia, incineration induced explosion of toxic air pollutants due to open burning and dumping in uncontrolled sites [1]. So, the proper disposal method is still a significant challenge in developing countries.

The bivariate analysis showed that chemical wastes were more significantly produced in urban, medium sized hospitals with ICU departments. This is because urban and large hospitals have chemotherapy among their services where cancer patients occupy internal medicine and ICU departments where chemical disinfectants are widely used. Furthermore, rural areas highly depend on municipality, whose responsibility is to dispose regular wastes, instead of private companies to dispose their wastes. It implies that rural areas found difficulties to contract with private companies which had no access to such regions.

The multivariable analysis presented several correlates for good waste management. First, segregation was satisfactory in more than half of the hospitals. It is a vital step to reduce the volume of hazard wastes when they are segregated correctly according to a similar study in Nigeria [11]. Another consistent study in Yemen revealed that proper segregation at source reduces infectious wastes to 1% - 5% [3]. Next, segregated chemical wastes should be stored in a separate facility. Produced chemical wastes should not only be segregated at source from other types of wastes, but they should also be stored in separate areas to avoid incompatibility issues. Chemicals should be placed in a separated storage area since they affect human health at different sites such as neurological, congenital, cardiovascular and respiratory conditions. In addition, it is highly efficient to separate incompatible chemical wastes since their reaction may lead to change in chemical properties and create dangerous incidents such as release of toxic and corrosive vapours. Second, budget allocation was a marked correlator. True responses for budget allocation in the current study were few. Most respondents refused to answer this question or have no idea about it. This is related to that infection control and financial departments do not have connections concerning the plan of this process. Also, inconsistent responses among hospitals made it impossible to study its association with other factors. However, budget alloca-

tion was preserved for purchasing necessary supplies in Ethiopia [1]. Besides, a study in Yemen showed that the lack of dedicated budget affected the conduction of training in the facility [3]. Then, collecting containers must have the following conditions: They should be labelled, color-coded, free of leaking, filled to three-quarters and emptied at least once per day. The hospitals declared that the type of used containers depend on the type of wastes. Nylon black bags were used for general wastes, cartoon bags for recyclable wastes and plastic containers for medical wastes including yellow containers for infectious wastes. This colour coding process aids in a better segregation, storage and disposal of wastes since it allows a facilitated defining of wastes. A Nigerian study revealed that knowledge of colour coding is an essential factor for proper segregation [11]. On the contrary, mismanagement of wastes in Yemen was noticed as 0% of public hospitals used special bags once to collect medical wastes due to their insufficiency [3]. Meanwhile, WHO proposed that hospitals should provide either plastic or strong plastic containers for medical wastes, and containers should be free of leaking to avoid spills of polluting liquids [8]. According to United Nations environmental programs, 10% of healthcare wastes are considered to be potentially infectious and contaminating [3]. Concerning sharps, they should be separated, sealed and labelled in specific single-use containers to avoid any accidental pricks. WHO regulations ensure that sharps should be properly secured and do not fall out of the container, so should only be filled to their three-quarters [8]. Another essential correlate is the availability of protective equipment. Hospitals who had insufficient equipment suffered from poor funding due to economic crisis in Lebanon. The WHO insisted on having protective heavy gloves and shoes to protect hands and feet against the risk of accidental sharp pricks [8]. In contrary, MOPH in Lebanon do not have guidelines for such precautions. Additionally, training was an essential advantageous component in 93.3% of surveyed hospitals. The committee managed to make regular training sessions once or twice per year as well as training the new staff. A study conducted in Ethiopia highlighted the importance of training in waste management and stated that training increases pharmaceutical waste management by 4.34 [1].

5. Conclusion

In all, hospitals tend to take international guidelines of proper waste management into account. However, local policies and monitoring of this process are missed in Lebanon, so Lebanese hospitals do not have unique and unified practices in this domain. Most importantly, they do not have same collection, transport and disposal methods. As a result, the ministry of public health has a multiple of key roles in this process to set policies, fund, regulate, organize, audit and follow-up the practices. Also, training is an essential step to achieve good waste management outcomes. Universities are responsible to educate undergraduates to be well-prepared for correct disposal methods. Nevertheless, the OPL should train postgraduates regularly about the negative impact of wrong disposal on man and environment and to provide knowledge about safe routes of dispos-

al through posters, awareness campaigns and programs. The Lebanese economic crisis is a critical factor that affects the success of waste management process negatively. Thus, authorities should always take the medical sector into consideration to avoid its retraction.

Conflicts of Interest

The authors declare no conflicts of interest.

References

[1] Mohammed, S.A., Kahissay, M.H. and Hailu, A.D. (2021) Pharmaceuticals Wastage and Pharmaceuticals Waste Management in Public Health Facilities of Dessie Town, North East Ethiopia. *PLOS ONE*, **16**, e0259160. https://doi.org/10.1371/journal.pone.0259160

[2] Kenny, C. and Priyadarshini, A. (2021) Review of Current Healthcare Waste Management Methods and Their Effect on Global Health. *Healthcare*, **9**, 284. https://doi.org/10.3390/healthcare9030284

[3] Al-Emad, A.A. (2011) Assessment of Medical Waste Management in the Main Hospitals in Yemen. *Eastern Mediterranean Health Journal*, **17**, 730-737. https://doi.org/10.26719/2011.17.10.730

[4] Riaz, K. (2020) The Study of Infectious Hospital Waste Management in Two Hospital of Pakistan. https://www.walshmedicalmedia.com/open-access/the-study-of-infectious-hospital-waste-management-in-two-hospital-of-pakistan-60181.html

[5] Kwikiriza, S., Stewart, A.G., Mutahunga, B., Dobson, A.E. and Wilkinson, E. (2019) A Whole Systems Approach to Hospital Waste Management in Rural Uganda. *Frontiers in Public Health*, **7**, 136. https://doi.org/10.3389/fpubh.2019.00136

[6] (2008) Firecode—Fire Safety in the NHS. Stationery Office, London. https://www.england.nhs.uk/wp-content/uploads/2021/05/HTM_05-03_Part_G.pdf

[7] Ali, M., Wang, W. and Chaudhry, N. (2016) Management of Wastes from Hospitals: A Case Study in Pakistan. *Waste Management & Research*, **34**, 87-90. https://doi.org/10.1177/0734242X15616474

[8] WHO (2011) Health-Care Waste Management Rapid Assessment Tool. https://www.who.int/publications/m/item/health-care-waste-management-rapid-assessment-tool

[9] Health Care without Harm (2015) Inspection Checklist: Waste Holding and Storage. https://noharm-global.org/documents/inspection-checklist-waste-holding-and-storage

[10] Lebanon Health Resilience Project in Collaboration with the World Bank. https://www.moph.gov.lb/en/Pages/6/22726/lebanon-health-resilience-project-in-collaboration-with-the-world-bank

[11] Awodele, O., Adewoye, A.A. and Oparah, A.C. (2016) Assessment of Medical Waste Management in Seven Hospitals in Lagos, Nigeria. *BMC Public Health*, **16**, Article No. 269. https://doi.org/10.1186/s12889-016-2916-1