Strategies for Developing Medical Waste Management Interventions in Various Countries: Systematic Review

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Abstract

The problem of medical waste is a national, regional, and international problem. Medical waste management interventions are very important so that the waste generated is managed properly and correctly. This is because medical waste is included in the category of hazardous and toxic waste. Some medical waste is included in the category of hazardous waste and some are included in the infectious category.
Methods: This review was conducted based on sources from Google Scholar, Pubmed, Emerald Insight, Doaj with the types of journals published such as ELSEVIER, IJSDGE, PROCEEDINGS, ICCEM, HINDAWI, JPHE, JSTFT, JET, AJEST, JCH, WMR, BMC Health Services research and two reports from WHO (World Health Organization). Furthermore, screening of titles, abstracts, and the content selection or content according to inclusion and exclusion was carried out, which obtained 14 articles that were analyzed further.
Results: This review found that the strategy for developing medical waste management interventions such as training or health education is very important to increase awareness and develop skills for health workers so that they know and understand the functions and responsibilities in managing medical waste generated from health care facilities. Medical waste management interventions in various countries through steps such as situation analysis (pre-intervention) conducted to assess health waste management (HWM) practices, solutions offered to minimize observed risks, and advocacy made to improve administration in health facilities where some intervention measures were developed. Post-intervention is carried out to identify medical waste management efforts that have been carried out by intervention and identify locations that require attention for follow-up.
Conclusion: Various types of medical waste produced can be dangerous and cause health problems, especially during collection, sorting, storage, storage, transportation, and destruction as well as final disposal. Therefore, every country needs a strategy for developing medical waste management interventions to reduce the risk of accidents for paramedics, staff, and patients as well as the environment.

Keywords
strategy, intervention, medical waste management, medical, systematic review

1. Background
In general, all countries, both developing countries, and developed countries, are very concerned about the problem of medical waste, because medical waste is included in the category of hazardous and toxic waste. Therefore, it needs to be managed properly and correctly so as not to endanger public health and the environment. The World Health Organization (2014) says medical waste is waste generated from every activity in health service facilities such as hospitals, health centers, clinics in solid, liquid, and gas forms1. The types of waste generated from each health facility are infectious waste, pathological waste, sharp object waste, chemical waste, pharmaceutical waste, cytotoxic waste, radioactive waste, and ordinary waste 2 . Of the total medical waste produced, 75-90% is non-hazardous (non-infectious) waste such as leftovers from patient food, paper, plastic cannons, and others. 10-25% is hazardous (infectious) waste that can pose a risk to the environment and health 3.

According to research conducted by the World Health Organization (2004) in 22 developing countries, it shows that the proportion of health care facilities that do not use proper and proper medical waste disposal ranges from 18% to 64% 4 . Therefore, it is necessary to have a shared responsibility starting from the official leadership of health care facilities and medical and other staff in managing medical waste generated as a result of health service activities. If

not managed, infectious waste can become a source of disease spread to staff, patients, visitors, or the community around the health care facility. Improper environmental management will risk the transmission of disease. Several health risks that may be caused by the presence of a hospital include infectious diseases (hepatitis, diarrhea, measles, AIDS, influenza), radiation hazards (cancer, genetic organ disorders), and chemical hazards 2.

In connection with the problem of medical waste management, it is necessary to have a management system that is carried out in a comprehensive and integrated manner starting from sorting, collecting, storing, transporting to processing 5. In addition, waste management requires legal certainty, clarity of responsibility, and authority of the central government to local governments, as well as the involvement of the community and all stakeholders. Likewise, medical waste management must be managed properly to create a healthy scope of life for every living creature. According to Babanyara et al (2013), Many countries currently do not have proper regulations regarding medical waste management and if they do exist, they do not practice or implement them, for example, several cities in Iran such as Tehran, Mashhad, Kashan, and Rasht, although there are laws in this regard, they fail or are not serious in enforcing the existing rules. So that the management of medical waste does not run efficiently 6.

Looking at the negative impact of medical waste that poses a hazard to the environment and also the impact on public health and other living things when disposed of directly into the environment. In addition, medical waste has characteristics and properties that are not the same as general waste, mainly because it is unstable, reactive, explosive, flammable, and toxic 7 . Therefore, it is necessary to develop a medical waste management intervention strategy to prevent risks to health and the environment.

To control, reduce and minimize the production of medical waste in every health care facility, management efforts are required according to applicable health procedures 8. With the right strategy, the level of medical waste production can be reduced by up to 15% and the risk of endangering health is also very small 6. So in this case, medical waste management interventions emphasize how medical waste disposal should not be misused by irresponsible people. This is because medical waste or waste generated from any health service will produce a biohazard 9.
The intervention development strategy is considered important because it ensures that facility managers, paramedics, and other staff are aware of and understand the potential risks associated with healthcare waste, and the rules and procedures required for safe management 10. Good management will prevent injury to health workers, patients, and the community in health facilities. In addition, the person responsible for the management of medical waste must have adequate knowledge, attitude, and behavior 11.

Based on the description above, the main objective in writing this systematic review is to find out strategies for developing medical waste management interventions in various countries. This systematic review approach is to find valid and practical findings from several previous studies on a specific phenomenon 12.

2. Method

2.1 Literature Review search strategy

The writing of this Systematic Review uses the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-analyses) method which is carried out systematically by following the stages or procedures of the Systematic Review which consists of several steps such as setting the background and objectives, research questions, searching for articles, criteria inclusion and exclusion, selection process, article evaluation, data extraction, and data synthesis. Search articles using the keywords strategy, intervention, medical waste management were accessed from internet searches from databases, namely Google Scholar, Pubmed, Emerald Insight, and Doaj. The purpose of this article search is to get quality and relevant articles to your needs. Article search is limited to articles in English and international publications. The total number of articles obtained is 75 and out of these 75 articles, a selection process will be carried out to meet the inclusion and exclusion criteria.

2.2 Inclusion and exclusion criteria

Based on the systematic review procedure, the articles reviewed must meet the following inclusion criteria:

- Inclusion Criteria
  a) International journal dealing with strategies for developing medical waste management interventions
  b) Research articles published in a span of 10 years (2011-2020)

c) Types of research articles (review articles, research articles)
d) Fully accessible research articles (full text)

- Exclusion Criteria
  a) International articles irrelevant to strategies for developing medical waste management interventions
  b) Research articles published over 10 years
  c) And so on (not part of the inclusion criteria)

3. Selection process

The selection process or article collection is carried out in stages, namely:

- Relevant Article Search
- Article Submission from 2011-2010
- Carry out screening according to the inclusion and exclusion criteria
- Combining review results
- Determining the results, findings from the grouping that have been carried out need to be discussed to conclude the context or results of the review

4. Article evaluation

Evaluation of this article is intended to evaluate the quality and new findings of a scientific article with an international category that is included in the Systematic Review. These criteria can be used to select articles that will not be used. The assessment was carried out in journals related to the topic of strategies for developing medical waste management interventions. It should be understood that the so-called scientific literature can be:

- Paper from Scientific Journal
- Paper from Conference (Proceedings)
- Report (Report) from the Trusted Organization
- BooksTextbook

5. Data extraction

In this Systematic Review, data extraction is carried out by looking at the entire journal publication in the appropriate 10 year period, then writing down the important findings from the article and proceeding to the next stage, namely data synthesis. The process of journal tracing activities is carried out as shown in the following chart:

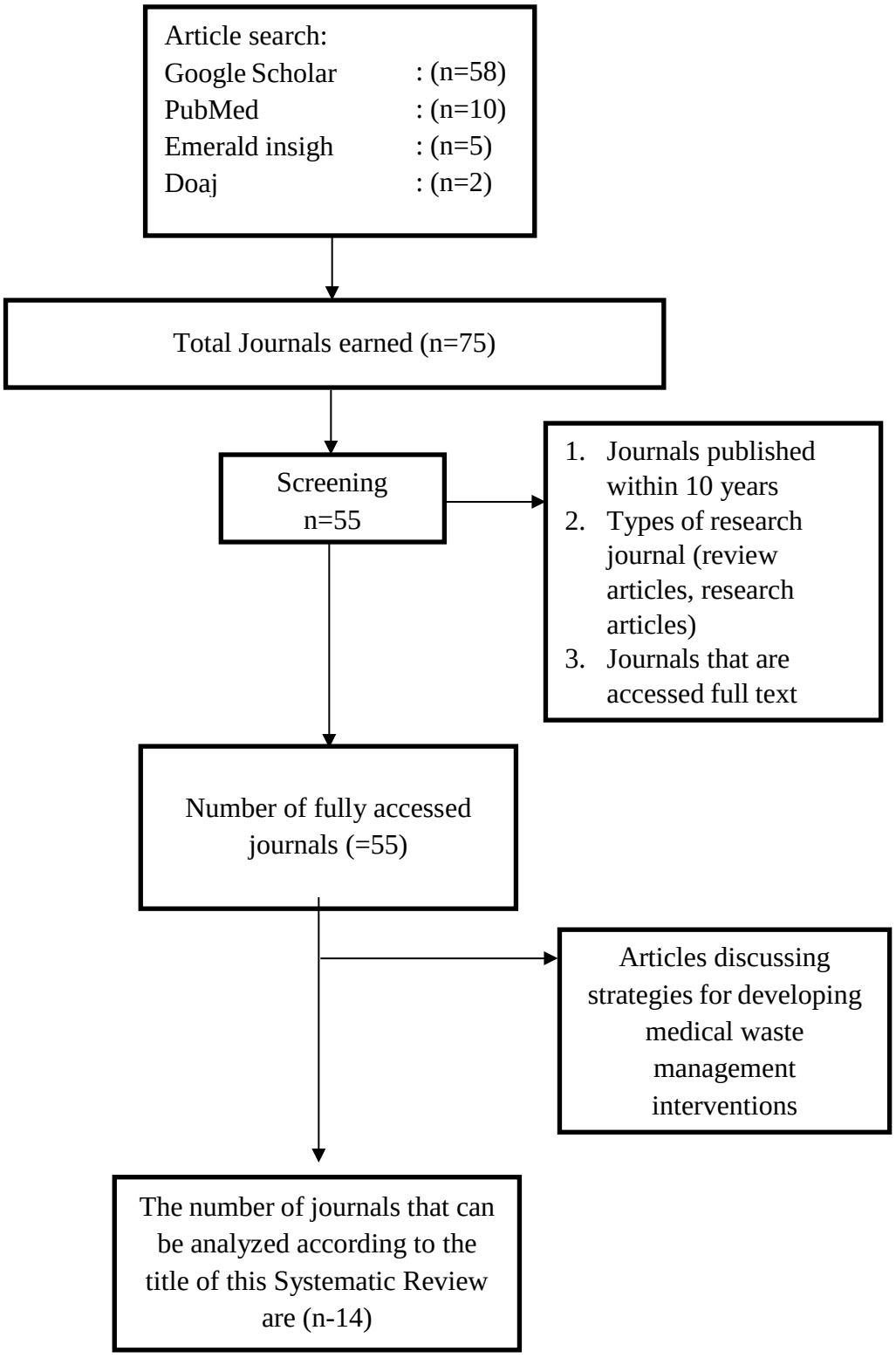

Figure 1. PRISMA Diagram: Stages of Systematic Review

All of the extracted articles were taken from several sources, namely Google Scholar, Pubmed, Emerald Insight, Prayer with the types of journals published such as ELSEVIER, IJSDGE, PROCEEDINGS, ICCEM, HINDAWI, JPHE, JSTFT, JET, AJEST, JCH, WMR, BMC Health Services research and two reports from WHO (World Health Organization). Furthermore, screening of titles, abstracts, and the content selection or content according to inclusion and exclusion was carried out, which obtained 14 articles that were analyzed further. This data extraction is very important in helping and tracing articles that can be analyzed and developed in the future.

6. Data synthesis

This Systematic Review was synthesized using a narrative method by grouping similar extracted data according to the measured results to answer the objectives. Research journals that match the inclusion criteria are then collected and a journal summary is made including the name of the researcher, the year of publication of the journal, the country of research, the title of the study, the method, and a summary of the results or findings. These elements become the completeness or comprehensive description of the articles obtained as a synthesis of this Systematic Review. The summary of the research journals is entered into a table sorted alphabetically and the year the journal was published and following the existing format.

7. Results

Based on the search results, 55 articles were found that were considered suitable for the purpose and then combined and then screened whether the titles in the articles were the same or not. After screening, it was found that there were 14 articles with the same title, from 55 journals, then screened based on eligibility according to the inclusion and exclusion criteria, obtained 14 articles for further review. The literature search strategy can be seen in Table 1 as follows:

Table 1. literature search strategy

No.	Search Engine	Google scholar	Pubmed	Emerald insigh	Doaj
1.	Search results	58	10	5	2
2.	Fulltext, pdf, 2011-2020	40	10	5	-
3.	Appropriate title	40	10	5	-
4.	Eligible according to the inclusion and exclusion criteria	8	4	2	-
Result		**14**			

The source of this systematic review is taken from studies conducted in various countries. The analysis of the 14 articles shows that 1 journal with explanatory descriptive design, 4 journals with a quasi-experimental design, 3 journals with a cross-sectional design, 1 journal with qualitative design and comparative methods, 5 journals with a quantitative descriptive design. The list of review journals on strategies for developing medical waste management interventions in various countries is as limited as the following:

Table 2. List of medical waste management in different countries

No.	Countries	Article	First Author	Publication Year
1.	Indonesia	1	I Gusti Ngurah Gede Putra	2017
2.	Egypt	2	Ahmed Mohammed Elnour	2015
			Gihan Hosny	2018
3.	India	1	Tukaram B. Zagade	2012
4.	Iran	1	Jafar Sadegh Tabrizi1	2018
5.	Ethiopia	1	Desta Debalki	2017
5.	Kuwait	1	Naglaa M. Abdo	2019
6.	Nepal	1	Binaya Sapkota	2014
7.	Pakistan	2	Ramesh Kumar	2016
			Ramesh Kumar	2015
8.	Nigeria	1	O. A. Mokuolu	2016
9.	Palestine	1	M.I. Tabash	2016
10.	Spain	1	Margarita Mosquera MD, PhD, MPH	2014
11	Turkey	1	Aclan Ozder	2013

After conducting a study quality assessment for 14 journals that meet the inclusion criteria, then perform an analysis based on the author's name, title, method, and results, namely the grouping of important data in the journals obtained. The results of the analysis or review can be seen in the following chart:

Table 3. Results of article review

No.	Authors and Year	Name of Journal	Methods	Data analysis technique	Result
1.	I Gusti Ngurah Gede Putra, Sang Putu Kaler Surata, Gusti Ayu Ari Agung, (2017)	Medical waste management strategy in the inpatient primary health care center with system approach: a SWOT Analysis	Deskriptif Explanatory	SWOT Analysis	The strengths found in this research are the implementation of medical waste management at the puskesmas, sufficient funds and adequate infrastructure. Weaknesses identified were untrained personnel, poor planning, and lack of discipline in each unit. Opportunities identified in this study are written regulations on environmental health programs, institutions in the form of Public Service Agencies, regular training programs by health authorities and third parties who are willing to cooperate in the management of medical waste. Some of the identified threats are environmental pollution, high local community demands and congestion

					problems in incinerator operating permits.
2.	Ahmed Mohammed Elnour, Mayada Mohamed Reda Moussa, Mohamed Darwish El-Borgy, (2015)	Impacts of an Educational Intervention Program on the Attitude of Kosti, Rabak, and Eduiem Hospitals' Nursing and Sanitation Staff with regard to Healthcare Waste Management	Design Quasi-Experimental	Statistical software (Statistical Package for the Social Sciences) SPSS version 21.	The results showed that the attitudes of nurses and sanitation staff were generally positive about HCW (health care waste). management, and significantly increased after the implementation of the educational intervention program.
3.	Gihan Hosny, Shimaa Samir, Rania El-Sharkawy, (2018)	An intervention significantly improve medical waste handling and management: A consequence of raising knowledge and practical skills of health care workers	Design Experimental	Statistical software IBM SPSS version 20.	After the intervention there was a significant increase in knowledge among all knowledge items in the four items related to sorting medical waste, knowledge about color coding system for segregation, general waste disposal in black bags and disposal. infectious waste in red bags. Regarding waste handling practices, 80% were in the bad practice category pre-training and changed to 0.8% post-training; 1.1% were in the good practice category and increased to 92.1% post-training
4.	Tukaram B. Zagade, Dr. Asha K. Pratinidhi, (2012)	Assessment of Effectiveness of Educational Intervention on Knowledge among Bio-Medical Waste Handlers.	Design Quasi-Experimental	Statistical software (Statistical Package for the Social Sciences) SPSS version 21.	The effectiveness of educational interventions has shown an increase in the proportion of workers answering knowledge-related questions correctly. The percentage increase ranged from 6.4% to 78.1%
5.	Desta Debalkie and Abera Kumie, (2017)	Healthcare Waste Management: The Current Issue in Menellik II Referral Hospital, Ethiopia	Cross sectional qualitative study	Data analysis was carried out based on the results of interviews with key informants, observations and documentation.	To reduce the risk of health waste on public health and the environment, there are cost-effective interventions including providing better medical waste management systems and complete facilities, compliance with national regulations and increased awareness of all stakeholders need to adopt in hospital waste management.
6.	Jafar Sadegh Tabrizi,	Medical waste management	Design experimental	Data analyzed using EXCEL	In general, there is a 30% increase in MWM (medical

	Mohammad Saadati, Mahdieh Heydari, Ramin Rezapour and Roghaie Zamanpour, (2018)	improvement in community health centers: an interventional study in Iran		2016	waste management) standard compliance from (45.8-75.1%) at CHC, after the intervention.
7.	Naglaa M. Abdo, Wafaa S. Hamza, Mariam A. Al-Fadhli, (2019)	Effectiveness of education program on hospital waste management	Design experimental	Epi Info software program version 7.	Improved all aspects of KAP (knowledge, attitude, practices) regarding the management of infectious waste and sharps and a statistically significant difference between the results of the pre-test and post-test ($p<0.01$).
8.	Binaya Sapkota, Gopal Kumar Gupta and Dhiraj Mainali, (2014)	Impact of intervention on healthcare waste management practices in a tertiary care governmental hospital of Nepal	Design experimental	Statistical software (Statistical Package for the Social Sciences) SPSS version 21.	Waste management policies and standard operating procedures were developed following the intervention, and they are consistent with national and international laws and regulations. Medical waste management pretest and posttest evaluation scores were 26% increasing to 86%.
9.	O. A. Mokuolu1, R. S. Akindele and H. O. Olawumi, (2016)	Development of Improved Solid Hospital Waste Management Practices in a Nigerian Tertiary Hospital	Design experimental	Statistical software (Statistical Package for the Social Sciences) SPSS version 20.	After conducting an introduction to medical waste management, the number of workers who were very satisfied was 48%. Knowledge is very influential on the management of medical waste management. Therefore, it is concluded that ongoing training/capacity development and debriefing on waste management remains important to consolidate the gains made on HWM (health waste management).
10.	Ramesh Kumar, Ratana Somrongthong, Jamil Ahmed, (2016)	Effect of Medical Waste Management Trainings on Behavior Change Among Doctors Versus Nurses and Paramedical Staff in PAKISTAN	Design Quasi-Experimental	Statistical software (Statistical Package for the Social Sciences) SPSS version 20.	After conducting an intervention or training, the results show that there is an increase in the level of knowledge of paramedics, nurses, doctors and a positive attitude towards medical waste management.
11.	Ramesh Kumar, Ratana	Effectiveness of intensive healthcare	Design Quasi-Experimental	Statistical software	The post-intervention survey showed a

	Somrongthong and Babar Tasneem Shaikh, (2015)	waste management training model among health professionals at teaching hospitals of Pakistan: a quasi-experimental study		(Statistical Package for the Social Sciences) SPSS version 22.	statistically significant difference (<0.05) between the intervention group and the control group in terms of knowledge, attitudes and behavior. Besides, inside control group no statistically significant difference was reported (>0.05) after 3 months.
12.	M.I. Tabash, R.A. Hussein, A.H. Mahmoud, M.D. El-Borgy, B.A. Abu-Hamad, (2016)	Impact of an intervention programme on knowledge, attitude and practice of healthcare staff regarding pharmaceutical waste management, Gaza, Palestine	Design Quasi-Experimental	Statistical Package for the Social Sciences (SPSS) version 16	Knowledge and level of unfavorable behavior (score 50%) detected in the pre-intervention phase, were found to increase to a satisfactory level (score 75%) in the follow-up phase while Attitudes were found to be positive (score 75%) in all phases of the study.
13.	Margarita Mosquera MD, PhD, MPH, Maria José Andrés-Prado MD, MPH, Gil Rodríguez-Caravaca MD, PhD, MPH , Pello Latasa MD, MPH, Marta E.G. Mosquera PhD, (2014)	Evaluation of an education and training intervention to reduce health care waste in a tertiary hospital in Spain.	Design Quasi-Experimental	Microsoft Excel 2000 (Microsoft Corporation, Redmond, WA) and SPSS version 17.0 (IBM Corporation, Endicott, NY.	After the intervention, there was a significant decrease in the average monthly waste volume of 6.2%. A statistically significant difference was found in the infectious waste and the weight of genotoxic/pharmaceutical waste separated before and after the intervention (P < 0.05).
14.	Aclan Ozder, Bahri Teker, Hasan Huseyin Eker, Selma Altındis, Merve Kocaakman and Oguz Karabay, (2013)	Medical waste management training for healthcare managers - a necessity?	Design Experimental	Statistical Package for the Social Sciences (SPSS) 11.5	Statistically significant differences were found between those who had received medical waste management training (pre-test and post-test) and those who had not (p<0.01). It was observed that the level of information of all health care managers who had received training on waste management had increased after the training was completed.

8. Discussion

8.1 Medical waste management interventions

Intervention is the intervention of a party or person to help solve problems. In the context of medical waste management, the intervention program is carried out based on the results of the pre-test and tailored to the needs of each health service facility. In addition, materials that will be used to carry out interventions such as education or training should be tested before using them13.

The intervention development program must ensure that medical staff or health facilities are aware of and understand the potential risks associated with medical waste as well as proper procedures and management 10. The effectiveness of educational interventions in India has shown that it increases the knowledge of medical professionals in answering questions related to medical waste management. The percentage rate went from 6.4% to 78.1% 14. In addition, there is also a study that proves that the knowledge before the intervention (pre-test) of the officers' knowledge level was low 9.6% after the intervention (post-test) the level of knowledge increased to 97.3%. 10.

Intervention programs such as training or Health Education are very important to raise awareness and develop skills for health personnel so that they know and understand the functions and responsibilities in managing medical waste generated from health care facilities 13. Ensure good communication between health workers and patients and the community around health facilities in keeping the environment clean and healthy.
Much research has focused on health waste management practices in Jordan, Iran, Egypt, Saudi Arabia, Kuwait, Tanzania, Mauritius, Netherlands, Finland, Korea, Turkey, Brazil, Mongolia, Greece, USA, UK, China, Bangladesh, and India. . There are some countries where the legal provisions are less stringent such as In Bangladesh, Nigeria, Iran, Jordan, Libya, Botswana, and India regarding the management of health waste, appropriate waste treatment facilities, protective measures and training steps which are considered efficient 15.

Medical waste management interventions in various countries by going through steps such as situation analysis (pre-intervention) are carried out to assess health waste management (HWM) practices, solutions offered to minimize observed risks, and advocacy made to improve administration in health facilities where a number of intervention measures were developed. Post-intervention was carried out to identify medical waste management efforts that have been carried out by intervention and identify locations that require attention for follow-up 16.

The main key to the intervention program is advocating with various partners both at national and international levels to increase the capacity of Health services in managing medical waste as well as the design and procurement of medical waste collection facilities 16. In addition, conducting audits as a strategy to improve the quality of medical waste management 6.

The success of developing waste management interventions in several countries that have succeeded in increasing knowledge, attitudes, and behavior can be seen in the following table:

Table 4. Successful development of interventions

Intervention Program	**Country**	**Pre-intervention**	**Post-intervention**
Health education or training on medical waste management	Egypt	9.6%	97.3%
	India	6.4%	78.1%
	Iran	30%	45-75.1%
	Kuwait	47.1%	63.7%
	Nepal	26%	86%
	Pakistan	47%	92%
	Palestine	50%	75%

8.2 Impact of medical waste on the environment

Environmental problems have become the most serious problem in the world. This problem is not only the responsibility of one country but the responsibility of all nations on this earth. Therefore, various efforts have been made to manage medical waste so as not to damage the environment and reduce the volume of waste production. One of the strategies taken to manage medical waste from sorting to the processing at the TPA (Final Disposal Site) so as not to pollute the environment is to create regulations in the form of laws at the National, Regional and International levels which state that the medical waste produced is required to be managed properly. good and right 17. In general, the management of medical waste in health facilities is the

responsibility of health workers because, in addition to providing health services, on the other hand, medical waste is produced so that it is not disposed of in any place 18.

In fact, medical devices used by health service providers from hospitals, health centers, and private clinics to treat their patients contain hazardous and toxic materials, this will be very dangerous for the environment if after using these medical devices are not managed properly and as it should 18. To minimize the risk of medical waste must be managed from the source before being disposed of and this requires good management 19.

Irregular management of medical waste from health care facilities will lead to environmental pollution, and infectious waste can lead to transmission of more than 30 pathogens including typhoid, hepatitis B, hepatitis C, HIV, Escherichia coli, Staphylococcus aureus, and Pseudomonas Aeruginosa 15. Environmental pollution can cause many diseases that can affect human health and the surrounding environment from the lightest to the most severe (serious).

Environmental protection from the dangers of medical waste is very important. To that end, the role of the official leadership of health care facilities in environmental health is primarily related to being aware of environmental conditions around health care facilities and working with the community or patients to adequately control any risks associated with medical waste20. This is very important because medical waste also potentially causes air pollution and waste is very dangerous to the health of paramedics, patients, and society as infectious waste, pathological waste, chemical waste, pharmaceutical waste, genotoxic waste, and radioactive waste 11. World Health Organization (WHO) said that the medical waste generated from healthcare activities needs to be managed properly to prevent the risk of the hazards of medical waste can be minimized 21.

8.3 Impact of medical waste on health.

Medical waste usually contains infectious pathogens, namely viruses and bacteria. Infected hospital waste (medical waste) can transmit disease, especially if it encounters a portal of entry. There is epidemiological evidence that strong of Canada, Japan, and the United States, that the main concern of hospital waste that is transmitted to the transmission of HIV / AIDS and viral hepatitis B or C virus (HBV) through wounds caused by needles and syringes contaminated by the blood of patients 22.

The collection and sorting of medical waste is a very important step to reduce the risk of accidents by paramedics, staff, and patients. However, not all health care facilities can manage medical waste properly, for example in Iran according to data from Mesdaghinia et al (2009) only 25% of primary health care facilities perform medical waste management well 6.

The intervention development strategy is very important for health care facility managers, medical and non-medical staff to increase their awareness of medical waste management 16. Improvements in current medical waste management practices in healthcare facilities in Bangladesh have a significant long-term impact in minimizing the spread of infectious diseases. Medical waste requires special handling and management from source to final disposal 23. Medical waste can pose a threat to public health and the environment, therefore it must be treated seriously. Medical waste can spread disease to healthy subjects when contaminated with blood or body fluids from sick patients 24.

The growth of the worldwide health sector over the last decade combined with the use of cheap medicines of different categories has contributed to a large amount of medical waste20, as shown in the following table:

Table 5. Medical Waste

No.	Waste category	Description
1.	Infectious waste	Patient tissue, syringes, blood, bandages, culture cultures, materials or equipment that come into contact with infectious diseases or other media that are thought to be contaminated by the patient's disease
2.	Pathological waste	Waste comes from human body tissue. For example: organs, fetus, blood, vomit, urine, and other body fluids
3.	Pharmaceutical waste	Waste containing pharmaceutical ingredients. For example: includes pharmaceutical products, drugs, vaccines, expired serums, drug spills
4.	Genotoxic waste	Cytotoxic waste is material that has been contaminated or may be contaminated with cytotoxic drugs during the compounding, transport or therapeutic action of cytotoxic.
5.	Chemical waste	Chemical waste is generated from the use of chemicals in medical, veterinary, laboratory reagents, expired disinfectants, sterilization processes, and research.
6.	Waste with heavy metal content 3	Battery, faulty thermometer, blood pressure meter (Tensimeter)
7.	Pressurized containers	Gas cylinders, aerosol cans
8.	Radioactive waste	Radioactive waste is material that is contaminated with radioisotopes originating from medical use or radionuclide research. This waste can come from, among others, nuclear medicine, radioimmunoassay, and bacteriology, which can be in the form of solid, liquid, or gas.
9.	Sharps waste	Needles, knives, knives, broken glass infusion sets, syringes, scalpels.

Management of medical waste (medical waste) is not only a legal requirement but also a social responsibility in the Health system, because of the potential risk to human health and environmental impacts of global concern 6. For example, in Ghana, it is imperative to obtain better medical waste management methods or systems to treat waste in the long term. One of the factors affecting the less efficient waste management system is due to limited budgets such as in Ghana and Nigeria 25. There are reports of epidemiological studies linking various unfavorable health outcomes with the installation of medical waste management facilities as they relate to public health 26.

9. Conclusion

Development strategy Medical waste management interventions are very important for the health of paramedics, staff and patients, and the environment. Medical waste management in developing and developed countries is different. Developed countries are oriented towards technology and sufficient budget while developing countries still use human resources and limited budgets. Therefore, health care facilities need to prepare human resources (HR) who have the system, technology, and management capabilities for medical waste management. Medical waste management must be supported by adequate human resources, organization, facilities, and budget. All facilities related to medical waste management must be equipped with permits in accordance with applicable regulations.

Reference

Yasir Nadeem. Health Implications of Hospital Waste Management Practices in Gujrat, Pakistan. Published online 2014:1-30.

Doyle T, Alemayehu T, Baraki N. Knowledge, and Practice of Health Workers about Healthcare Waste Management in Public Health Facilities in Eastern Ethiopia. J Community Health. 2019;44(2):284-291. doi:10.1007/s10900-018-0584-z

Singh R, Singh G, Singh K. A Study of the Bio-Medical Waste Management in a Teaching Hospital (NCMC A Study of the Bio-Medical Waste Management in a Teaching Hospital (NCMC and Hospital, Panipat). IOSR J Dent Med Sci . 2018;17(July):29-39.doi:10.9790/0853-1707102939

Singh JP, Saxena S, Kumar A, Kumar M, Kumar A. Impact of educational intervention on the knowledge of biomedical waste management among healthcare workers in the tertiary care district hospital, Shahjahanpur, U. P. Associate Professor, Department of Community Medicine Autonomous State Medical Col. 2021;4(2):94-97.

Wulandari P, Kusnoputranto H. Medical Waste Management and Minimization Efforts At Public Hospital. Case Study: Public Hospital in East Jakarta, Indonesia. J Kesehat Masy (Journal of Public Heal . 2015;9(2):77-84. doi:10.12928/kesmas.v9i2.2127

Tabrizi JS, Saadati M, Heydari M, Rezapour R, Zamanpour R. Medical waste management improvement in community health centers: An interventional study in Iran. Prim Heal Care Res Dev. Published online 2018. doi:10.1017/S1463423618000622

Lanyuy GD, Jane FA, Wilfred FM. Medical waste management and disposal practices of health facilities in Kumbo East and Kumbo West health districts. Int J Med Med Sci . 2017;9(1):1-11. doi:10.5897/ijmms2016.1272

Al-Habash M, Al-Zu A. Efficiency and Effectiveness of Medical Waste Management Performance, Health Sector and its Impact on Environment in Jordan Applied Study. 2012;19(6):880-893. doi:10.5829/idosi.wasj.2012.19.06.2775

Tabash MI, Hussein RA, Mahmoud AH, El-Borgy MD, Abu-Hamad BA. Impact of an intervention program on knowledge, attitude, and practice of healthcare staff regarding pharmaceutical waste management, Gaza, Palestine. Public Health. 2016;138:127-137. doi:10.1016/j.puhe.2016.04.001

Hosny G, Samir S, El-Sharkawy R. An intervention to significantly improve medical waste handling and management: A consequence of raising knowledge and practical skills of health care workers. Int J Health Science (Qassim). 2018;12(4):56-66. http://www.ncbi.nlm.nih.gov/pubmed/30022905%0Ahttp://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=PMC6040849

Ozder A, Teker B, Eker HH, Altındis S, Kocaakman M, Karabay O. Medical waste management training for healthcare managers - a necessity? J Environ Heal Sci Eng . 2013;11(1):1-8. doi:10.1186/2052-336x-11-20

Ashtari A, Sadegh Tabrizi J, Rezapour R, Rashidian Maleki M, Azami-Aghdash S. Health care waste management improvement interventions specifications and results: A systematic review and meta-analysis. Iran J Public Health. 2020;49(9):1611-1621. doi:10.18502/ijph.v49i9.4074

Elnour AM, Moussa MMR, El-Borgy MD. Impacts of Health Education on Knowledge and Practice of Hospital Staff with Regard to Healthcare Waste Management at White Nile State Main Hospitals, Sudan. Int J Health Science (Qassim). 2015;9(3):311-325. doi:10.12816/0024698

Zagade TB, Pratinidhi AK. Assessment of Effectiveness of Educational Intervention on Knowledge among Bio-Medical Waste Handlers. Int J Sci Res . 2014;3(9):371-377.

Sapkota B, Gupta GK, Mainali D. Impact of intervention on healthcare waste management practices in a tertiary care government hospital of Nepal. BMC Public Health. 2014;14(1):1-8. doi:10.1186/1471-2458-14-1005

Mokuolu O, Akindele R, Olawumi H. Development of Improved Solid Hospital Waste Management Practices in a Nigerian Tertiary Hospital. Nigerian J Technol . 2016;35(3):674. doi:10.4314/njt.v35i3.28

Mosquera M, Andrés-Prado MJ, Rodríguez-Caravaca G, Latasa P, Mosquera MEG. Evaluation of an education and training intervention to reduce health care waste in a tertiary hospital in Spain. Am J Infect Control . 2014;42(8):894-897. doi:10.1016/j.ajic.2014.04.013

Kumar R, Somrongthong R, Shaikh BT. Effectiveness of intensive healthcare waste management training model among health professionals at teaching hospitals of Pakistan: A quasi-experimental study. BMC Health Serv Res . 2015;15(1):1-7. doi:10.1186/s12913-015-0758-7

Baaki TK, Baharum MR, Ali AS. Determining a conceptual framework for safe and sustainable healthcare waste management (SSHCWM) implementation in healthcare facilities. J Facil Manag. 2019;17(1):40-56. doi:10.1108/JFM-11-2017-0059

Mohiuddin A. Medical Waste: A Nobody's Responsibility After Disposal. Int J Environ Sci Nat Resources. 2018;15(2). doi:10.19080/ijesnr.2018.15.555908

World Health Organization, Emmanuel J, Pieper U, et al. Safe management of wastes from health-care activities. Published online 2014:329. http://apps.who.int/iris/bitstream/10665/85349/1/9789241548564_eng.pdf

Agarwal R. Medical Waste Issues, Practices and Policy by Seminar on Health and the Environment Center for Science and Environment Page No: Environ Prot. Published online 1998:1-52.

Hassan AA, Tudor T, Vaccari M. Healthcare waste management: A case study from Sudan. Environ - MDPI. 2018;5(8):1-16. doi:10.3390/environments5080089

Fraiwan LA, Lweesy KY, Oweis RJ, Al-Bataineh O, Hung YT. Medical waste management. Handb Environ Waste Manag Air Water Pollut Control. Published online 2012:1015-1088. doi:10.1142/9789814327701_0023

Asante BO, Yanful E, Yaokumah BE. Healthcare Waste Management; its Impact: A Case Study of the Greater Accra Region, Ghana. SSRN Electron J . 2014;3(3):106-112. doi:10.2139/ssrn.2410909

Lekwot 1 VE, Nunyi 1 BV, Ifeanyi 1 E, I 2 C, Adamu 3 B. Public health implications of improper hospital waste disposal in Zonkwa district of Zangon-kataf local government area, Kaduna state. J Res Environ Sci Toxicol.2012;1(2):23-28. http://www.interesjournals.org/JREST

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