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## **RISK ASSESSMENT OF THE CURRENT HANDLING OF MEDICAL WASTE IN HOSPITALS OF SANA'A CITY, YEMEN**

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### **Abstract**

*Waste that is generated from healthcare establishments is potentially harmful to human beings and environment. The objective of this study is to assess the environmental and health risk associated with processes of the current handling of medical waste in hospitals of Sana'a city, Yemen. The observations and follow up the current handling of medical waste were done through frequent visits to the studied hospitals. A preliminary risks analysis (PRA) technique was applied as an analysis tool to identify and to evaluate the potential hazards of the activities and processes of the current handling of medical waste in the studied hospitals. Eighteen events related to containment, segregation, collection, transportation, waste storage, and waste treatment were analyzed. The results obtained in this study showed that 89% of the events of waste handling processes, which have been analyzed, were in high-risk levels. All events were in high-risk levels,*

*suggesting need to prioritize all these processes' events. For minimizing or interrupting the potential risks of the current handling of hospitals waste, the hospitals' management and the relevant ministries in the Yemeni government should cooperate to develop comprehensive plan for management of medical waste, taking into account the results of this study.*

### **Keywords**

Medical Waste, Hospitals Waste, Risk Assessment, PRA, Sana'a city, Yemen

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## **1. Introduction**

Continuous progress in medical sciences and technology and expansion in the number of health institutions worldwide has been accompanied by increasing quantities of potentially hazardous medical waste. The risks include occupational exposure of health workers and waste-handlers and environmental exposure of the public caused by medical waste mismanaged (Al-Emad, 2011).

In Yemen, due to the ignoring of the health sector to the appropriate management of medical waste, the hospitals' wastes are still largely mismanaged (Alwabr, Al-Mikhlaifi, Al-Hakimi, & Dughish, 2016a). Improper handling of hospitals' waste may create a health risk among medical staff, waste handlers, patients, and the surrounding environment (Sawalem, Selic, & Herbell, 2009; Bokhoree, Beeharry, Makoondlall-Chadee, Doobah, & Soomary, 2014). In case of proper management of medical waste the quantity of hazardous medical waste produced from hospitals might be approximately 26% or less (Alwabr, Al-Mikhlaifi, Al-Hakimi, & Dughish, 2016b). Exposure to the hazardous medical waste could lead to series of different hazards such as (infection, infertility, genital deformities, cancer, mutagenicity, dermatitis, asthma, typhoid, cholera, hepatitis, AIDS, and other viral infections) (Oli et al., 2016). Persons that exposed to needle stick injury to a needle used on an infected source patient has risks of 30%, 1.8%, and 0.3% of becoming infected with HBV, HCV and HIV respectively (Twinch, 2011).

All individuals dealing with hazardous healthcare waste are potentially at risk, nurses and healthcare staffs among the main groups at risk (Khanehzaei, Ishak, AbdManaf, & Abdullah, 2014). Appropriate management of hospitals waste and the practicing of safety measures can help towards the safe disposal of hospitals waste addition to protection of the community from various adverse effects of the hazardous waste (Khazae et al., 2015).

Risk assessment by using the preliminary risk analysis (PRA) technique is a systematic process of collect, assessing and documenting information and data to assign a level of risk. And

to provides the basis of taking action to manage and reduce the negative consequences of acute public health risks (W.H.O., 2012). These techniques have presented good application structure in the process and industrial activities (Quintella, Addas-Carvalho, & Da-Silva, 2008). The results of a risk assessment should be used to control measures that reflect the risk (W.H.O., 2012).

The objective of this study is to identify and analyze the environmental and health risk associated with all processes of the current handling of medical waste in the public hospitals of Sana'a city, Yemen, by using the PRA technique as a tool to assess the finding against the risk criteria and identify opportunities for risk reduction, and make recommendations as appropriate.

## 2. Materials and Methods

Medical waste is almost generated in all governmental hospitals of Sana'a city. Medical waste, which is improperly segregated, collected, and disposed of, which may lead to a negative impact on environmental and public health. Four hospitals were selected for this study, which are Al-Thawra, Al-Kuwait, Republic and Military. Comparing to the other hospital, these hospital considered as the leading, oldest, and largest hospitals in Sana'a city.

The observations and follow up the current handling of medical waste were done through frequent visits to the studied hospitals. An assessment of the current handling of the waste generated in the studied hospitals was performed using the PRA technique.

The application of the PRA technique is to identify and to evaluate the potential hazards and risks associated with all events, and steps involved in the current processes of handling and transporting of medical waste. Also, to characterize and prioritize an adverse event in terms of occurrence and severity of the event (Department Of Occupational Safety and Health, 2008). A likelihood occurrence is an event that is likely to occur to the specific period and circumstances and was divided into five categories. And the hazard severity was divided into five categories based on an increasing level of severity at an individual's health, the property, and the environment. The intersection of severity and likelihood determines the level of risk acceptability on the matrix (Table 1).

**Table 1:** Risk Assessment Matrix

		Hazard severity				
		(1) No effect	(2) Minor	(3) Major	(4) Fatal	(5) Catastrophic
Likelihood of occurrence	5 Very likely	5	10	15	20	25
	4 Likely	4	8	12	16	20
	3 Possible	3	6	9	12	15

	<b>2 Unlikely</b>	2	4	6	8	10
	<b>1 Very unlikely</b>	1	2	3	4	5

  

<b>Low risk = 1-4</b>	<b>Medium risk = 5-12</b>	<b>High risk = 15-25</b>
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Based on the current handling of medical waste in the studied hospitals, eighteen events related to containment, segregation, collection, transportation, waste storage, and waste treatment were analyzed. Sheets were used to organizing the information that was obtained during field working such as, waste handling processes, hazard identification, risk analysis, and risk control.

### 3. Results and Discussion

From the analysis of eighteen events related to the processes of containment, segregation, collection, transportation, waste storage, and waste treatment, six sheets of results were obtained. In Table 2 and 3, the results of only the segregation and collection process sheets are shown, as an example of the analysis carried out in this study. The results of the analysis suggest the preventive actions for minimizing or interrupting the potential risk from each event of the processes of the current handling of hospitals waste.

#### 3.1. Containment Processes

The events related to the containment processes such as lack of a sufficient number of the waste containers, the wrong places for the containers placed, lack of color-coding, unlocked containers, lack of sterilization for reusable containers, and spread of hazardous waste surroundings the containers. All these events were determined on the level of high-risk, represented potential health hazards to the medical staff, patients, workers, and visitors. This result was agreed with a previous study conducted in Brazil (Carvalho & Silva, 2002).

A sufficient number of color-coded containers should be located in all the necessary locations to decrease and eliminate the risks of the containment processes.

#### 3.2. Segregation Processes

As shown in Table 2 the events related to the segregation process was determined on the level of high risk. Lack of segregation processes of sharp and infectious/hazardous waste in all the studied hospitals represented the most acute potential hazards to health. Needles constitute an important part of the sharp waste category, which are particularly hazardous because they are often contaminated with the patients' blood, causing blood-borne diseases to the medical staff, workers, scavengers, patients, and visitors. This result was agreed with a previous study conducted

in Algeria reported that the sharps, infectious, and the human anatomical waste were in the area of high risks (Sefouhi, Kalla, Bahmed, & Aouragh, 2013).

Appropriate segregation processes in a source of waste generation lead to distinguishing hazardous waste from non-hazardous waste, this will reduce the risks of hazardous waste handling; also, will reduce the total volume of hazardous waste, hence reducing the costs of waste disposal.

**Table 2:** Risk analysis of the process of waste segregation in the studied hospitals

No	Hazard identification				Risk analysis			Risk control
	Activities (Events)	Status	Hazards	Effects	L	S	R	(Preventive actions)
1	Segregation of infectious and hazardous waste.	Unavailable	-An infection risks -Toxic - Corrosive - Poisonous - Combustible -Hazardous	- The spread of the diseases threats to the health of human beings or any other beneficial uses of the environment. - Damaging effects on the human being and environment. - Carcinogenic and other health risks.	4	4	16	- Infectious and hazardous waste should be segregated and collected properly in the yellow color bins' marked with the international infectious, and dangerous symbol. - Use of appropriate personal protective equipment. - The staff has to receive written information and training on waste segregation.

2	Segregation of sharp waste.	Unavailable	<ul style="list-style-type: none"> <li>- Cut</li> <li>-Injury</li> <li>-Punctured</li> <li>-Wound</li> <li>-Infection</li> </ul>	<ul style="list-style-type: none"> <li>- Injured by needle and fingers permanently damaged.</li> <li>- Ulcer on legs.</li> <li>-Hands cut due to handling broken glass.</li> <li>-Poses a special risk for deadly diseases such as HIV/AIDS.</li> </ul>	5	4	20	<p>Sharp waste should be segregated properly, and collected in rigid containers.</p> <p>Puncture-proof containers and fitted with covers should be used for disposal of sharp waste</p> <p>Appropriate personal protective equipment should be used during dealing with sharp waste</p> <p>The term of " SHARP " should be labeled on sharp waste containers to remind medical staff what it contains.</p> <p>A sharp containers should be sealed and sent for disposal of with potentially infectious waste before filled to more than three-quarters</p>
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L= Likelihood; S = Severity; R= Risk.

### 3.3. Collection Processes

Table 3 shows that events of (the lack of waste handling plan and personal protective materials) were determined in level of high risk, while events of (the lack of record keeping system and cleaning system of containers) were determined on level of medium risk. Therefore, in processes of collection events related to (the establishment of waste handling plan, and supply of the necessary protective materials) should be given top priority to begin the elimination and decrease the related risk.

**Table 3:** Risk analysis of the process of waste collection in the studied hospitals

No	Hazard identification				Risk analysis			Risk control
	Activities (Events)	Status	Hazards	Effects	L	S	R	(Preventive actions)



1	Waste collection plan.	Unavailable	-The spread of infection. -Human risks. - Environmental Risks.	The lack of waste collection plan leads to inappropriate procedures for waste management causing increase negative impacts on the environment, occupational health, and public health.	4	4	16	<ul style="list-style-type: none"> <li>- Waste management plan including segregation should prepare by hospitals' managements.;</li> <li>- A collection of the waste containers should be done through the designated routes as a part of the waste management plan.</li> <li>- Disposal of waste should be once or twice per day..</li> <li>- The sharp containers should be replaced before filled three-quarters.</li> <li>- The waste bags should be transferred by using specified waste trolley.</li> <li>- Manual handling of the waste should be avoided.</li> </ul>
2	Record keeping system functioning in relation to waste collection .	Unavailable	Lack of the essential information about the current management of the waste	Continuous problems in waste management.	5	2	10	<ul style="list-style-type: none"> <li>- Record keeping system should include in the waste management plan.</li> <li>- Future progress and sustainability of the waste management program depend on an analysis of the record keeping system and take necessary measures accordingly.</li> </ul>
3	Waste handlers using protective materials during waste handling.	Unavailable	Health risks to the waste handlers during dealing with waste	<ul style="list-style-type: none"> <li>- Cut or puncture of the skin by sharp waste.</li> <li>- The splashing of blood or other body fluids on the mucous membranes particularly on the mouth, eyes or nose.</li> <li>- Inhalation of pollutants emitted from the waste.</li> </ul>	4	4	16	<ul style="list-style-type: none"> <li>- The waste handlers should wear protective materials such as heavy duty gloves, long boots, mask, apron etc.</li> <li>- Hospitals' management should provide the necessary protective materials.</li> <li>- The waste management plan should include the rules relating to using of protective materials.</li> </ul>
4	The system of cleaning bins after emptying.	Unavailable	The increase of infectious and hazardous risks .	Health risks to the patients and to the hospitals' staff.	3	2	6	<ul style="list-style-type: none"> <li>- During a replacement of the bins, clean same color bins should be placed at the sites.</li> <li>- Routinely decontaminate, wash, and clean the re-usable waste containers after emptying.</li> </ul>

*L= Likelihood; S = Severity; R= Risk.*

### 3.4. Transportation Processes

The events related to the transportation processes (e.g., an absence of special trolleys for carrying waste bins, using uncovered waste bins during transportation, improper routes for

transportation of waste, and unavailability of a special vehicles for transportation of waste out of the hospitals for final disposal) were determined in the level of high risk, represented potential hazards among medical staff, patients, visitors, workers, and surrounding environment.

Applying control methods (e.g., special trolleys and vehicles, suitable routes for transportation of waste, regularly supervision, and monitoring of waste transportation) will participants to eliminate direct and indirect contact between people and hazardous waste.

### **3.5. Waste storage Processes**

The events related to the waste storage processes (e.g., a lack of appropriate waste storage rooms was determined in the level of high risk) leads to a spread of infection, odors, and another risk to the human health and environment.

### **3.6. Waste Treatment Processes**

The events related to the waste treatment processes such as a lack of infectious waste treatment system in the source of production was determined in the area of high risk, represented the serious potential environmental, and health hazards inside and outside of the hospitals' sites. Disinfection of infectious waste in the source of production will maximize safe and sanitary recycling/reuse.

## **4. Conclusions**

In all the studied hospitals, the existing system of the medical waste management was not satisfactory, unsuitable, unhygienic and unacceptable. The events of (the lack of segregation system between hazardous and non-hazardous waste, unavailability of color-coded containers, an absence of rules and regulations applying to the collection of waste, lack of appropriate waste storage rooms, a lack of infectious waste treatment system in the source of production, insufficient personal protective equipment, and absence of plan for safety handling of medical waste) all that's been among the main causes that raising the exposure to the potential risk of the hospitals waste.

## **5. Recommendations**

For minimizing or interrupting the potential risks of the current handling of hospitals waste, the hospitals' management and the relevant ministries in the Yemeni government should cooperate to develop a comprehensive plan for management of medical waste, taking into account the results of this study.

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