

## Occupational Safety and Health Accidents among Biomedical Waste Handlers in Nairobi County

Mburu Moses Nguthu Gikunju Joseph K. Onguso M. Justus Wakibia Joseph  
Institute of Energy and Environmental Technology, Jomo Kenyatta University of Agriculture and Technology,  
PO Box 62,000 – 00200 , Nairobi Kenya

### ABSTRACT

This study was conducted to investigate the reasons for prevalent increase in the number of occupational accidents among biomedical waste handlers despite the Waste Management Authority's regulatory framework defining the laws and procedures that govern the collection, storage, processing, and disposal of biomedical waste in Nairobi County and recommend appropriate actions to counter the situation. The two areas of investigation consisted of determining the causes of occupational accidents and evaluating the attitude and knowledge of biomedical waste handlers in Nairobi County. Both, the qualitative and quantitative research paradigms were used in the study. A sample size of 168 participants from the target population of 1000 biomedical waste handlers was chosen with 160 questionnaires returned for statistical analysis. The study used a descriptive statistics approach to generate tables with the mean, standard error of the mean, t-distributions, percentages, and significance tests among other statistical measures to address the research objectives on the basis of the Petersen's Accident/Incident and the human factors theories. On the causes of accidents, the results showed strong positive Skewness indicating problems with waste management practices, inadequate knowledge on waste classification at source, inadequate attention to rules and regulations governing the collection and handling of biomedical waste, inadequate training and awareness, poor enforcement of waste handling standards and policies, and inadequate knowledge on the classification and handling of biomedical waste. This revealed the nature of accidents to include pricks, contaminations, muscle tearing, scratches, being struck by falling objects and sustaining injuries due to falls. On knowledge and attitude of biomedical waste handlers, significant challenges were revealed showing that inadequate knowledge on safe waste handling methods with a significant number showing that their educational attainments barred them from comprehending the regulations and procedures for handling biomedical waste. A significance test at Kendall's tau coefficient statistic showed strong positive correlation between educational levels and managing biomedical waste. It was recommended that the Waste Management Authority designs a customized training program to address the problems facing biomedical waste handlers in Nairobi County.

**Keywords:** Biomedical waste, hazards, Accidents, Waste Management, injuries, pricks, Nairobi County

### I. INTRODUCTION

The processing, storage, transportation, and disposal of biomedical waste is a global problem that continues to be a significant challenge among Kenyan cities whose rapidly increasing population going for medical services continues to produce large amounts of biomedical waste. The case explains a situation among many countries in the world including Kenya struggling to address occupational accidents inclusive of psychosocial, biological, chemical, ergonomic, and physical hazards. A situational analysis in Kenya shows that an estimated 20% of biomedical wastes generated in Nairobi County pose significant challenges of high potential infections and injuries among biomedical waste handlers (Othigo, 2014). Biomedical waste is defined as "waste generated by health care activities that includes a broad range of materials, from used needles and syringes to soiled dressings, body parts, diagnostic samples, blood, chemicals, pharmaceuticals, medical devices and radioactive materials" (Othigo, 2014, p.3). The potential results of poor waste management include exposing waste handlers to infection, toxic effects and injuries, and risks polluting the environment if waste is not appropriately segregated and disposed of. The study views emerging issues on poor classification and management of biomedical wastes, inadequate and inappropriate knowledge on the procedures of handling healthcare wastes, and problems in complying with statutory laws underpin the some of the areas of focus of investigation. Bedsides, Muniafu and Otiato (2010) note that weak compliance with the laws of the government of Kenya and the World Health Organization's (WHO) guidelines on healthcare waste storage, transportation, and disposal present significant problems to address. Managing waste in Kenya is vested on the local authorities through the County Government Act of 2012 Laws of Kenya and the Public Health Act Cap 242 Laws of Kenya (Othigo, 2014). Subsequent county lawss have been enacted by local authorities to help manage solid waste and sewerage services. The Environmental Management and Coordination Act (EMCA) Cap 387 Laws of Kenya obligates industries and businesses to take the responsibility of managing waste resulting from their activities. Furthermore, Henry, Yongsheng, and Jun (2006) demonstrate the importance of complying with the Environmental Management and Coordination (Waste Management) regulations of 2006 on managing hazardous and non-hazardous wastes.

### **Objectives of the study**

- 1) To determine the causes of occupational accidents among biomedical waste handlers in Nairobi County.
- 2) To evaluate the attitude and knowledge of biomedical waste handlers in Nairobi County affect the biomedical waste handlers?

## **II. LITERATURE REVIEW**

Proper handling of biomedical waste is a global problem that keeps on recurring due to the large amounts of waste generated from different facilities offering medical services. The problem has significant implications on the occupational health of the waste handlers. The case depicts a situation in Kenya that is struggling to address occupational health accidents that are a daily occurrence among biomedical waste handlers in Nairobi County. A situational analysis in Kenya shows that an estimated 20% of biomedical wastes generated in Nairobi County pose significant challenges of high potential infections and injuries among biomedical waste handlers (Othigo, 2014). This study was based on the theoretical and empirical reviews of related literature on occupational safety and health hazards based on the human factors theory and the Petersen's Accident/Incident theory. The theories explain the persistent problem of occupational or workplace accidents that biomedical waste handlers experience in Nairobi County. The framework provides an explanation of the risks and hazards affecting personnel directly involved in handling waste based on the research objectives.

### **Theoretical Review**

Reinach and Viale's (2006) discourse of occupational accidents that biomedical waste handlers experience are explained in the context of Petersen's Accident/Incident and the human factors theories. Muniafu and Otiato (2010) build on this precise exposition of the reasons for the persistent problems of workplace hazards typical of Nairobi County waste handling embodied in the key elements defined in the theories. Despite some significant variations in the perspectives on the application of the theories, Wickens, Hollands, Banbury, and Parasuraman (2015) view the human factors theory as providing accurate explanation of the sources of problems in biomedical waste handling on the basis of overload, inappropriate responses, and inappropriate execution of waste collection, transportation, and disposal activities. The theory showed that inadequate biomedical waste handling skills and poor judgment of waste handling risks was the foundation of the study.

### **Empirical Reviews: Casues of occupational biomedical waste accidents**

To be consistent with the Duty of Care requirements, correct classification of biomedical waste forms a solid foundation for ensuring effective protection of waste handlers under strict compliance with the waste management laws. Empirical evidence by Henry et al. (2006) show that combining a small amount of hazardous waste with non-hazardous waste makes the resulting waste 100% hazardous, which poses a lot of risk for the worker. The challenges is to ensure commitment and compliance with waste segregation and management practises such as practises and laws have shown places employees are at a greater risk of contracting diseases by handling inappropriately segregated waste.

Inappropriate containment of waste to its level of risk such as waste that requires UN approved packaging and poorly implemented decontamination procedures to prevent and minimise exposure to pathogens and contagious fluids add to the waste segregation challenges.

A similar study on the composition of waste by Muniafu and Otiato (2010) provided evidence showing that 15% to 25% of waste generated from hospitals is hazardous while the remaining 75% is non-hazardous. Wrong combination of non-hazardous with hazardous wastes makes the entire waste 100% hazardous (Ferri, Chaves, & Ribeiro, 2015). A study by Muniafu and Otiato (2010) based on a quantitative analysis of data showed that lack of proper segregation techniques exposes waste handlers significant health risks besides widening the scope of those vulnerable to the health risks such as doctors, nurses, patients, hospital management staff, the general public, and the environment. Inappropriate waste segregation, failure to adhere to municipal laws and systems laws besides the failure to follow the WHO guidelines on waste management leads to the wrong disposal of waste from hospitals. Muniafu and Otiato (2010) have noted this to be the direct result of unawareness problems, laxity in law enforcement, lack of process ownership, and gaps in constant monitoring of waste management methods. Despite the serious gaps and methodological flaws of Muniafu and Otiato's (2010) study on biomedical waste classification and management challenges, the discourse accurately represents actionable issues to protect biomedical waste handlers. Among Muniafu and Otiato's (2010) proposed that Ferri et al. (2015) build on include the use of a comprehensive Workplace Safety and Health Management framework consisting of policy and commitment, effective planning, reliable implementation and operations, performance measurements, and an audit review program.

According to Ahmed, Zeyad, Thakir and Mohammed (2015), 90% of Nairobi County biomedical waste handlers have poorly worked audit reports with records of work related accidents, which is a statutory requirement for organizations to comply with in waste management. Ahmed et al. (2015) assessed compliance in

record keeping of 30 organizations targeting a population of 100 organizations that generate biomedical waste and established that 73% failed to keep records to evade responsibility for employees vulnerable to the risk of accidents and other workplace hazards. The study noted physical injuries from sharp objects like needles and blades constituted the leading causes of infection from diseases such as hepatitis B and HIV, liquid wastes, plastics, and incinerator ash. Parizeau (2015) noted several emerging accident related issues and work related accidents to include deficiency in knowledge on how to apply preventive measures to human health and contamination with untreated anatomical wastes. Ahmed et al. (2015) conducted a study of Hospital Staff Exposure Risks and Awareness on Poor Medical Waste Management- A Case study of the Tabuk Regional Healthcare System- Saudi Arabia. It was established that the strongest exposure risk factors were sharp and needle stick injuries for Healthcare personnel (Patan & Mathur (2015). The risk and the likelihood of nosocomial infections resulting from poor waste management and control, ingestion of repackaged drugs that have been disposed of, inhalation of air and dust particles from biomedical waste are direct causes of health risk and workplace accidents.

A study conducted by Siddharudha (2015) on Occupational Exposure to Infection on Healthcare Waste Handlers of a Tertiary Care Hospital in South India, established that 41.8% of healthcare waste handlers had exposure to healthcare waste and 'needle stick injuries. Siddharudha (2015) identified pharmaceutical wastes, heavy metal wastes, pressurized containers, and chemical wastes inclusive of laboratory reagents, expired disinfectants, and organic chemical wastes as the main sources of accidents biomedical waste handlers incurred.

Ahmed et al. (2015) established that the most significant problems noted among biomedical facilities were poor maintenance of incinerators that are often in bad working conditions. Incinerators in good working conditions are a precondition for the reduction or prevention of work related hazards including toxic chemicals such as heavy metals and dioxin. Siddharudha (2015) recommended that compliance with special equipment handling guidelines including emergency provisions in case of accidents were mandatory especially when handling biomedical waste and during waste related handling emergencies (Garg & Sarkaret al., 2013). The study recommended facilities to develop programs to train and create awareness among biomedical waste handlers and organizations that generate healthcare waste such as the Kenya National Bio-safety Authority employees on Work related accidents.

### **Knowledge and attitude of biomedical waste handlers**

According to Othigo (2014), the defining elements of effective accident management include the knowledge and attitude of waste handlers that determines the extent and compliance levels in the bio-medical waste collection, transportation, and disposal regulations and standards. Such requirements are consistent with the Kenya National Guidelines on Safe Disposal of Pharmaceutical Waste, 2001, which embeds hazard protection elements that include rarely used equipment such as face masks, obligatory overalls, leg protection, disposable gloves, obligatory industrial aprons, and eye protectors. Siddharudha and Sowmyashree (2015) assessed the common causes of occupational waste handling accidents and concluded in a recommendation that designing methods to overcome problems such as failing to provide adequate warning signals in the workplace, failure to immunize workers, poor management practices, lack of proper waste packaging, and poor waste transportation practices constituted effective methods of managing accidents. Moving of dangerous equipment must be penalized so as to control the level of accidents. Based on the guidelines, organization that fails give to adequate warning signals to machine operators or those working in unsafe environments with dangerous equipment must be penalized to control the frequency of accidents. Othigo (2014) established that failing to develop and implement programs to curb work related stress among employees was among the leading causes of work related accidents. The study showed no evidence of hazard communication that discusses aspects of current biomedical waste plans within the hierarchy of waste handlers. Othigo (2014) argues that communication could provide workers with the appropriate instructions on how to handle biomedical wastes besides providing information on collective protective measures and awareness of overall hazard prevention policies.

Pietra et al. (2005) conducted a study the effect of system approach and a blame-free environment on organizational performance. It was established that a system approach and a blame-free environment, aimed at better organizational performances as well as leading to much better results than focusing on individuals. Furthermore, it was also found that the use of technology, information accessibility, communication, patient collaboration and multi-professional team-work are successful strategies to reach the goal of patient safety within healthcare organizations.

### **Investigation of Employer Compliance Status to Regulations**

A study by Evelyne (2013) assessed biomedical waste compliance status at the Mater Hospital in Nairobi County using the policy framework for regulating biomedical waste management of the Hospital as a standard. The results showed that Mater Hospital has a program in place that directs waste handlers on waste management legislations and policies to ensure effective accident management. Inclusive of the legislations and policies were

the Public Health Act Cap 242, Radiation Protection Act Cap 243, management of Hazardous Waste, Poisonous Substances Act 247, Food Drug and Substances Act 254, Medical Practitioners and Dentist Act 253, Environmental Management and Coordination Act Cap 387 Laws of Kenya, Water Act 2002, Land Control Act Cap 406, and Environmental Management and Regulations (Waste Management Regulations 2006 ensuring that there is safe biomedical wastes handling at the institution. Despite the policy and legislation framework in place being driven by an effective waste management program, compliance with the laws was at the minimum besides lack of records to show the level of compliance within the biomedical waste handlers.

### **Use of Personal Protective Equipment**

One of the requirements suggested by Wilkins (2009) for avoiding the prevalence of workplace accidents is the use of protective equipment to avoid direct contamination because of equipment failure. Singh and Gupta (2009) view legislations as a tool that provides guidelines and rules for the protection of workers, which are often not followed. This is consistent with the Petersen's Accident/Incident theory which suggests that every worker deserves protection from hazardous waste to live a healthy life. However, the study suggested that Kenya National Bio-safety Authority should develop, implement and enforce health and safety policy on use of personal protective equipment among bio-medical solid waste facilities. Bio-medical health facility must provide or purchase personal protective equipment on top of educating their employees on the importance of use of personal protective gear while working at facility.

Wilkins (2009) conducted a study on personal protective Equipment in the humanitarian governance of Ebola: between individual patient care and global bio-security in Ghana found that the importance of personal protective Equipment in mediating between individual patient care and bio-security helps in saving individual lives and protecting populations. From the findings, it was recommended that the government must monitor and carryout consistent annual health and safety check up within the bio-medical waste facility to ensure all employed staff health standards are followed.

### **Personal Hygiene**

According to Boss and Roy (2014), the World health organization policy framework provides that every employees working in any given organization is entitled to safe and good personal hygiene. Towards those goal, the study recommends that the Kenya National Bio-safety Authority must ensure that the implementation of HWM Rules 2005 is followed at all levels so as to maintain employee personal.

Boss and Roy (2014) conducted a study on personal hygiene among bio-medical waste handlers. From the study, it was established that maintaining personal hygiene is crucial in reducing careless disposal of wastes by Healthcare facilities which is a concern for medical staff, patients, general community and largely the environment. The results of the study recommend that the Kenya National Bio-safety Authority must also punish organization that fails to avail personal protective device. It must also ensure that all the safety standards on personal hygiene are used, and this is achieved through monitoring of training program that are offered by bio-medical solid waste facilities on personal hygiene.

According to Sharma (2010), awareness on Bio-Medical Waste Management among Healthcare Personnel of Some Important Medical Centers in Agra, it was found that inappropriate practice of BMW handling and management exposes handlers and general public to health and environment hazard once they do not keep their personal hygiene.

### **Critique of the Existing Literature Relevant to the Study**

Reinach and Viale's (2006) discourse of Petersen's Accident/Incident and the human factors theories accurately relate occupational safety and health hazards among biomedical waste handlers to the theories' defining elements with minor inconsistencies. Othigo (2014) build on Reinach and Viale (2006) exposition that failed to link theory with empirical evidence of waste management and workplace related hazards. Despite the logical fallacies in Othigo's (2014) investigations, the theories were conceptualised in a framework that relied on un-stated facts exclusive of valid assumptions to the research problem. However, Othigo (2014) provided valid results using a suitable research design, valid sample size, and current data despite excessively narrowing the study of focus to workplace hazards and challenges. In one instance on classification of waste, the author relied on personal opinion rather than empirical evidence to show how failing to comply contributed to the challenges related to classification and management of waste.

A lot of primary research exists that provide scientific facts on waste handling occupational accidents. A research by Muniafu and Otiato (2010) on occupational accidents uses key words such as prick injuries, contamination, sharps, pathological, and chemical contacts to describe occupational accidents. The author depicts the source of exposure to workplace accidents on the failure of biomedical waste handlers to inappropriately apply workplace regulation such as wearing of protective clothing. Muniafu and Otiato (2010) do not identify such accidents to be related to the problem of wrongful classification such as categorizing sharps

with the pathological waste. Communication problems do not arise in the study. Henry et al. (2006) accurately depicts the type of accidents to include Mucocutaneous injury and pricks despite being narrow in scope. The elements captured define occupational safety and health hazards among biomedical waste handlers based on study findings by Wilkins (2009) on the use personal protective equipment. In addition, its scope was not identified. Thus, there is need for the current study to examine how the use of personal protective equipment's determines the occupational safety and hazard among bio-medical waste handlers in Nairobi County.

### Research Gaps

It is imperative to note that different authors had little discourse on the challenges biomedical waste handlers experience at the place of work despite providing detailed and accurate exposition of the use of policies, procedures, and categorisation of waste. One area with glaring gaps was how to ensure compliance with Nairobi County laws and by laws and other statutory requirements on biomedical waste handling and management at the place of work besides the methodological weaknesses that happen within the study.

## III. METHODOLOGY

### Study Design

The quantitative and qualitative mixed paradigms were used in the study based on analysis of the literature and statistical analysis of data was used in the study. A descriptive approach was used to generate tables with the statistical measures of the mean, mode, and percentages summarizing the spread and nature of the responses. The rationale for using a descriptive research design includes providing a better understanding of the current situation on biomedical waste handlers in Nairobi County, provide the rationale for the incident prevalence of occupational health accidents despite the existence of policies, guidelines, and laws governing the segregation, collection, transportation, and disposal of healthcare waste.

### Area of Study

The study was conducted in Nairobi County Five with specific concentration among five facilities that consisted of three public hospitals; Mathari Referral Hospital, Mbagathi District Hospital and Kenyatta National Hospital and One NEMA registered private BMW disposal sites within Nairobi County; EnviroSAFE Limited.

### Target Population

The target population of 1000 people consisted workers in every stage of the biomedical waste handling cycle of waste generation stages, the segregation stage, waste loading transportation and unloading stage.

### Sampling Method

The study used purposive sampling method. The sampling method is justifiable in that it was selective look at legally operational biomedical waste handling facilities.

### Sample Size Determination

The sample size was determined using the following method. .

In theory, the confidence interval was based on the form:

(Point estimate)  $\pm$  (Margin of error)

- The point estimate was a value computed from the sample based on the sample proportion.
- The margin of error (or "plus or minus number") was computed from a variety of components – the level of confidence (e.g. 95%), the variability in the outcome variable, and the sample size.

Besides, the variables were ordinal in nature with some categorical characteristics.

The facilities used for the study have a target population of 10,000 biomedical waste handlers who work at different stages. To determine the sample size for use in this study, the following formula recommended by Mugenda and Mugenda (2003) was used:

$$n = \frac{(Z_{\alpha/2})^2 P(1-P)}{d^2}$$

Where; n = the desired sample where population > 10 000

Z = standard normal deviation (1.96) corresponding to 95% confidence limit.

d = degree of precision usually set at 0.05.

P = Proportion of the target population expected to have the (0.5) P taken as 50%.

$$n = \frac{(1.96)^2 (0.5)(0.5)}{0.0025} = 384.16$$

The sample was adjusted for finite population as follows, Fishers' *et al.* (1998)

$$n_f = n/1 + (n/N)$$

Where;  $n_f$  = the sample for size < 10 000  
 $n$  = desired sample size for population > 10 000.  
 $N$  = estimate of the population size (300)  
 $n_f = 384/1 + (384/300) = 168$

### Research Instruments

The questionnaire was the preferred tool for data collection because

## IV. RESULTS AND DISCUSSION OF THE FINDINGS

### Statistics of the Sample Size

#### Statistics

**Table 1: Returned questionnaires statistics**

Returned questionnaires

N	Valid	160
	Missing	0
Mean		1.0000
Std. Deviation		.00000
Std. Error of Skewness		.192
Std. Error of Kurtosis		.381

The report in table 1 shows that 160 questionnaires were returned showing a Standard Error of Kurtosis of .381 and Standard Error of Skewness of .192 showing a dataset with the desired properties of respondents. This makes the sample characteristics to show an asymmetrical distribution, which justifies the use of the 160 returned questionnaires for the study.

### Causes of accidents among biomedical waste handlers in Nairobi County

Table 2: Causes of occupational accidents among Biomedical waste handlers

#### Statistics

	Educational Status	Improper waste classification at source	Inadequate attention to directions	Inadequate training and awareness	Lack of enforcement of waste handling standards	Poor enforcement of waste handling policies	Inadequate waste classification knowledge
N Valid	160	160	160	160	160	160	160
N Missing	0	0	0	0	0	0	0
Mean	3.2063	1.2688	1.3000	1.1750	1.2625	1.2000	1.2375
Median	3.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Std. Deviation	1.04669	.44470	.45970	.38116	.44137	.40126	.42689
Skewness	.477	1.053	.881	1.727	1.090	1.514	1.245
Std. Error of Skewness	.193	.172	.193	.177	.099	.111	.182

Table 2 shows the statistics of Skewness of .477 for educational status while that for inadequate attention to directions is .881, which is less symmetrical. However, the Skewness for improper waste classification knowledge (1.053), inadequate training and awareness (1.727), Lack of enforcement of waste handling standards (1.090), poor enforcement of waste handling policies (1.514), and poor waste classification knowledge (1.245) have positive values that are greater than 1.0 showing that the distribution is far from symmetrical. The results show highly positive values of the Skewness, which is very pointed and statistically undesirable. The statistics points out that the variables noted have significant implications on the increase in the number of accidents noted among biomedical waste handlers in Nairobi County. The statistics shows the variables that were tested to determine the extent of their contributions for the prevalence of accidents among biomedical waste handlers in Nairobi County.

**Table 3: Statistics on responses to causes of accidents**  
**Causes of accidents among biomedical waste handlers**

	Frequency	Percent	Valid Percent	Cumulative Percent
Poor waste management practices	32	20.0	20.0	20.0
Poor waste classification at source	25	15.6	15.6	35.6
Poor enforcement of waste handling policies	17	10.6	10.6	46.3
lack of enforcement of waste handling standards	19	11.9	11.9	58.1
Inadequate training and awareness	20	12.5	12.5	70.6
Poor waste classification knowledge	37	23.1	23.1	93.8
Inadequate attention to directions	10	6.3	6.3	100.0
Total	160	100.0	100.0	

Table 3 shows the percentage distribution of responses among the 160 respondents. The question that was answered here what variable the respondent deemed, contributed to the workplace occupational accidents while at their day to day activities of handling biomedical waste. The results showed that 20 % of the respondents deemed accidents to be due to poor waste management practices, 15.6% due to poor waste classification at source, 10.6% due to poor enforcement of waste handling policies, and 11.9% due to lack of enforcement of waste handling standards. Besides, 12.5% of the respondents regarded inadequate training and awareness as the factors that contributed to workplace accidents, 23.1% poor waste classification knowledge, and 6.3% was due to inadequate attention to direction

**Nature of occupational accidents**

**Table 4: Occupational waste handling accidents**

Occupational accidents				
	Frequency	Percent	Valid Percent	Cumulative Percent
Pricks	47	29.4	29.4	29.4
Contaminations	24	15.0	15.0	44.4
Muscle Tearing	21	13.1	13.1	57.5
Scratch	6	3.8	3.8	61.3
Falls	13	8.1	8.1	69.4
Lifting heavy objects	21	13.1	13.1	82.5
Struck by falling object	28	17.5	17.5	100.0
Total	160	100.0	100.0	

Table 4 shows an investigation on occupational accidents showed that 29.4% of the respondents agreed that they have been pricked, 15.0% noted that they have suffered contamination which includes hazardous and non-hazardous chemicals, 13.1% had muscle tearing, and 3.8 % noted that they had suffered scratches. The results show that 8.1% have suffered falls, while 13.1% have lifted heavy objects, and 16.9% have worked in high temperature and low temperature environments. However, 17.5% recorded having been struck by falling objects.

**Table 5: Statistical analysis of waste handling accidents**

Statistics							
	Struck by falling materials	Lifting heavy objects	Pricks	Contaminations	Muscle Tearing	Scratch	Falls
N Valid	160	160	160	160	160	160	160
N Missing	0	0	0	0	0	0	0
Mean	1.7000	1.3000	1.4000	1.3313	1.3563	1.2375	1.3125
Std. Deviation	.45970	.45970	.49144	.47214	.48039	.42689	.46497
Skewness	-.891	.881	.412	.724	.606	1.245	.817
Std. Error of Skewness	.192	.192	.192	.192	.192	.192	.192

The report in table 5 shows a statistical analysis of the question on the types of occupational accidents that biomedical waste handlers are exposed to. A Skewness of -.891 shows the distribution of effects of struck by S

**Table 6: Knowledge on safe waste handling methods**

Knowledge on safe waste handling methods					
	Frequency	Percent	Valid Percent	Cumulative Percent	
Valid	Strongly agree	51	31.9	31.9	31.9
	Agree	51	31.9	31.9	63.7
	Neither agree nor disagree	35	21.9	21.9	85.6
	Disagree	18	11.3	11.3	96.9
	Strongly disagree	5	3.1	3.1	100.0
	Total	160	100.0	100.0	

Table 6 reports the results of the statistical test in answering the question if lack of knowledge on safe waste handling methods contributed to the workplace related accidents. The results show that 31.9% of the respondents strongly agreed that lacking appropriate knowledge on waste handling methods was a significant cause of occupational accidents. Of the respondents, 31.9% agreed that lacking appropriate knowledge was a direct cause of accidents while 21.9% neither agreed nor disagreed that knowledge on safe waste handling methods was an intervening variable that underpinned the cause of occupational accidents. However, 11.3% disagreed on the Knowledge on safe waste handling methods as a reason for the prevalence of accidents and 3.1% strongly disagreed.

**Table 7: Effects of education on biomedical waste handling accidents**

Effects of education on biomedical accidents prevention					
	Frequency	Percent	Valid Percent	Cumulative Percent	
Valid	Strongly agree	67	41.9	41.9	41.9
	Agree	46	28.7	28.7	70.6
	Neither agree nor disagree	24	15.0	15.0	85.6
	Disagree	14	8.8	8.8	94.4
	Strongly disagree	9	5.6	5.6	100.0
	Total	160	100.0	100.0	

Table 7 reports the statistics that answers the question on if education on had any positive effects in the prevention of accidents among biomedical waste handlers in Nairobi County. The results show that 41.9% strongly their educational status enabled them to take preventive measures while 28.7% agreed, 15% of the respondents neither agreed nor disagreed and 14% disagreed while 9% strongly disagreed that their educational status had any effect in preventing them from occupational accidents. To test the implications of education on accident prevention, a Kendall's tau coefficient statistic test statistical test was conducted as shown in table 8.

**Table 8: Correlations of education with safe waste handling methods**

Correlations				
		Knowledge on safe waste handling methods	Effects of education on biomedical waste handling accidents	
Kendall's tau_b	Knowledge on safe waste handling methods	Correlation	1.000	.834
		Coefficient		
		Sig. (1-tailed)	.	.305
	Effects of education on biomedical waste handling accidents	Correlation	.834	1.000
		Coefficient		
		Sig. (1-tailed)	.305	.
	N	160	160	

Table 13 reports the results of a Kendall's tau coefficient statistic test on a 1-tailed significance test with the results showing significant values at  $t(\tau_b = .834, p = .305)$  a coefficient of -.034, indicating a strong positive correlation between the two variables.

## V. DISCUSSION AND CONCLUSION

This study was conducted on predesigned and pretested questionnaire to determine the causes of occupational accidents and to evaluate the attitude and knowledge of biomedical waste handlers in Nairobi County. The results demonstrated that the problems of occupational accidents were largely due to management problems in enforcing standards, policies, and training programs that continuously target the employees and those responsible for their inspection and enforcement. This conclusion is drawn from the statistical results that show positive



Skewness at .477 indicating that the educational status of the waste handlers negatively impacts on their ability to comprehend and implement the various requirements necessary for classifying and handling biomedical waste. The Skewness is at .881 for inadequate attention to directions. Besides, the Skewness for poor waste classification at source (1.053), inadequate training and awareness (1.727), lack of enforcement of waste handling standards (1.090), poor enforcement of waste handling policies (1.514), and poor waste classification knowledge (1.245) are at 1.0 or greater than 1.0. The potential accident causing materials that are generated as biomedical waste consists of solids, liquids, sharps, and laboratory waste must be handled while ensuring that employees are completely and continuously protected. Poor classification at source, which has a Skewness of 1.053 and a 15.6% rating by biomedical waste handlers, is a significant source of occupational accidents. That means the minimization of accidents can be achieved through effective management and classification at source to ensure that direct contact with waste handlers, animals and other environmental elements such as rain, wind, and heat do not happen. It is appropriate to ensure that sharp elements are retained within sharp proof materials or containers, leak-proof plastic bags such as disposable or reusable pails and bins for secure transportation. It is imperative to address the inadequate training and awareness problem that has Skewness at 1.727 to enable appropriate waste segregation and management practices to be observed appropriately. It was evident that use of protective clothing with 34.4% wearing of gloves, 30.6% wear overall, 63.1% eat at the place of work, and 63.1% of accidents are reported while 36.9% are not show a poor attitude towards the use of protective gear and preventive measures. Additional emergence attention and reporting of accidents is a prerequisite to a safe working environment. In conclusion, there is need for a training program by the Waste Management Authority to address the gap in knowledge among the biomedical waste handlers in dealing with the challenges that happen in the working environment such as accident prevention techniques and effective waste management techniques to address the main causes of accidents.

## References

- Andrews, R.N., Lord, W.B., O'Toole, L. J., and Requena, L.F. (1993). Guidelines for Improving Wastewater and Solid Waste Management. WASH Technical Report No. 88. Office of Health, Bureau for Research and Development, U.S. Agency for International Development, Washington, DC, USA.
- Ahmed, N. B., Zeyad, T., Thakir, A. & Mohammed, E.(2015) Analysis of Hospital Staff Exposure Risks and Awareness about Poor Medical Waste Management- A Case study of the Tabuk Regional Healthcare System- Saudi Arabia. ADR Journals.<https://eis.hu.edu.jo/deanshipfiles/pub104316485.pdf>
- Baveja, G., Muralidhar, S. & Aggarwal, P. (2000). Hospital Waste Management – An overview, Hospital Today, 5 (9), pp 485–486.
- Central Pollution Control Board of India, (2000). Manual on Hospital Waste Management. EPA (2013). Hazard Standards for Lead in Paint, Dust and Soil (TSCA Section 403). Available online at [www.epa.gov/lead/hazard-standards-lead-paint-dust-and-soil-tsca-section-403](http://www.epa.gov/lead/hazard-standards-lead-paint-dust-and-soil-tsca-section-403)
- Dohare et al. (2013). A Study of Hospital Waste Management Status in Health Facilities of an Urban Area. International Journal of Pharma and Bio Sciences, 4, (1): 1107 - 1112
- Evelyn, A. O. (2013). Evaluation of Biomedical Waste Management: A Case Study Of The Fisher, A. A., Laing, J. E., and Strocker, J.E., (1998). Handbook for Family Planning, Operation Research Design in Sampling. Population Council, pp 40 – 45.
- Heldal K. K., Halstensen A. S., Thorn J., Eduard W., Halstensen T. S. (2003). Airway inflammation in waste handlers exposed to bio-aerosols assessed by induced sputum. European Respiratory Journal number, 21, pp 641–645.
- Hildebrandt V. H., Bongers, P. M., Kemper HC, Dul J. (2002). The influence of climatic factors non- specific back and neck- shoulder disease. Ergonomics; January, pp 456-475.
- Kanki, M., T., Tsukamoto, T. & Shibata, T. (2002). Klebsiella pneumoniae produces no histamine: Raoultella planticola and Raoultella ornithinolytica strains are histamine producers. Appl. Environ. Microbiol. 68:3462-3466.
- Kunitoshi S. (1990). Improvement of Solid Waste Management in Developing Countries, JICA.
- Kelkar R. (1998). A practical approach to hospital waste management in India - Industrial safety Chronicle, Oct–Dec, pp. 67–70.
- Lehtinen L. (2002). Occupational Health and Safety. African Newsletter on Occupational Health and Safety, Vol. 12, pp 32-34
- Mater Hospital in Nairobi County- Kenya. Masters Thesis. University of Nairobi Digital Repository <http://erepository.uonbi.ac.ke/handle/11295/75428>
- MA Hassan, & RP Misra (2011). Knowledge, Attitude, and Practices about Biomedical Waste Management among Healthcare Personnel: A Cross-sectional Study. *Indian Journal of Community Medicine*, 36, (2): 143–145.
- Morais, V.P., Daporta, M.T. Bao, A.F. and Campello, M.G. (2009). Enteric Fever-Like Syndrome Caused by

- Raoultella ornithinolytica. *J. Clin. Microbiol*, vol. 47 no. 3 868-869
- Michel et al (2009). *Safety and risk management in hospitals*. IQ Scientific Institute for Quality of Healthcare, Radboud University Nijmegen Medical Centre. Retrieved from <http://www.health.org.uk/sites/default/files/SafetyAndRiskManagementInHospitals.pdf>
- Ministry of Health Kenya, (2007), National Policy on Injection Safety and Healthcare Waste Management.
- Muthee, M. M., Onguso M. J., Kiiyukia C., Makhonge P. & Nyakundi W. O. (2014). Biosafety and Biomedical Hazards among the Support Staff of Kenyatta National Hospital, Mbagathi District Hospital and Kiambu District Hospital in Kenya. *Journal of Agriculture Science and Technology*, 16 (1).
- National Environment Management Authority (2005), State of Environment; Pollution and Waste Management
- Olima W. H. A. (2001). *Community participation in urban Development planning in Kenya*, in Guenter Kroes and Jonas Yaw Kokor (eds), Community development in Sub Saharan Africa, Spring Research Series Number 31 Dortmund, Germany
- Patan, S. & Mathur, P. (2015). Assessment of biomedical waste management in government hospital of Ajmer city. *International Journal of Research in Pharmacy and Science*, 5, (1): 6 – 11
- Pietra, L. ., Calligaris, L., Molendini, L., Quattrin, R. & Brusaferrero, S. (2005). Medical errors and clinical risk management: state of the art. *Acta Otorhinolaryngologica Italica*, 25, (9). pp. 339-346.
- Sargent, V. E., & Gallo, F. (2009). Use of personal protective equipment for respiratory protection. *ILAR Journal*, 44, (1) Pp. 52-56.
- Siddharudha, S. & Sowmyashree, H. (2015). Occupational Exposure to Infection: A study on Healthcare Waste Handlers of a Tertiary Care Hospital in South India. *Journal of The Association of Physicians of India*, 63, [http://www.japi.org/november\\_2015/03\\_oa\\_occupational\\_exposure.pdf](http://www.japi.org/november_2015/03_oa_occupational_exposure.pdf)