

**BIOSAFETY PRACTICES AND BIOMEDICAL HAZARDS AMONG THE SUPPORT STAFF
OF KENYATTA NATIONAL HOSPITAL, MBAGATHI DISTRICT HOSPITAL AND
KIAMBU DISTRICT HOSPITAL IN KENYA**

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Abstract

Biomedical hazards, also known as infectious hazards or medical hazards are defined as hazards generated during the diagnosis, testing, treatment, research or production of biological products for humans or animals. This study aimed at determining biosafety practices and biomedical hazards among the support staff from Kenyatta National Hospital, Mbagathi District Hospital and Kiambu District Hospital. A descriptive study design was employed for this study to sample the support staff working in the three hospitals. The respondents were strictly the hospital support staff in cleaning, mortuary and handling of health care waste. Probability sampling method was used to select out the 400 respondents. Structured questionnaire was used for data collection which was analyzed using SPSS. Blood and blood products, tissues, sharps and used materials by patients were identified as the major biohazards to hospital support staff. Approximately 33 (63.5%) hospital support staff from Mbagathi District hospital, 35 (67.3%) from Kiambu District hospital and 195 (66.7%) from Kenyatta hospital agreed that they handled blood, sharps and other materials used by patients in the hospitals. The Pearson Chi-Square Tests $\chi^2(8) = 15.546$; $P = 0.046$ implied that the Handling blood, sharp or any other materials used by patients in hospital had association with the hospital the respondents came from. In conclusion the study has demonstrated that hospital support staff needs to be trained on biosafety issues especially medical waste management because their practices are below standards. Hospitals used in the study are facing many challenges because this sector is almost ignored in terms of safety of support staff, segregation, collection, transport, treatment and final disposal. The study recommends that all staff and waste handlers in each hospital should agree on responsibilities towards biosafety policy in Kenya.

Key words: Biomedical hazards, biological products, biosafety, waste management.

1.0 Introduction

Biomedical hazards, also known as infectious hazards or medical hazards are defined as hazards generated during the diagnosis, testing, treatment, research or production of biological products for humans or animals (Sawalem *et al.*, 2009). Biomedical waste hazards includes syringes, live vaccines, laboratory samples, body parts, bodily fluids and waste, sharp needles, cultures and lancets. The main sources of biomedical waste are hospitals, medical clinics and laboratories (Rao *et al.*, 2004). Because biomedical waste can be detrimental to human health, the Kenya law requires such facilities to follow procedures that protect the public from coming into contact with it. Agencies in Kenya that regulate different aspects of biomedical waste include Occupational Safety and Health Administration (OSHA), Food and Drug Administration (FDA) and Nuclear Regulatory Commission. In the process of healthcare delivery, biological hazards are generated which includes sharps, human tissues or body parts and other infectious materials (Baveja *et al.*, 2000) also referred to as "Biomedical hazards" or "Hospital Solid hazards". Medical hazards are defined to include all types of hazards produced by health facilities such as general hospitals, medical centres and dispensaries. Medical hazards represent a small amount of total residues generated in a community.

Hospitals are health institutions providing patient care services. It is the duty of hospital and healthcare centres to take care of public health. This may directly be through patient care or indirectly by ensuring a clean, healthy environment for their employees and the community (Patil and Pokhrel, 2005). However, such residues can potentially transmit diseases and present an additional risk to the support staff of the healthcare facilities, patients and the community when the biological hazards are not managed properly (Silva *et al.*, 2005). Improper disposal and handling of medical hazards including open dumping and uncontrolled burning for instance increases the risk of spreading infections and of exposure to toxic emissions from incomplete combustion (Silva *et al.*, 2005). This study focused on determination of biosafety practices and identifying biomedical hazards among the support staff in Kenyatta National Hospital, Mbagathi District hospital and Kiambu District hospital in Kenya. The objectives of this study were to, identify the level of biohazards, find out the biosafety practices among the support staff from the selected hospitals and to establish the compliance of the selected hospitals regarding OSHA (2007) on biosafety and international rules and regulations or standard practices

2.0 Materials and Methods

2.1 Study Site

The study was conducted in Nairobi County and Kiambu County, in three public health facilities namely; Kenyatta National Hospital, Kiambu District Hospital and Mbagathi District Hospital. Kenyatta National Hospital had approximately 450 support staff, Kiambu District Hospital had 80 support staff and Mbagathi District Hospital had approximately 80 support staff. The hospitals chosen were convenient

due to their proximity and represented National hospitals and District hospitals. Support staffs were used due to their lack of proper training and the biomedical hazards they handle.

2.2 Study Design

A descriptive study design was employed for this study. This is because the research was a fact finding survey and this type of research design is the most recommended (Wiegmann *et al.*, 2007).

2.3 Sampling Method and Sample Size

The required sample size was obtained using a probability sampling procedures where the hospital support staffs were chosen randomly from different departments. Identification of the hospitals in which to carry out the research was identified using purposive sampling based on who was appropriate for the study and a total of 400 participants were chosen for the study.

Table 1: Distribution of sample size in the different hospitals

Department	Kenyatta National Hospital.		Kiambu District Hospital		Mbagathi District Hospital	
	No. of employees	Sample size	No. of employees	Sample size	No. of employees	Sample size
Medical	42	28	15	9	8	5
Orthopedics & Surgery	65	43	20	13	10	7
Pediatrics	30	19	10	7	6	4
Others	313	206	35	23	56	36
Total	450	296	80	52	80	52

2.4 Data Collection Tool

Required data were obtained using questionnaires and retrieved from records. Data required were divided into primary and secondary data. Closed ended questionnaires were used to collect wide array of first hand information using a five point Likert Scale to address the respondents' perception of the safety and health systems in the hospitals. The questionnaire items were put on a 5-point Likert scale ranging from 1 (strongly disagree), 2 (disagree), 3 (unsure) 4 (agree) to 5 (Strongly agree) (Gibbons *et al.*, 2006). Secondary data were collected through scrutiny of documents e.g. General Registers, Health and Safety policies, various statutory audits and other health and safety literature.

2.5 Data Analysis

Data was analyzed using ANOVA tables, regression analysis, correlation coefficients and chi square tests χ^2 .

3.0 Results

3.1 Identifying Biohazards in Hospitals

From the findings of this study it was quite evident that the major biohazards in hospitals included blood and blood products, sharps, vomituous, soiled clothing, beddings, body tissues and organs. The other biohazard includes working in an environments containing air contaminated with biohazardous agents. They are generally classified as health care waste. Approximately 33 (63.5%) hospital support staff from Mbagathi District hospital, 35 (67.3%) from Kiambu District hospital and 195 (66.7%) from Kenyatta hospital agreed that they handled blood, sharps and other materials used by patients in the hospitals. The Pearson Chi-Square Tests $\chi^2(8) = 15.546$; $p = 0.046$ implied that the Handling blood, sharp or any other materials used by patients in hospital had association with the hospital the respondents came from (Table 2).

Table 2: Biohazards profile in the selected hospitals

Question	Hospital	% Responses					Chi-square Significance value.
		SD	D	UN	A	SA	
1.	Handling blood, sharps or any other materials used by patients in hospitals						
	MDH	11.50%	5.80%	0%	63.50%	19.20%	
	KDH	5.80%	3.80%	7.70%	67.30%	15.40%	0.046
	KNH	6.00%	15.90%	5.60%	5.60%	66.70%	
2.	Being in direct contact with people, patients and equipment at least daily						
	MDH	7.70%	5.80%	0.00%	42.30%	44.20%	
	KDH	1.90%	3.80%	19.00%	5.00%	10.30%	0.002
	KNH	1.60%	9.90%	5.70%	55.70%	27.10%	
3.	Having been injured by sharp or other material while working						
	MDH	23.10%	38.50%	3.80%	26.90%	7.70%	
	KDH	5.80%	34.60%	0.00%	34.60%	25.00%	0.0001
	KNH	1.60%	10.90%	4.70%	58.30%	24.50%	
4.	Handling other biohazardous materials including blood and blood products						
	MDH	7.70%	3.80%	3.80%	55.80%	28.80%	
	KDH	1.90%	9.60%	0.00%	67.30%	21.20%	0.394
	KNH	3.60%	10.40%	4.70%	59.90%	21.40%	
5.	Wearing protective clothing while working in highly hazardous areas and cleaning						
	MDH	5.80%	13.50%	3.80%	55.80%	21.20%	
	KDH	11.50%	25.00%	3.80%	42.30%	17.30%	0.014
	KNH	2.60%	8.90%	5.70%	62.50%	20.30%	
6.	Being in contact with contaminated body substances, vectors and formites						

	MDH	11.50%	3.80%	3.80%	61.50%	19.20%		
	KDH	1.90%	9.60%	5.80%	67.30%	15.40%	0.021	
	KNH	1.60%	13.00%	4.20%	57.80%	23.40%		
7.	Handling other biohazardous materials including vomitous							
	MDH	11.50%	3.80%	3.80%	57.70%	23.10%		
	KDH	1.90%	9.60%	0.00%	59.60%	28.80%	0.003	
	KNH	1.60%	14.60%	1.60%	65.60%	16.70%		

KEY: KNH: Kenyatta National Hospital; KDH; Kiambu District Hospital; MDH: Mbagathi District Hospital; SD: Strongly Disagree; D: Disagree; UN: Uncertain; SA: Strongly agree; A: Agree

Support staff in Mbagathi District Hospital, Kiambu District hospital and Kenyatta National Hospital agreed unanimously that they wear protective clothing while working in highly hazardous areas and while cleaning (Figure 1).

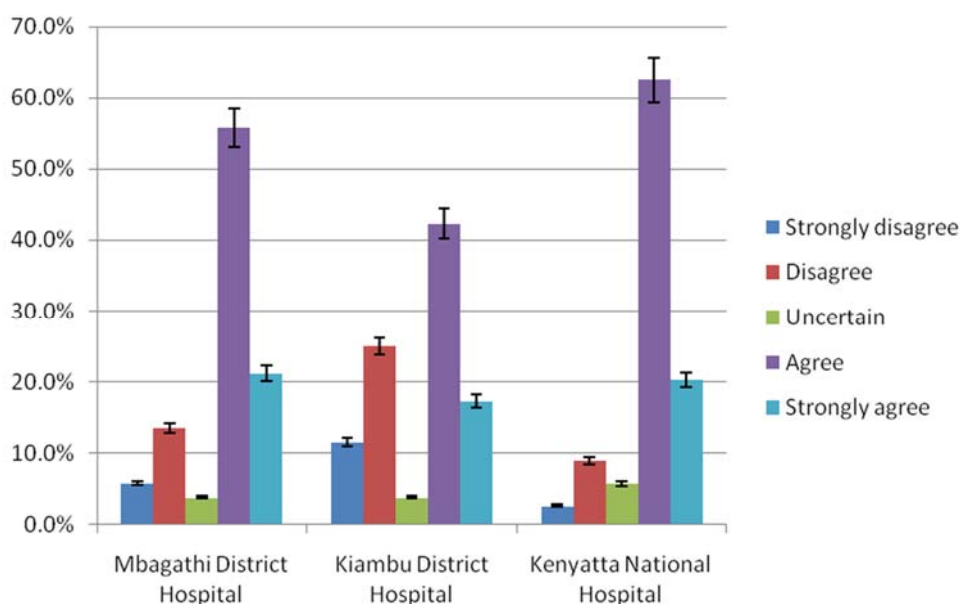


Figure 1: Response of hospital staff on wearing protective clothing while working in highly hazardous areas and while cleaning

The Chi-Square Tests $\chi^2(8) = 15.546$; $P = 0.046$ implied that the Handling blood, sharp or any other materials used by patients in hospital had association with the hospital the respondents came from therefore the association is significant (Figure1). It is significant because the p calculated is less than 0.05 which is the level of significance according to the study.

The ANOVA table on the seven variables under Identification of Biohazards in hospitals regression model had $F_7 = 16.697$; $p=0.000$ indicating that the seven variables influence on the model was very significant (Table 3).

Table 3: The ANOVA table for identification of biohazards in hospitals

Model		Sum of Squares	Df	Mean Square	F	Sig.
1.	Regression	51.323	7	7.332	16.697	0.000
	Residual	126.461	288	0.439		
	Total	177.784	295			

Estimates coefficient tablet-test indicates that the null model was significant as the constant/intercept with $t=10.852$, $p < 0.0001$. The significant variables in the seven variables included in the model were two, that is having been injured by sharp or other materials while working with $t=9.624$, $p < 0.0001$ and handling other biohazardous materials including blood and blood products also with $t = -3.864$, $p < 0.0001$. In terms of the significance the variable with p values of > 0.05 were not significant meaning that the variable had a negative association among the three hospitals and vice versa. This informs the researcher that the two variables in the seven were the main predictor variables that influenced the model (Table 4).

Table 4: Identification of biohazards in the selected hospitals

Model		USTC		STC	t	Sig. (p)
		B	Std. Error	Beta		
1	(Constant)	2.127	.196		10.852	.000
	Handling blood, sharp or any other materials used by my patients in hospital	.005	.059	.006	.086	.931
	Indirect contact with people, patients and equipments at least daily	-.057	.064	-.069	-.887	.376
	Having been injured by sharp or other materials while working	.379	.039	.587	9.624	.000
	Wearing protective clothing while	.058	.043	.080	1.353	.177

working in highly hazardous areas and while cleaning					
Coming into contact with contaminated body substances, vectors and formites	.115	.081	.146	1.421	.157
Handling other biohazardous materials including vomitous	-.086	.076	.110	-1.140	.255
Handling other biohazardous materials including blood and blood products	-.294	.076	-.376	-3.864	.000
a. Dependent Variable: Hospital					

Key: USTC: Unstandardized Coefficients; STC: Standardized Coefficients

Figure 2 confirms that the variables included in the model imitate a normal distribution.

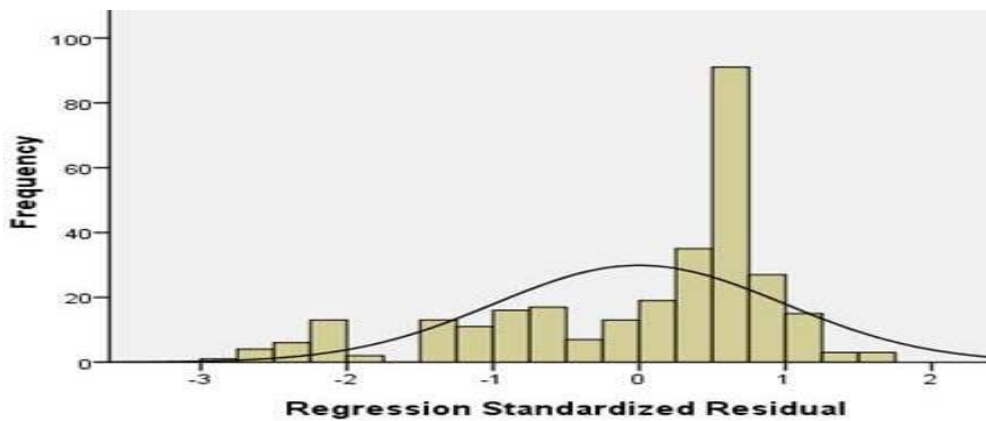


Figure 2: Normal distribution of identifying biohazards in hospitals variables

3.2 Biosafety Practices/Procedures among the Hospital Support Staff in Hospitals

In the hospitals sampled the biosafety practices/procedures favored KNH with 249 (85.4%) of the respondents agreeing that the incidents in the health facility are evaluated and recommendations made. On the other hand the respondents at Kiambu District Hospital (57.7%) and Mbagathi District Hospital 21 (40.4%) disagreed with this variable and suggested that most of the incidents that occur are not evaluated and thus leaving hospital support staff prone to infections resulting from hospital injuries. The Pearson Chi-Square Tests with $\chi^2 (8) = 157.3$; $P < 0.0001$ implied that this variable had an association with the hospital the respondents/interviewee work. The variables have significant association among the hospitals except 'Never involved in the ongoing review of biosafety in my department' which has a p value of 0.057 which is more than 0.05 hence not significant. The various biosafety practices/procedures are shown in Table 5.

Table 5: The biosafety practices/procedures in the selected hospitals

Question	Hospital	Responses					Chi
		SD	D	UN	A	SA	Significance value.
1. All incidents are evaluated and recommendations made	MDH	9.60%	30.80%	40.40%	17.30%	1.90%	0.0001
	KDH	25.00%	32.70%	30.80%	11.50%	0.00%	
	KNH	0.00%	7.80%	6.80%	66.10%	19.30%	
2. Recommendations related to incident analysis are made known to all staff	MDH	21.20%	26.90%	36.50%	15.40%	0.00%	0.0001
	KDH	11.50%	36.50%	46.20%	3.80%	1.90%	
	KNH	1.00%	10.40%	9.40%	59.40%	19.80%	
3. Sometimes not given enough time to get the job done	MDH	3.80%	15.40%	36.50%	38.50%	5.80%	0.0001
	KDH	0.00%	9.60%	38.50%	34.60%	17.30%	
	KNH	8.30%	26.60%	13.00%	41.70%	10.40%	
4. Cannot always get the type of equipment needed to do a job safely	MDH	7.70%	19.20%	3.80%	59.60%	9.60%	0.001
	KDH	0.00%	15.40%	0.00%	69.20%	15.40%	
	KNH	8.30%	29.20%	1.60%	37.50%	23.40%	
5. Never involved in the ongoing review of biosafety in my department	MDH	3.80%	15.40%	3.80%	53.80%	23.10%	0.057
	KDH	1.90%	17.30%	9.60%	67.30%	3.80%	
	KNH	7.80%	20.30%	3.60%	55.20%	13.00%	

KEY: KNH: Kenyatta National Hospital; KDH; Kiambu District Hospital; MDH: Mbagathi District Hospital; SD: Strongly Disagree; D: Disagree; UN: Uncertain; SA: Strongly agree; A: Agree

The R-Square which indicates how well the predictor variable fit the model indicate that approximately 40% of the variation in the model can be explained by the predictor variable which is a relatively good model fit. The standard error of the estimate which is also the measure of precision indicates that the model is precise as the precision value is small (Table 6).

Table 6: The model summary of biosafety practices/procedures

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.627 ^a	.394	.383	.610

Predictors: (Constant), Never involved in ongoing review of biosafety in my department, Accidents evaluated and recommendations made, Sometimes not given enough time to get job done safely, Recommendations related to incident analysis made known to staff, Cannot always get right equipment needed to do the job safely.

The ANOVA table on the five variables under biosafety practices/procedures in hospitals regression model had $F_5 = 37.665$; $P=0.001$ indicating that the five variables influence on the model was very significant. Estimates coefficient tablet-test indicates that the null model was significant as the constant/intercept with $t = 6.740$, $p < 0.0001$ indicates. The significant variables in the five variables included in the model were three that is Accidents evaluated and recommendations made $t=5.057$, $p<0.0001$, Recommendations related to incident analysis made known to staff $t= 5.824$, $p < 0.0001$ and Sometimes not given enough time to get job done safely $t=-2.604$, $p < 0.001$. This informs the researcher that the three variables in the five were the main predictor variables that influenced the model (Table 7).

Table 7: Estimates coefficient for biosafety practices/procedures in hospitals

Model		Unstandardized Coefficients		Standardize d Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.189	.176		6.740	.000
	Accidents evaluated and recommendations made	.226	.045	.318	5.057	.000
	Recommendations related to incident analysis made	.260	.045	.374	5.824	.000

	known to staff					
	Sometimes not given enough time to get job done safely	-.113	.043	-.161	-2.604	.010
	Cannot always get right equipment needed to do a job safely	.028	.043	.044	.643	.520
	Never involved in ongoing review of biosafety in my department	-.028	.040	-.041	-.704	.482
a. Dependent Variable: Hospital						

Figure 3 confirms that the variable included in the model imitates a normal distribution.

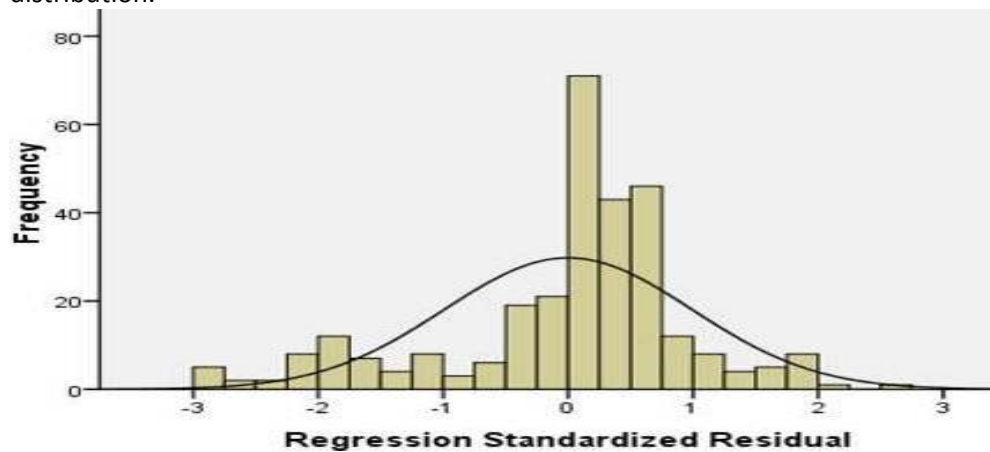


Figure 3: Normal distribution of biosafety practices/procedures variables Waste segregation and colour codes

From the findings of this study it was noted that all the hospitals had their medical wastes segregated in different colored containers as shown in Plate 4.1. The photo presented in this plate was taken at MDH medical ward showing how the waste is segregated.



Plate 1: Color coded medical waste containers including sharp box. Source MDH medical ward.

Next to the section where the above photo was taken was a clear guideline on the notice board on how all hospital waste should be segregated as shown on plate 2.



Plate 2: Segregation of medical waste notice. Source MDH medical ward notice board.

The black container is a signage for non infectious waste for example papers, packaging materials and food. A yellow container is a signage for infectious waste for example gauze, dressings, and blood and intra venous fluid lines. A red container is a signage for highly infectious waste for example teeth, placenta, sputum and test tubes. The yellow box is a signage for sharps waste for example infusion sets, broken slides scalpels and needles. After waste has been transported to the disposal point the medical waste means of transport say van or wheelbarrow is cleaned by a hospital support staff. This exposes the hospital support staff to infections if not well dressed with the proper personal protective equipments.

The compliance of hospitals with OSHA (2007) as regards biosafety and internal rules

From the findings of this study it is evident that Kenyatta National Hospital was more compliant compared to Mbagathi District hospital and Kiambu District hospital. The results are summarized in Table 8.

Table 8: Compliance of hospitals with OSHA 2007

Compliance of hospitals with OSHA 2007	KNH		KDH		MDH	
	YES	NO	YES	NO	YES	NO
Is the hospital registered under OSHA 2007	X			X		X
Has the hospital carried out a safety health audit	X			X		X
Does the hospital have a safety and health policy	X			X		X
Has the hospital developed a biosafety waste management policy	X		X		X	
Is there a health care waste management guideline	X		X		X	
Is there a biosafety waste management committee in your hospital	X		X		X	
Are housekeeping supervisors included in the committee	X		X		X	
Does this hospital organize training on health care waste management for its workforce	X		X		X	
Do you have quality assurance guideline for whether the workforce is competent enough for health care waste treatment and disposal	X		X		X	
Is there a waste treatment plant in the hospital	X			X		X
Do you have a procedure for formally recording and reporting accidents, diseases and dangerous occurrences to DOSHS	X		X		X	
If yes in question 11, is reporting of biohazard exposures part of what is reported	N/A		N/A		N/A	
Has a risk assessment been carried out	X			X		X
Does the committee conduct quarterly meetings	X			X		X
Have medical examination (pre – employment, periodic, termination of employment) been carried out to those support staff with risk of exposure to biological hazard	X			X		X

4.0 Discussion

4.1 Biohazards Profile in the Selected Hospitals

In the Kenyan hospitals different kinds of therapeutic procedures such as cobalt therapy, chemotherapy, dialysis, surgery, delivery, resection of gangrenous organs, autopsy, biopsy, para-clinical exams and injections among others are carried out and result in the production of infectious wastes, contaminated sharps with patients, blood and secretions, radioactive wastes and chemical materials which are considered to be hazardous wastes as described by Prilss *et al.*, (1999). This statement by Prilss *et al.* (1999) concurs with the findings from this study. The amount of waste generated in the hospitals depends upon various factors such as number of beds, types of health services provided, economic, social and cultural status of the patients and the general condition of the area where the hospital is situated. For example, in hospitals located in low socio-economic areas of the cities, most of the waste consists of residues from fruits which are voluminous and abundant whereas in those located in high socio-economic areas of the city; most of wastes contain flowers, cans and single use containers for food according to a study done by Askarian *et al.*, (2004) on waste generated in different hospitals. However, during the interview with waste management staff in the hospital in this study, they could not tell the amount of waste generated in the hospital daily. They could not also provide information with respect to which departments that generated the highest and lowest amounts of medical waste in the hospitals studied. The majority of the respondents in the three hospitals, that is, agreed to be in direct contact with people, patients and equipment at least daily. The Pearson Chi-Square Tests $\chi^2 (7) = 24.084$; $P < 0.002$ implied that direct contact with people, patients and equipments at least daily in hospital had a strong relation with the hospital the respondents came from. The findings of this study concur with a study on medical waste in hospitals by Patil and Pokhrel (2005) who stated that hospitals are health institutions providing patient care services. It is the duty of hospitals and health care establishments to look after the public health. This may directly be through patient care or indirectly by ensuring a clean, healthy environment for their employees and the community at large (Patil and Pokhrel, 2005).

4.2 Biosafety Practices/Procedures among the Hospital Support Staff in Hospitals

Majority of support staff have been exposed to needle injuries in the past especially in KNH (84.4%), MDH (32.7%), KDH (46.2). The management has neglected the support staff at the selected District hospitals with 75% of respondents in Mbagathi District hospital and 67.3% in Kiambu District hospital disagreeing that the management takes care of their health. The practice of proper segregation of sharps materials in rigid puncture proof containers was the commonest practice in the three hospitals assessed in this study. It is noteworthy that only 10% or less portion of the waste stream that is potentially infectious is the most immediate threat to

human health (patients, workers, public) if indiscriminate disposal of sharps (needles, syringes, lancets, and other invasive tools) is allowed.

However, beside the effort that has been shown by the Kenyan government in the provision of sharps boxes for use in most public and faith based facilities (95%), it is apparent that if proper sharps waste management were instituted in all health care facilities, most of the risk of disease transmission from health care waste would be reduced markedly as observed by Felicia *et al.*, (2008) in their study on occupational safety in health facilities.

The Pearson Chi-Square Tests $\chi^2 (7) = 72.47$; $P < 0.0001$ implied that employees having been injured by sharp or other materials while working in hospital had a very strong dependency with the hospital the respondents came from. This is in contrast with Kenyatta National Hospital which had 58.3% of respondents agreeing to have been injured by sharps and other materials while working.

4.3 Hospitals Compliance with OSHA regarding Biosafety

All workplaces are required to comply with OSHA 2007 and other standard practices in regards to biosafety. From the findings of this study it is evident that Kenyatta national hospital (93.3%) was more compliant compared to Mbagathi District hospital (46.6%) and Kiambu District hospital (46.6%). This may be attributed to KNH having a higher allocation of resources in terms of finances and opportunities for training. The main non compliance in all the three hospitals was that none had a procedure of formally recording and reporting accidents, diseases and dangerous occurrences to DOSHS. This has a very huge impact in terms of contributing to the non existence of a national database of the prevalence of biological exposures in our health facilities.

5.0 Conclusion

The study has demonstrated that in general, hospital support staff needs to be trained on biosafety issues especially on medical waste management. The study concludes that the major sources of biohazards in hospitals include; blood and blood products, sharps, vomitous, soiled clothing, beddings, body tissues, organs and also working in environments with air contaminated with bioharzadous agents. Only Kenyatta National hospital had a biosafety policy on waste management in their health facility compared to the District hospitals respectively (Mbagathi District hospital and Kiambu District hospital). The study concludes that the biosafety practices/procedures among the hospital support staff in Kenyatta National hospital were high compared to the other hospitals. The study also concludes that Kenyatta National hospital is highly compliant with OSHA 2007 as regards biosafety and internal rules and regulations as compared to the two District hospitals who had not complied with most of the provisions of OSHA 2007.

6.0 Recommendation

All staff and waste handlers in each hospital Concerned ministries should agree on a clear specification of responsibilities towards biosafety measures in Kenya. There is need for sustained cooperation among all key actors in implementing a safe and reliable biosafety strategies, not only in legislation and policy formation but also particularly in its monitoring and enforcement. There should be an obligation for HCF to ensure a safe and hygienic system of medical waste handling

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