



Factors influencing Healthcare Waste Management System in Machakos County, Kenya

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ABSTRACT

Introduction: Machakos County health facilities have poor healthcare waste segregation, treatment and disposal practices; patients, health workers including waste handlers and the general population are exposed to risks of needle stick injuries and infection of HIV/AIDS and Hepatitis B&C. All population is exposed to risks associated with furans, dioxins and heavy metals released to the environment through open and crude burning of healthcare waste. World Health Organization recommends supporting and strengthening a health system based on six health system building blocks that includes quality service delivery. The study focused on strengthening the service delivery pillar of health systems in which good health services are expressed as both personal and non-personal quality care, through addressing aspects of safe healthcare waste management (HCWM) herein viewed as non-personal services that directly or indirectly affect patient, health workers and the general population health. The purpose of this study was to determine factors affecting HCWM system in Machakos County. Specific objectives were to determine the healthcare waste management process, health Managers role, human resource factors, and how healthcare waste management policy implementation affect HCWM system in health facilities in Machakos County. **Methods:** We used survey research design. A sample size of 120 respondents was drawn using both stratified random and purposive sampling techniques. Data was collected using questionnaires and an interview guide. **Results:** The findings showed that the role of health managers ($\beta_2 = .436, P < .001$), human resource factors ($\beta_3 = .065, P < .002$), and healthcare waste management policy implementation ($\beta_4 = .275, P < .001$) influenced management of healthcare waste system. **Conclusions:** Health managers' role had the strongest positive and significant influence on HCWM. **Recommendations:** i) adoption of safe technologies for treatment and disposal of healthcare waste, ii) refresher trainings on HCWM to all healthcare staff on existing HCWM policies in Kenya, iii) provision of adequate budget to procure enough HCWM commodities, iv) provision of adequate personal protective equipment to all health staff, and v) vaccination of health staff against Hepatitis B.

Key words: *Healthcare Waste Management Policy Implementation, Health Managers Role, Human Resource Factors, Machakos County, Kenya.*

Introduction

Good health services are those which deliver effective, safe, quality personal and non-personal health interventions to those who need them, when and where needed, with minimum waste of resources (WHO, 2006). Patients, health workers and the general population do not therefore need to suffer from risks associated with provider services including handling of healthcare waste generated during medical procedures carried in our health facilities. These effective non-personal health interventions, according to the researcher, includes safe management of healthcare waste to manage health risks associated with handling, treatment and disposal and are the basis for this research. In many countries knowledge about the potential for harm from healthcare waste has now become more prominent to governments, medical practitioners and civil society. Increasingly, managers and medical staff are expected to take more responsibility for the wastes they produce from their medical care and related activities (WHO, 2014).

However, a lot of discussion on the management of healthcare waste has always been about the technologies of its treatment forgetting that this forms only one part of the entire healthcare waste management system. Other aspects including planning, monitoring, budgeting and training are also important (Health Care Without Harm, 2016). Healthcare facilities should have a waste management policy and a waste management plan. It is the responsibility of health information management and public health professionals to plan health information systems, develop health policies, and identify current and future information needs (Stacey, 2012).

Studies in Africa indicate the continent is not positioned to tackle the quantity of hazardous waste it produces. Much of the waste is dumped without treatment in open dumps and poorly functioning incinerators. While increasing awareness has driven many individual country reports on general solid waste streams in Africa, the overall picture of healthcare waste management is still unclear in Kenya (Udofia, Fobil, & Gulis, 2015).

The guiding principles reflected in the Kenya injection safety and health care waste management policy are not well aligned to global recommendations. Both the World Health Organization (WHO) and Kenya have strategies on healthcare waste management emphasize strengthening the logistics system, advocacy and behavior change. However, Kenya's policy prioritizes capacity building and developing information systems including the monitoring and evaluation (M&E) system while WHO strategies stress waste minimization, recycling, innovating non-incineration technology and conducting research into risk factors for exposures and their outcomes as the better priority strategies for achieving safe injections and appropriate waste treatment and disposal (Okwesio, 2016).

In Kenya, due to poor segregation practices, it is common to find that up to 50% of waste in some facilities is infectious. Waste management in Kenya experiences monumental challenges. Systems required to safely manage medical waste from cradle-to-grave are still being formulated and marketed. Indiscriminate disposal of medical waste poses grave dangers to the service providers, the patients, and the community at large (GoK, 2015). In recent times, there have been press statements of medical waste being disposed of in an incorrect manner. This situation has adversely affected the poor disadvantaged members of society (Daily Nation, 2015).

Machakos County, like other counties in Kenya, experiences the problem of healthcare waste management. Machakos County has poor medical waste segregation, treatment and disposal practices, thus, exposing patients, health workers and the general public to risks associated with such poor practices, such as exposure to HIV/AIDS, Hepatitis B & C. Poor management of solid waste is a general problem because there are no controlled landfills in Machakos County and hence there is complete reliance on open uncontrolled burning (Ikiara, Karanja, and Davis, 2004). There are currently over 110 health facilities spread across the county and the doctor/population ratio is about 1:62,325. Hence, the amount of healthcare waste produced by the healthcare facilities is very huge posing a great challenge of its management in Machakos County (Machakos County Government, 2013).

Open uncontrolled burning of medical waste in Machakos County health facilities has exposed patients, health workers and local residents living around these facilities to air, land and water pollution through release of dioxins, furans and heavy metals that are carcinogenic to humans and lethal to ecosystems life (NEMA, 2016). Therefore, this study sought to determine the factors affecting healthcare waste management system among healthcare facilities in Machakos County. The study was guided by the following specific objectives to determine healthcare waste management process, health managers role, human resource factors, and how healthcare waste management policy implementation influences healthcare waste management system in health facilities in Machakos County.

Methods

The study adopted a survey research design with a total of 120 respondents who were selected purposively from four selected health facilities in Machakos County. Primary data was collected using a questionnaires and secondary data was obtained through review of existing literature related to healthcare waste management. A five point likert scale was used where 5 = strongly agreed, 4 = agreed, 3 = neutral, 2 = disagreed and 1 = strongly disagreed. The respondents were requested to state their agreement level with the statements presented for each study variable with regard to healthcare waste management in their health facilities. Quantitative data was analyzed using SPSS version 25. Descriptive statistics are presented in frequencies, percentages, mean and standard deviation and inferential statistics were to determine the association between the independent and dependent variables.

Results

General Characteristics of Respondents

General characteristics of respondents included sex, age, education level, occupation, length of service in current health facility and distribution of the respondents in the healthcare facilities in Machakos County (**Table 1**). The study showed that most of the respondents 74(61.6%) were from Machakos Level 5 Hospital. This could be attributed to the fact that it is the biggest healthcare facility in Machakos County therefore having a larger number of healthcare staff than the other, three selected facilities in the County. Majority of the respondents were male 69(58%) and nearly half 58(48%) were aged between 31-45 years. Most of the respondents 79(65.8%), nearly all respondents 113(94%) did not hold any administrative position in the health facility, and half 59(49.2%) had worked in the current health facility for 6-15 years. Therefore, the respondents in this study had clear information of healthcare waste management

systems adopted by their healthcare facilities and thus provided accurate insight on the status and condition of their healthcare waste management at their facilities.

Table 1: General Characteristics of Respondents

General Characteristics of Respondents	Frequency	Percentage
Sex		
Male	69	58
Female	51	42
Age		
Below 30 Years	45	38
31-45 Years	58	48
46-55 Years	13	11
Above 56 Years	4	3
Education Level		
Certificate	21	17.5
Diploma	79	65.8
Bachelor's Degree	20	16.7
Respondents Occupation		
Health staff	113	94.2
Health facility administrator	2	1.6
Waste handler	5	4.2
Length of Service in years		
<5	54	45.0
6-15	59	49.2
>16	7	5.8
Respondents distribution by healthcare facilities		
Level 2 (Ndalani Dispensary)	5	4.2
Level 3 (Kithimani Health Center)	13	10.3
Level 4 (Matuu Hospital)	28	23.3
Level 5 (Machakos Level 5 Hospital)	74	61.6

Healthcare Waste Management Process

The researchers sought to establish the process of healthcare waste management among healthcare facilities in Machakos County (**Table 2**). A five point likert scale was used where 5 = strongly agreed, 4 = agreed, 3 = neutral, 2 = disagreed and 1 = strongly disagreed. The respondents were requested to state their agreement with the statements with regard to healthcare waste management process in their health facilities. The mean score indicates the level of agreement by respondents among the aspects of healthcare waste management process.

Table 2: Healthcare Waste Management Process

Statement	SA	A	N	D	SD	Mean	Std. Dev
	%	%	%	%	%		
There are separate containers (Bins) for different types of wastes.	33.3	59.2	4.2	3.3	0.0	4.23	0.422
Healthcare waste is segregated before treatment & disposal.	15.8	69.2	5.8	5.0	4.2	3.88	0.621
Healthcare waste is treated before it is finally disposed of.	10.8	55.0	14.2	11.7	8.3	3.48	0.903
The path for handling waste from segregation to final disposal is clearly indicated in the facility.	9.2	65.8	11.7	13.3	0.0	3.71	0.806

Key: SA=Strongly Agreed, A=Agreed, N=Neutral, D=Disagreed, and SD=Strongly Disagreed

As illustrated in Table 2, it was found that, (59.2%) of the respondents indicated to have separate containers (Bins) for different types of wastes. Similarly, (69.2%) of the respondents indicated that healthcare waste was segregated before treatment and disposal. It was found that (55.0%) of the respondents indicated that healthcare waste was treated before it was finally disposed of. It was further established that (65.8%) of the respondents indicated that path for handling waste from segregation to final disposal was clearly indicated in their healthcare facility.

The Role of Health Managers

The second objective was to establish the role of health managers on healthcare waste management system in healthcare facilities in Machakos County (**Table 3**). The mean score indicates the level of agreement by respondents. The results revealed that (65.8%) of the respondents indicated to have a department responsible for healthcare waste management planning, (56.7%) of the respondents indicated to have budget for healthcare waste management. It was found that (64.2%) of the respondents indicated to have adequate healthcare waste segregation bins, (66.7%) of the respondents indicated to have adequately provided with HCWM segregation bin liners. It was also found that (58.3%) of the respondents indicated to have HCWM policies and procedures adopted by their healthcare facility. The finding revealed that HCWM policies and procedures adopted had the highest mean score among the other factors to influence healthcare waste management system among the four selected healthcare facilities in Machakos County.

Table 3: The role of health managers

Statements	SA %	A %	N %	D %	SD %	Mean	Std. Dev
There is a department within the institution responsible for HCWM planning.	17.5	65.8	7.5	8.3	0.8	3.91	0.810
There is budget for healthcare waste management.	8.3	56.7	15.0	15.8	4.2	3.49	0.996
The healthcare waste segregation bins are adequate.	2.5	64.2	20.0	10.8	2.5	3.53	0.819
HCWM segregation bin liners are adequately provided.	4.2	66.7	15.8	10.8	2.5	3.59	0.835
There is HCWM policies and procedures adopted.	0.8	58.3	29.2	10.0	1.7	3.47	0.755

Key: SA=Strongly Agreed, A=Agreed, N=Neutral, D=Disagreed, and SD=Strongly Disagreed

Human Resource Factors

The study sought to establish how human resource factors influence healthcare waste management among healthcare facilities in Machakos County (**Table 4**). The mean score indicates the level of agreement by respondents among the aspects of human resource factors.

Table 4: Human Resource Factors

Statement	SA %	A %	N %	D %	SD %	Mean	Std. Dev
There is a department within the institution responsible for HCWM planning.	17.5	65.8	7.5	8.3	0.8	3.91	0.810
There is budget for healthcare waste management.	8.3	56.7	15.0	15.8	4.2	3.49	0.996
The healthcare waste segregation bins are adequate.	2.5	64.2	20.0	10.8	2.5	3.53	0.819
HCWM segregation bin liners are adequately provided.	4.2	66.7	15.8	10.8	2.5	3.59	0.835
There is HCWM policies and procedures adopted.	0.8	58.3	29.2	10.0	1.7	3.47	0.755

Key: SA=Strongly Agreed, A=Agreed, N=Neutral, D=Disagreed, and SD=Strongly Disagreed

The findings established that most (63.3%) of the respondents indicated there was high level of healthcare waste management knowledge by the staff and more than a third (77.5%) of the respondents indicated that health workers show concern to HCWM practices adopted. It was

found that most (66.7%) of the respondents indicated that there was provision of training to health workers on HCWM regularly. It was also found that more than half (59.2%) of the respondents indicated that all their health workers are aware of the vaccination for protection against risks of HCWM and majority (65.8%) of the respondents indicated that all their health workers are aware of the management of needle-stick injuries/pricks in their healthcare facility. The finding revealed that health workers concern to HCWM had the highest mean score among the other factors to influence healthcare waste management system among the four selected healthcare facilities in Machakos County.

Healthcare Waste Management Policy Implementation

The researcher sought to establish the influence of healthcare waste management policy implementation on healthcare waste management system in Machakos County (**Table 5**). The mean score indicates the level of agreement by respondents among the aspects of healthcare waste management policy implementation.

Table 5: Healthcare Waste Management Policy Implementation

Statement	SA %	A %	N %	D %	SD %	Mean	Std. Dev
The healthcare facility has written policies dealing with healthcare waste management.	9.2	56.7	15.8	15.0	3.3	3.53	0.970
The policies, plans, manuals, and/or written procedures are consistent with national laws, regulations, and any permits.	6.7	56.7	22.5	12.5	1.7	3.54	0.859
The healthcare facility policy explicitly mention a commitment to protect the environment.	4.2	61.7	20.8	11.7	1.7	3.55	0.818
The healthcare waste management policies and/or plans are reviewed or updated at least once a year.	0.0	58.3	21.7	15.8	4.2	3.34	0.893
There are policies and plans related to healthcare waste management included in occupational health and safety.	4.2	61.7	16.7	16.7	0.8	3.52	0.850

Key: SA=Strongly Agreed, A=Agreed, N=Neutral, D=Disagreed, and SD=Strongly Disagreed

The findings revealed that, just over half (56.7%) of the respondents indicated to have written policies dealing with healthcare waste management, and that policies, plans, manuals, and/or written procedures are consistent with national laws, regulations, and any permits in their healthcare facility. Most of the respondents (61.7%) indicated that their healthcare facility policy explicitly mentions a commitment to protect the environment and over half (58.3%) indicated that healthcare waste management policies and/or plans are reviewed or updated at least once a year at their healthcare facility. The study established over half of the respondents

(61.7%) indicated that there are policies and plans related to healthcare waste management included in occupational health and safety policy in their healthcare facility.

Bivariate Linear Correlation

Study result on bivariate linear correlation are shown in **Table 6**.

Table 6: Bivariate Linear Correlation Analysis (N=120)

	Healthcare Waste Management System	
HCWM Process	Pearson Correlation	.149
	Sig. (2-tailed)	.103
Health Managers Role	Pearson Correlation	.564**
	Sig. (2-tailed)	.000
Human Resource Factors	Pearson Correlation	.307**
	Sig. (2-tailed)	.001
HCWM Policy	Pearson Correlation	.500**
	Sig. (2-tailed)	.000

** . Correlation is significant at the 0.01 level (2-tailed).

* . Correlation is significant at the 0.05 level (2-tailed).

The study established that there was a positive and significant influence of the health managers' role on the healthcare waste management system ($r = .564^{**}$, $P < .001$). The bivariate linear correlations analysis also revealed that there is a positive and significant influence of human resource factors ($r = .307^{**}$, $P < .001$) and healthcare waste management policy implementation ($r = .500^{**}$, $P < .001$) on the healthcare waste management system in Machakos County. However the healthcare waste management process had no influence on healthcare waste management system.

Multiple Regression Analysis

A multiple regression analysis was done on the four factors (healthcare waste management process, health managers' role, human resource factors, and healthcare waste management policy) to test their combined influence on healthcare waste management system in Machakos County. The regression output containing all the four variables in this study was found to be valid ($F = 17.496$, $P < .001$) meaning the four factors in this study are good predictors explaining the variations of healthcare waste management systems.

The results of regression analysis indicate significant influences of the factors that influence the management of healthcare waste system in Machakos County. The coefficient of determination (R-squared) of 0.746, shows that 74.6% of the total variations in management of healthcare waste can be explained by three independent variables (health managers' role, human resource factors, and healthcare waste management policy). The remaining percentage (25.4%) can be explained by the factors excluded in the multiple regression models under investigation in this study. The standard error of estimate (0.163) shows the average deviation of the independent variables from the line of best fit.

The findings in **Table 7** revealed a mean square of 450.010. The F-test result was 17.496 with a significance of 0.000. This meant that the probability of these results occurring by chance was less than 0.01 ($P = <0.001$). Therefore, a significant relationship was present between all the independent variables and dependent variable. T-test was also used to find out the probability of the relationship between each of the individual independent variables and the dependent variable occurring by chance.

Table 7: Healthcare Waste Management System^a: Regression Coefficients

Model	Unstandardized Coefficients		Standardized Coefficients Beta	t	Sig.
	B	Std. Error			
(Constant)	11.401	4.841		2.355	.211
Healthcare Waste Management Process	.293	.213	.103	1.372	.000
Health Managers' Role	.986	.234	.436	4.207	.000
Human Resource Factors	.155	.219	.065	.706	.002
Healthcare Waste Management Policy Implementation	.480	.156	.275	3.086	.000

^aDependent Variable: Healthcare Waste Management System

The multiple regressions results in indicate that the role of health managers (X_2 : $\beta_2 = .436$, $P < .001$), human resource factors (X_3 : $\beta_3 = .065$, $P < .002$), and healthcare waste management policy implementation (X_4 : $\beta_4 = .275$, $P < .001$) influenced management of healthcare waste system under investigation in this study. The value of the constant ($\beta_0 = 2.355$, $P < .211$) indicate that management of healthcare waste may not exist without the four factors under investigation in this study. The coefficient of X_2 , X_3 , X_4 , indicates that an improvement of any of these factors leads to an improvement of management of healthcare waste system by index by .436, .065, and .275 respectively. From the findings health managers' role had highest positive and significance influence on Healthcare Waste Management System.

Discussion

Majority of the respondents were male 69(58%) and this could be attributed to the fact that the healthcare facilities considered gender disparity or the respondents were somewhat equally distributed giving better results in gender distribution for the study. The finding disagree with Ørnamark and Oluoch (2010) who found that the health care administrations in Kenya are all characterized by significant gender inequality among healthcare workers. Most of the respondents (48%) felt in age bracket of 31-45 Years. The findings concurrent with Das and Biswas (2016) who found in their study that the mean of age of the total subjects (healthcare workers) was 31.80 years with standard deviation of 10.34. However, majority of the respondents (65.8%) had attained diploma education. The finding is in agreement with Nazli et al. (2014) who found in their study that based on the level of education, most of the respondents (healthcare workers) were Diploma holder in Hospital Batu Pahat and further concluded in their findings that hospitals should institute regular training and education to doctors, nurses, laborers and also waste handlers of the concession companies. It was also

found that most of the respondents were health staff (94.2%). Furthermore, most of the respondents (75.0%) had worked at their healthcare facilities for a period between 5-15 Years. The findings on experience are in support of this finding, Omari (2015) notes that employees with more experience have exposure in respective industry; moreover, this period is relatively satisfactory to provide reliable data.

The study results show that separate containers (Bins) for different types of wastes had the highest mean score among the other factors to influence healthcare waste management system among the four selected healthcare facilities in Machakos County. The findings concur with Jang et al. (2006) who proposed that segregation of medical waste must be done at the point of generation and disposed according to the relevant classifications. The findings on how the human resource factors influence healthcare waste management are in agreement with a study by Soyam et al. (2017) who found out in their study that all health care workers have good attitude towards bio-medical waste management. Nursing staff were best among all health care workers in Delhi.

With regard to healthcare waste management policy implementation the study revealed that healthcare facility policy mentioning commitment to protect the environment had the highest mean score among the other factor that influence healthcare waste management system among the four selected healthcare facilities in Machakos County. The findings are in line with the Waste Management Regulations 2006, under the EMCA 1999, which imposes duty of care on the occupier of premises where health care waste is handled to take measures to ensure that such waste is handled without adverse effects on human health and to the environment and natural resources (GoK, 2006).

The study findings revealed the health facilities waste segregation practices were inappropriate due to inadequate enough commodities. The healthcare facilities (HCFs) had obsolete technologies on treatment of HCW using open burning, burning chamber, and incineration. Deep pit burying and open burning were common disposal methods used by the HCFs. Health workers lacked adequate HCWM training. The findings revealed that policies and responsible person for HCWM was available in most HCFs. However, budgeting for HCWM was not available in most of the selected healthcare facilities in Machakos County.

The results show that most health workers had knowledge and awareness on HCWM but only a few were aware of at least 3 of the 4 principles of HCWM. It was found that not all health workers use personal protective equipment (PPEs) and seek vaccination. Further, Posters, Charts and Impromptu supervisions for awareness creation of HCWM was used in the healthcare facilities in Machakos County. The findings revealed that few HCFs regularly reviewed and customized policies and plans on healthcare waste with occupational health and safety. However, most healthcare workers were not aware of the customized policies and guidelines with some having said that the policies were too shallow.

The T-test results for the coefficient of multiple determinations for the four independent variables were 1.372, 4.207, 0.706, and 3.086. Therefore, the probability of these results occurring by chance was less than 0.01 for the four independent variables. This means that the multiple regression coefficient for the four independent variables were statistically significant

at ($p < 0.01$) level. The coefficients or beta weights for each variable allows the researcher to compare the relative importance of each independent variable. This study used the standardized coefficients in explaining multiple regression equation. According to Gelman (2008), there is no constant (or intercept) in this equation and the β (called the beta weight) is substituted for the b (called the regression coefficient). On factors contributing to the inefficient HCWM System, it was found that on manager's role: Low Budgeting and inadequate commodity supply contributed. On HCWM Process: Poor knowledge on the principles of HCWM was a factor. On Human Resource: Lack of Capacity building to staff on HCWM was a factor. On HCWM Policy implementation: Shallow customization of HCWM and OSH policies was a factor.

Conclusion

The study concluded in correlation results three independent variables; health manager's role, human resource factors and healthcare waste management policy had positive and strong relationship with the dependent variable healthcare waste management system among the four selected healthcare facilities in Machakos County. However healthcare waste management process had no statistical significance but had weak positive relationship with healthcare waste management system.

The study concluded that there was inefficient healthcare waste management process in the four healthcare facilities in Machakos County. The study concluded that the health managers understand their role on healthcare waste management but lack capacity building and enough funding to purchase required HCWM commodities in the four healthcare facilities in Machakos County.

The study concluded that healthcare workers lack adequate capacity building through continuous medical educations on HCWM and enough HCW commodities hence leading to inefficiencies on HCWM in the four healthcare facilities in Machakos County. The study concluded that most health workers had little or no information on the customized HCWM policies and guidelines in the four healthcare facilities in Machakos County.

Recommendations

- i) There is need for frequent updates and refresher trainings on HCWM to all healthcare staff and waste handlers in line with existing HCWM policies for the HCFs in Machakos County & in Kenya.
- ii) The county governments in Kenya to provide enough budget to HCFs so that they can procure enough HCWM commodities.
- iii) There is need for adoption of safe technologies for treatment and disposal of HC waste by HCFs in Kenya.
- iv) There is need for monitoring and evaluation for HCWM by healthcare facilities in Kenya.

Competing Interests

There are no competing interests in this research publication.

Authors Contributions

Authors Contributions: Michael Musango Mwanja conceptualized this study. All the authors contributed to the study design and data analysis. All the authors participated in the review and approval for the final version of the publication manuscript.

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