

environmental consequences as a result of their waste handling, treatment and disposal activities [4] This study compares the level of knowledge of issues concerning medical waste in two hospitals in Kenya a public and a private institution.

Materials and Methods

The study was conducted to determine knowledge and attitude towards MW management among the health professionals and individuals in selected hospitals in Kenya. The study participants included doctors, clinical officers, public health officers, nurses, laboratory technicians, cleaners and waste handlers. The study was done in the period of April 2015 to August 2015.

Study sites

The study site chosen for this study included Kenyatta National Hospital (KNH) situated in Nairobi County. This was chosen due to the fact that it's the largest public teaching and referral hospital, founded in 1901, with over 1800 beds, over 6000 staffs, 50 wards, 24 theatres (KNH, website) The PCEA Kikuyu Mission Hospital (KMH) represented a private hospital serving Kiambu and surrounding counties. Founded in 1908, with about 218 beds, around 346 staff, 5 wards, 4 theatres (KMH, website).

Study design

Descriptive cross sectional hospital based study

Study population

All health workers at KNH & KMH who meets the criteria of inclusion

Inclusion criteria: hospital personnel handling and managing MW with diverse backgrounds & and who gave consent to the study.

Exclusion criteria: those not tasked with medical waste management

Sample size

- $N = Z^2/P(1-P)/d^2$ [10]
- Sample Size determination Prevalence of population estimated to be at risk (0.20) which is the 20% of health workers at risk in Kenya, World Health Organization (WHO, 2003), N=sample size, P=prevalence of population estimated to be at risk (0.20) which is the 20% of health workers at risk, Z=score of confidence interval (CI) (1.96 at 95% CI), d=tolerable error (5%)

$$N = Z^2 / P(1-P) / d^2 = 1.96^2 \times 0.20 \times (1-0.20) / 0.052^2$$

- N= 246

Study questions

The respondent was supposed to respond (yes or no) as to whether he/she has knowledge towards the following issues that concern MW management

Question 1. Existence of medical waste management and handling rules 1998

Question 2. Source of segregation of medical waste in the hospital

Question 3. Improper medical waste management can lead to spread of diseases

Question 4. Recognition of the international biohazard sign

Question 5. Presence of a waste manager in the hospital

Data collection techniques

The information was obtained from the respondents through a pre-designed self-administered questionnaire adopted from WHO recommended assessment tool [1]. Anonymity of the study participants was maintained to enhance participation and to ensure confidentiality. The questionnaire consisted of knowledge questions regarding medical waste management issues.

Data processing and analysis

The structured questionnaire was coded and a master sheet prepared before the beginning of data collection to make the data ready for entry into the master sheet using statistical package for social scientists (SPSS) version 16.0 program. The data obtained were analyzed as per objective stated for the study using descriptive and inferential statistics.

Ethical consideration

Formal permission was obtained from the management of both hospitals (KNH ethical committee KNH-ERC/A/189, KMH board of management). Each study participant was explained the objective of the study and they consented to participate sectional hospital based study.

Results

Distribution of health professionals who participated in the study

The results of participants of health professionals who participated in this study are presented in Table 1. It describes the distribution of participants according to gender, profession, level of education and job experience in both hospitals (KNH and KMH).

| Character | | KNH | | KMH | | x ² | df | p-value |
|------------|------------------------|-------|------------|-------|------------|----------------|----|---------|
| | | Count | Column N % | Count | Column N % | | | |
| Gender | Male | 137 | 55.7 | 117 | 47.6 | 3.255 | 1 | 0.072 |
| | Female | 109 | 44.3 | 129 | 52.4 | | | |
| Profession | Nurses | 171 | 69.5 | 119 | 48.4 | | | |
| | Laboratory technicians | 14 | 5.7 | 12 | 4.9 | | | |

| | | | | | | | | |
|--------------------|------------------------------------|-----|------|-----|------|--------|---|--------|
| | Clinical officer | 8 | 3.3 | 12 | 4.9 | | | |
| | Doctors/Dentists | 34 | 13.8 | 17 | 6.9 | | | |
| | Cleaners | 14 | 5.7 | 79 | 32.1 | | | |
| | Public health officers | 3 | 1.2 | 5 | 2 | | | |
| | Waste handlers | 2 | 0.8 | 2 | 0.8 | 61.875 | 6 | 0.000* |
| Level education of | Degree and above | 68 | 27.6 | 40 | 16.3 | | | |
| | Diploma | 23 | 9.3 | 57 | 23.2 | | | |
| | Professional/KCSE/KCPE Certificate | 155 | 63 | 149 | 60.6 | 21.828 | 2 | 0.000* |
| Job experience | 1-5 years | 60 | 24.4 | 74 | 30.1 | | | |
| | 5-10 years | 105 | 42.7 | 97 | 39.4 | | | |
| | Over 10 years | 81 | 32.9 | 75 | 30.5 | 2.01 | 2 | 0.36 |

Table 1: Shows distribution of health care workers according to their socio-demographic variables on medical waste knowledge issues at KNH and KMH.

In KNH (137, 55.7%) and KMH, (117, 47.6%) were males while the females were (KNH, 109, 44.3%), KMH, 129, 52.4%). Distribution by gender was not significantly different across the hospitals (Table 1: $\chi^2=3.255$, $df=1$, $p=0.072$).

Majority of the health workers who participated in the study were nurses in each of the hospitals (KNH, 171, 69.5%, KMH, 119, 48.4%). There was a significance difference among the health workers participants in both hospitals ($\chi^2=61.875$, $df=6$, $p=0.000^*$ Table 1).

Majority of the health care workers had professional certificates (KNH, 155, 63%, KMH, 149, 60.6%), degree and above holders (KNH,

68, 27.6%, KMH, 40, 16.3%) and the least were diploma holders with (KNH, 23, 9.3%, KMH, 57, 23.2%). The level of significance was statistically different ($\chi^2=21.828$, $df=2$, $p=0.000^*$ Table 1).

The distribution of respondents among the health workers based on job experience was (KNH, 1-5 years 60, 24.4%, 5-10 years, 81, 32.9%, over 10 years 39, 15.9%, KMH, 1-5 years 97, 39.4%, 75, 30.5%, 35, and 14.2%). There was no statistical difference among the various years of job experiences ($\chi^2=2.010$, $df=2$, $p=0.366$, Table 1).

| Knowledge on: | Responses | KNH | | KMH | | χ^2 | df | p-value |
|---|-----------|---------------|--------------|---------------|-------------|----------|----|---------|
| | | frequency=246 | percentage % | frequency=246 | percentage% | | | |
| Q.1 Government plan rules on MW management 1998 | No | 39 | 15.9 | 35 | 14.2 | 0.254 | 1 | 0.614 |
| | Yes | 207 | 84.1 | 211 | 85.8 | | | |
| Q.2 Source of segregation of medical waste | No | 38 | 15.4 | 34 | 13.8 | 0.26 | 1 | 0.61 |
| | Yes | 208 | 84.1 | 212 | 86.2 | | | |
| Q.3 Improper medical waste management can lead to health problems | No | 29 | 11.8 | 41 | 16.7 | 2.398 | 1 | 0.121 |
| | Yes | 217 | 88.2 | 205 | 83.3 | | | |
| Q.4 Recognition of the international biohazard sign | No | 60 | 24.4 | 61 | 24.8 | 0.011 | 1 | 0.917 |
| | Yes | 186 | 75.6 | 185 | 75.2 | | | |
| Q.5 Presence of a waste manager in your hospital | No | 34 | 13.8 | 65 | 26.4 | 12.152 | 1 | 0.000* |
| | Yes | 212 | 86.2 | 181 | 73.6 | | | |

Table 2: Knowledge and attitude of health care workers towards some important aspects regarding medical waste management.

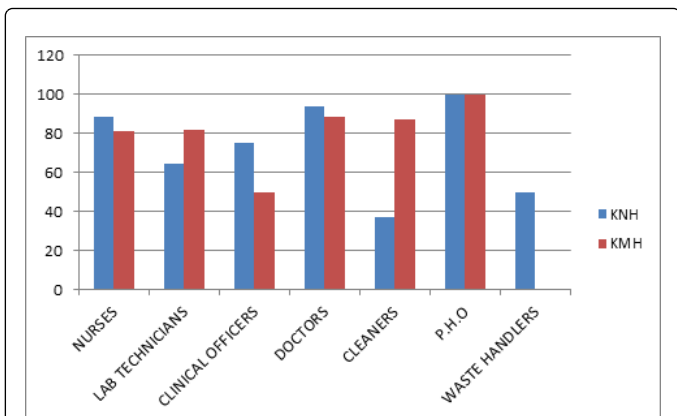


Figure 1: Knowledge of MW management and handling rule of 1998 among health workers professionals.

Professionals such as P.H.O, doctors and nurses were more aware of this rule than the waste handlers (Figure 1).

Existence of government medical waste management and handling rule of 1998

There was no significance difference among the respondents on this issue among the genders, profession, level of education and job experience ($\chi^2=0.254$, $df=1$, $p=0.614$, Table 2).

Professionals such as P.H.O, doctors and nurses were more aware of this rule than the waste handlers

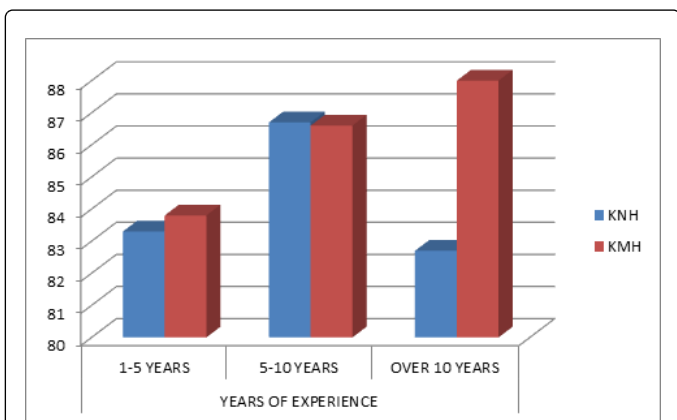


Figure 2: Respondents performance of health workers who were aware of where segregation of MW in the hospital takes place.

Source of segregation of MW in the hospital

The P.H.O, those with higher level of education were more familiar with where segregation of MW takes place in the hospitals as compared to the waste handlers. Those with 1-5 years of experience (83.3%) were more aware in KNH while over 10 years had the most knowledge in KMH (88%) (Figure 2). There was no significance difference in both health institutions ($\chi^2=0.260$, $df=1$, $p=0.610$, Table 2).

Improper medical waste management can lead to health problems and disease spread

Doctors and public health officers were more aware that mismanagement of medical waste can lead health problems in both hospitals (KNH and KMH 94.1%) as compared to waste handlers. Respondents with job experience of 1-5 years in KNH (93.3%) had more knowledge compared to KMH which had over 10 years (90.7%) with most knowledge on (Figure 3). There was no significance difference among respondents ($\chi^2=2.398$, $df=1$, $p=0.121$, Table 2).

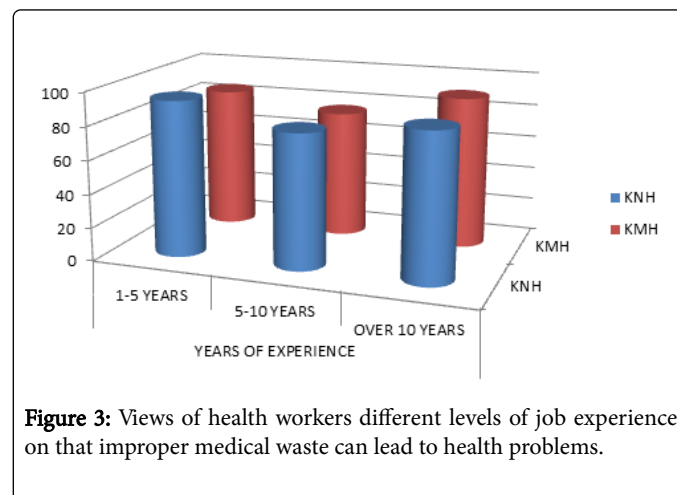


Figure 3: Views of health workers different levels of job experience on that improper medical waste can lead to health problems.

Identification of biohazard symbol

This issue scored the lowest among other questions. In KNH (66.7%) while nurses had (87.2%) and the least were waste handlers in each hospital (1,50%) (Figure 4). The highest level of education at KNH was degree and above (94.1%) while at KMH was (97.5%). The most knowledgeable job experience group was 1-5 years in KNH (88.3%) and 5-10 years in KMH (69.3%). There was no significance difference among the respondents in both hospitals ($\chi^2=0.11$, $df=1$, $p=0.917$, Table 2).

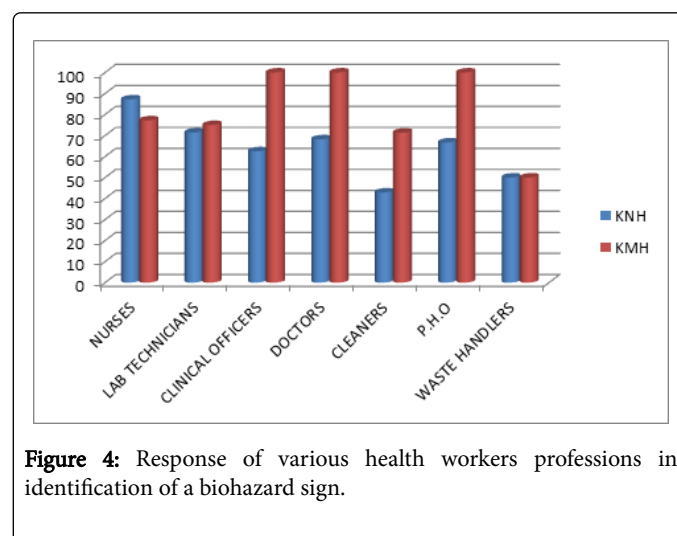


Figure 4: Response of various health workers professions in identification of a biohazard sign.

Presence of a waste manager in the hospital

There was a significance difference among the respondents towards this issue ($\chi^2=12.152$, $df=1$, $p=0.000^*$ Table 2). Most doctors and P.H.O who also had the highest level of education were more aware that their hospitals had a person in charge of management of MW (KNH 85.3%, KMH 100% respectively) while waste handlers were not aware (KNH 50%, KMH 0.00%). The group with less job experience was more aware with KNH (1-5 years and 5-10 years, each scoring 86.7% and 86.7% respectively while KMH had over 10 years' experience group scored (85.3%), (Figure 5).

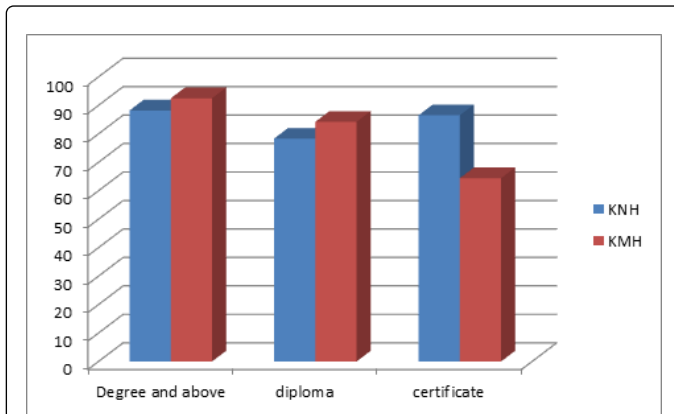


Figure 5: Performance of different levels of education against knowledge on presence of a waste manager in the hospitals.

| | Hospitals | | χ^2 | df | p- value |
|----------------------|------------|------------|----------|----|----------|
| | KNH | KMH | | | |
| | Column N % | Column N % | | | |
| Poor (less than 50%) | 2.4 | 1.6 | | | |
| Fair (51-70%) | 16.7 | 22.4 | | | |
| Good (71-100%) | 80.9 | 76 | 2.815 | 2 | 0.245 |
| Total | 100 | 100 | | | |

Table 3: Overall hospitals performance on knowledge of MW management issues.

Discussion

Results from the current study on distribution of health-workers based on social demographic variables revealed lack of influence towards knowledge and awareness towards medical waste issues. It revealed that, females were more aware of MW management issues than their male counterparts. Female gender was a strong indicator of knowledge of medical waste in the current study though the difference was not significant. This finding is similar to that of Khartoum, [11] that revealed that women though highly educated just like they play their roles in the family which include managing household waste they ensure that other tasks such as medical waste management aspects are taken care of. The difference in knowledge though not significant can

be explained by lack of knowledge towards importance of medical waste management and hence implementation amongst the males.

The profession most awareness towards medical waste issues was public health officers and doctors. The results are similar to research done in Tonga [12], which could be explained by the fact that most of the employed are professionals. Good profession goes together with a higher level of education most of the times. A high level of education is paramount in understanding aspects concerning medical waste management [13]. The professional are employed section of the population and is also presumably the sector that handles or at least is responsible for overseeing, supervising and ensuring the medical waste like the household waste is managed [14].

The current study reveals that job experience among the staff did not matter in knowledge of medical waste issues. There were the least experienced (1-5 years) but committed on issues of management of medical waste and the long serving (>10 years) and dedicated to serve. This is similar to results done Khartoum, 2014 [11] and could be explained by enthusiasm of the young (1-5 years), towards their career and loyalty of the old (>10 years) and tiredness and disappointment of the mid experience (5-10 years).

MW management and handling rule of 1998, demands that all health care institutions had to ensure safe disposal and environmentally sound management of waste produced by health-care institutions as specified in the rules for proper disposal of medical waste [15]. Results findings from the current study in both health institutions showed improved level of knowledge. This is slightly higher from the results reported in the study conducted in Bhopal which showed that 54.5% of health professionals were aware about the existence of MW management and handling rules 1998 [16]. The knowledge about MW and handling rules was much better in public health officers and doctors as compared to other staff. These findings were similar to other studies in which technically qualified personnel like the doctors, nurses and lab staffs have high knowledge regarding this rules but was low among sanitary staff. This shows that the people with higher education have more knowledge about MW management and the rules prescribed in them [17].

The source of segregation of medical waste was the most known issue in both hospitals with 85.07% in KNH and 84.06%the in KMH in the present study. This finding is supported by the observations made in the study done at Bangalore which stated that 87.5% of the study subjects were in favor of segregation of MW occurring at source of generation. These findings are similar to research done previously which found that knowledge regarding segregation was more among paramedical staff like nurses than medical staff like doctors [18]. Segregation of different types of MW at the source and their appropriate storage for disinfection, sterilization etc. would ensure that infectious wastes do not get mixed with non-infectious wastes as this would infect the entire waste [19]. The segregation and identification of the waste is the primary and most important step to be taken in the process of medical waste management.

With respect to risks that health workers could be exposed to due to improper disposal and management of medical waste, the study revealed that the issue scored highly. This result is consistent with the study done in S. Africa [20] that indicated that most health care workers (98.5%) agreed that improper management of MW could lead to transmission of infections in health care workers and patients. The difference may be due to the time gap of the study. Improper management of MW causes serious health and environmental

problems in terms of air, water and land pollution and has a greater chance of causing infected diseases [21].

Knowledge on recognition of a biohazard symbol that indicates that infectious waste should be separately segregated from non-infectious waste. In the current study, these results are in agreement with study done by Wasee, who found that persons with higher level of education were more aware regarding this issue of recognizing the international biohazard sign [22].

Presence of a waste manager can encourage staff to make active contribution towards the proper MW management; can help prepare other health workers in handling and disposing of MW products from the health centers which can effectively minimize the risk of spread of hazardous diseases [23]. The significance difference on this issue among other questions can be explained by individual interests and differences on matters in question for example in this case medical waste management aspects [24]. Similar study was done in Kings George Hospital in Visakhapatnam in India to assess the awareness about MW management among health care workers which concluded that in order to improve the existing conditions a hospital control committee headed by a hospital manager, is necessary to supervise all aspects of MW management [25].

Conclusion

The main findings of the present study can be summarized as follows,

Male gender were the majority health professionals but had less knowledgeable on issue of medical waste management than their female counterparts in both hospitals.

Doctors and public health officers who also record the highest level of education were among the most knowledgeable staff in the hospitals towards MW management matters.

There were the least experienced group of health workers but committed and the long serving and dedicated to serve hence job experience was not a factor to be considered in the current study.

KNH a public hospital was more knowledgeable on medical waste issues than KMH a private hospital.

Professional's health workers such as doctors and P.H.O. had better knowledge and attitude in theoretical rules and regulations e.g. handling rule of MW 1998, and understand the importance of presence of a waste manager in a hospital while nurses, clinical officers and laboratory technicians had knowledge on technical issues such as source of MW segregation and recognition of biohazard sign.

Recommendations

With this view, it is assumed that health care providers may be having adequate knowledge but the practices are inappropriate due to lack of proper facilities and interest of the individual it is therefore imperative to evaluate practice on medical waste management among the healthcare providers working in the health institutions in Kenya with view to prepare an information booklet on the status.

This study brings to point important aspect to consider when designing management strategies of medical waste. The researcher hopes that this study will create awareness regarding the problem of medical waste management in hospitals and will generate interest for control effort for effective medical waste management.

There is need for collaboration of both private and public hospitals on supervision of issues, rules legislation of medical waste management and planning on issues of management of medical waste in Kenya as it is a health hazard to the general public and the environment.

There is need for continuous training for personnel in the hospitals on matters of medical waste rules and legislation to know and understand about the potential risk involved.

Monitoring by supervisors should be conducted to ensure compliance and environmental health and waste management experts must be included in the infection control team in the hospitals.

There is need for entrepreneurship ideas in training, seminar, workshops, conferences, by concerned institutions such as universities on matters of MW management. A media campaign is also necessary to create awareness and urgency of safe disposal of medical waste.

Suggested research for the future includes a study of the top decision and policy makers to be conducted to find out their perceptions and attitudes to medical waste management.

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