

An Assessment of Healthcare Waste Segregation in Selected Hospitals in Kampala District

¹Godfrey Olum, Ndejje University Uganda, labejagodfrey@gmail.com:

²Favor Excellence, Soroti University, efavor@sun.ac.ug:

³Wilson Muyinda Mande, Nkumba University, mandewm@gmail.com:

⁴Henry Buwule Musoke, Ndejje University Uganda, hbuwule@ndejeuniversity.ac.ug:

Abstract

Across Sub-Saharan Africa, an increasing need to intervene in healthcare waste is evident. This has been driven by population growth, increased number of healthcare facilities and number of materials used on rising patients. In addition to these drivers, health facilities have increased in Kampala since 1990s due to relative peace and business entrepreneurs. Thus, to identify separation methods and their effect formed the objective. For this study, qualitative and quantitative methods were adopted to collect data especially the field observation, survey questionnaires and reviewed documents. Data were organized using Microsoft excel and later Statistical Products and Service for analysis. Therefore, the focus of the article remained on waste segregation or sorting practice in selected hospitals especially Mulago National Referral Hospital and surrounding private healthcare facilities. Results indicate that healthcare personnel remain frontline separators healthcare waste with 98% using color coded bins although some wastes could be observed lying outside near official offices. Within some black bins, mixed waste – solid, sharp, soft, food, hard utensils and blood-stained woolen materials were observed. In wards and laboratories, separation into red, and green bins were observed; packing could be made within similar rooms for transportation through hand-pushing to nearby stationed vehicles. In all, there was increased vigilance of healthcare personnel towards waste segregation using color – coded bins. But, the mixing of some hazardous and sharp materials calls for a more vigilant approach.

Key words: healthcare waste, segregation, healthcare personnel, patients, Hospitals

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INTRODUCTION

In the modern world, dire effect of healthcare waste has increased due to the numbers of patients, size of facilities and above all; improper separation or sorting and other management practices (Mitiku et al., 2022). Health facilities generate unneeded materials daily and improper management is hazardous to human health and environment. The waste have got highest degree in transmitting diseases, contaminating soil, surface, ground water with pathogenic microbes, toxic and some heavy metals have effect on every organisms (Berhanu, 2022; Nkubitu, 2022). Some of the diseases include nosocomial, skin disorders, intestinal parasitosis, hepatitis and typhoid. Thus, the need for proper segregation / sorting waste is key beginning in healthcare management practices since it can safeguard lives of patients, healthcare providers and personnel, waste workers, scavengers, public and environment. Thus, this study seeks to identify some of the methods used in separation of the healthcare waste and their effects. This has been sought after a thorough realization that despite the provision of separation items by the MOH to the healthcare centers, medical waste has been physically observation in the municipal solid waste in Kampala District.

In Ghana, it is indicated that people have been at risk of cross contamination of healthcare waste due to lack of thorough sorting during generation (Adu et al., 2020). Risks have been observed due improper sorting disposal hazardous and non-hazardous waste types, use of open fire pits, and poor incinerators to burn infectious waste. Similarly, in Egypt, the background under which a by Khashaba et al. (2023) was carried out indicates improper healthcare waste management which were alarming in the healthcare centers. The observed practices from the two case studies show high percentage for the spread of infectious diseases and pollution of the environment. The contaminated sharps mixed during separation into brown safety boxes, color coding for other infectious waste containers was inconsistent. In such situation, medical waste can equally be found in the municipal waste.

What is clear with healthcare waste management practices is the fact that key point is separation during generation. No matter the final stage such as disposal, recycling, dip-dumping or burning, separation remain the main driver to proceeding practices. However, the stage seems to be under-looked

with scarce literature. This prompted a study on Bale zone, Southern Ethiopia to assess segregation practice and its correlation to healthcare personnel (Sahiledengle, 2019). Results indicate that out of 409 health workers, 53.8% had good separation practice of waste and this poses a question how the rest of the workers were generating similar waste. Additionally, what was the effect of such practices on the environment, human and especially the patients and healthcare workers. In the study, it is indicated that males had a positive attitude and separation practice of healthcare waste as compared to females. No male department or position could be in operation without segregation container as compared to females. The fact that healthcare facilities cannot isolate themselves from employing females' healthcare workers, the extent to which female improper waste generation practices affect the environment and humans needs to be articulated in such cases.

In Tanzania, comparative study was conducted between healthcare waste management practices in Ilala and Kinondoni municipalities in Dar es Salaam (Manyele & Lyasenga, 2010). The study indicates that 60% and 70% of incinerators surveyed in Ilala and Kinondoni respectively, were in bad conditions without chimneys, ash pits, cover for waste loading and ash removing doors. Additionally, the 9% and 47% of the workers in Ilala and Kinondoni respectively, never had Standard. In Kenya, KAP was conducted especially on how waste is segregated, the organizational factors affecting separation of wastes, knowledge and attitude towards separation in Kenya (Maina, 2018). The findings indicate that the main waste segregated from the rest were syringes and needles. Apart from surgical blades and needles that were separated in yellow sharp container, other wastes were sorted into any bin. Instructions and guidelines were clear directing health personnel into clear segregation practice, but segregation was not sufficient since there was lack of different bins essential in separation. The absence of such bins such as green and black indicates inadequate knowledge to use bins in separating wastes. While the absence of other bins is an indication for the need to increase training of health workers, the effects were already being felt onto humans and environment but with limited or no documented information.

As indicated by empirical literature, Sub-Saharan Countries have poor healthcare waste separation practice which is a source for other inefficiencies and risk factors. In all the countries reviewed, there is limited training of nurses and other health personnel in waste separation, financial challenges, limited waste utilities such as bins and other containers, poor managerial support, inabilities in post-separation and collection. This calls for timely training based on behaviour and increased supervision that would increase self-regulatory framework. These challenges increase risk of mixing waste during generation rather than separation basing on bins. Once there is poor separation, the consequent practices such as packing, storing, transporting, burning, burying and disposing become compromised.

Uganda like other nations is no exception. It was not until 1990s that there was increased health facilities and numbers patients (Mwesigwa et al., 2021). Thus, the quest for proper healthcare waste management which starts with segregation. Alongside this discourse, government increased its health facilities within and outside Kampala District which has been energized by private investments in healthcare facilities (Njuguna et al., 2023). All these facilities however remained under policy approach by Ministry of Health – MoH for supervision, monitoring and quality assurance. Despite the vigilance and alignment to MoH approaches, cases of healthcare waste have been witnessed in dumping places around Kampala District and some disposable places such as Kitezi waste ground (Kayiwa et al., 2020). This prompted this study about healthcare segregation

While the current health system stems from 1990s, there is less or no strong healthcare waste separation and other management practices; strong supervisory and systemic structures. This means that over

90% of the waste collected or generated is considered risk factor to the population due to mixing of hazardous and non-hazardous waste. In Kampala District especially, most healthcare personnel are aware of the legal and institutional framework in place. Even some studies within and outside Kampala District show various gaps which needs to be filled. Nonetheless, the increased cases of healthcare waste in municipal solid waste are driving forces to assess the separation process in selected healthcare centers in Kampala District.

This study has been guided by the need to identify methods used in separation of the healthcare waste and their effects to the environment and human life especially the healthcare personnel and patients. In such situation, the study seeks to respond to different questions especially if there has been special treatment given to individuals affected by improper management of healthcare waste in both private and public healthcare centers in Kampala, Uganda. The study also plays an oversight role to the healthcare facilities about their neglected obligation; and to the government policy makers on how to frame a policy that can be adhered to by all stakeholders.

LITERATURE REVIEW

Literature on methods used in separation of healthcare waste and their effect has been presented variedly from one location to another. Justifying inconclusive research since there are different results from various research carried. In Kenya for example, Otieno et al. (2025) assessed the influence of waste management infrastructure on source segregation of medical waste at the JOOTRH in a descriptive survey of 112 nursing officers, 41 doctors, 13 laboratory technicians, 20 clinical officers, and eight heads of departments. Using a semi-structured questionnaire and interview schedules, data was collected. Results show that Hospital waste management infrastructure ($\beta = .513$) has a significant ($p < 0.05$) influence on source segregation of medical waste, and contributes approximately 38.4%-unit changes in source segregation of medical waste at JOOTRH ($R^2 = .384$).

Affordofe et al. (2025) assessed the medical waste generation rate, management practices, and healthcare workers' knowledge, attitudes, and practices at Bule Hora University Teaching Hospital, Ethiopia in a cross-sectional study. The direct waste measurement, observational checklists, and structured questionnaire administered to 115 healthcare workers were used in collecting data. Results show that hospital generates an average of 687.72 kg of healthcare waste per day; of which 56.94% was classified as general waste and 43.06% as hazardous waste. The waste generation rate was 1.58 kg/bed/day, with infectious waste accounting for 33.78% of the total. The knowledge, attitudes, and practices analysis revealed that while 88.69% of respondents recognized the importance of proper waste management, only 52.17% believed that healthcare waste was properly managed in their service unit. Segregation practices were inadequate, with only 28.69% having received formal training on healthcare waste management. The primary disposal methods—open burning (65.21%) and placenta pit burial—raised concerns about environmental contamination and public health risks.

Shalanyuy et al. (2025) examined 56 freely consented nurses' knowledge on waste segregation in a hospital based descriptive cross-sectional study design in the Kribi and Ebome hospital. The data was collected using a well-structured questionnaire divided into 4 sections based on the specific objectives of the study. The study found that 57.1% of participants had good knowledge about hospital waste segregation, though only 19.6% were aware of the WHO color-coded bin system, and just over one-third had formal training in medical waste handling. Regarding attitude, 44.6% exhibited a good attitude towards waste segregation, with many acknowledging the importance of sharps safety, colour codes, and post-exposure prophylaxis,

although some saw reporting injuries as a burden. In practice, only 42.9% demonstrated good segregation practices, with high adherence to sorting and protective measures, but low awareness of post-disposal waste outcomes.

Nsanzimana et al. (2025) assessed the determinants of improper healthcare waste (HCW) segregation at a tertiary Referral hospital in southern Rwanda. Waste segregation was classified as proper or improper, with independent variables including hospital departments and segregation facilities. Logistic regression was used to identify factors influencing improper segregation, with significance set at 0.05. Healthcare waste segregation performance varied by department, with the intensive care Unit achieving the highest rate (69%), and internal Medicine having the lowest (55%). Internal Medicine had a significantly higher probability of inappropriate segregation (AOR: 1.887, 95% CI: 1.011-3.588, $p = 0.048$). The lack of infectious waste bins (AOR: 2.273, 95% CI: 1.656-3.118, $p = 0.001$) and non-infectious waste bins (AOR: 1.476, 95% CI: 1.045-2.086, $p = 0.027$) increased the likelihood of improper segregation. the presence or absence of red or black plastic bags in waste bins had no significant effect on HCW segregation performance. inadequate healthcare waste segregation was common, particularly in internal Medicine. Designated waste bins increased segregation, whereas color-coded bags had little effect.

Abdikarim et al. (2025) assessed the infectious and sharps waste management practices and waste segregation in Somalia's healthcare facilities through a nationwide cross-sectional study Results indicates that more than 60% of healthcare facilities lacked proper waste segregation systems, and many reported insufficient colour-coded or covered bins. For infectious garbage, incineration was the most common approach (33.57%), whereas for sharps waste, pit burning was the most common option (52.48%). The geographic location and the type of waste management strategies used were significantly correlated ($p < 0.001$), indicating regional inequalities. These results draw attention to the numerous discrepancies and structural shortcomings in the systems for managing medical waste.

Oladapo et al. (2024) examined previous works undertaken on healthcare waste management (HCWM) practices around the world, notably the developing countries with a particular interest in segregation, collection, transportation, treatment, and disposal of HCW. This study draws attention to the environmental hazards arising from each stage of HCWM. Factors affecting HCWM practices have also been discussed. This study revealed evidence of poor HCWM practices in many developing countries. It also showed the impacts of human and non-human factors on HCWM practices. Proper documentation, sufficient budget, adequate supply of HCWM materials, frequent training of healthcare workers, and development of local manuals and guides are essential if a country is determined to achieve efficient and sustainable HCWM system.

Ayele et al. (2024) investigated solid healthcare waste management practices and develop guidelines to improve management practices in Ethiopia. The setting was all health facilities found in Hossaena town in which a mixed-method study design was used under sequence research design. The observational finding shows that colour-coded waste bins are available in 23 (9.6%) rooms; 90% of the sharp containers were reusable, and 100% of the waste storage bins were plastic buckets that were easily cleanable. In 40 (97.56%) health facilities, infectious wastes were collected daily from the waste generation areas to the final disposal points. Two hundred seventy-one (50.2%) of the respondents were satisfied or agreed that satisfactory procedures are available in case of an accident. Only 220 (40.8%) respondents were vaccinated for the Hepatitis B virus

METHODOLOGY

A cross – sectional descriptive design of healthcare facilities was used to assess healthcare waste segregation practices (Zuleika et al., 2022). The design has been used since it allows an observational foam of study to describe the population characteristics as well aa prevalence healthcare conditions. The selected healthcare facilities in Kampala Central were the area of study. It is located in Kampala District as one of Divisions. The other divisions being Kawempe, Nakawa, Rubaga and Makindye. A total of 219 health centers in Kampala Central were targeted and selected using a multi-stage purposive sampling that collect daily medical waste (Medard et al., 2017). Within each health-center, one – three units of waste separation were observed using observational checklist. Unit of study included health units like hematology and blood transfusion, serology and parasitology laboratories – surgical, maternity, pediatrics, orthopedics, private and psychiatry; histopathology and clinical chemistry were selected basing on purposive approach. Purposive sampling was also applied to select the units where healthcare wastes are generated and separated before packing and transporting. Purposively, it only focused on units generating wastes during the daily operations. Some units generating office wastes of medical personnel; radiology department and dermatology clinics were excluded from the study.

Out of 219 targeted healthcare centers, a sample size of 204 was selected, determined using the formula as;

$$n = \frac{N}{1+N(e)^2} \text{ (Ajay \& Micah, 2014)}$$

A simple random sampling technique was adopted to select 204 participants, one selected from each healthcare unit. This could be made using the lists accessed from departmental offices. The sampling approach was applied since it gives equal opportunities to all individuals ready to participate in the study. Data was collected using administered questionnaire, analyzed by SPSS tools such as Chi-Square, Pearson Correlation Coefficient, linear regression and ANOVA. Ethical procedure and adherence were followed starting with seeking permission from the university and health facility to access healthcare waste bins and generating departments. In each unit, heads were informed the purpose of the survey with main emphasis on assessment of waste separation during generation by units and departments. The main investigator had an assistant, knowledgeable in research methods especially observations and using administered tool to collect the data.

RESULTS AND DISCUSSION

The findings have been presented under the headings of segregation practices, compliance to the standard operation procedure (SOP), bin availability, observations on transportation and storage.

Generation Practices

The medical waste practices or methods through observations are presented in Table 1. Table 1.1 indicates observations made from n=312 (80%) points where separation could take place in 204 healthcare facilities. Only 20% (n=37) points were not separating waste. This report indicates that n=312 (70%) in healthcare facilities were plastic bins while n=121 (20%) were not, some were smart bins or AI-based waste tracking but were not commonly used. This means that despite of the increased call for the use of such items, they are not wholly embraced. Observations made in such separation areas were the use of paper box which could absorb liquid. Results also indicate that despite being placed at patients' disposal, n=421 (66%) were not used and only n=211 (34%) were under use.

Table 1: Illustration of healthcare bins at generation observed

Container observed	Remarks	Frequency (n=204)	Percent
Separation areas	True	312	80%
	False	37	20%
Coded colored bins	True	501	93%
	False	32	7%
Bins with reference	True	413	81%
	False	91	19%
Plastic bins at use	True	312	70%
	False	121	30%
Bins placed outside	True	113	20%
	False	463	80%
Bins at patients use	True	211	34%
	False	421	66%
Bins at workers use	True	661	94%
	False	41	6%
Properly marked bins	True	118	22%
	False	431	78%

Observations indicate that workers could use bins highly, n=661 (661) as compared to none – use, n=41(6%), It was also found unmarked bins, n=431(78%) were many than observed marked bins, n=118 (22%). The wall chats in the patients' wards had direct instructions how to utilize bins placed in the patients' wards. Some rules and regulations on using bins were also observed in some units despite having established that there are some medical personnel that defy instructions to use certain bins for particular waste.

Generation Practices

Despite having many separation - points i.e., n=312 (80%) observed, only n=131 (21%) separation bins were observed as indicated in Table 2. This supported the view that there are individual healthcare personnel that hardly follow regulations about separation of waste.

Table 2: Illustration of segregation practices

Practices observed	Remarks	Frequency (n=204)	Percent
Separation bins	Yes	131	21%
	No	512	79%
Biohazard symbols on bins	Yes	32	6%
	No	561	94%
Leaking bins	Yes	16	4%
	No	511	96%
Septation in patients' places	Yes	161	15%
	No	500	75%
Overfilled containers	Yes	116	19%
	No	503	81%

Within n=512 (79%) bins observed, there were either mixed healthcare used materials such as sharp objects, stained blood cotton woolen, and solid wastes. While there were cameras in the healthcare wards and separation units that would have enabled to identify proper and improper use of bins, this study established that some are not functioning and there is dearth in implementing such policies. Table 2 also indicates that n=32 (6%) had biohazard symbols, yet n=561 (94%) had nothing. This leaves hospital communities at the edge of mixing wastes despite having policies and chats illustrating separation process and handling of waste. Very few bins n=16 (4%) were leaking as opposed to n=511 (96%) bins observed. Some separation could take place within places occupied by patients, n=161 (15%). This was most observed among out-patients receiving medication.

Standard Operation Procedure (SOP)

Observations were also made on individual health personnel using standard operation procedures (SOPs) in different units and departments that would separate waste as indicated in Table 3. For closed shoes n=818, health facilities' uniform n=622, gloves n = 832, aprons n = 911 and face masks n=321 were observed. This study was informed that use of face masks was common during Covid – 19 period but this reduced with its reduction in 2022.

Table 3: SOPs observed

Practices observed	Frequency (n=204)
Closed shoes	818
Uniform	622
Gloves	832
Aprons	911
Face masks	321

Effect of the methods used on separation of the healthcare waste

This study established whether different methods used have a positive effect on separation of waste and descriptive quantitative results are presented in Table 4.

Table 4: Illustrating responses to effect of bin – method in separation process

Variable	n = 204				
	Strongly disagree	Disagree	Not sure	Agree	Strongly agree
Bin placed in patients' wards	16 7.8%	35 17.2%	33 16.1%	54 26.5%	66 32.4%
Bins in separation areas	13 6.4%	4 2.0%	39 19.1%	61 29.9%	87 42.6%
Coded colored bins	32 15.7%	18 8.8%	27 13.2%	62 30.4%	65 31.9%
Bins with reference number	3 1.5%	19 9.3%	48 23.5%	65 31.9%	69 33.8%
Bins put outside the wards	9 4.4%	19 9.3%	40 19.6%	54 26.5%	82 40.2%
Bins placed inside the wards	6 2.9%	16 7.8%	35 17.2%	74 36.3%	73 35.8%

Bins placed in patients' wards had n=66 (32.4%) participants who strongly agreed; n=54 (26.5%) agreed; n=33 (16.1%) were not sure; n= 35 (17.2%) disagreed; and n=16 (7.8%) strongly disagreed. Bins in separation areas had n= 87 (43.6%) of participants who strongly agreed; n=61 (29.9%) agreed; n =39 (19.1%) was not sure; n = 4 (2.0%) disagreed; and n=13 (6.4%) strongly disagreed. Coded colored bins had n = 65 (31.9%) of participants that strongly agreed; n=62 (30.4%) agreed; n=27 (13.2%) was not sure; n=18 (8.8%) disagreed; and n=32 (15.7%) strongly disagreed. Bins with reference number had n=69 (33.8%) of the participants who strongly agreed; n = 65 (31.9%) agreed; n=48 (23.5%) was not sure; n= 19 (9.3%) disagreed; and n=3 (1.5%) strongly disagreed. Bins put outside the wards had n= 82 (40.2%) of the participants who strongly agreed; n=54 (26.5%) agreed; n = 40 (19.6%) was not sure; n= 19 (9.3%) disagreed; and n=9 (4.4%) strongly disagreed. Bins placed inside the wards had n=73 (35.8%) of the participants that strongly agreed; n=74 (36.3%) agreed; n=35(17.3%) was not sure; n=16 (7.8%) disagreed; and n=6 (2.9%) strongly disagreed.

The varied results indicate that policy in separation is not followed as required; as well as lacuna in implementation. It is also an indication that there is lack of behavioral responsiveness which is attributed by limited training of the healthcare workers in waste management and separation. analysis through linear regression has been presented as follow;

Table 5: Model Summary^b

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.312 ^a	.097	.070	.449

a. Predictors: (Constant), Bins placed inside the wards, Bins with reference number, Bins placed in patients' wards, Bins in separation areas, coded colored bins , Bins put outside wards

b. Dependent Variable: Positively affect healthcare waste separation.

The model summary shows that R^2 was .097 which is translated to mean that using bins in waste management is explained 10% of separation. Under normal circumstances therefore, there are other factors such as effectiveness of the policy, awareness of dangers of non-separated waste, and policy implementation which partly contribute to waste separation. Under ANOVA, the factor analysis and significance are presented as;

Table 6: ANOVA^a

	Model	Sum of Squares	df	Mean Square	F	Sig.
1	Regression	4.274	6	.712	3.539	.002 ^b
	Residual	39.648	197	.201		
	Total	43.922	203			

- a. Dependent Variable: Do you always engage is healthcare waste separation
b. Predictors: (Constant), Bins placed inside the wards, Bins with reference number, Bin placed in patients' wards, Bins in separation areas, coded colored bins, Bins put outside the wards.

ANOVA analysis indicates the linearity between the use of bin method and waste separation $F(6,203) 3.539$, with $p < 0.02$. This implied that 6 additional units change in application of bin method cause a highly significant change in waste separation. The coefficient explanations are presented as;

Table 7: Coefficients^a

Model		Unstandardized Coefficients		Standardized Coefficients Beta	t	Sig.
		B	Std. Error			
1	(Constant)	1.164	.241		4.839	.000
	Bin placed in patients' wards	-.045	.025	-.128	-1.840	.067
	Bins in separation areas	.050	.029	.121	1.738	.084
	Coded colored bins	.051	.023	.154	2.211	.028
	Bins with reference number	.064	.031	.142	2.055	.041
	Bins put outside the wards	-.040	.028	-.101	-1.416	.158
	Bins placed inside the wards	.054	.031	.123	1.735	.084

- a. Dependent Variable: Do you always engage is healthcare waste separation

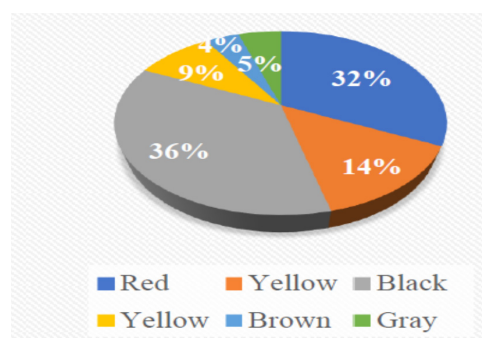
The coefficients of regression show differences in Beta and P-value results. The significant results are presented under coded coloured bins and bins with reference numbers. Thus, the coefficient regression for coded coloured bin indicates Beta = .154 and $p = .028$ which reveals that the first null hypothesis (H_{01}). Thus, "there is no positively significant effect of coded coloured bins on waste separation" is rejected. Instead, the alternate hypothesis "there is positively significant effect of coded coloured bins on waste separation" is accepted.

Similarly, on bins with reference number, Beta = .142 $p = .041$ which reveals that the first null hypothesis (H_{01}). Thus, "there is no positively significant effect of bins with reference number on waste separation" is rejected. Instead, the alternate hypothesis "there is positively significant effect of bins with reference number on waste separation" is accepted. The rest of the variables were not significant which leads retaining their null hypotheses.

Laboratory results

This study established that almost all health facilities in Kampala have one laboratory points apart from few cases which could have different points per sections. This made visited laboratory points to 151. Results on color of separation bins is presented in Figure 1.

Figure 1: Colored bins in laboratories



Results in Pie-chart 1.1 indicates that most laboratories use black (36%) and red (32%) bins. The choice depends on procurement and not any other factor since all bins serve the same purpose. Separation for sharp objects preserved to smaller bins. Laboratory bins ranged from one – three.

Observations and remarks with personnel

Uganda has legal and institutional framework for waste management on paper but less emphasis has been designated to healthcare waste. These include the National Environmental Act, 2019 under the Ministry of Water and Environment (MWE) with the mandate to develop, manage, and regulate water and environment resources, including waste management in Uganda. The National Environment (waste management) Regulation, 2020 and Guidelines for the Management of Landfills in Uganda under the National Environment Management Authority (NEMA). The Local Government Waste Management Ordinance Kampala Capital City Authority (KCCA) Act, 2010 under KCCA. It is responsible for urban demonstrative divisions and waste management waste. The Public Health Act under the Ministry of Health with its mandate which stems from Public Health Act, Cap 281. The Local Government Act under the Ministry of Local Government which gives mandate to the ministry to manage decentralized services to district and urban authorities across Uganda, including Solid Waste Management. The National Energy Policy, 2019 under the Ministry of Energy and Mineral Development. It calls for the use of waste-to-energy products like briquettes, power generation from the waste incineration and biogas. The National E-waste Management Policy, 2020 under the Ministry of Information, Communication, Technology and National Guidance. It oversees e-waste policy in collaboration with government entities. This policy provides for the establishment of e-waste management facilities and informs the public e-waste management. It also works to promote both local and foreign investors in the establishment of e-waste management facilities in Uganda. The National Industry Policy, 2020 under the Ministry of Trade and Industry. The policy promotes cleaner production practices, recycling of waste, appropriate waste management and disposal as well as efficient resource management programmes. The last is the Investment Code Act, 2020 under Uganda Investment Authority (UIA). The Act spells out procedures for foreign investors and regulations on foreign investment, comprising priority investment sectors that include value addition across several sectors. Among the sectors of interest is waste recycling

From the ministries, the functioning department and committees for supervising and monitoring healthcare waste management practices are visibly functioning. While most hospital and other healthcare personnel and directors are aware of the government laws and rules over waste management, hospitals in Kampala and across Uganda have not yet developed mechanisms and standards of separation, collection and uniform disposal. That is why different hospitals would use similar or different methods of collection and separation, as well as disposing. Otherwise, most healthcare directors know that burying healthcare waste is wrong due to effect to the soil. Besides, today's burial ground is tomorrow's playground, farm and constructed area.

Healthcare officers also know that burning healthcare waste is wrong and mixing such waste with the rest of municipal waste is also wrong. The need for training different stakeholders and visible work must be present if healthcare waste management is to flow by international and national standards.

Healthcare waste generation

This is a daily norm and unavoidable activities since everyday hospitals or healthcare centers receive a patient. Hence, there is qualitative and quantitative generation of waste starting with small to big healthcare centers [shops]. Across Uganda, there is no specific time for accumulation of healthcare waste. This calls for daily training of the healthcare personnel and patients' caregivers in generation practices that are unavoidable. The question is, who is meant to train such persons in the current healthcare facilities? This has remained a gap that need intervention since most healthcare personnel and patients' caregivers are the most generators of waste in their disguise or ignorant knowledge about harm that would result. These questions also call for cost – benefit analysis to evaluate the economic impact of adopting various and better waste management segregation practices. Some of the economic constraints can also affect allocation resources which can easily hinder budgetary process at hospital level in the due Course of policy implementation.

Segregation during generation

This study was more focused on this stage which is the basis to other management practices of healthcare waste. Failure or making any mistake at this stage is essential and can lead to giving other excuses to other stages to make more mistakes. For example, once sharps, blood-stained materials and municipal wastes are mixed up, it becomes hard for proper packing and storing. It also becomes a challenge for transportation as well as disposal. Generation and separation [sorting] must be smooth so that there is no step broken in a process of management. This will reduce costs for other processes, reduce waste risks to healthcare personnel, patients and patients' caregivers. During this study, this was found absence in all healthcare facilities that were visited. As noted by healthcare personnel that were able to discuss with the observers, there are few if not none, health facilities that follow the World Health Organizations (WHO) basic three – bin system in Uganda for simple and safe waste segregation system at the point of waste generation. This is a gap that enforcement agency would emphasize. However, the monitoring and supervision to such, can also be a problem to the nation since a systemic mechanism for healthcare waste management practices is completely lacking in Uganda. This calls for modern waste segregation technologies such as RFID tagging, smart bins, or AI-based waste tracking, which could enhance practice. A good example of failure to segregate healthcare wastes from municipal is presented in Figure 2.

Figure 2: Forms mixing waste



Healthcare waste handling

It was observed and mentioned that transporting waste within facilities differ from place to another. Most facilities transport waste by wheelbarrows while others use hands in boxes and polyethene papers. Transporting staff observed with and without personal protective equipment (PPF) – gloves, especially those carrying boxes. They did not have satisfactory PPE to protect eyes, masks, aprons, and closed shoes as recommended by WHO. The fact that this was majorly an observation study, we did not go extra – miles to establish the knowledge of such staff towards this equipment.

Storage and transportation

Over 70% of the healthcare facilities visited, the best form of storing waste is well illustrated in Figure 3.

Figure 3: Illustration of common storage of waste



The facilities have one – three areas where wastes are packed and stored in an open space for various months. This has been the sources of mysterious diseases to health officers. Although some areas are isolated, most of them are near buildings and widows of various personnel. The likelihood of rainwater to flash flued from forms of packs to trenches is possible.

RESULTS AND DISCUSSION

This study documented the separation practices through observation and methods used during the survey with their effect. Although the data collector would move with a familiar person at the health facility to show where bins have been placed and piling / storing of waste, the study indicates that there is still ignorance towards the use of bins. In Kampala, health facilities are both public and private but most private facilities tend to follow separation practice but not to international standard of three bins at a point of separation as mentioned by Lugada et al. (2022). The private health facilities are also limited in space since they are established within urban centers and between congested buildings. This paper however falls short since it did not go extra-miles to assess this extent. It also falls short to compared the SOP guidelines by the WHO although some of SOPs have been practiced as presented in the results. What is clear however remains that with increased population and urbanization, the number of health facilities been raised to serve the increasing patients. The different activities which take place in the due course necessitates the separation and management of healthcare waste although there is no robust system for such (Karenzi et al., 2019).

Results indicate that there is effort by health facilities to buy and place bins in different locations and points of separation. They are placed in the wards, laboratories, and patients' destination (Agunyo et al., 2021). This is a step that needs more support such that patients' caregivers and healthcare personnel adhere to norms that compel using bins. However, there is still a standing question how patients' caregivers can easily and quickly identify variations in bins. Recall, not all of the patient care – givers are literate. The failures in proper segregation are an indication that the government and MOH's guidelines have not fully been implemented the health facilities' directors. It shows inefficiency of the health system that hardly consider healthcare waste management

practices priority to increase and allocate funding to harness the problem. While there are implementing agencies in waste management that work to dispose wastes in designated areas, healthcare waste needs more care and effective agencies with knowledgeable individuals at work. Allocation of more funds to the sector and clear budgeting approaches are essential to comprehend the problem which has been weakly done in the current Uganda.

Therefore, the health institutions emphasis on waste management especially separation need to be strengthened. The fact that separation has been examined at the hospital level, establishing hospital-level waste segregation guidelines, aligned with national health regulations must be worked on. Hospitals need to come up with defined and clear penalties to individuals deviating from the norms of waste separation and incentives to compliant individuals (healthcare personnel and patients' care givers). Above all, the MOH' oversight roles through regular waste audits must be enhanced for effective implementation and compliance and other international standards. Secondly, capacity building and training need to be enhanced at hospital level since it is the most source of healthcare waste. Training must focus on separating waste, packing and storage. The dangers of unseparated waste to humans, environment and soil need to include in training. This training should be mandatory to staff on proper segregation techniques. The waste management certification programs for healthcare workers must be issued and adhered in various aspects of remuneration and recruiting.

The government through MoH must increase waste segregation infrastructure and the focus should be towards the improved infrastructure associated with the Artificial Intelligence (AI). Mandatory installation of color-coded waste bins at all key points in hospitals must be done since they are significantly important in segregating the waste. There should be an implementation of the digital tracking tools (QR codes, RFID tags) to enable personnel towards segregation efficiency in all healthcare facilities. This shall increase transparency, efficiency and responsiveness. Besides, adequate Personal Protective Equipment(PPE) and handling tools for waste personnel must be availed. The MoH and healthcare facility's administration must intensify monitoring, evaluation and accountability mechanisms. These should be done through quarterly waste audits with other intended benefits to support the facility. The MoH should come up with a peer-review accountability systems among hospital items such as bin – used and staff which will increase possible approaches to responsive. The use of automated data collection systems to track waste management performance need to be emphasized within the healthcare units.

As the most stakeholders and beneficiaries as well, community engagement and sustainability programs must be enhanced at each level of private and public hospitals towards generation and separation of bins. These should enable the public have knowledge of how to generate and separate waste, as well as to reduce its generation while at the health facilities. Public awareness campaigns on healthcare waste risks need to be conducted through different fora like burial services, church services, market places and government meetings. This becomes important since the public is one of the sources for the contribute wastes while at the health facilities. The awareness campaigns need to embrace different colors of bins and their numbering, placement and intentions.

Partner institutions such as NGOs and CSOs must be engaged at a high rate so that there is coherence approach to make the public understand bins used while in the hospitals as well as dangers of healthcare waste. Above all, the MoH and healthcare facilities should look for eco-friendly alternatives like biodegradable medical supplies and non-incineration waste treatment. Lastly, each healthcare center needs to come up with risk assessment and mitigation programs with the main focus of identifying risks facing healthcare facilities.

Conclusions

As one of the activities in waste management practices, once it is done properly, segregation improves the safety, efficiency, and environmental sustainability of healthcare waste management. This calls all people involved in generating or collecting healthcare waste to ask themselves about the extent to which they have been accurately doing it in accordance to the WHO standards when especially by applying the “three-bin approach. In doing so, the healthcare waste will be a behavioral practice rather than an instruction narrative. This study has also identified generation and collection of waste as multi-task which involve different people within the facilities. The fact that the use of bins is one of the practices used to collect and generate healthcare waste, the onus remains on proper utilization in order to obtain the heeded results.

Recommendations to the health institutional level: The health institutions should have a high level of training to its personnel in collection and segregation methods of waste. Partner institutions like the NGOs and CSOs need to register with the health institutions under the government umbrella to train personnel in such practices. They should also be aligned with the government authorities in order to win confidence and trust among the health personnel with reference to qualifications, experience and authority. The need to increase bins in healthcare facilities or bins to three at the point of separation is imperative in order to meet international standards under the WHO.

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