

Full Length Research Paper

Factors affecting medical waste management in low-level health facilities in Tanzania

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A study on evaluation of medical waste management systems was conducted in the low-level health facilities (LLHFs) in Dar es Salaam by comparing Ilala and Kinondoni municipalities. Questionnaires, interviews, visits and observation were used in data collection. The study has revealed that; most of the facilities have no specific disposal sites. In Ilala, 70% of the health facilities burn wastes in poorly designed incinerators, open pit burning or on the ground while in Kinondoni, 83% of the facilities bury wastes in the pits. More than 50% of the disposal sites surveyed are not fenced and were in close proximity to human settlements. About 60 and 70% of incinerators in the surveyed facilities in Ilala and Kinondoni municipalities, respectively, are not in good working conditions, 50% of them being of low capacity with some parts missing, e.g., chimneys, ash pits, covers for waste loading and ash removing doors. Also, 9 and 47% of the healthcare facilities in Ilala and Kinondoni, respectively, do not have the Standard Operating Procedures. Medical waste transportation is a serious problem, as 71% of the facilities in Kinondoni carry the wastes on hands to the disposal sites while in Ilala, 40% of LLHFs use wheelbarrows. Waste segregation and colour coding are poorly adhered to while most of the storage areas are too small. It was concluded that, the medical waste management in LLHFs is still poor. Awareness should be raised among LLHFs workers on proper management of the medical wastes.

Key words: Medical waste management, low-level health facility, waste generation, waste segregation, incineration, waste disposal.

INTRODUCTION

According to the Healthcare Waste Management Monitoring Plan, healthcare waste is defined as all the waste hazardous or not, generated by health institutions during medical activities, preventive, curative and/or diagnostic (MOHSW, 2006). Waste from health facilities may be contaminated and become infectious. Manyele (2004) defines medical waste as any solid waste generated in the diagnosis, treatment, or immunization of human beings or animals, related to research, production or testing of biologicals from all types of healthcare institutions, including hospitals, clinics, dental or veterinary and medical laboratories. Infectious medical waste include: culture and stock of infectious agents,

pathological wastes, waste human blood and products of blood, used sharp instruments, contaminated animal autopsy that were in contact with infectious agents and laboratory wastes from medical, pathological, carcasses and body parts, wastes from surgery or pharmaceutical or laboratory wastes (Manyele et al., 2003; Manyele, 2004). More specifically healthcare waste has a high potential of carrying micro-organisms that can infect people who are exposed to it, as well as the community at large if it is not properly disposed of (MOHSW, 2006). The LLHFs include health centers, dispensaries, laboratories and special clinics such as eye clinics, HIV/Sexually Transmitted Diseases, Reproductive Child Health, and dental clinics. These facilities are facing a wide range of challenges in managing waste they generate, spanning from financial, technical and administrative problems. The health facilities in Tanzania

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are struggling to achieve high standards in healthcare waste management, efforts of which are being hampered by financial constraints and lack of skills. Most studies on medical waste management did not focus on such levels. Selection of the LLHFs as the study area was based on the fact that, there were several related studies which have already been conducted in the high-level health facilities (regional and district hospitals) in Tanzania (Manyele et al., 2003; Manyele, 2004; Manyele and Anicetus, 2006) but not in the LLHFs. This study is meant to investigate the critical problems facing the LLHFs, and will provide information that can be used for comparing medical waste management in the LLHFs with the high-level health facilities.

The study was conducted in the Dar es Salaam City, comprising of a sample of LLHFs in the Ilala and Kinondoni municipalities, where a large number of LLHFs of different sizes are located. This study evaluates the whole process of Medical Waste Management in the LLHFs in the city of Dar es Salaam, in particular, by comparing the situation between Ilala and Kinondoni municipalities. Geographically, the two municipalities are at a sea level, as they are bordered by the Indian Ocean on the east. The water table is very low, despite small differences between the two municipalities. The socio-economical state, education, standard of living as well as industrialization is higher compared to other cities and towns in the country. Population density is high, with most of areas being overcrowded, leading to LLHFs located within the close proximity to the residential buildings. The funding for handling biomedical wastes in Ilala and Kinondoni is very poor especially for private facilities, which leads to dubious handling of the medical waste they generate. Skills on medical waste management have been provided to high-level health facilities, without emphasis on the LLHFs. All these problems, necessitates studying the actual situation in the LLHFs.

LITERATURE REVIEW

Healthcare waste management

Healthcare waste management includes all activities involved in waste generation, segregation, transportation, storage, treatment and final disposal of all types of waste generated in the healthcare facilities, stages of which require special attention. This will ensure that inputs (funds, equipment and facilities), activities and outputs (safe workplaces, healthy environment, healthy workers) for the safe handling and disposal of healthcare waste are in place (MOHSW, 2006). Hospital waste handling is a hazardous activity which requires a high standard of training. It calls for specific training that depends on the nature of the work in the hospital, the hazards and possibility of worker exposure, and the responsibilities of

individual workers (US-DOE, 1996; Blackman, 1996). Poor hazardous medical waste management is a problem, not only in Tanzania but also in all other developing countries of the world (Manyele and Anicetus, 2006; Manyele et al., 2003).

Global perspectives of the hazardous medical waste management

Environmentally sound management involves taking all practical steps to protect human health and the environment from hazardous wastes, like medical waste. In an ideal world, this would mean reducing the generation of hazardous wastes to zero. In practice, environmentally sound management means strictly controlling the storage, transport, treatment, reuse, recycling, recovery and final disposal of wastes (UNEP, 2000). When segregated and properly managed, medical waste streams are usually very small in quantity (WHO, 1999). In addition, most waste generated in the healthcare facilities can be treated as regular municipal solid waste except for a varying portion needing special attention such as sharps, pathological wastes, and other potentially infectious wastes, pharmaceutical, biological and hazardous chemical wastes, collectively known as "Special healthcare wastes" and requires proper packaging, storage, transportation and disposal (World Bank, 2000). The lack of segregation between hazardous and non-hazardous waste, an absence of rules and regulations applying to the collection of waste from the hospital wards and the on-site transport to a temporary storage location, a lack of proper waste treatment, disposal of hospital waste along with municipal garbage, insufficient training of personnel, insufficient personal protective equipment and lack of knowledge regarding the proper use of such equipment are among the problems highlighted in literature are prominent factors contributing to poor medical waste management (Manyele and Anicetus, 2006; Meherdrad et al., 2004).

In Africa, the situation of poor medical waste management is similar in South Africa, Mozambique, Swaziland, Kenya and Tanzania (Leonard, 2003; Manyele et al., 2003, Manyele, 2004a; Manyele 2004b; Manyele and Anicetus, 2006). Illegal dumping is a serious problem in most developing countries. Almost all the countries recognized poverty as a basic factor that dwarfed the success of African efforts in the area of environmentally sound management of hazardous waste. An additional challenge was the state of the medical waste incinerators of the low operating temperatures (~ 200°C), resulting in excess generation of toxic gases like HCl, CO, co organics, dioxins and furans. Since the locations of these facilities (in hospitals) are usually located in very close proximity of communities, the emissions from the incinerators present a serious health risk to the same community which the hospital is meant

to serve (Manyele, 2004a).

National perspectives of hazardous medical waste management

Studies conducted in Tanzania regarding medical waste management has described medical waste management in Tanzania as being poor and that the general awareness on issues related to medical waste management, is lacking among generators and handlers (Manyele et al., 2003; Manyele, 2004b; Manyele and Anicetus, 2006). Apart from the poor medical waste management practices reported in Tanzania, steps to combat the problems posed by poor management led to construction of 13 pilot small scale incinerators in various parts of the country, the situation which motivated the government to extend the small scale incinerators to all referral, regional and district hospitals (Manyele, 2004b; Manyele and Anicetus, 2006). There is a serious inadequacy in handling medical solid wastes in the Dar es Salaam City. Due to poor control of wastes, hospital owners are not well inspected on how they handle and dispose of the wastes they produce; as a result, hazardous wastes reach the dumpsite without notice. In addition, they have reported that, data on waste generation in Dar es Salaam is inadequate, making it difficult to plan for an efficient medical waste management system.

Healthcare waste management practices

All individuals exposed to hazardous healthcare waste are potentially at risk of being injured or infected (WHO, 2002). Some of the health facilities have been reported to dispose off the syringes in the pit latrines (Aylward et al., 1995; Manyele, 2004b; Manyele and Anicetus, 2006). When the syringes are not disposed-off properly by burning (destructive incineration) or burying, patient to community transmission of infection can occur. The knowledge of practitioners about the safe disposal methods of used syringes is scanty, which traces back to deficiency of medical colleges' curricula (Gumodoka et al., 1996).

Occupational and public health risks associated with medical waste

Improper disposal of medical waste could expose the hospital to significant penalties, including fines and the suspension of services (Yale-New Haven Hospital and Yale University, 1997). During handling of wastes, the medical and ancillary staff as well as the sanitary laborers can be injured if the waste has not been packed safely. In that respect, sharps are considered to be the most

dangerous category of waste. Many injuries occur because syringe, needles or other sharps have not been collected in safety boxes or because these have been overfilled. On dumpsites, scavengers may also come in contact with infectious waste if not properly treated or disposed of. Dumping healthcare waste in open areas is a practice that can have major adverse effects on the population. The chemical poisons in hospital wastes can affect different parts of the body; for instance, hepatotoxic (e.g., carbon tetrachloride, tetrachloroethane), nephrotoxic (e.g., halogenated hydrocarbons); haematopoietic (benzene, phenols); and neurotoxic (e.g., methanol, metals and/organometallics) and anesthetics agents (e.g., ethyl ether, esters and acetylene hydrocarbons) (Griffin, 1990).

Dumping of healthcare waste in uncontrolled areas can have a direct environmental effect by contaminating soils and underground water. During incineration, if no proper filtering of flue gases is done, air can be polluted causing illnesses to the nearby populations. This has to be taken into consideration when choosing a treatment or a disposal method by carrying out a rapid environmental impact assessment (UNEP/WHO, 2005). In addition to health risks to patients and personnel, consideration should be given to the impact of healthcare waste on human health and the environment outside the healthcare establishments (Rutala and Mayhill, 1992). At the level of the built environment, the size and structure of a settlement has an important influence on the character and urgency of waste management needs. In urban areas, the physical characteristics of a settlement including such factors as density, width and condition of roads, topography, etc., need to be considered when selecting and/or designing waste collection procedures and equipment such as containers and vehicles (Peter et al., 1996). At the level of natural systems the interaction between waste handling procedures and public health conditions is influenced by climatic conditions and characteristics of local, natural and ecological systems. The degree to which uncontrolled waste dump sites become breeding ground for insects, rodents and other disease vectors and a gathering place for dogs, wild animals and poisonous reptiles depends largely on prevailing climatic and natural conditions. In practical terms climate determines the frequency with which waste collection points must be serviced in order to limit negative environmental consequences (Peter et al., 1996). In the last few years there has been growing debates over the incineration of healthcare waste. Under some circumstances, including when wastes are incinerated at low temperatures or when plastics that contain polyvinyl chloride (PVC) are incinerated at low temperatures, dioxins and furans and other toxic air pollutants may be produced as emissions and/or in bottom or fly ash (ash that is carried by air and exhaust gases up the incinerator stack). Exposure to dioxins, furans and co-planar Polychlorinated Biphenyls (PCBs)

may lead to adverse health effects (WHO, 2006). Not only that, but also antibiotics poured down the drain can kill beneficial microbes and bacteria in septic systems.

STUDY METHODOLOGY

Population, sampling procedure and sample size

Random sampling design was used to obtain the LLHFs in which the study was conducted. These included health centers, special clinics. All LLHFs of Kinondoni and Ilala were listed. During random sampling each health facility was selected depending on the total number of particular LLHFs in a municipality. The cross-sectional study was conducted in a total of 65 selected LLHFs of Ilala and Kinondoni municipalities. In Ilala 35 LLHFs were selected and in Kinondoni only 30 LLHFs were selected.

Data collection

The main tools used in data collection were questionnaires, interviews, visiting and personal observation. Questionnaires were distributed to different health facility workers in different departments of the selected health facilities. The focus was on evaluation of the risks of infections associated with improper handling of hazardous medical waste, also assessing the use of sustainable and safe procedures of handling and disposing medical waste and lastly assessing the time taken to store medical waste in the selected health facilities in Ilala and Kinondoni municipalities were used. Secondary data such as available documents, e.g., different reports from different departments served also as a source of information.

Major parts of the questionnaires/assessment tool

General information of the facility

This part of questionnaire mainly inquired on the general information such as the number of employees/workers in the facility, the average number of patients served in each health facility and the accompanied departments in the health facilities.

Waste generation and handling

This part of questionnaires investigated on the type of waste generated in the health facilities. In this case the following types of wastes were investigated: Infectious wastes (e.g., blood and body fluids), anatomical wastes (e.g., human tissues, body parts, foetus, etc.), sharps waste, chemical wastes (e.g., reagents, solvents, etc.), pharmaceutical wastes, (e.g., outdated medications), radioactive wastes and genotoxic wastes. Also investigations were made to know if there are any protective gears used during handling of the waste.

Waste storage

This part investigated on the presence of a temporary storage premise large enough to handle the waste generated. Also investigations were made to know if the facilities temporarily store waste before treatment and disposal, and if the waste is stored, for how long the facility stores that waste before further actions. The standard time for storing medical wastes recommended by the World Health Organization should not exceed 24 h. Also

investigations were made to know if the waste handler weigh and keep records for the waste generated. This part also investigated the presence of any hand washing facility and a written Standard Operating Procedure (SOP) for waste management in the facilities. So the time from the responses was compared to this standard time. Storage areas should be fenced, big enough and well ventilated and should be accessible by the authorized personnel only.

Waste segregation

Investigation was made on whether the facility practices waste segregation or not. Also the following were investigated: if the color coding system were used in managing waste in the facilities, the type of containers used in collection of waste in the health facilities and if those containers were readily available all the time for use. Also the average filling capacity of the bins and the number of containers present for waste collection per section were investigated. Investigations were also made to know if there is any special equipment for sharp waste handling in health facilities.

Treatment and disposal of healthcare waste

This part of questionnaires investigated on the methods and the siting of waste treatment facility in the respective LLHF, also the presence of any specific area for healthcare waste disposal was investigated. The disposal method used in health facilities and means of healthcare waste transportation were also investigated. Investigations were also made to know if the facilities incinerate wastes, the size of the incinerator present in the health facility, and if the incinerators were in good operating conditions.

Management issues

Investigations were made to know if there is any training provided to the healthcare workers on good practices in healthcare waste management, to whom it was provided, if the facilities face any problem in conducting waste management, also if there are any external funds to support waste management practices in the health facilities and if the funds were enough.

Data analysis

The numeric data collected from the selected health facilities in Ilala and Kinondoni municipalities was compiled using the Microsoft Excel computer software. Then data was coded using the numbers 1 and 0. Number 1 implies the presence of a particular item and 0 the absence of such item/category. The coded items were summed up to provide the frequencies and the percentage was calculated using MS Excel and SPSS software.

RESULTS AND DISCUSSION

Number of workers in the health facilities

Medical waste management in all health facilities depends on the number of workers in different departments. If the number of workers in the health facilities is not satisfactory the healthcare workers may devote most of their time in attending the patients with little attention paid to medical waste management.

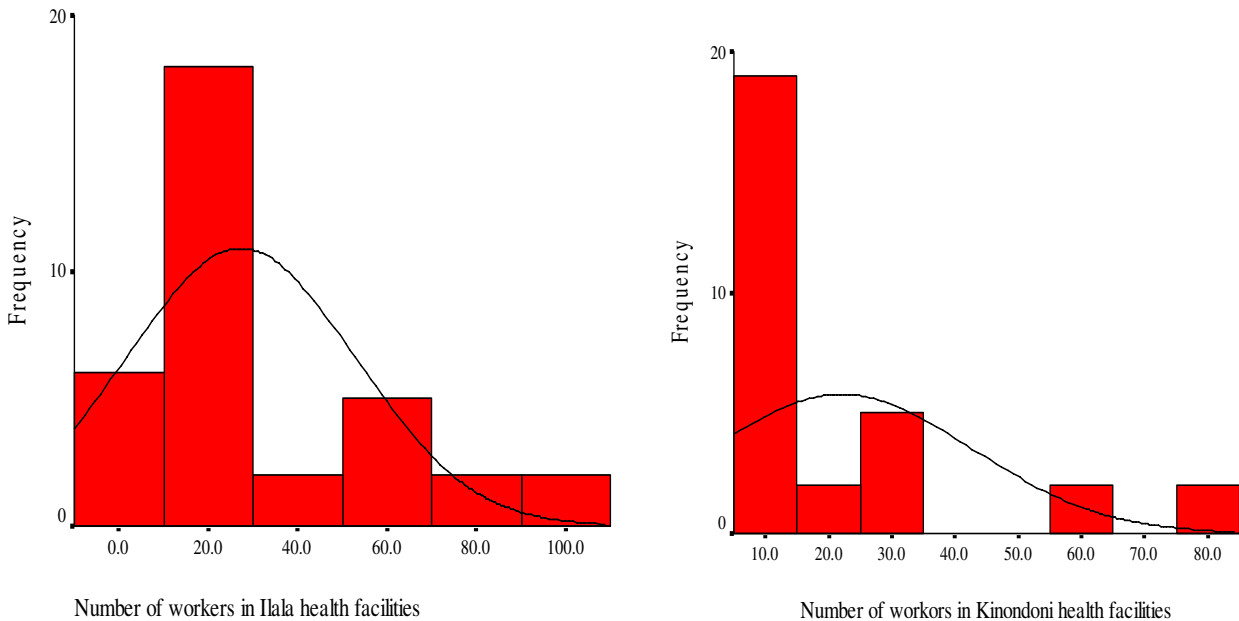


Figure 1. Distribution of the number of workers in Ilala and Kinondoni LLHFs.

Hence, extra costs have to be incurred to pay for laborers. On the other hand, this is directly related to poor medical waste management. Figure 1 shows the histogram of the number of workers in Ilala and Kinondoni LLHFs. In the 35 healthcare facilities surveyed in Ilala municipality a total number of 956 workers who served 1,577 patients per day were observed. Right skewness of the curve implies that most of the facilities have the number of workers which is higher than the mean value that is 27. The maximum number of workers per health facility being 95 and minimum number was 6. Hence, the work load in terms of patients served per day is reasonable so that workers can effectively take part in medical waste management.

In the 30 surveyed health facilities in Kinondoni municipality, however, the total number of workers was 661 and the total number of patients served in those facilities was 1705. The maximum number of workers was 83, the mean value was 22 and the minimum number of workers was 5 as shown in Figure 1. This means that, in average there are about 22 workers in each health facility. Right skewness of the curve implies that in most of the facilities in Kinondoni the number of workers is beyond the mean with an extremely high staffing value up to 83 workers.

Number of patients served daily in the LLHFs

Figure 2 shows the distribution of number of patients served per day for LLHFs in Ilala and Kinondoni Municipalities. Right skewness of the curve implies that the number of patients served per day in most of

the facilities in Ilala is higher than the average but with an extremely high value to the right in which 350 patients are served in Mnazi Mmoja health facility, which has resulted into right skewness. The maximum number of patients served per day in Ilala health facilities was 350; the minimum number being 6 patients per day. The average number of patients served in Ilala health facilities per day is 25. The higher the number of patients served per day the higher the amount of medical waste generated, hence increased chances of transmission of infectious diseases and the higher the rate of environmental pollution, if the waste generated is not properly monitored.

In the surveyed 30 health facilities in Kinondoni, the, maximum number of patients served per day was 400; the mean value was 57 and the minimum value was 8 patients per day. This means that on average 57 patients are served per day in Kinondoni whereas in Ilala 25 patients are served per day. Thus, Kinondoni will generate large quantities of healthcare waste than Ilala. Right skewness in this case implies that the number of patients served in some of the facilities is beyond the mean, but with two extremely high values to the right in which there is up to 350 and 400 patients served per day in Magomeni and Tandale health facilities, respectively. These LLHFs are located in densely populated areas of the city.

The ratio of patients per worker in the LLHFs

Figure 3 shows the spread of data for the ratio of patient served per worker in Ilala and Kinondoni health facilities. In majority of the facilities the average number of patients

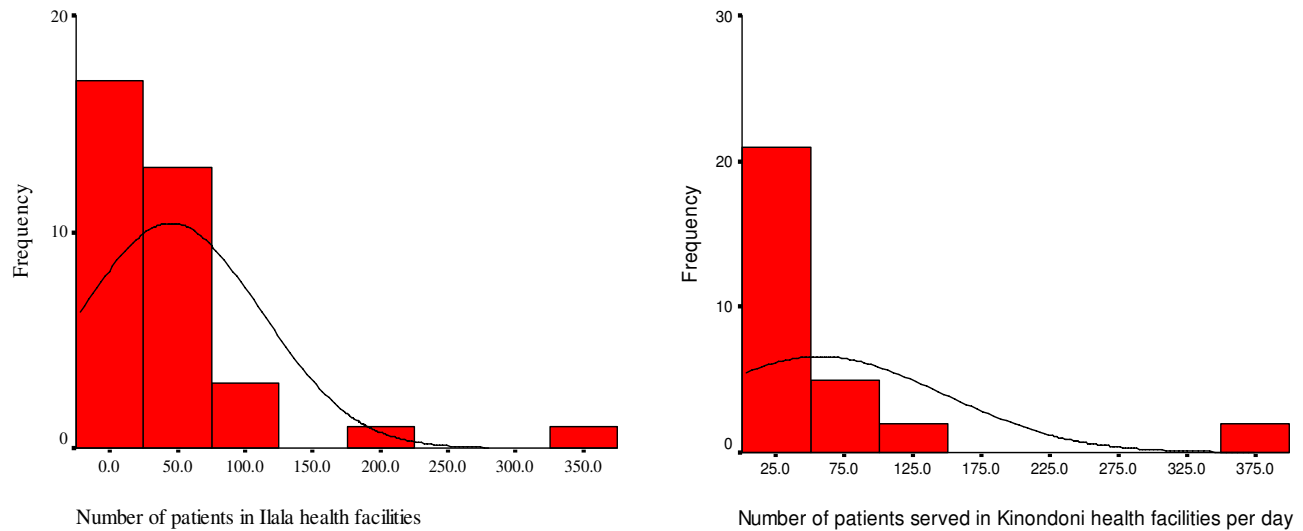


Figure 2. Distribution of the number of patients served in the LLHFs per day.

served per worker is 2. The right skewness of the curve implies that the ratio of workers per patient in some of the facilities in Ilala is higher, up to 10 patients per worker which indicates that some workers serve a higher number of patients beyond the average of 3 patients per worker. This is the case for the Arafa dispensary of Vingunguti and Appolo health facility of Mchafukoge in which the patients per worker ratio are 7 and 10, respectively.

However the minimum ratio is 0.12 which indicates that some workers are idle during the day due to fewer patients visiting their health facilities. This can be attributed to low number of patients visiting the LLHFs due to their poor services or lack of specific services or expertise.

As compared to Ilala health facilities in which the maximum ratio is 10, in Kinondoni health facilities the maximum ratio is 25; the mean value is also 3 and the minimum value is 0.14. This means that about 3 patients are served per worker per day. The fact that up to 25 patients are served per worker per day indicates a deterioration of health services and generation of larger volumes of unmanaged healthcare waste, especially in Tandale dispensary located in a densely populated area in Manzese.

The major departments in the health facilities

The major departments in the surveyed LLHFs are laboratories, pharmacies, general stores, inspection rooms, operation rooms, wards and doctors' offices. All health facilities in Ilala and Kinondoni municipalities have doctors' offices, in which patients get consultation and medical treatment. More than 90% of LLHFs in both municipalities have laboratories, in which patients' samples are taken for diagnosis to be undertaken, and

which contribute to hazardous waste generation. Examples of patients' samples collected include blood, stool, urine, sputum, etc. Only few low-level facilities have operation rooms (23 and 27% of LLHFs in Ilala and Kinondoni, respectively) because most of the operations are referred to the high-level health facilities. Such rooms generate hazardous infectious waste which needs attention. This is because the high-level facilities have most of the equipment used for operations and the specialist doctors are mostly found in the high-level facilities than in the LLHFs.

Only 46% of the surveyed health facilities in Ilala and 50% in Kinondoni have wards for admitting patients. Only a small percentage of patients are admitted in the LLHFs, most of the patients are admitted in the high-level facilities. The number of departments in each health facility has a close relation to the amount of medical waste generated in the health facility. Figure 4 shows the percentage distribution of the surveyed health facilities with different departments in Ilala and Kinondoni municipalities.

Waste generated and handling

Each department in the health facility generates a certain amount of waste which varies depending on the activities carried out in the particular department. It was difficult to know the actual amount of waste generated in the surveyed facilities because none of those facilities weigh and keep record of the waste generated. The study revealed that most of the surveyed LLHFs in Kinondoni municipality generate radioactive wastes. Radioactive waste includes liquid, solids and gases contaminated with radionuclide whose ionizing radiations have genotoxic effects and these includes x-rays, gamma-rays as well as

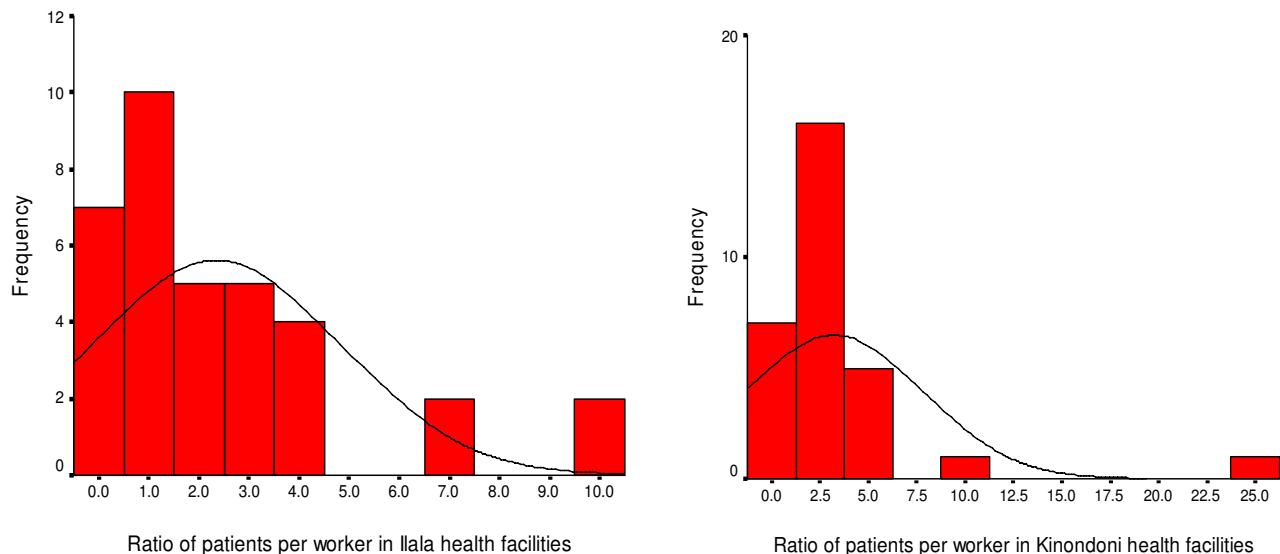


Figure 3. The ratio of patients per worker in Ilala and Kinondoni health facilities.

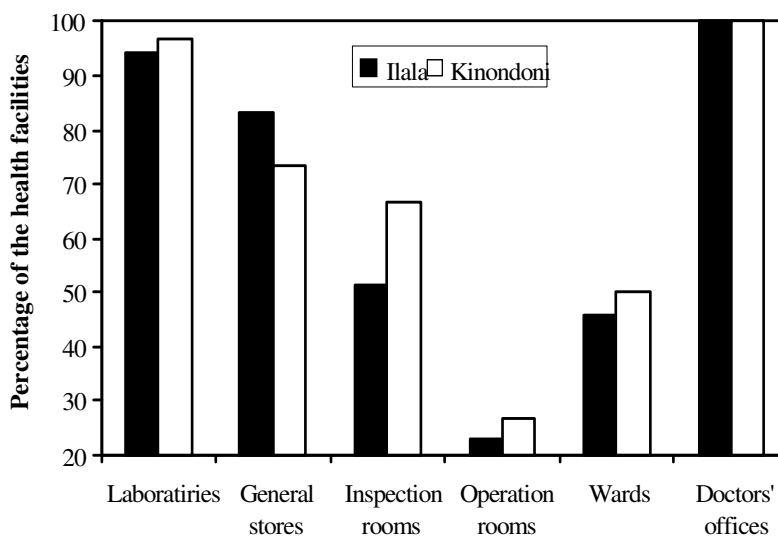


Figure 4. Percentage distribution of the surveyed health facilities with accompanied departments in Ilala and Kinondoni municipalities.

alpha and beta particles. This implies that in Kinondoni municipality, there are a high number of facilities in which those radio nuclides are produced. In Ilala, only 6% of the health facilities generate such wastes due to a few number of the facilities engaged in activities which results into generation of radioactive wastes. Sharp wastes includes all objects and materials that pose a potential risk of injury and infection due to their puncture or cutting properties e.g., syringes with needles, blades, broken glasses, etc. Generation of sharp wastes by majority of the facilities in Ilala municipality is contributed by a number of factors; this can be due to the fact that most of the surveyed facilities in Ilala are situated in urban areas and

few facilities in semi-urban areas, whereas in Kinondoni most of the surveyed facilities are located in semi-urban areas. The status of people in urban and semi-urban areas differs, with high living standard in urban areas who can afford health services and hence more medical waste generation. Figure 5 shows the percentage distribution of the surveyed LLHFs and the type of waste generated in Ilala and Kinondoni municipalities.

Chemical wastes in Ilala were generated by 40% of the surveyed facilities and in Kinondoni 90% of the surveyed facilities generate such waste. Infectious waste in Ilala is generated by 46% of the surveyed facilities whereas in Kinondoni is generated by 67% of the surveyed health

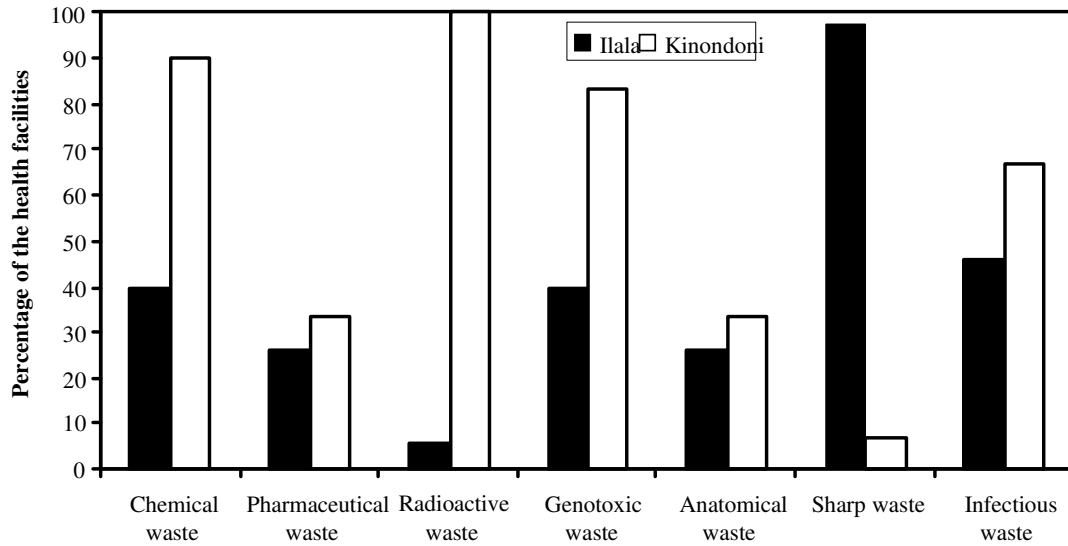


Figure 5. Percentage distribution of the surveyed LLHFs and the type of waste generated in Ilala and Kinondoni municipalities.

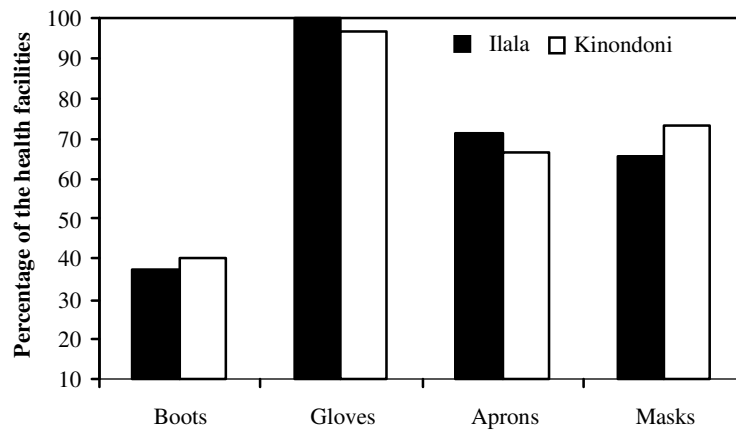


Figure 6. Percentage distribution of the surveyed LLHFs and the protective gears used in Ilala and Kinondoni municipalities.

facilities. Infectious waste include all biomedical and healthcare waste known or clinically assessed to have the potential of transmitting infectious agents to human or animals. These basically depend on the activities performed in the respective department and the type and number of patients attending the facilities. Highly infectious waste includes all viable biological and pathological agents artificially cultivated in significant elevated numbers, e.g., cultures and stocks, which are mainly generated in hospital health laboratories. Some health facilities in the two municipalities generates anatomical wastes, these include all organs including placentas, tissues as well as blood and other body fluids. These wastes are not much generated in the facilities of the two municipalities (about 30% of LLHFs) based on the number of patients attending those facilities. Thus,

most of patients of prenatal and postnatal cases are attended in the government hospitals as there are currently no any charges.

The protective gears for medical waste management

Figure 6 shows the percentage distribution of the surveyed LLHFs and the protective gears used in Ilala and Kinondoni municipalities. The main protective gears used in the LLHFs surveyed in the two municipalities are gloves, boots, aprons, coats and masks. All surveyed health facilities in Ilala use gloves while in Kinondoni 97% of the surveyed LLHFs use gloves. This is because gloves are the mostly used protective gears to protect hands from infectious materials. Types of gloves to be

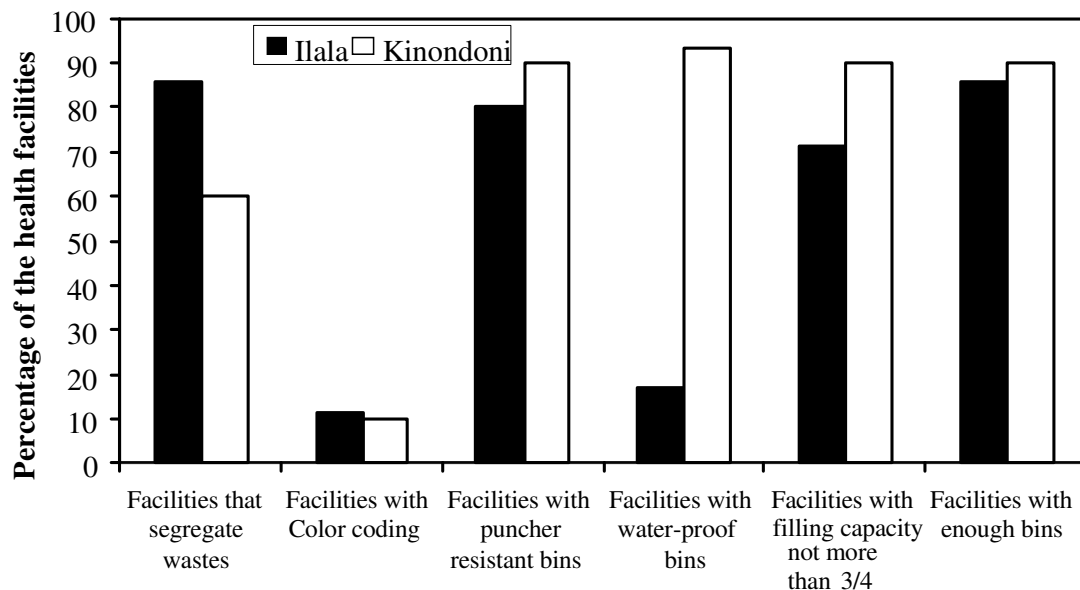


Figure 7. Percentage distribution of the surveyed LLHFs and the segregation steps followed in Ilala and Kinondoni municipalities.

worn depend on the handling activity to be conducted. More than 65% of the surveyed LLHFs in the two municipalities use apron and masks. Apron is made of rubber or plastic to provide a waterproof barrier along the front of the health facility workers' body.

Aprons should be worn during cleaning or during procedure in which blood or body spills are expected, to prevent soiling of the service providers' dresses. Only 37% of the LLHFs in Ilala and 40% in Kinondoni municipalities use boots as protective gears in medical waste management. This percent is low compared to the importance of the boots in blocking hazards posed by medical waste generated in LLHFs. Thus, enough personal protective gears should be supplied to the health facilities so as to rescue the life of service providers' and patients.

Waste segregation

Figure 7 shows the percentage distribution of the surveyed health facilities and the segregation steps performed in Ilala and Kinondoni municipalities. Most of the surveyed LLHFs in the two municipalities segregate medical waste into infectious and non-infectious waste. In some facilities even though segregation is performed, sharp wastes are later found mixed with general waste during incineration. So In some facilities, segregation is not perfectly performed, despite the availability of specific containers for waste collection. In most of the facilities no proper segregation as general waste and sharps waste were observed mixed in common collection vessels. Proper segregation of healthcare waste must follow the

standardized procedures, according to national guidelines. It is important to segregate waste because it fosters the reduction of risks to healthcare workers, and enhances cost control for hazardous waste disposal by decreasing treatment costs. Also, majority of the surveyed LLHFs have enough bins for waste collection such as puncher resistant bins and water proof bins with exception of the Ilala municipality in which only 17% of the surveyed health facilities have water proof bins. This is due to lack of awareness and poor management in LLHFs. In some of these health facilities the bins were overfilled. Despite the availability of enough bins in some health facilities color coding practices in the two municipalities is poor. Only 11% of the surveyed facilities in Ilala and 10% of the surveyed facilities in Kinondoni municipality practice color coding. This implies that wastes are segregated into infectious and non-infectious wastes but the process does not put into consideration color of the containers or bags attributable to poor management in the LLHFs.

The recommended color coding states that yellow color should be applied to the safety boxes used to collect sharp wastes, needles and syringes and also radioactive waste; red color should be used for containers used to collect infectious wastes and blue color should be used for containers used to collect non-infectious wastes. Thus monitoring healthcare waste management should be a continuous process involving generation or production, segregation, transportation, and disposal of healthcare waste. Bags and containers of waste collected must be replaced immediately by new ones of the same type. Thus, a supply of fresh waste collection bags or containers must be readily available at all times where

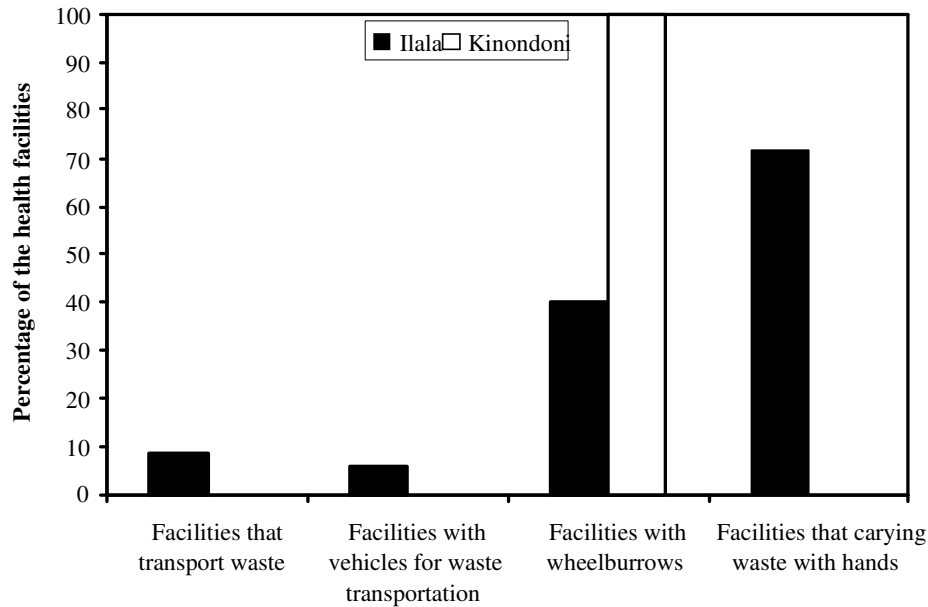


Figure 8. Distribution of the surveyed health facilities and important issues on waste transportation in Ilala and Kinondoni municipalities.

waste is produced.

Medical waste transportation

In all of the surveyed LLHFs, transportation of medical waste is the major problem, as shown in Figure 8. About 9% of the surveyed facilities in Ilala transport waste and none of the health facility transport medical waste in Kinondoni municipality. This is because none of the municipalities have a public medical waste treatment unit, so that they rely on on-site disposal. Some health facilities with off-site transportation/treatment have supporting companies to facilitate the process. Problems hindering off-site transport include lack of designated vehicles for waste transportation. Off-site transportation is required when hazardous healthcare waste is treated outside the healthcare facility. In Ilala, only about 6% of the LLHFs have vehicles for medical waste transportation while none exist in Kinondoni, because most of the surveyed facilities in Ilala are privately owned as compared to Kinondoni in which most of the facilities are publicly owned. All surveyed health facilities in Kinondoni municipality use wheelbarrows for medical waste transportation and in Ilala up to 40% of the surveyed health facilities use wheelbarrows. This is basically due to the poor management and financial crisis for both private and public facilities. This means that all surveyed LLHFs in Kinondoni municipality performs on-site disposal of the medical waste using wheelbarrows as the means of transporting medical waste.

It is interesting to note that 71% of the LLHFs in Ilala carry the medical waste on hands to the disposal areas.

Transporting the waste on hands is a hazardous process because it can harm the waste collectors if not well packed and treated. This can easily lead to transmission of infectious diseases to the health workers. During on-site transportation, healthcare waste should be transported within the hospital by means of wheeled trolleys, containers or carts that are not used for other purposes.

Medical waste storage

Most of the surveyed health facilities in Ilala and Kinondoni municipalities store the medical waste and the waste is stored not more than 24 h in majority of the facilities. The main problem with storage is that the storage premises are not big enough to handle the medical waste generated. Figure 9 shows the percentage distribution of the surveyed health facilities and the important issues on waste storage in Ilala and Kinondoni municipalities. Only 49% of the surveyed health facilities in Ilala and 43% of the surveyed health facilities in Kinondoni have large storage premises. It is suggested that, non-risk healthcare waste should always be stored in a separate location from the infectious or hazardous healthcare waste in order to avoid cross-contamination. The storage area should be big enough and well ventilated.

The findings of the study show that, it is just few health facilities in the two municipalities that weigh the wastes and keep the record of waste generated. In Ilala only 11% of the surveyed health facilities weigh the wastes and keep the records while only 7% of LLHFs do so in

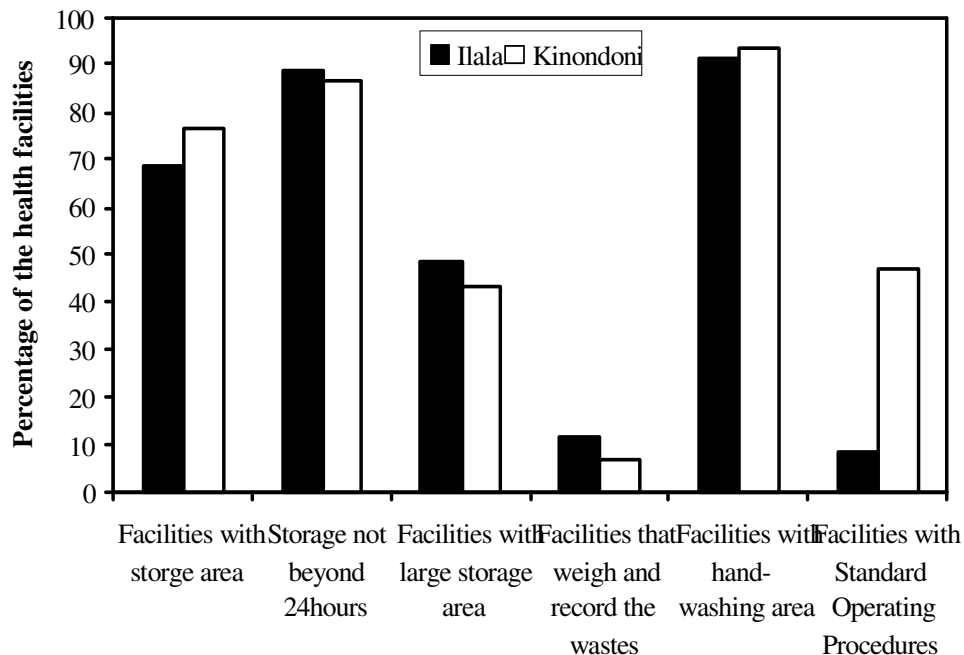


Figure 9. Percentage distribution of the surveyed health facilities and important issues on waste storage in Ilala and Kinondoni municipalities.

Kinondoni. This is also the management problem in the LLHFs because the amount of waste generated in all facilities should be weighed and recorded in order to know the amount of waste generated per day so as to be able to plan for the management of such wastes. Furthermore, it is just few of the surveyed health facilities have the Standard Operating Procedures (SOPs) for medical waste management. For instance, only 9% of the LLHFs in Ilala and 47% in Kinondoni have SOPs. Lack of SOPs in the facilities implies that those facilities work through experience and not due to laid down guidelines. It is also a management problem because the guidelines for good practices on medical waste management should be developed by all health facilities. Majority of those surveyed health facilities in the two municipalities have hand washing areas.

Treatment and disposal

The most effective means of preventing the transmission of blood borne pathogens is to prevent exposure to needle stick injuries. Figure 10 shows the percentage distribution of the surveyed health facilities according to the waste treatment methods in Ilala and Kinondoni municipalities. Findings of the study have shown that some of the surveyed facilities have specific area for medical waste disposal. In Ilala only 54% and in Kinondoni only 10% of the surveyed health facilities have such areas. This means that some of the waste is disposed of in open areas and some into latrines and in

rubbish pits. This seems to be a problem not only in the LLHFs in the Dar es Salaam city but also in other cities in Tanzania. For example a study which was conducted in Mwanza region of Tanzania reported that, in most of the healthcare facilities, rubbish pits were used for disposal of the discarded syringes and needles and these rubbish pits were so shallow, that used syringes could be retrieved from them easily. Some of the health facilities disposed off the syringes in the latrine. None of these practices are adequate in medical waste management.

In Kinondoni majority of the surveyed health facilities disinfect sharp wastes and syringes after use but in Ilala only some health facilities disinfect sharps waste. If sharp wastes are not disinfected after use and yet 54% of those facilities have no specific areas for medical waste disposal, most of the infectious diseases affecting people in the municipality might have been transmitted through infected sharp wastes. It was observed that some of the surveyed health facilities perform off-site treatment of the medical waste in the two municipalities. In Ilala, only 49% of the LLHFs and 53% in Kinondoni use off-site treatment of the medical waste. The main disposal mechanism for the medical waste in Ilala health facilities is incineration, whereby, 71% of the LLHFs in Ilala use incinerators. In some LLHFs the water table is so shallow that pits for burying cannot be made. In Kinondoni, only 43% of the LLHFs incinerate the medical waste. The disposal sites in the two municipalities are not of good standard, it is only 8.5% of the surveyed disposal sites set at 1.5 m above the water table, and in Kinondoni only 27% of the surveyed sites are set at 1.5 m above the water table. If

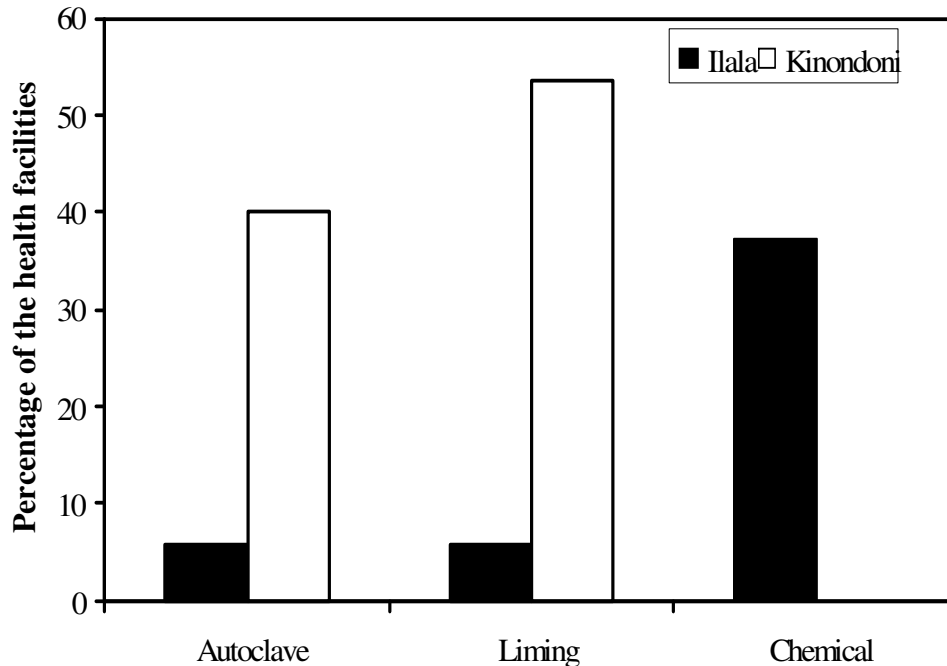


Figure 10. Distribution of the surveyed health facilities according to waste treatment method in Ilala and Kinondoni municipalities.

If the incinerated ashes contain heavy metals, the latter can easily access the groundwater, if the ashes are not properly managed. It was also observed that the wastes are incompletely burnt, and that those areas in which infectious wastes are buried some vegetable gardens are prepared. The main disposal mechanism in Kinondoni health facilities is burying, where 83% of the LLHFs bury the medical waste since in most of the areas the water table is not shallow as in Ilala. In Ilala facilities it is only 3% of the surveyed facilities that bury the medical waste.

Alternatively, some health facilities in the two municipalities use autoclaves, liming and chemical method for the medical waste treatment. Only 5.7% of the surveyed facilities in Ilala have autoclaves compared to 40% in Kinondoni. It is obvious that autoclaves are expensive that's why just few private LLHFs afford to purchase them. In Ilala, again 5.7% of the LLHFs use liming in treating medical waste while in Kinondoni, liming is used by 53% of the surveyed facilities. In Ilala only 37% of the surveyed facilities use chemicals in medical waste treatment which was not observed in Kinondoni. Majority of the surveyed disposal sites were not fenced and they are situated in close proximity to the human settlement areas. It is more interesting to note that in those open places the wastes are not completely burnt, some pieces of sharp wastes and other wastes are left and these can be picked up by children to play with. If those wastes are not properly treated there is a greater risk of transmitting infectious diseases to the community. In some health facilities wastes are left in their containers

in the disposal sites for several days before treatment, which is unsafe practice.

Incineration

The findings of the study show that majority of the surveyed facilities in the two municipalities incinerate medical waste and most of the incinerators are present within the respective health facilities. Figure 11 show the percentage distribution of the surveyed health facilities and the incineration information in Ilala and Kinondoni municipalities. The results showed that 60% and 70% of the surveyed facilities in Ilala and Kinondoni, respectively, have incinerators which are not in good operating condition. Most of the incinerators have worn out chimneys or were made without chimneys, and most of the incinerators lack covers for the waste feeding door and in the ashes removing door. It is just in few facilities in which the disposal sites with incinerators are fenced and located far from the human settlement areas. In Mzizima dispensary of Ukonga the incinerator is located too close to the human settlement areas, the chimney is long but the covers are missing. Most of the incinerators have no ash pits for ashes collection, thus 46.7% of the surveyed facilities in Ilala and 56.7% of the surveyed facilities in Kinondoni have no ash pits for ash collection.

Furthermore, most of the incinerators are small and not enough to handle amount of medical waste generated. In Kinondoni 70% of the surveyed facilities have small

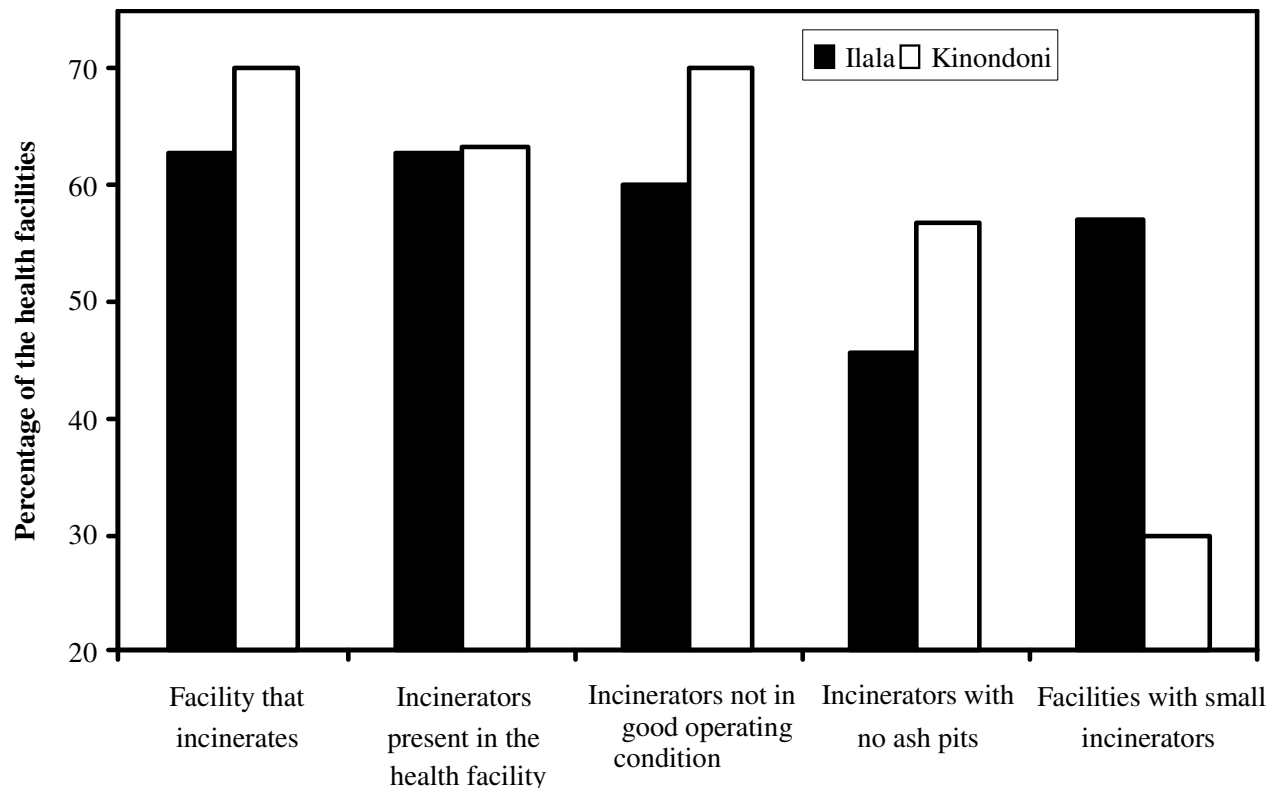


Figure 11. Distribution of incineration information in Ilala and Kinondoni municipalities.

incinerators. These are basically of small-capacity single chamber incinerators. It is interesting that in Ilala burning is the major wastes disposal mechanism but still most of the incinerators are not in good working conditions. During waste disposal high temperature dual-chamber incinerators are more effective than the small capacity-single chamber incinerators. The small capacity-single chamber incinerators may nevertheless constitute a serious air pollution hazard to the surrounding area due to the relatively low operating temperatures and the lack of emission control systems. For this purpose, only well trained staff should operate the incinerator. Proper operation procedures must be followed to ensure high temperatures are adequately reached. It is interesting that no specific areas for burying ashes from incinerators are allocated in some LLHFs. In highly populated areas high temperature incinerators (900°C) should be used for infectious wastes disposal. Improper or incomplete combustion by incinerators can produce pollutant gases which are not environmentally friendly.

Health facility management issues

The study shows that management of medical wastes in the surveyed LLHFs is poor. This is contributed by several factors, especially those related to facility

management. Figure 12 shows the percentage distribution of the surveyed health facilities and the management issues in Ilala and Kinondoni municipalities. In Ilala only 25.7% of the surveyed health facilities involve all members in the whole process of medical waste management. Also in Ilala municipality only 37.1% of the surveyed facilities provide training on good practices on medical waste management. Hospital waste handling is a hazardous waste activity which requires a high standard of training. It calls for specific training that depends on the nature of the work in the hospital, the hazards and possibility of worker exposure, and the responsibilities of individual workers. Moreover, no facility receives enough external funds to support medical waste management in the LLHFs. It is only 2.8% of the surveyed facilities in Ilala and 13% of the surveyed facilities in Kinondoni that receive external funds to support medical waste management. This is the reason which has resulted into the situation of having incinerators which are not in good operating condition. Having enough funds the incinerators could be maintained or high temperature incinerators could have been procured. Furthermore, respondents from 83.3% of the surveyed facilities in Kinondoni have stated to have problems in the whole process of medical waste management. All problems faced in the surveyed facilities are mainly caused by lack of supportive supervision in all management activities

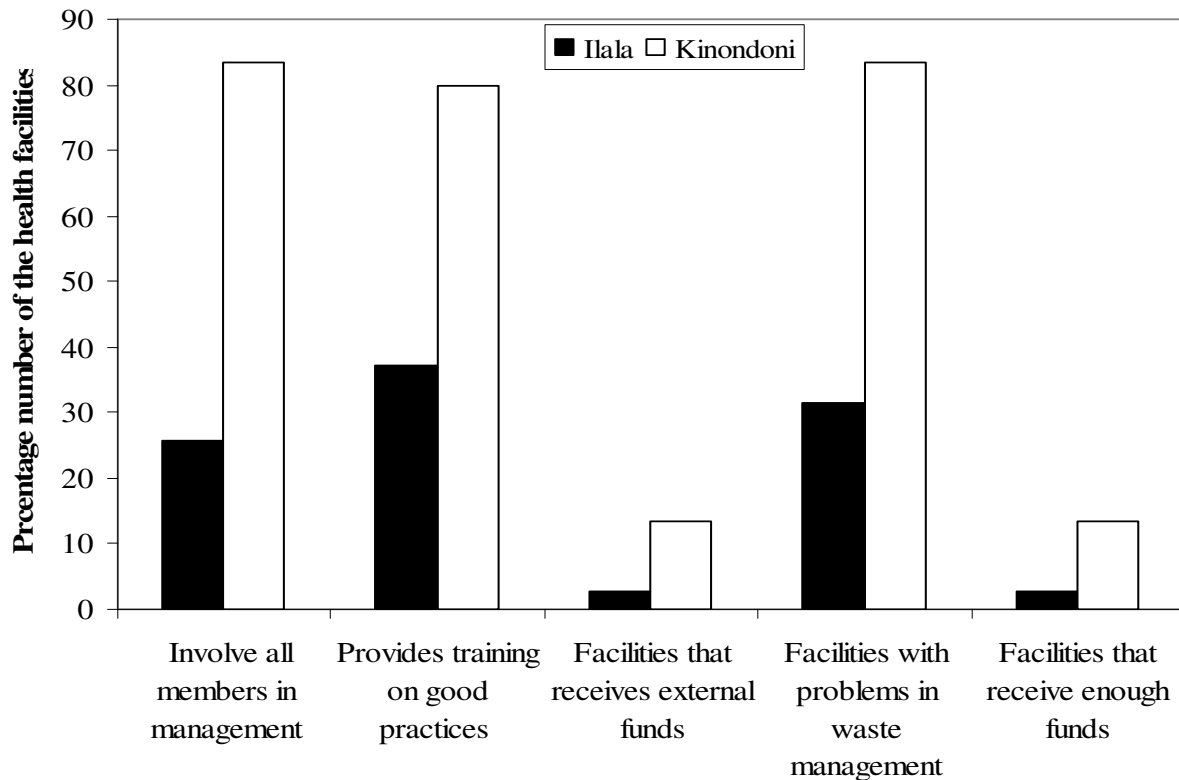


Figure 12. Analysis of the management issues in LLHFs in Ilala and Kinondoni municipalities.

and financial crisis for public health facilities in the two municipalities.

CONCLUSION AND RECOMMENDATION

The findings of the present study have shown that the process of medical waste management in the surveyed LLHFs in Ilala and Kinondoni municipalities is poor. No safe disposal in most of the health facilities. Thus, in most of the health facilities no specific sites for medical wastes disposal, no designated vehicles for waste transportation, etc. It is only a few of the surveyed health facilities that have vehicles for transportation of medical waste. Thus, some of the waste collectors carry the waste on hands and just few of the surveyed health facilities transport the waste using wheelbarrows. Some of the surveyed health facilities use burning and burying as the methods of waste disposal. Most of the wastes are burnt in open areas and the wastes are not completely burnt. In some facilities infectious wastes are buried in shallow pits in areas with shallow water table, in addition some shallow pits are made just adjacent to the vegetable gardens. This is not safe since decomposition of those wastes in the shallow pits can easily transmit infectious diseases to the community. It is interesting that most of the disposal sites are not fenced and are found in close

proximity to human settlement areas. So the risks of transmission of infections associated with improper handling of hazardous medical waste are high.

The findings of the study have also shown that incinerators in most of the health facilities are not in good working conditions, that is, they are too small to handle the amount of medical wastes generated, some lack ash pits for ashes collection, in some incinerators some parts are missing, e.g., chimneys, covers for the waste feeding door and covers for ashes removing door. It is only few health facilities which segregate waste into infectious and non-infectious waste and color coding practices in the surveyed health facilities in the two municipalities is poor. The present study has revealed that in some facilities the healthcare waste is stored for more than 24 h. So it is concluded that medical wastes handling and disposal procedures in the health facilities in the two municipalities are not sustainable and safe. Also majority of the health facilities do not have the Standard Operating Procedures. Not only that but also most of the facilities do not involve all members in the whole process of medical waste management, no regular training and furthermore, untrained casual laborers are involved in the process of medical waste management. Most of the facilities are facing financial crisis and still no facility receives enough external funds to support medical waste management. These conclude that in most of the surveyed LLHFs the

process of medical waste management is generally poor.

RECOMMENDATION

The following recommendations have been suggested:

- All LLHFs should be provided with Standard Operating Procedures so as to act according to those procedures.
- Efforts have to be made in reinforcement or implementation of the existing waste management guidelines in each municipality.
- All disposal sites should be established far from the human settlements and should be fenced.
- Healthcare waste handlers need to be adequately trained and provided with enough Personal Protective Equipment.
- Enough external funds are needed to support medical waste management (monitoring and evaluation) in the LLHFs.
- To make the disposal mechanism of the medical waste effective, action should be taken by the responsible personnel to make sure that all incinerators are in a good working condition and with ash pits for ashes collection and replacement of the missing parts and if possible to purchase the high temperature incinerators.
- Pits for burying sharp wastes or infectious wastes should not be made in the areas with shallow water table so as to save the environment and the peoples' health.

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REFERENCES

- Aylward B, Lloyd J, Zaffran M (1995). "Reducing Risk of Unsafe Injections in Immunization Programmes", Financial and Operational Implications for Various Injection Technologies. Bull. World Health Organization 73: 531-140.
- Blackman WC (1996). Basic Hazardous Waste Management, 2nd Edition, Lewis Publishers, Inc., Michigan.
- Griffin RD (1990). "Principles of Hazardous Materials Management", Lewis Publishers, Inc., Michigan, USA.
- Gumodoka B, Vos J, Berege ZA (1996). "Injection Practices on Prescriptions, Patient Demand and Sterility in Mwanza Region, Tanzania", Trop. Med. Int. Health 1: 874-880.
- Leonard L (2003). "Health Care Waste in Southern Africa", A civil society perspective. Proceeding International Health Care Waste Management Conference and Exhibition, Johannesburg, S. Africa.
- Manyele SV, Anicetus H, Bilia MH (2003). "Globalization and its effects on Medical Waste Management in Tanzania" IET Annual Conference and General Meeting, AICC Arusha, Tanzania.
- Manyele SV (2004a). "Effects of Improper Hospital Waste Management on Occupational Health and Safety", African Newsletter on Occupational Health and Safety 14: 30-33.
- Manyele SV (2004b). "Medical Waste Management in Tanzania: Current Situation and the Way Forward", Afr. J. Environ. Assessment Manage. AJEAM, <http://ajeam-ragee.sl-writers-series.org/>; 8: 74-99.
- Manyele SV, Anicetus H (2006). "Management of Medical Waste in Tanzanian Hospitals", Tanzania Health Res. Bull. 8(3): 177-182.
- MOHSW (Ministry of Health and Social Welfare) (2006). Healthcare Waste Management Monitoring Plan".
- Peter S, Karl W, Jurg C (1996). Conceptual Framework for Municipal Solid Waste Management in Low-Income Countries. Urban Management and Infrastructure: Undp/Unchs (Habitat)/World Bank/SDC Collaborative Programme on Municipal Solid Waste management in Low-Income Countries.
- Rutala WA, Mayhall CG (1992). J. Med. Waste Infec. Control Hospital Epidemiol. 13(1): 38-48.
- UNEP (United Nations Environment Programme) (2000). "Minimizing Hazardous Wastes": A Simplified Guide to the Basel Convention; France, GE 04-03062.
- UNEP/WHO (2005). "Preparation of National Medical waste Management Plans in Sub-Saharan Countries", Guidance Manual, www.who.int/water_sanitation_health/medicalwaste/en/guidancemanual, Retrieved on 28th September 2007.
- WHO (1999). Technet Subcommittee Meeting on the Disposal Destruction of Sharps and other Infectious Waste. Geneva, World Health Organization.
- WHO (2002). "Reducing Risks, Promoting Healthy Life", World Health Report. Geneva, World Health Organization.
- WHO (2006). "Management of Waste from Injection Activities at District Level", Guidelines for District Health Managers, Geneva, Switzerland.
- World Bank (2000). Health Care Waste Management Guidance Note.
- Yale-New Haven Hospital and Yale University (1997). Risk Management handbook: www.yale.edu/sustainability.envreport.pdf, Retrieved on 30th September 2007.