Hospital solid waste management practices in Limpopo Province, South Africa: A case study of two hospitals

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Abstract

The shortcomings in the management practices of hospital solid waste in Limpopo Province of South Africa were studied by looking at two hospitals as case studies. Apart from field surveys, the generated hospital waste was weighed to compute the generation rates and was followed through various management practices to the final disposal. The findings revealed a major policy implementation gap between the national government and the hospitals. While modern practices such as landfill and incineration are used, their daily operations were not carried according to minimum standards. Incinerator ash is openly dumped and wastes are burned on landfills instead of being covered with soil. The incinerators used are also not environmentally friendly as they use old technology. The findings further revealed that there is no proper separation of wastes according to their classification as demanded by the national government. The mean percentage composition of the waste was found in the following decreasing order: general waste (60.74%) > medical waste (30.32%) > sharps (8.94%). The mean generation rates were found to be 0.60 kg per patient per day.

1. Introduction

The World Health Organization (WHO, 2000) defines hospital solid waste as any solid waste that is generated in the diagnosis, treatment or immunization of human beings or animals, in research pertaining thereto, or testing of biological, including but not limited to: soiled or blood-soaked bandages, culture dishes and other glassware. It also includes discarded surgical gloves and instruments, needles, lacents, cultures, stocks and swabs used to inoculate cultures and removed body organs. Despite problems arising from these unwanted wastes, a civilised society cannot do without a healthcare system. This is a basic requirement for human kind.

The waste generated from hospitals is now recognised as a serious problem that may have detrimental effects either on the environment or on human beings through direct or indirect contact. Some of the health impacts originating from exposure to hazardous hospital wastes include mutagenic, tetragenogenic and carcinogenic effects, respiratory damage, central nervous system effects, reproductive system damage and others (Blackman, 1993). Diseases like diarrhoea, leptospirosis, typhoid, cholera, human immunodeficiency virus and hepatitis B virus can be transmitted through the mismanagement of especially hazardous hospital waste (Mato and Kassenga, 1997). Environmental nuisance may also arise due to foul odour, flies, cockroaches, rodents and vermin.

Over the years, various waste management systems and practices have been reported for appropriate handling and safe disposal of hospital wastes. Some of these practices include landfills (Li et al., 2002; DWAF, 1998), incineration (Morselli et al., 2002), autoclaving (Palenik and Cumberlander, 1993) and recycling (Lee et al., 2002). Generally there is no single practice as a solution to the problems of managing hospital waste, so in most cases, a
number of practices are used in combination. Each practice has its own weaknesses and strengths.

In South Africa, the problem of waste from hospitals has been recognised by the concerned agencies and various government regulations have been framed to systematise its implementation (DEAT, 2000). There is generally an emphasis towards modern hospital waste practices that reduce risks of hazardous wastes to humans or to environment by treating them first before being disposed in a landfill. So far over 90% of South African toxic hospital waste is incinerated, while hospital waste that is regarded as non-toxic is either dumped openly or landfilled (DWAF, 1998).

In most hospitals, the incinerators that are used still have the old technology and are potential sources of significant quantities of hazardous pollutants such as dioxins, furans and heavy metals like cadmium (Cd), mercury (Hg), and lead (Pb).

This study was aimed at assessing the solid waste management practices in Limpopo Province, South Africa by looking at two hospitals. It analyses the issues and current shortcomings faced by many hospitals in the province and the nation for implementing the required hospital waste management practices. Further, it gives appropriate suggestions that can easily be implemented to improve the current situation.

2. Background to the case study hospitals

The two hospitals discussed in this paper are found in the Limpopo province of South Africa. The province was formerly known as Northern province in the old apartheid system. Both hospitals are government owned and are found in the far northern region of Limpopo province. However, Tshilidzini hospital is the farthest, which is right in the Limpopo valley while Elim hospital is at the very beginning of the valley.

2.1. Tshilidzini hospital

Tshilidzini hospital is situated in an area known as Tshisaalu. It falls under Thohoyandou Municipality, which is in the far northern-region of Limpopo Province. The largest town closest to it is Thohoyandou Town that is 6 km away. Thohoyandou town was the provincial capital of the former black homeland of Venda. The town has a total population of about 26,000. The hospital serves mostly people from this town and many other villages/settlements outside the town. It is the largest hospital in the area. Limpopo valley has one of the hottest temperatures during summer in South Africa; the highest summer temperatures can reach 43 °C while the lowest are around 20 °C. Winters are generally mild; winter temperatures can be as high as 30 °C and as low as 7 °C.

2.2. Elim hospital

Elim hospital is situated in a town called Elim, which falls under Makhado Municipality. It is also in the far northern-region of Limpopo Province. Makhado town (formerly known as Louis Trichardt) is the largest town closest to it, which is 10 km away. Elim town also belonged to the former homeland of Venda in the old dispensation. Since Makhado town has a hospital of its own, Elim hospital serves mostly people from the town and surrounding villages. Temperatures in the area are also hot since it is very close to the start of Limpopo valley but are a few degrees lower (±5 °C) than right in the valley.

2.3. Period of the study

The study was conducted between April and July 2003 at Tshilidzini hospital and from August to December 2003 at Elim hospital.

3. Materials and methods

3.1. Materials

A weighing balance of capacity 120 kg and a plastic bin with an empty weight of 2.0 kg and volume of 50 L for collecting and weighing the waste were used for the measurements. Shovels and forks were used for loading and sorting the waste; gloves, facemasks and a lab coat were used for personal protection. For waste quantity measurements at the nurse’s home, a plastic bin with a capacity of 10 L and empty weight of 0.2 kg was used.

3.2. Methods

3.2.1. Measurement sites

The quantities of waste generated were measured in all of the wards of the two hospitals. This included their respective kitchens (cafeterias), pharmacy sections and for Elim hospital, the nurse’s homes. This was done because of the need to have a comprehensive spectrum of sources and types of wastes from the two hospitals. Measurements were repeated at least twice. In cases where were measured results were not still convincing, a third measurement was performed in that particular ward.

3.2.1.1. Wards of hospitals. Tshilidzini hospital admits up to 530 patients. At the time of the measurements, there were 450 patients admitted in the hospital. It has close to 1800 permanent workers. It is estimated to have an average inpatient admission of 160 and an outpatient attendance of 340 per day. It has 10 major wards including the kitchen.

Elim hospital has close to 1000 permanent workers. It is estimated to have an average inpatient admission of 70 and an outpatient attendance of 240 per day. It has 9 major wards including the kitchen. At the time of the measurements, there were 250 patients admitted. It has a total of 323 beds.
3.2.1.2. Nurse’s home of residence. At Elim hospital, nurse’s homes were also included in the measurements of waste generated.

3.2.1.3. Cafeterias or kitchens. Measurements were done for all the waste generated from kitchens of the two hospitals. In both hospitals, the food from the kitchen feed patients admitted in the wards.

3.2.2. Questionnaire surveys and interviews

Additional data on solid waste management practices at the two hospitals were obtained mainly from infectious control nurses, hospital superintendents, and occupational and public health officers through direct questionnaire surveys and interviews. Individuals in these positions were chosen because they were thought to be conversant or responsible for solid waste management at the respective sources within the hospitals.

3.2.3. Visual inspection and field investigations

To establish the esthetic quality of the study areas and to establish a basis for evaluating how study facts and figures correlate, visual assessment and field investigations were conducted in all wards of the two hospitals. Generated waste was also followed through the various management practices, and visual inspection and field investigations were similarly done. This allowed the collection of first hand information and experience of how solid waste is actually managed at the two hospitals under normal working conditions. The assessment and investigations were also conducted to aid in the selection and design of the measurement procedure for the quantities generated in each ward.

3.2.4. On-site waste segregation and measurements

On-site waste segregation and measurements were made after arrangements with respective occupational and public health officers. The officer informed nurses in charge of the wards in advance so that all the waste generated that day was not collected until it was measured. Two to three wards were measured a day, usually just before 8.00 am, which is the time waste is collected from various wards and is taken to the central storage room or for treatment. Since in some cases, waste was not collected according to their types, but rather was mixed together, this demanded prior sorting before measuring. In some cases where one type of waste was too predominant, the less dominant was assumed to be negligible of the mixed two.

The weighing procedure was as follows:

- Determination of weight ($W_b$) of empty bin using the weighing balance
- Filling of the bin with sample waste while shaking the bin constantly to avoid undue void spaces
- Determination of gross weight ($W_T$) of bin container and waste using the weighing balance
- Determination of the average number of patients ($p$) admitted/contributed to waste generated in each hospital at the time of measurements ($t$)

The above procedure was followed for the measurements of samples of wastes on different sampling days and at different waste sources during the whole study period. The waste generated rates per patient per day ($W_G$) were computed using the relation:

$$W_G = \sum (W_T - W_b)/p = \text{(kg per patient per day)}.$$

4. Results and discussion

4.1. Introduction

Previous South African policies in dealing with any solid waste management including hospital waste were focused predominantly on so-called “end of pipe” treatment. In the year 2000, the government introduced a new policy contained in the white paper on integrated pollution and waste management (DEAT, 2000). This is a policy that shifts emphasis to pollution prevention, waste minimization, impact management and remediation. It is also so far the most comprehensive policy on solid waste management, including hospital waste. Fig. 1 gives a summary of a functional approach to this policy. The policy tries to address the management of the entire waste handling process, from generation to disposal in an integrated way. For hospital solid waste, the Department of Health has developed various guidelines and recommendations regarding management practices that are used to handle waste from source to final disposal. These guidelines are
4.2. Classifications, definitions and types of waste

Table 1 gives the classification of the waste generated at the two hospitals, which is similar. Waste is classified as general, medical, and sharps. General waste is defined as hospital waste that does not pose any immediate danger to humans or the environment. Examples of general waste include packaging materials such as cardboard, office paper, leftover food, cans etc. Pathological waste is waste that contains tissues, organs, placentas and other body parts. Infectious waste is defined as waste that contains pathogens in sufficient quantity that when exposed to it can result in diseases. Examples of this waste include culture plates, drainage bags, surgical and theatre wastes, contaminated plastic items etc. Sharps are defined as anything that could cause a cut or puncture leading to wound. Items like needles, syringes, scalpels, knives, broken glass, etc. form part of sharp wastes. All of these definitions are consistent with those reported in the literature (Mato and Kassenga, 1997; Lee et al., 2002; Mato and Kaseva, 1999). However, neither of the hospitals had a clear definition of medical waste. Medical waste is only known to include infectious, pathological and chemical waste. From the literature, the terms hospital and medical wastes have often been used interchangeably (Lee et al., 2002; Mato and Kaseva, 1999). Lee et al. (2002) used the term medical waste to deal with all types of wastes produced by healthcare facilities rather than the term hospital waste. This is in direct opposition to how these terms are defined at the two hospitals. Hospital waste is therefore defined as any waste that is produced from healthcare facilities such as general hospitals, medical centres, medical laboratories or animal hospitals. This therefore includes both non-hazardous and hazardous waste constituents. Medical waste was found to mean all hazardous wastes except sharps. The classifications of the waste by the two hospitals were taken so as to compare with international practices. It was not easy to obtain the classifications from the national government, as there are no regulations on hospital waste but only guideline documents.

The types of waste generated in the two hospitals are typical of any country. What differ are perhaps the amounts generated due to variation in standard procedures executed in the medical field. Most of the waste types were found in almost all the wards at the two hospitals except for the kitchen where only general waste was present (Table 2).

4.3. Amount of waste generated

4.3.1. Hospital waste generation rates

Generally, quantities of waste generated depend on the status of the hospital, level of instrumentation and sometimes location of the medical facility (Mato and Kaseva, 1999). The generation rates were computed to be 0.55 and 0.65 kg per patient per day for Tshilidzini and Elim hospitals, respectively. This resulted into an average of 0.60 kg per patient per day for the two hospitals. The generation rates indicate the type of services offered at the two hospitals and suggest that they are not different. The generation rates are comparable to those obtained...
from a survey conducted in Dar es Salaam, Tanzania of 0.55 kg per patient per day (2.43 kg per bed per day) with a range of 0.15–1.3 kg per patient per day (0.84–5.8 kg per bed per day) (Mato and Kassenga, 1997). The study done in Tanzania further revealed that hospitals with modern medical facilities and good services were found to have higher waste generation rates than the rest. For example, Aga Khan hospital (one of the best hospitals) were found to have a waste generation rate of 1.3 kg per patient per day, nine times that of Temeke hospital (0.15 kg per patient per day). The generation rates for Canada and the USA were also reported to be higher because as developed nations, they generally have modern facilities and good services (Airan et al., 1986 in Mato and Kassenga, 1997). In Canada and the USA, the generation rates were reported to range from 4.3–5.8 kg per bed per day.

Both hospitals studied can be said to have lower generation rates compared to modern hospitals. Both hospitals lack modern medical facilities but are said to still have good services. Another reason could be that both hospitals are not situated in a highly urbanised environment and most patients do not represent affluent communities. Affluent communities tend to generate more wastes since their lifestyles demands consumption of a high amount of goods and services (Gwebu, 2003).

### 4.3.2. Major generators of the waste in each hospital

Table 2 gives the amounts generated in each ward in Tshilidzini (2a) and Elim (2b) hospitals. The amount generated is also given as percentage composition for both hospitals in Fig. 3. The percentage generated in each ward at Tshilidzini hospital was of the following decreasing order: maternity (28.85%) > kitchen (20.09%) > medical (16.19%) > surgical (11.94%) > casualty (7.52%) > theatre (5.55%) > OPD (4.85%) > laboratory (2.3%) > X-ray (1.8%) and intensive care unit (1.18%). For Elim hospital, the following decreasing order was found: maternity (29.32%) > kitchen (21.01%) > casualty (9.85%) > surgical (8.97%) > theatre (8.10%) > medical (7.88%) > OPD (7.00%) > laboratory (3.72%) > TB ward (3.28%) and Nurse’s home (0.88%). The amount of waste generated in each unit was found to depend on several factors such as size and number of patients, type of services offered, etc. There was no general pattern except that in both hospitals, the maternity ward was found to generate the highest percentage of waste and was almost similar in the two hospitals. The kitchen unit followed with also a similar percentage generated in the two hospitals.

### 4.3.3. Major compositions of the waste

Fig. 4 gives the major composition of the types of waste generated in the two hospitals studied. The compo-
osition was almost the same in the two hospitals, with mean values in the following decreasing order: general waste (60.74%) > medical waste (30.32%) > sharps (8.94%). Both hospitals offer inpatient services that are high. This explains why generated waste is high because of food related services. In a survey conducted by Mato and Kassenga (1997) in hospitals in Dar es Salaam, the percentage of generated waste was found to be lower as many hospitals were offering outpatient services. However, in a study conducted by Patil and Shekdar (2001) on the health care waste management in India, the proportion of general waste was reported to be high because inpatient services were offered most. The percentage of general waste ranged from 50.46–88.31%, with a mean value of 71.37%. The mean value of medical waste (infectious, pathological and chemical) was 27.85%. For sharps, the percentage ranged from 0.41–1.42%, with mean value of 0.78%. These percentages are in agreement with the results of this study, except for sharps which were found to be much higher.

Results of individual compositions of medical waste were approximations in some cases because of occasional instances during which these types of waste were missed during collection since the same color coded containers are used, especially mixing of chemical waste with other medical wastes. Nonetheless, the composition of medical waste was found to be in the following decreasing order: pathological (61.95%) > infectious (28.70%) > chemical (9.35%). As a percentage of the total solid waste generated in each hospital, the mean composition was: pathological waste, 18.74%; infectious waste, 8.68% and chemical waste, 2.91%. A study conducted in India (Patil and Shekdar, 2001) on the average composition of total solid waste in hospitals found infectious waste ranging from 10–36.23% with an average of 18.83%; for pathological, the range was from 4.06–19.71% with an average of 8.1%. The composition for chemical waste ranged from 0.22–2.77% with an average of 0.9%. The mean values found in this study for medical waste composition are therefore not very different from reported ranges for hospitals in India. In this study, most of the medical waste was found coming from maternity and theatre wards, which are known to generate a large amount of pathological and infectious waste. During the waste measurements, the amount of pathological waste was seen to be higher than the amount of infectious waste, which is consistent with the reported percentage compositions.

4.4. Waste management practices

4.4.1. Waste collection and segregation

The Department of Health has developed national guidelines on the management of hospital waste (Kluge, 2001). Color is used to differentiate containers for storing various types of hospital waste at the generation point (Table 3). Infectious waste should be stored in a yellow marked, strong leak proof bag or container. Chemical and pharmaceutical waste is supposed to be stored in a brown marked plastic bag or container. Black marked plastic bags in containers are to be used for storing general waste. Radioactive waste should be stored in a red lead box labeled with a radioactive symbol. Sharps are to be stored in a yellow marked puncture proof container with covers on them (called bin beez).

Sharps were found to be the only types of waste collected in the recommended containers in both hospitals. Infectious, pathological and chemical wastes were all collected in red plastic bags. This to some extent could be promoting mixing of these types of wastes during collection, as was observed in many wards. One reason for using red plastic bags was that they were less costly and more accessible compared to other plastic bags recommended by the Department of Health. In some wards, the site survey also found that these wastes were also mixed with general waste. This type of mixing waste was common at Tshilidzini hospital. The only intensive care unit and the gynecology unit in the maternity ward were found to be efficient in separating the waste into the various types during collection. At Elim hospital, any general waste found to contain medical waste was treated as hazardous waste, thus requiring special handling and management similar to any medical waste.
### Waste sorting, storage and transportation

Site surveys in the hospitals revealed that most wards have a temporary storage room for putting containers that get full during the day or at night. For Tshilidzini hospital, the waste is collected from the wards in the morning just before 8:00 am each day. At Elim hospital, the site survey found that wastes are removed from the wards twice per day at 8:00 am and 3:00 pm. Waste is therefore not allowed to accumulate within the wards, which is a good thing since the region has very hot summer seasons, which causes waste to decompose very fast thus producing unwanted odours. Waste is transported to the central storage room and/or for appropriate management practices (Fig. 2). General waste, instead of however being temporary stored in the wards, it is stored in designated stands outside each ward. The central storage room at Tshilidzini hospital was found not to have any locking system, meaning that any person could go there anytime, which could be dangerous considering the types of waste stored. A locking system should therefore be designed. The room itself is not in good condition, and plastic bags containing waste are just put on the ground. Often, there are leakages on the floor from plastic bags containing medical waste, which could be a source of environmental hazard.

### Incineration

The study revealed that in both hospitals, the incinerators used are rudimentary as they have poor design and operational problems. The incinerators are situated within the perimeter of the hospital grounds. Table 4, shows the percentage of the waste that is incinerated in both hospitals. A properly designed incinerator should completely burn waste leaving a minimum of residual in the form of ashes and should be equipped with scrubbers to trap toxic air pollutants emitted. The incinerator at Tshilidzini hospital was found to be the most poorly designed. Its capacity was also just enough to treat all of the generated waste per day. The incinerator is self-made and is constructed from burned bricks and cement; it has a shape of house fireplace. Waste is burned using coal as fuel, which does not allow proper control of temperature. A high amount of ash is generated because of the incomplete burning of waste. Its chimney is also short and, depending on wind direction,
emitted gases are dispersed to nearby communities, causing nuisance and being a potential cause of bronchitis and pulmonary ailments such as asthma (Mato and Kassenga, 1997). Waste that is improperly incinerated, especially that containing plastic materials, is known to give rise to toxic gases such as dioxins and furans that are carcinogenic (Lee et al., 2002). A study by Palenik and Cumberlander (1993) examined in detail the possibility of using autoclaves to treat contaminated sharps. Sharps are generally known to be capable of transmitting diseases. Safe handling and disposal of sharps is an essential part of any infection control program. The two hospitals could also extend the treating of infectious waste to sharps.

4.4.5. Open dumping

The site survey found out that all of the incineration residues from both hospitals are openly dumped at sites close to the incinerators. Recommendations from the Department of Health are to dispose of incinerator residues in a landfill (Kluge, 2001). Open dumping has long been recognized as a potential source of public health and environmental problems. The national government generally has accepted landfill as the final option of resting hazardous hospital solid waste. Open dumping, because of its inherent problems such as leakage of toxic substances into the environment; easy access from insects, rodents and other small animals, most of which are disease vectors, has been replaced by landfiling in the management of solid wastes. Also wind easily blows over the dumped waste, dispersing air pollutants to nearby communities.

The South African Environment Conservation Act 1989 (Act 73 of 1989) stipulates that waste can only be disposed at a waste disposal facility that has permit issued by the Ministry of Water Affairs and Forestry. Such a facility must be properly designed, operated and monitored in accordance with permit conditions (DWAF, 1998). Despite this requirement, there is no evidence to suggest that the hospital management got permission to operate an open dump for ash incinerator. This is another example of a policy implementation gap between the government and hospitals in terms of how to handle hospital waste.

4.4.6. Landfill

Both hospitals have landfills that are being used to dump all of the general and medical wastes, and this is the main waste management practice at the two hospitals (Table 4). The landfills are located a few meters from the hospital premises but within the hospital fences. The main idea of the landfill is for storage and containment of the waste deposited into it. However, how the landfills are operated at the hospitals is in sharp contrast to normal procedures. At present, the landfills are operated like an open dump. Each day, the general and medical wastes are dumped in the landfill and later burned. Burning is aimed at reducing the volume of waste and stopping the spread of papers.

This process is repeated until the landfill is full, and then the landfill is covered with soil. In normal operation of the landfill, the wastes are spread over, compacted and then covered with a layer of soil on a daily basis. This eliminates the need for burning the waste as practised at the hospitals. The burning itself is a potential source of generating toxic chemicals. This is more likely since wastes such as plastics, syringes and paper are burned together. There is high
chance that toxic chemicals like dioxins and furans are generated. Population growth in the area (Tshilidzini hospital) has led to residential homes being built close to the landfill site on the outside of the hospital fence. Depending on the wind direction, when the waste is burned, smoke reaches these homes, dispersing toxic air pollutants. The community living near the landfill therefore acts as passive samplers through inhalation of polluted air.

The landfills at the hospitals are supposed to be divided into two portions, one for putting general waste and the other, medical waste. Only general waste is supposed to be burned. However, in practice this is not followed. Both general and medical wastes are mixed at the landfill and burned together.

4.4.7. Recycling

Recycling at both hospitals is being undertaken (Table 4), although at a small scale. Most the waste that is being recycled is leftover food. Other general wastes that have potential for recycling but that are not recycled include plastic bags, plastic containers and cans. These plastics come from various sources within the hospital, but the major percentage comes from cafeteria related service (25%) and medical packaging (26%) (Lee et al., 2002).

Most of the cans also come from cafeteria related services and within the hospitals; these were mainly empty cans of drinks of beverages used by patients, staff and visitors at the hospital. Plastics and cans have a high potential to be recycled. This is important, especially because the National government policy emphasis on all forms of waste is on reclamation and recycling. However, the opportunity to recycle or reclaim any plastics and cans generated at the hospitals is missed.

The current practice is that all plastics and cans are collected in the same containers used for any other form of general waste in mixed form (black plastic bags), and are then sent to a landfill. The hospital waste management at the hospital therefore needs to introduce a scheme whereby all recyclable material is disposed and collected in separate containers. The containers need to be clearly marked and made available in all strategic areas within the hospital. Some other studies have emphasized the involvement of generators in any recycling program (Salhofer and Isaac, 2002; Garces et al., 2002). This demands proper public edu-

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<tr>
<th>Types of waste</th>
<th>Current practices</th>
<th>Recommendations</th>
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<tr>
<td>Generation</td>
<td>Colour coded containers are used to separate various waste types. However, in many wards, there is mixing of waste. General waste is often mixed with pathological or infectious waste. Pathological and infectious wastes are also sometimes mixed together. Only one colour code is used to store pathological and infectious waste.</td>
<td>(i) Environmental health education is needed for nurses on hospital waste management followed by strict monitoring for compliance. (ii) Proper containers with correct colour codes are needed in all wards to prevent mixing of the different waste types. (i) Considering that the region is characterised by hot temperatures, Tshilidzini hospital should also be collecting their waste twice per day.</td>
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<tr>
<td>Transport</td>
<td>At Tshilidzini hospital, waste is collected once from the wards at 8.00 am. At Elim hospital, waste is collected at 8:00 am and 3:00 pm.</td>
<td>(i) The central storage room should be properly cleaned to reduce the possibility of any spread of diseases. (ii) All waste going to the central storage room should be inspected so that there are no leakages. (iii) The storage room should be properly secured to avoid any unauthorized person entering.</td>
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<tr>
<td>Storage room</td>
<td>Waste is temporarily stored in a central room at Tshilidzini hospital before being taken to each handling practice. Some of the waste leaks out, especially fluids from infectious and pathological waste. The room is not locked.</td>
<td>(i) Both incinerators should be stopped immediately as they are a source of health and environmental hazard. (ii) Waste should instead be taken to a designated hazardous landfill. (i) Hospitals are doing well in this regard. However, ensuring that all infectious waste is autoclaved is still needed. (i) Most of the other general wastes such as tins, wastepaper etc. should be part of the recycling program. (ii) This means that source separation of general waste in each ward should be introduced.</td>
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<tr>
<td>Incineration</td>
<td>Tshilidzini hospital uses a locally made incinerator like a fireplace using coal as fuel. Elim hospital uses one with diesel as fuel and with old technology. In both cases, incinerator ash is openly dumped near incinerators.</td>
<td>(i) Incineration should be stopped immediately as it is a possible source of health problems and environmental pollution. (ii) Hospitals may consider putting general waste in a separate landfill from hazardous waste. (iii) Landfills should be properly secured so that no animals can access them.</td>
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<tr>
<td>Autoclaving</td>
<td>Infectious waste taken for autoclaving.</td>
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<tr>
<td>Recycling/reuse</td>
<td>All leftover food is recycled or reused.</td>
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<tr>
<td>Open dumping</td>
<td>Incinerator ash is just openly dumped.</td>
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<tr>
<td>Landfill</td>
<td>Sharps, infectious waste, general and chemical wastes are taken to landfills. At landfills, waste is burned instead of being compacted and covered by soil. Landfills are not very secure from animals such as dogs.</td>
<td>(i) Burning of waste at landfills should stop immediately as it is a possible source of health problems and environmental pollution. (ii) Hospitals may consider putting general waste in a separate landfill from hazardous waste. (iii) Landfills should be properly secured so that no animals can access them.</td>
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cation of all staff and patients at the hospital so that they are fully aware of the need and importance of recycling. Of course, the other hindrance to the start of recycling programs at a hospital is the risk of transmitting infections. However, considering that medical waste disposal costs are increasing and available landfill space is decreasing, waste minimization efforts through recycling and reuse is encouraged.

Currently, many hospitals in developed nations like the USA are operating programs to recycle uncontaminated office paper, cardboard, metal cans and selected glass (Lee et al., 2002). For recycling plastics at a hospital, Lee et al. (2002) proposes a methodology on how best to do it in each department/unit. One important thing is first to decide whether patients with potential infections used the plastics or not. All plastics not used by patients be recycled along with those used by non-infectious patients. Those plastics deemed contaminated with infections should be disposed in a landfill.

5. Conclusion and recommendation

5.1. Conclusion

There is a serious mismanagement of hospital waste, which is typical of many semi-rural hospitals in South Africa. The management practices available are not accomplishing the job properly and are not environmentally friendly. General and medical wastes are often mixed together during collection. Although recommended national government waste management practices to handle hospital waste are used, such as landflling and incineration, their operations and technologies leave much to be desired. The incinerators use coal and diesel as fuel, which is a potential source of toxic air pollutants that have both human health and environmental consequences.

Although the cost of options is cited as the main cause of poor waste management, the waste managers at the hospitals can still do much with the limited resources to improve the situation.

5.2. Recommendations

The summarized recommendations are given in Table 5. Most of the recommendations require only a commitment to hospital waste management by the staff and its management at both hospitals to be implemented, without any much additional financial budget.

References


