

# TREATMENT AND DISPOSAL OF MEDICAL WASTE IN RURAL AND URBAN CLINICS WITHIN POLOKWANE MUNICIPALITY OF SOUTH AFRICA

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## Abstract

The objective of the study was to assess the medical waste management practices used by clinics located in the Polokwane Municipality, South Africa. The clinic personnel were not informed prior to the visit. A walkthrough survey was conducted on-site where potential health and safety risks were identified and noted. The health care personnel in charge of specific clinics completed the questionnaires providing general and detailed information about the treatment and disposal of medical waste. Frequencies and percentages were calculated from the data obtained. Data obtained indicate that (i) medical waste was not segregated from general waste in most of the clinics, (ii) rural clinics were burning medical waste with general waste inside the clinic yard (iii) there was no sufficient collection and transport of medical waste in clinics, (iv) sharps were disposed at various hospital incinerators and (v) most of the clinics did not have storage facilities for medical waste.

**Keywords:** medical waste, incinerators, walkthrough survey

## 1. INTRODUCTION

Medical waste is defined as any waste that is generated in the treatment, diagnosis or immunization of human beings or animals, in the production or testing of biological matter (Lee and Huffman 1996). According to the Health Act, 1977 (Act no.63 of 1977) of South Africa, regulated medical waste can be classified into different categories. These include anatomical waste, infectious non-anatomical waste, sharps and similar waste, pharmaceutical and genotoxic chemical waste as well as radioactive waste.

Anatomical waste includes human and animal waste contemplated under the definition of “biomedical material” excluding blood and body fluids, extracted teeth, nail clippings and hair. Infectious non-anatomical waste is any waste known or clinically assessed to be at risk of being contaminated with micro-organisms such as microbiological laboratory waste from surgeries and autopsies performed on patients with communicable diseases and all contaminated waste (blood, body fluids, teeth, hair, etc.) from infectious patients, as well as discarded vaccines. Sharps and similar waste include any clinical item capable of causing a cut or puncture, including but not limited to needles, syringes, blades, clinical glass and similar articles.

Pharmaceutical waste include products and medicinal chemicals that can no longer be used in the treatment of patients and have been returned from patient care areas, and that have become outdated or have been stored improperly or are no longer required. Chemical waste includes waste from diagnostic or experimental work or any other use which is genotoxic (carcinogenic, mutagenic, teratogenic or otherwise capable of altering the genetic material), and items contaminated with such chemical waste. Radioactive waste include all material contaminated with radio-isotopes, which arise from medical or research use of radionuclides. It should be handled and disposed of in accordance with the Nuclear Energy Act (Department of Minerals and Energy, 1999; Mato and Kaseva 1999; Rutala and Weber 1991; Abd El-Salam, 2010).

Various methods exist for the management and/or disposal of medical waste (Alumuneeff and Memish 2003; Levendish et al. 2001; Nouwen et al. 2001; Okello et al. 1997; Swai and Mtalo 1996; Conrardy et al. 2013; Graikos et al. 2010; Abd El-Salam, 2010). Among these the process of incineration is the burning of medical waste in temperatures ranging from 982°C to 1093°C. This process provides the advantage of volume reduction (waste minimization) as well as the ability to dispose of recognizable waste and sharps (Hu and Shy 2001; Lee and Huffman 1996; Levendish et al. 2001; Lohman and Seigneur 2001; Nouwen et al. 2001). Other methods used for the treatment of medical waste include autoclaving or steam sterilization, microwaving, macrowaving and landfilling (Klansin and Harding 1998; Lee, et al. 2003).

Previous studies have indicated that management of medical waste in developing countries was not improving according to the required standards (Alagöz and Koasoy, 2008; Askarian et al. 2004; Dehghani et al. 2008). The most worrying conditions occur in rural hospitals and clinics, which are unable to give the required special care in handling medical waste, mostly because of a lack of resources. Many rural clinics use to burn medical waste on site in pits. In Gauteng Province, guidelines on the treatment of medical waste have been developed (Government of Gauteng Province, 2004). The objective of introducing these guidelines is to enable supervisors at health care facilities to improve the standard of health care waste (HCW) management. The following steps have been identified as the "cradle to grave" (i.e. health care waste pathways which are conducted through a number of stages at health care facilities during treatment/final disposal) of health care waste management: (i) health care waste generation, (ii) segregation, (iii) containerization, (iv) intermediate storage (v) internal collection and transport, (vi) centralized storage, (vii) external collection and transport, (viii) treatment, (ix) collection and transport of treated residues and (x) disposal of health care waste (GGP, 2004).

Due to the fact that medical waste can pose a serious health risk to the community, coupled with paucity of published research in South Africa, there is a need to assess the management of medical waste in clinics and other health care facilities and to improve health and safety conditions. This paper describes a study which was conducted on medical waste management in rural and urban clinics in Polokwane, South Africa, in order to ascertain any possible risks associated with mismanagement of medical waste and to recommend appropriate waste management practices.

## **2. METHODS**

The study was conducted by visiting four urban and nineteen rural clinics within Polokwane Municipality. The study was piloted in two local clinics and a few changes were made to the questionnaire. Prior to the visit, an induction about health and safety precautions was conducted by a qualified nurse. The participants were supplied with protective clothing (hand gloves). Questionnaires were issued to the nursing personnel in charge of the clinics. The nursing personnel gave consent to participate in the study by signing an informed consent form. One questionnaire was allocated per clinic (23 in total) and was completed by one nursing personnel per clinic. A 28-item anonymous self-administered questionnaire was developed based on the literature and current situation in South African clinics. The questions aimed to collect data on aspects such as daily operations at the clinics and nursing personnel, the facilities used for sorting medical waste, handling of medical waste, interim storage facilities and final disposal sites. All information was treated as confidential. Clinics and the person completing the questionnaire remained anonymous.

Interviews were conducted with nursing personnel in charge of clinics. A walkthrough survey was conducted inside clinic rooms and yards where disposal practices of medical waste were observed. Containers for storing medical waste and sharps were examined in consulting and storerooms. The methods used by clinic personnel to handle, treat and dispose of medical waste were also observed. Facilities for washing and cleaning that include availability of running water, soaps and disinfectants were also observed. The general housekeeping conditions which include cleanliness in clinic rooms, toilets and clinic yards were also observed. Control and safety measures such as isolation used in clinics to avoid risks caused by medical waste were examined. The placenta pits, incinerators and dumping sites were also examined inside clinic yards. The nursing personnel provided information about medical waste management plans implemented during the interviews. Data was collected and all the findings and observations were recorded. The data gathered was used to assess the compliance of clinics with the required standards and regulations in terms of medical waste management. Areas that need improvement were identified.

The information completed on the questionnaires was verified by comparing it with the observations during a walkthrough survey and information provided during the interview. Data from the questionnaires were captured electronically in Microsoft Excel 2007. Analysis was performed using SPSS version 11.0. Frequencies and percentages were calculated from the data obtained. Analysis of the questionnaires provided valuable information about the compliance of the clinics to the regulations on treatment and disposal of medical waste.

### 3. RESULTS

Twenty-three questionnaires from clinics were completed. The storage areas used to store medical waste and sharps are indicated in Table 1. The results show that only 4% of rural and urban clinics have specific storerooms in which to store medical waste. Only 5% of rural clinics have storage rooms to store medical waste and sharps while there were storage rooms in two urban clinics (50%). About 44% of rural and urban clinics lacked specific storage rooms and were using consulting rooms to store medical waste. There were no storage rooms for medical waste and sharps in some rural clinics (42%) and consulting rooms were used to store medical waste. About 52% of rural and urban clinics were using consulting and storage rooms to store medical waste. The majority of rural clinics (53%) were using consulting and storage rooms to store medical waste.

**Table 1:** Storage areas used for medical waste by rural and urban clinics in percentages

Waste storage	Rural clinics		Urban clinics		Total**	
	%	N*	%	N*	%	N*
Store rooms only	5.3	1	50	2	4.3	3
Consulting rooms only	42.1	8	0	0	43.5	8
Consulting and store rooms	52.6	10	50	2	52.2	12

\*\*Total number of rural and urban clinics      \*Number of clinics

The clinics use different types of containers to dispose of medical waste. Table 2 indicates the type of containers clinics use to dispose sharps and medical waste. Only one rural clinic had containers for sharps, while 95% had containers for both sharps and medical waste. All urban clinics were using containers for sharps and medical waste. The majority of rural and urban clinics (96%) use containers to dispose of medical waste. Seventy-four percent of rural and urban clinics use special buckets made of plastic material to dispose sharps. These containers were specially designed to minimise the possibility of needle pricks. They were made of plastic and had lids. They were labelled and designed to prevent leakage.

In some rural clinics (21%), both plastic buckets and cardboard boxes were used to dispose sharps. Seventy-five percent of urban clinics use special buckets to dispose sharps. Both metal and plastic containers are used to dispose sharps in one urban clinic (25%). Ninety-six percent of rural and urban clinics have separate containers for sharps and medical waste. Some of the bins used to dispose solid medical waste like bandages are not labelled and they have no lids. In total, 96% of rural and urban clinics are using separate containers for medical waste and sharps.

**Table 2:** Containers used by rural and urban clinics to dispose sharps and medical waste in percentages

Waste storage	Waste disposal	Rural clinics		Urban clinics		Total**	
		%	N*	%	N*	%	N*
Available containers	Sharps only	5.3	1	0	0	4.3	1
	Sharps and medical waste	94.7	18	100	4	95.7	22
Type of sharp containers	Plastic	73.7	14	75	3	73.9	17
	Cardboard	5.3	1	0	0	4.3	1
	Metal and plastic	0	0	25	1	4.3	1
	Plastic and cardboard	21.1	4	0	0	17.4	4

\*\*Total number of urban and rural clinics \*Number of clinics

The various disposal methods and areas used are shown in Table 3. Eighty-seven percent of rural and urban clinics dispose of sharps at different hospital incinerators. Thirteen percent of urban and rural clinics have incinerators inside the clinic yards. There are functional incinerators in two clinics, and sharps were incinerated inside clinic yards. There is a non-functional incinerator in one rural clinic. Eighty-four percentages of rural clinics respectively are disposing sharps at various hospital incinerators. In total, 87% of urban and rural clinics dispose of sharps at hospital incinerators. The sharp containers are collected from these clinics by hospital workers and transported to the various hospitals.

The containers for sharps are not collected regularly from rural clinics which result in storage problems. Medical waste is burnt on-site with general waste and the ash was buried in the clinic dumping site. A can is used in which medical and general waste is burned. At some rural clinics (95%), solid medical waste such as used bandages and gloves are not burned but just dumped in the clinic dumping site. The dumping sites visited were usually holes in the ground and the size thereof varied from clinic to clinic. The results in Table 3 show that 83% of rural and urban clinics are using dumping sites to dispose solid medical waste.

In one urban clinic (25%), solid medical waste is incinerated while in another rural clinic (5%) the waste is incinerated and disposed at a dumping site. Two urban clinics (50%) use municipal dumping sites to dispose solid medical waste. There are placenta pits in the majority of rural clinics (84%). However, most of the placenta pits are not used regularly in these clinics. There are dumping sites in all rural clinics (100%) but only one urban clinic (25%) has a dumping site.

**Table 3:** The percentages of various disposal methods and areas used by rural and urban clinics

Waste storage	Waste disposal	Rural clinics		Urban clinics		Total**	
		%	N*	%	N*	%	N*
Disposal of sharps	Clinics with incinerator	15.8	3	0	0	13	3
	Hospital incinerator	84.2	16	100	4	87	20
Disposal of soiled medical waste (e.g. used bandages and gloves)	Incinerate	0	0	25	1	4.3	1
	Clinic dumping site	94.7	18	25	1	82.6	19
	Incinerate and burning onsite	5.3	1	0	0	4.3	1
	Municipal dumping site	0	0	50	2	8.7	2
Placenta pit	Present	84.2	16	0	0	69.6	16
	Absent	15.8	3	100	4	30.4	7
Clinic dumping site	Present	100	19	25	1	87	20
	Absent	0	0	75	3	13	3

\*\* Total number of urban and rural clinics    \*Number of clinics

#### 4. DISCUSSION

Clinics lack adequate storage facilities for the handling of medical waste before final disposal. According to the Health Act of South Africa no 63 of 1977, medical waste should be stored in a medical waste storage area until it is removed for final disposal. However, the above stated Health Act is not being implemented by majority of clinics visited during this study. The medical waste storage area should be vermin-, insect-, and rodent proof, have easily cleanable floors and wall finishing and general construction should be totally enclosed, adequately ventilated, lighted and lockable according to the legislation.

The majority of clinics were disposing of medical waste at dumping sites. This was similar to the findings by the Making Medical Injection Safer (MMIS) project in Ethiopia where open burning of medical waste in a hole was mostly used as a disposal method (Habtetsion et al. 2009). In the present study, some urban clinics dispose of medical waste at municipal dumping sites together with general waste. This could increase the risks of exposure to infections among municipal workers during the handling, transportation and disposal of such mixed waste. In some clinics, medical waste was burnt in drums usually at night. A hole was dug in the ground in which burnt medical waste (ash) was buried. In some clinics, the dumping sites were shallow, not well constructed and protected and were accessible to children and animals. The ash in some instances is left unburied and it could be spread all over the clinic yard and surrounding houses by the wind. According to the South African Health Act no 63 of 1977, every generator of medical waste should dispose such waste in such a way that it does not cause a health hazard to the handler or the general public. Some dumping sites are easily flooded by water during the raining season and this could increase the risk of waterborne diseases to the public.

The ash that results from burned medical waste is buried in the clinic yard. Urban clinics dispose of medical waste at municipal dumping areas together with general waste. This practice may increase the risk of infections among handlers of waste such as municipal workers. The hospital incinerators are used for the disposal of sharps. The ash that results from incineration is hazardous and needs special treatment. It is normally disposed of at the sanitary landfill. Placenta pits seen in some clinics were not used at all, because babies were not delivered in these clinics.

Several studies conducted in developing countries did not indicate satisfactory improvement in waste management (Alagöz and Koasoy 2008; Askarian et al. 2004; Dehghani et al. 2008; Tsakona et al. 2007). The guidelines published by the World Health Organisation (WHO) aims to assist large and small health care institutions to develop effective waste management plans (WHO, 2005; Pruss et al. 1999). Previous studies conducted in South America, African and Asian countries have indicated qualitative and quantitative improvements in medical waste management in a few clinics and small health care centers (Da Silva et al. 2005; Mohamed et al. 2009; Shinee et al. 2008). Some of the studies indicated that there was a lack of a regulatory legal framework or specific public policies related to medical waste management (Askarian et al. 2004; Dehghani et al. 2008). Waste management plans and policies are in place in South Africa but the major challenge is the implementation thereof.

The non-compliance to the legal framework reported in the present study is similar to reports of Da Silva et al. (2005).

The study conducted in China by Ruoyan et al. (2010) indicated that many primary health care centers lack proper waste management strategies as compared to secondary or tertiary health care centers and the problems identified are related to poor waste segregation, a lack of equipment, inadequate location for storage, poor sanitary protective measures and unsafe on-site disposal (Ruoyan et al. 2010). Similar non-compliance circumstances were also reported by studies conducted in primary health care centers in developing countries such as Laos (Phengxay et al. 2005), Turkey (Alagoz and Kocasoy 2008) and Mongolia (Shinee et al. 2008). One of the major challenges reported in the present study was poor waste segregation. This challenge was mainly due to lack of facilities for waste segregation in most of the clinics. It is most appropriate to quantify and classify waste by type for treatment purposes (Tsakona et al. 2007).

In China, Ruoyan et al. (2010) reported that primary health care centers were experiencing a number of waste management inadequacies such as poor waste segregation. The same situation was observed in the present study where medical waste was not sorted properly in the majority of clinics. This was due to a lack of a proper medical waste management system and equipment. Most of the staff members were aware that there are specific regulations to adhere to in segregating waste. Irrespective of the availability of the containers, sharps were not segregated from medical waste. According to the South African Health Act no 63 of 1977, "every generator of medical waste and where applicable, every transporter and disposer of medical waste shall cause such waste to be sorted in such a way that it does not cause a health hazard for any handler or any other person or the environment." Notwithstanding, it appeared that a shortage of plastic bags (i.e. red bags for medical waste and black bags for general waste) and containers in some clinics were a contributing factor to poor waste segregation.

Abd El-Salam (2010) and Abdulla et al. (2008) reported that most of the sampled hospitals were using incineration to dispose of medical waste. According to the Making Medical Injections Safer (MMIS) project, low temperature incineration was used to dispose medical waste in Ethiopia (Habtetsion et al. 2009). In the present study, the majority of clinics were using hospital incinerators to dispose sharps while a few clinics were incinerating sharps inside the clinic yards. The ash resulting from the incinerators is hazardous and requires special care during treatment and disposal. It is most appropriate that it is disposed in a sanitary landfill.

In Egypt, the study (Abd El-Salam, 2010) indicated that domestic wastes were transported to municipal dumping sites while medical wastes were transported to municipal incinerators by municipality trucks that were not compliant with safety regulations. In the present study, both rural and urban clinics reported that sharps were transported to hospital incinerators by the hospital trucks. Some urban clinics reported that medical waste was transported by municipal trucks to dumping sites.

The collection service of medical waste was poor in clinics. In some instances buckets full of sharps were packed at the clinics several weeks before collection and transport to hospital incinerators. A survey conducted in private clinics, nursing homes and hospitals in Asia revealed that health care personnel at these facilities received little or no training in handling, transport, treatment or disposal of medical waste (Council of State Government, 2002).

The following recommendations are based on the main findings of this study and are set out below:

#### **4.1 Promotion of waste segregation**

There is a need to establish and implement the waste segregation practices in clinics to prevent the risk of infections to workers who handle waste and the general public. Some clinics are burning waste or dump waste in municipal bins that are transported to dumping sites that are not secured. The waste contains mercury and other heavy metals, chemical solvents and preservatives which are known to be carcinogenic, which when burned produce dioxins and other pollutants that are hazardous. Proper waste segregation can be maintained by providing training to workers and using proper containers and signs for waste.

#### **4.2 Implementation of sharps management system**

A proper sharps management system should be implemented in all clinics. Sharps should be segregated from waste and disposed in rigid, puncture proof containers to prevent the risk of needle-stick injuries and possible infections with blood-borne pathogens. Workers should be equipped with appropriate skills for safe disposal of used sharps.

#### **4.3 Promotion of health workers safety through training and proper use of personal protective equipment**

Workers who handle medical waste are at risk of exposure to infections and hazards such as radioactive and chemical wastes. Proper training should be offered to all workers who handle waste to make them aware of the health risks. In addition, workers should be provided with sufficient protective equipment to protect themselves against exposure to hazards and infections associated with medical waste.

#### **4.4 Provision of secure storage, collection and transportation of medical waste**

The majority of clinics do not have adequate storage facilities for medical waste. Storage rooms that comply with requirements of the Health Act should be made available and used for proper storage of medical waste before collection to disposal sites.

Medical waste should be collected and transported by properly registered and accredited contractors using vehicles that comply with the requirements of the Health Act. The vehicles should be designed appropriately to prevent the spillage of medical waste and emergency procedures for accidents or medical waste spillage should be available. The vehicles that transport medical waste should be clearly marked in accordance with the relevant road rules to ensure that appropriate measures can be taken to prevent pollution in the event of an accident.

#### **4.5 Provision of secure disposal sites**

There is a need for the establishment of a registered sanitary landfill for disposal of medical waste. It is recommended that medical waste should be disposed at a properly registered sanitary landfill. Incinerators should be operated and maintained according to manufacturer's guidelines to prevent pollution through emissions.

#### **4.6 Developing plans and policies on waste management**

All the clinics should have a waste management plan/policy. It should be used for implementing and improving the waste management system, environmental performance and enhancing health and safety of the public. The policy should be documented, accessible and communicated to all workers that come in contact with medical waste. Each clinic should have a designated person (preferably a Waste Management Officer) and the waste management team responsible for waste management and implementation of the policy.

### **5. FURTHER RESEARCH QUESTION**

Further research about other alternative methods to dispose medical waste should be investigated. There is a need to investigate the possibility of using alternative methods, such as medical waste disposal by encapsulation.

### **6. CONCLUSION**

The present study showed that there was poor management of medical waste in most of the clinics visited. Medical waste was not properly disposed in most instances and special attention is needed as it poses a potential public health risk with an inadvertent environmental burden. Given the fact that poor management of medical waste can pose a serious health risk to the community, this study suggests that there is a need for the promotion of public awareness about medical waste, training of clinic personnel and handlers of medical waste, enforcement of existing legislation and establishment of sanitary landfill. These measures should be implemented to ensure proper management of medical waste in the clinics and other health care facilities where medical waste is generated.

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