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IV. THE 'WASTE' OF MODERNITY

Medical Waste Management in Kenya:
Opportunities for Improvement

Nashaat Mazrui, MEM 2010

Introduction

I sat in a bus as we drove through the congested roads of Nairobi, exhausted after a long day in the field. Though I wished to fall asleep for the two hours that it takes to get to my destination, the activities of the day lingered in my mind preventing me from going into my slumber. I looked at my field notes for the fourth time and sighed. It was unbelievable that all the health facilities I visited that day had medical waste incinerators without adequate air pollution control devices. Residential areas surrounded most of the incinerators, and residents living there talked of choking smoke that seeped into their homes when the incinerator was operated. I closed my eyes for a while to comprehend the enormity of the health crisis. There is no doubt that it is a grave situation and, as a Kenyan, I consider it my responsibility to search for sustainable solutions to the crisis. Thus for the rest of my journey, I thought about the management of medical wastes in Kenya and how it could be improved.

Medical waste, also called bio-medical waste in Kenya, refers to waste produced in health facilities or research organizations during the diagnosis, treatment, or immunization of human beings and animals (WMR, 2006). The World Health Organization (WHO) classifies such waste into the following categories: infectious waste, sharps, pharmaceutical waste, chemical waste, genotoxic waste, radioactive waste, pathological waste, and pressurized containers (Pruss et al. 1999). Most health facilities worldwide prefer to incinerate medical waste as it has many advantages, such as sterilization of pathological or anatomical waste, volume reduction, and waste heat recovery (Hyland 1993). However, since medical wastes contain high amounts of chlorine in the form of disinfectants or plastic (polyvinyl chloride) (Hyland 1993), incinerating the material produces dioxins. These are chemicals that resist degradation and therefore bio-accumulate in the food chain. They are toxic to life and have been linked to the development of cancer, suppression of the immune system, cause of reproductive and developmental complications and endocrine disruption (Connett 1998; Darryl and Pat 1998). Dioxins enter the atmosphere as fumes. However, in an incinerator equipped with air pollution control equipment, most dioxins are concentrated in the fly ash, which is the fine solid removed from the flue stack (Diaz et al. 2005).

In addition to dioxin emissions, medical waste incinerators release considerable amounts of heavy metals that can be emitted as fumes, particles, and ash (Fritsky et al. 2001; Yuhas et al. 1994). Toxic discharged metals include cadmium, lead, mercury, chromium and arsenic (Singh and Prakash 2007). Chronic exposure to toxic metals can result in the suppression of hematological system, kidney failure, neurotoxicity, gastro-intestinal disorders, respiratory tract irritation, and cancer of the lungs and prostate (UNEP 2007).

The drawbacks of incinerating medical wastes have encouraged the development of alternative technologies for treatment and disposal. Although various new technologies are being considered world wide, only microwaving and steam sterilization seem to offer realistic alternatives to incineration (Lee et al. 2004). However, these two techniques do not completely sterilize pathological, radioactive, laboratory, and chemotherapy wastes (Lee et al. 2004).

Combining incineration and non-incineration technologies for medical waste treatment is therefore a good way of reducing pollution. It is thus not surprising that the regulations of Kenya, which aim to prevent the dumping of unsterilized medical

Nashaat Mazrui graduated with a Masters degree in Environmental Management at Yale FES. She holds a Bachelor of Science (BSc.) degree in Chemistry from the University of Nairobi, Kenya. Currently, she is interested in toxicology and risk assessment studies of air and water pollutants.

wastes, call for the employment of incineration and steam sterilization before final disposal. However, an emphasis on only the treatment of medical waste is not sustainable in the long run. Wastes are merely residues that our economy has not yet learned to use efficiently (Graedel and Allenby 1995) and it would be advantageous for Kenya to explore sustainable ways of using medical 'residues'. Doing so will not only have environmental and public health advantages but will also create sustainable jobs in the country. Exploration of such alternatives first requires the establishment of baseline data on the generation rate, management practice, treatment, and disposal of medical wastes currently employed. My study therefore aims to establish this data.

Methodology

In an effort to collect this information, I worked in Nairobi from June to August of 2009 gathering data on medical wastes from health facilities. I choose Nairobi for various reasons: first, as the capital city of Kenya, it is the most populated and cosmopolitan of all cities in the country; second, the United Nations Environmental Program (UNEP) headquarters is located in Nairobi, which makes the city a place of environmental interest to the international body; third, Nairobi is the center of policy formation in Kenya and is the location of government office headquarters.

Using a questionnaire and two research assistants, I visited 418 health facilities in Nairobi during the three months of field research. I sought information on medical waste generation rate; the extent of segregating medical wastes; recycling and record keeping practice; and methods employed for treating and disposing of medical wastes. For the purpose of this study, health facilities in Nairobi were divided in to four classes: hospitals, nursing homes, dispensaries, and clinics (Table 1).

For the quantitative analysis, I used Minitab 15 to calculate the average quantity of waste generated in each facility. The values were then subjected to a t-test to establish statistical difference. Also, I calculated simple percentages for the management and disposal methods employed.

Results and Discussion

Quantity of wastes generated

Health facilities categorize wastes into two main groups: sharps and infectious wastes. Sharps are taken to be items that can cut someone while infectious waste was any solid waste that has come into contact with a patient's body fluid. Within these two groups, it was found that hospitals generate the highest amount of both types of waste and the figures were statistically different from those generated by the other three facilities (Table 2).

Results from this study suggest that the generation rate of infectious waste for Nairobi is on the higher side for a developing country when compared to documented rates (Diaz et al. 2008). This could be because of the poor segregation practice as explained below.

Waste management practice

The most common practice in 97% of the facilities in Nairobi is the segregation of sharps while all other kinds of solid medical wastes are mixed together. This practice leads to increased dioxin and metal emissions during the incineration process (Alvim-Ferraz and Afonso 2003a, 2003b). Additionally, many facilities consider broken thermometers as sharps, which leads to increased mercury content in the waste.

Recycling and record keeping is not popular in health facilities. I found that less than 10% of

Table 1. Categories and definition of health facilities.

Type	Definition
Hospital	A facility offering both in-patient and out-patient services and with more than 70 beds
Nursing homes	A facility offering both in-patient and out-patient services with less than 70 beds
Dispensary	A facility designed to offer out-patient services with many doctors serving the patients
Clinics	A facility designed to offer out-patient services with one doctor serving the patients

Table 2. Waste generated in each type of facility

Facility Type	Sharps (kg/patient day)	Infectious wastes (kg/(patient day))
Hospital	0.015	0.9
Nursing Home	0.0093	0.35
Dispensary	0.009	0.093
Clinic	0.014	0.169

the facilities recycle pharmaceutical bottles and only one major hospital recently began recycling paper. Yet, medical equipment can be reused if designed for recycling, and if it can withstand the sterilization process (Pruss et al. 1999). Plastic syringes probably have the greatest potential for recycling since they contain a high plastic content (about 85%) and contribute the highest proportion of total medical plastic wastes (Lee et al. 2002). Opportunities also exist in the use of anaerobic digesters to consume pathological wastes into biogas for energy and nutrient-rich slurry for fertilizer usage.

Only 35% of the facilities admit to keeping some kind of records on the amount of medical wastes generated. Record keeping is an invaluable practice that can aid a waste manager in setting targets for waste reduction, and also in developing analytical tools such as mathematical models to be used in decision-making (Agunwamba 1998). The lack of record keeping hinders the development of effective medical waste policy.

Waste Treatment and Disposal methods

This study found that most health facilities subcontract waste treatment and disposal to a private company. In fact, 41% subcontract to companies that are licensed to collect general waste while only 27% subcontract to companies licensed to handle medical wastes. Of health facilities that did not subcontract waste disposal, 21% incinerate on site and then regard residual ash as general municipal waste and 11% directly deposit all their wastes in open dumps.

Considering that most of the facilities

Figure 1. Children playing in a municipal waste disposal ground

Figure 2. Pigs feeding in a municipal waste disposal ground

subcontract the disposal of wastes to general waste collectors, a large amount of unsterilized medical waste actually ends up in dumps. Toxic ashes from incineration are also disposed here leading to water and soil contamination through leaching of the chemicals. Since Kenya does not have a sanitary landfill yet, the potential for toxic substance to leach is much higher than in countries with sanitary landfills. Additionally, the current dumps in Nairobi are accessible to children and animals (Figures 1 & 2) and thus exacerbate the harms of medical waste management.

Last, but not least, this study found that all except two facilities that incinerate medical waste are located in residential areas and do not have adequate air pollution control devices. As discussed earlier, incineration is associated with many negative environmental and health effects and it seems ironic that health facilities themselves are contributing to these problems.

Conclusion

Though this paper is by no means exhaustive, it helps identify important areas that require improvement if medical waste management in Kenya is to be made more sustainable. The following list outlines the salient conclusions and recommendations of the study:

1. The amount of medical wastes produced in health facilities of Nairobi is higher than the average amount produced from developing countries. Efforts to minimize waste production should be encouraged through recycling and reusing resources.
2. Segregation of wastes is poorly conducted in facilities, yet rigorous segregation will minimize wastes, pollutant emissions and allow for recycling.
3. In spite of the fact that recycling is almost never done in health facilities, opportunities for recycling pharmaceutical bottles, medical plastic wastes, and pathological wastes exist.
4. Keeping comprehensive records of wastes generation is the first step towards developing a waste management plan, but very few facilities in Nairobi keep records.
5. The legal awareness among waste managers in health facilities is limited, thus it is important for regulations to be publicized such that all those responsible for generating, handling and disposing wastes are enlightened.
6. Almost all incinerators in the health facilities have poor or no air pollution control devices. Therefore, adequate pollution control measures need to be employed.
7. The government should construct a landfill to minimize the leaching potential of incinerator ashes and other pollutants in municipal wastes.

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References

Agunwamba, J. C. 1998. Solid waste management in Nigeria. Environmental Management 22: 849–856.

Alvim-Ferraz, M. C. M. and S. A. V. Afonso. 2003(a). Dioxin emission factors for the incineration of different medical waste types. Arch. Environ. Contam. Toxicol. 44: 460–466.

Alvim-Ferraz, M. C. M., and S. A. V. Afonso. 2003(b). Incineration of different types of medical wastes: emission factors for particulate matter and heavy metals. Environmental Science and Technology 37: 3152–3157.

Borowsky, A. R. and P. D. Fleischauer. 1993. Medical waste disposal- what's new? In 86th Annual Meeting and Exhibition, Air & Waste Manage. Assoc., Paper No. 93-TP-6003, Denver, CO, 13– 18 June.

Connett, P. 1998. Municipal waste incineration: A poor solution for the 21st Century 4th Annual International Management Conference. Waste–to–Energy, Nov 24 -25, 1998, Amsterdam.

Darryl, L. and C. Pat. 1998. Technical criteria for the destruction of stockpiled persistent organic pollutants. Greenpeace. International Science Unit.

Diaz, L. F., L. L. Eggerth, Sh. Enkhtsetseg and G. M. Savage. 2008. Characteristics of healthcare wastes. Waste Management 28: 1219–1226.

Filipponi, P., A. Polettini, R. Pomi, and P. Sirini. 2003. Physical and mechanical properties of cement based products containing incineration bottom ash. Waste Management 23: 145–156.

Fritsky, K. J., J. H. Kumm, and M. Wilken. 2001. Combine PCDD/F destruction and particulate control in a baghouse: experience with a catalytic filter system at a medical waste incineration plant. J. Air and Waste Manage. Assoc. 51: 1642–1649.

Genazzini, C., R. Zerbino, A. Ronco, O. Batic, and G. Giaccio. 2003. Hospital waste ashes in Portland cement mortars. Cement and Concrete Research 33: 1643–1650.

Graedel, T. E and B. R. Allenby. 1995. Industrial Ecology. Englewood Cliffs: Prentice Hall.

Hyland, R. G. 1993. Regulatory developments affecting medical waste disposal. In 86th Annual Meeting and Exhibition, Air & Waste Manage. Assoc., Paper No. 93-TA-47.03, Denver, CO, 13–18 June.

Jordan, J. W. 1994. Incineration alternatives in the treatment of medical waste. In 87th Annual Meeting and Exhibition, Air & Waste Manage. Assoc., Paper No. 94-RA123A.01, Cincinnati, OH, 19–24 June.

Lee B., M. J. Ellenbecker, and R. Moure-Ersaso. 2004. Alternatives for treatment and disposal cost reduction of regulated medical wastes. Waste Manage ment 24: 143–151.

Lee, B. K., M. J. Ellenbecker, and R. Moure-Eraso. 2002. Analyses of the recycling potential of medical plastic wastes. Waste Management 22: 461–470.

O'Connor, L., 1994. Improving medical waste disposal. Mechanical Engineering May: 56–59.

Park, H. S. and J. W. Jeong. 2001. Recent trends on disposal technologies of medical waste. J. Korean Solid Wastes Engineering Soc. 18: 18–27.

Pruss, A., E. Giroult, and D. Rushbrook. 1999. Safe management of wastes from health-care activities. Geneva, WHO.

Salkin, I. F. and E. Krisiunas. 1998. Alternatives to medical waste incinerators. J. Solid Waste Technol. Man age 25: 9–13.

Singh S. and V. Prakash. 2008. Toxic environmental releases from medical waste incineration: a review. Environ Monit Assess 132: 67–81.

UNEP. 2007. Environmental pollution and impacts on public health: implications of the Dandora municipal dumping site in Nairobi, Kenya.

USEPA. 1998. The Inventory of Sources of Dioxins in the United States. USEPA, Office of Research and Development, EPA/600/P-98/002Aa. External view Draft, April

Waste Management Regulation (WMR), 2006. The Environmental Management and Co-ordination (Waste Management) Regulations. Kenya Gazette supplement No 69, September 2006.

Yuhas, J. A., A. R. Borowsky, and F. A. Hasselriis. 1994. Comparison of air toxics emission from medical waste incinerators and waste hauling. In 87th Annual Meeting and Exhibition, Air & Waste Manage. Assoc., Paper No. 94-RA123A.02, Cincinnati, OH, 19–24 June.