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Preliminary Assessment of the Status of Hospital Incineration Facilities as a Health Care Waste Management Practice in Addis Ababa City, Ethiopia

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Abstract

Healthcare institutions generate different types of infectious and/or hazardous medical waste that poses enormous risk to patients, healthcare providers, waste pickers, and the community at large, if their disposal is not comprehensively and scientifically managed. This study was focused on the assessment of waste management practice, the status of existing medical waste incinerator facility found in Addis Ababa city government and private hospitals.

A cross sectional descriptive study was carried out with the aim of assessing the current facility status and practices. The study approach involved literature review, use of survey, an empirical investigation comprising physical visit, observation checklist, and group discussion. The results showed that poor hazardous waste handling practice indicating all hospital incinerator have 100% some sort of incinerator but in different grade level which were categorized in three groups such as 93% of them were local ordinary brick incinerator in various and poorly designed, constructed and operated manner, whereas 7% of them were modern imported incinerator still among these only 5% of them were functional but still operated below the standard whereas the rest were old and nonfunctional. This paper has highlighted the pitfalls of poor status of incinerator facility and management practices in hospital waste management.

Keywords: Incinerator facility; Hazardous waste; Waste management; Healthcare

Introduction

Healthcare institutions/facilities generate different types of infectious and/or hazardous medical waste that poses enormous risk to patients, healthcare providers, waste pickers, and the community at large, if their disposal is not comprehensively and scientifically managed [1,2].

Medical wastes are generated from services carried out in hospital wards and departments, clinics, diagnostic and research laboratories, immunisation centres, pharmacy, health centres, autopsy centres, transfusion and haemodialysis centres, acupuncture, nursing homes providing community care, at-home patient care, care of the elderly and services related to mental health and learning disabilities as well as harm reduction programs for drug addicts and undertakers [3-5].

Health care waste is considered the second most hazardous waste, after radioactive waste and certain types of health care waste represent a higher risk to health, these include infectious waste (15% to 25% of total health care waste), of which sharp waste constitutes 1%, body part waste 1%, chemical or pharmaceutical wastes 3%, and radioactive, cytotoxic or broken thermometers less than 1% [6-10]. Many hospitals simply dump all their wastes together from reception area trash to operating room waste without any form of segregation while in most cases, some hospitals use incinerators [7,8]. Poor medical waste management causes environmental pollution, unpleasant smell, growth and multiplication of insects, rodents and worms, and may lead to transmission of diseases like typhoid, cholera, and hepatitis like a,d,c,d etc., through injuries from sharps contaminated with blood [8-15]. Treatment of medical wastes in developing countries has commonly been carried out using different method and technologies such as open burning, open dumping, landfills, sanitary landfills, incinerators etc., [9,16-20]. According to a World Health Organization [10,21-25] assessment there were about 22 countries in 2002 which had about 64% hospitals with no proper waste disposal methods.

Thus, it is important to ensure that the design, operation, testing, and maintenance of incineration process provide maximum safety and minimum risk to the environment. Therefore, the need for conducting incinerator assessment in major hospital is of vital importance such amount of waste present treatment and disposal challenges [26]. Besides preventing cross contamination during the management process, selecting a suitable and environmentally friendly method is a top challenge [27,28].

Methodology

The methodology was following the general principles of both qualitative and quantitative methods of descriptive research. All the 53 hospitals were included in the survey which were comprised government, n-government Organization (NGO) and private medical practitioners registered with the Addis Ababa health bureau and Federal health Bureau found in Addis Ababa and categorized into three such as Referral hospital, specialized hospital and General hospital [29-33].

Survey was carried out for each category and vital information about management practice, the presence and the status hospital incinerator, examination of design, and construction and operation practice, sitting incinerator, safety issues, maintenance, inspection and disposal method and reviewed of the health and effect of pollutant on human released from improper functioning of incinerator [34]. Site visit was conducted for six months between to supplement support information gathered from the survey. Data were obtained in addition to the literature review, use of survey, an empirical investigation comprising physical visit, observation checklist, and group discussion interviews and in charge of medical waste management in each hospital were employed [35].

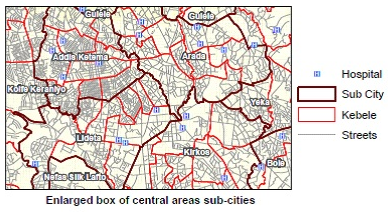

Figure 1: Map of Addis Ababa indicating hospital site of study.

Study area

Addis Ababa is the Federal Capital City of Ethiopia and the seat of the Federal Government and Parliaments. The City has gained international status by being the seat of the African Union (AU), several international organizations and numerous embassies. Addis Ababa is located in the Central part of Ethiopia and belongs to the Western highlands. All sides of the capital city are bordered by Oromiya Regional State (ORS), and cover an area of 53,000 ha [36]. The city is located at 902' N, 380 42' E. The lowest elevation of 2,326 meters above sea level at Bole International Air Port, in the southern periphery, and the highest over 3,000 meters at Entoto Mountains, North of the city. The high elevation moderate temperatures year-round and the city's position near the equator mean that temperatures are very constant from month to month [37].

There are ten sub cities divided into 99 kebeles. This map represents the spatial allocation of hospitals in the capital city (Figure 1).

Results and Discussion

The main result was summarized from 53 different governments (15), private (36) and non-government (2) hospitals found in Addis Ababa city during the course of the study. These hospitals comprised only referral, specialized and general hospital and mainly located in residential and commercial areas. The study briefed waste management/handling practice, status of hospital waste incinerator facilities and review the environmental and public health impacts of poor hospital incinerator in major hospitals in Addis Ababa city.

Waste management and related practice

The flow of waste management in reference to waste minimization, segregation, storage, handling, collection, transportation and treatment were not properly and adequately practiced by any of the surveyed hospital (Figure 2). However, in government hospital only two types color code labeling plastic buckets used such as yellow and black whereas in private hospital used uncovered plastic buckets of any type for on-site waste collection for all type of medical waste (Table 1).

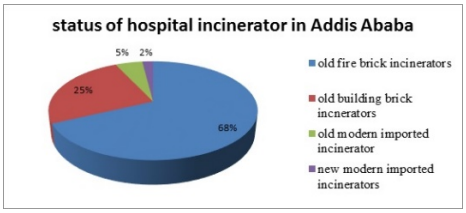

Figure 2: Status of hospital incinerator in Addis Ababa city.

Parameter	From 53 hospitals both private and government	Hospital	WHO limit
Hospital administration	90% Luck of commitment from top management	Government	None of them satisfied the guideline
Segregation	95% Poor (no complete color coding bucket)	Government and private	>>
Storage	97% Poor (no adequate site)	Government	>>
Handling	97% Poor practice	Government, private	>>
Collection	95% Poor (mixing all type of waste)	government and private	>>
Transportation	85% Poor practice	Government private and non	>>

Table 1: Waste management and related practice.

Types	Parameter	Recommendation	Finding (result assessed)

Capacity	Destruction rate, safety boxes capacity (100 kg/h)	Proper sizing is important depending on the amount of medical waste generated	No proper sizing made, not matched compared to the amount of waste generated per each hospital
Temperatures	Primary chamber	540 to 980 C (USEPA 1990)	Not regulated
	Secondary chamber	980 to 1200 C (USEPA 1990)	Not regulated in modern and brick incinerators
		>850/1100˚C (S. African and EU standards)	Not regulated in modern incinerators
		>1000/1100˚C (Indian and Thai standards)	Not regulated in modern incinerators
Air flows	Total combustion air	140-200% excess	Not regulated
	Supply and distribution of air in the incinerator	Adequate	Not regulated
	Mixing of combustion gas and air in all zones	Good mixing	Not regulated
Waste	Waste destruction efficiency	>90% by weight	Incomplete/inefficient
	Uniform waste feed	Uniform waste feed, and avoid overloading the incinerator	Overloading and not regulated
	Minimizing emissions of HCl, other pollutants	Avoid plastics that contain chlorine (polyvinyl chloride products)	Load plastic and all type of wastes (not regulated)
	Load only when incinerator operating conditions are appropriate	Pre-heat incinerator and ensure temperatures above 800 C. Avoid overheating	No regulated on this aspects
Controls and Monitoring	Temperature and many other parameters	Continuous for some, periodic for others	No regulation
Chimney	Height	At least 4-5 m high, needed for both adequate dispersion plus draft for proper air flow	Some has no Chimney but other has too short or below the standard
Source: Derived in part from USEPA (1990), UNDP (2003), and De Montfort literature.			

Table 2: Designing of hospital incineration.

Parameter	Guideline	Result
Waste Feed	The waste bag size should match with the waste feed door size of the incinerator.	100% brick and building incinerator Poorly constructed
Primary Combustion Chamber	Should be sized with the amount of waste feed.	Present but not well constructed
Secondary Combustion Chamber		100% None existence
Ash Removal	The ash collection chamber is located at the bottom of primary chamber	100% fire and building brick Poorly constructed
Chimney	4 m or 5 m depending of topography	65% no, in other not well constructed below or above
Monitoring and Control	Measures are needed for incinerator combustion control as well as for environmental monitoring and control.	100% none existence
Incinerator Building	Housing the Incinerator should be very well ventilated	5% secured but others not

Table 3: Construction of hospital incineration.

Incinerator	Guideline (MMIS/USA 2010)	Result assessed
Location	Should be at least 30 meters away from the closest inhabited building. SWJHRQ	100% were Confined in residential and commercial building
The prevailing winds	Should blow in a direction away from occupied buildings.	None of the hospital considered see Figure 2
Public passage	Should be no regular public passage within immediate proximity of the incinerator	20% of hospital incinerator suited along roadside
Vegetable or crop grow	Should be no horticulture or leaf crops within 300 meters of the incinerator in the direction of the prevailing winds.	5% garden plants present around the hospital to the prevailing wind
The bottom of the ash pit	Should be above the maximum level of the water table	No ash pit in the assessed hospital
Location of ash pit	Should be contained on site	100% of the hospital dispose its ash along with municipal waste to open dump site but 1% have ash pit on site
Placenta pit		All have some sort of placenta pit in the hospital compound
Compound situation	Should be secure and free from risk of vandalism or theft	5% secured
Fuel storage	Safe and secure storage of incinerator fuel.	65% secured fuel storage
Water supply	All HCWM disposal facilities should be equipped with a water supply.	None for this purpose

Table 4: Sitting of hospital incineration.

Parameter sought	Result obtained %	GUIDELINE (PATH/MMIS, 2010)
Health worker Safety	(100%) all hospital has no standardized personnel protective equipments (PPE) for incinerator operators	below
Operation	100% not operated in a good operating condition and operated by unskilled or easily trained personnel.	below
Maintenance and Repair	None regular service and preventative maintenance made	below
Facility inspection	None hospital made regular facility inspection	below
Operator logs	No operator logs which keep record and report information	below
Final Disposal	Incompletely burn down wastes and ashes remain, without further treatment Sent directly to municipality for open dumping.	below

Table 5: Other parameter.

Waste management and related practice

The flow of waste management in reference to waste minimization, segregation, storage, handling, collection, transportation and treatment were not properly and adequately practiced by any of the surveyed hospital. In government hospital only two types color code labeling plastic buckets used such as yellow and black whereas in private hospital used uncovered plastic buckets of any type for on-site waste collection for all type of medical waste see Figures 3 and 4. Similar study in Gondar [11] revealed that all surveyed HCFs didn't have appropriate and adequate color coded containers and plastic bags for healthcare wastes collection. Two out of ten hospitals used safety boxes for contaminated sharp collection. Open plastic buckets and safety boxes were used to transport manually to the disposal site. Besides, in Addis Ababa hospital reported that there was no segregation of waste into infectious, pathological and pharmaceutical, and had no separate color coding plastic buckets for the collection of infectious waste. The overall site observation in all surveyed HCFs had

no adequate and appropriate labeled containers for collection of healthcare waste.

Figure 3: Private Hospital.

Figure 4: Government Hospital.

The status of incinerators in major hospital

The survey showed that all hospitals more or less 100% have some sort of incinerator but in different grade level which categorized in three groups such as 68% and 25% were old fire brick incinerator and old build brick incinerator in various and poorly designed fashion and poor efficiency as shown in Table 2 Whereas 5% and 2% were old modern and new imported incinerator. However, only 5% of them were functional but still operated below the standard whereas the rest were old and non functional currently. The majority of the surveyed hospitals incinerate their MW and most of the incinerators were present within the respective hospitals. Similar study in Gondar reported that [11]. Only six out of eleven HCFs had incinerator which are made from breaks and these incinerators had poor efficiency. other study in Nigeria [13] reported that few functional incinerators in Nigeria are either obsolete or locally made from bricks and cement. Again in Lagos state (Nigeria), it was noted that there is only one functional incinerator which operates below standard due to continuous emission of toxic substances [14].

Design

Proper design and operation of incinerators should achieve desired temperatures, residence times, and other conditions necessary to destroy pathogens, minimize emissions, avoid clinker formation and slagging of the ash (in the primary chamber), avoid refractory damage destruction, and minimize fuel consumption. However, the survey showed that no proper design were made for all fire brick incinerator compared to the standard designed as shown Table 2.

Construction

Almost all brick incinerator in the assessed hospital were too old, fractured and poorly constructed. Besides, 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 and also most of the incinerators have no ash pits for ashes collection, thus 99% of the surveyed facilities of the surveyed facilities have no ash pits for ash collection and again most of the incinerators are small and not enough to handle amount of medical waste generated see Table 3. Furthermore, lack adequate plans, drawings, and quality control, resulting in incorrectly-built facilities.

According to the survey the hospital facilities built 93% of the brick incinerator basically of small-capacity single chamber incinerators and not enough to accommodate the amount of medical waste generated. one study reported that 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 and he asserted that for this purpose, only well trained staff should operate the incinerator and Proper operation procedures must be followed to ensure high temperatures are adequately reached [9].

Health worker safety

The survey showed that 100% of all hospital they had no completed standardized personnel protective equipments (PPE) for incinerator operators. A survey of healthcare centers in Abuja revealed that 18% of the wastes are incinerated in a local built brick incinerator without safety devices [15]. On the otherhand, 98% of the interviewed personnel involved in waste management confirmed that no regular medical screening and immunizations for them made by the hospital.

Operation

According to the surveyed results all (100%) of the hospital facilities have some sort of incinerator which were not operated in a good operating condition and operated by unskilled or easily trained personnel so that they couldn't operate properly as according to Operator guideline see Table 5 and 95% of the hospital faculties had no formal environmental health professional who operated on the incinerator rather they trained and operated jointly with other activities. Similar study in Tanzania [16] waste incinerators built between 2001 and 2003 showed that less than 40% had trained operators, many exhibited smoke problems and problems with ash disposal.

Sitting of hospital incineration

The location of an incinerator can significantly affect dispersion of the plume from the chimney, which in turn affects ambient concentrations, deposition and exposures to workers and the community [17].

None of (100%) the hospitals met the standard set for site selection for incinerator installation rather they installed on the available space see Table 4. The survey also showed that Sitting of brick and modern incinerators didn't consider the various meteorological conditions

including temperatures, wind speeds, stabilities, and topography. Furthermore, the site of the incinerator in all cases inappropriate along with chimney length, designed and construction were made without prior studied on these aspects (e.g., located in the children's playground, populated roadside, residential area, depression topography, besides the hospital staff quarters or near a primary school, etc.) as shown in Table 4. On the other hand, the majority of the assessed hospital showed that the length of incinerator chimney below the surrounding building which affects the plume distribution so that the huge amount concentration of pollutant remain in the ambient environment.

Facility inspection

The result said that no hospital made regular facility inspection included: Visual inspections of the facility for corrosion, leaks, mortar and seal failures; Testing of doors and other moving parts; Regular schedule maintenances.

Operator logs (Record-keeping and reporting)

The finding showed that almost all (100%) of the hospital has no operator logs which keep record and report information about how much waste deposited from the source, waste destroyed, and fuel consumed, equipment defects, and service and maintenance history.

Disposal practice after treatment was over with incineration

The survey showed that all hospital burn down their wastes incompletely opposed with set by (MMIS/USA/PATH) Guideline) and they didn't made any further treatment. Rather they scraped out the ash and the remained wastes directly sent to municipality for open dumping. One study in Abuja indicated that [15], hospital wastes collected from different hospital wards are burnt without due consideration of human and environment effect [15].

Conclusion

The overall findings of this study indicated that the majority of HCWs did not apply the recommended healthcare waste management practice set by USA/MMIS/WHO. Moreover, the current healthcare waste management practice in studied health facilities was managed improperly and can pose a risk for human health and the environment. Segregation of wastes was not practiced in all surveyed HCFs. Also, inadequate supply of color coded containers and low commitment of HCWs was observed. On the other hand, analysis of hospital incinerator showed that significant problems were seen regarding designing, construction, sitting, operation, maintenance and management of incinerators. Besides, all lack ash pits for ashes collection, in some incinerators some parts are missing, e.g., chimneys height, covers for the waste feeding door and covers for ashes removing door. Improper or incomplete combustion by incinerators can produce pollutant gases which are not environmentally friendly and also for public health.

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