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CHARACTERIZATION OF BIOMEDICAL WASTE OF MYSURU CITY HOSPITALS

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ABSTRACT

Hospitals generate waste which is chemically hazardous, infectious and often radioactive. Such waste because of inappropriate disposal/treatment strategies contributes to serious health hazards in the community Bio-medical waste (BMW) is generated mainly by health care establishments. The management of Bio-medical waste is still infant all across the world. It consists of Bio-medical waste as well as chemical waste with a portion of solid waste. According MOEF (Ministry of Environment and Forest) every hospital generating Bio-medical waste needs to set a requisite treatment facility nearby to ensure degradation of Bio-medical waste as the untreated Bio-medical waste should not be kept beyond 48 hours. The reality is that incinerators don't eliminate toxic substances, they concentrate them. The primary hazard with incineration is the toxic chemicals in the emissions leaving the stack. In the present study, bottom ash of Mysuru city hospitals was analyzed to determine concentration of the toxic heavy metals and practicing management systems.

KEYWORDS:Bio medical waste (BMW), Heavymetals, MOEF, Bottom ash, Hospital.

INTRODUCTION

Biomedical waste originates from human or animal health care, medical research, medical teaching facilities, funeral establishments, laboratories and other facilities. A portion of that waste stream is infectious or potentially infectious and presents a potential hazard to the public health and the environment.

The waste generating by the health care units are termed as medical waste. The hospital waste has always been considered potentially hazardous. The disposal of untreated bio-medical wastes poses an environmental and public health risk. It also presents an occupational health hazards to the health care personnel who handle these wastes at the point of generation, and those involved with their management i.e. segregation, storage, transport, treatment and disposal. The indiscriminate disposal of untreated wastes is the causes to spread the infectious diseases. Apart from these, a good amount of bio-medical wastes such as disposable syringes, Saline bottles, fluid bottles etc. etc. are picked up by the rag pickers and are recycled back into the market without any disinfection. It is imperative, therefore, to adopt appropriate system for the safe collection, storage, transport, treatment and disposal of the hospital wastes. Realizing the seriousness of the problems associated with the poor management of the bio-medical wastes, the Govt. of India had notified the Bio-Medical Waste (Management & Handling) Rules in the years 1998 in order to regulate the environmental menace due to mismanagement of the hospital waste.

Efficient medical waste management is a major problem particularly in India. Waste segregation at the points of generation and their compatibility and reliability issues are the main concern when it comes to current treatment and disposal practices. There is a potential for environmental exposure to toxic emissions from sub-standard incinerators (poor combustion conditions) and nuisance arising from foul stench not leaving out attraction and proliferation of vermin. Even though there is some uncertainty around the degree of risks posed by medical waste, there is rational agreement that illegal and uncontrolled disposal threatens the public health.

Over the last few decades, progress in medical science and technology and expansion in the number of health institutions worldwide has been accompanied by increasing quantities of potentially hazardous medical waste.

The risks include occupational exposure of health workers and waste handlers and environmental exposure of the public caused directly by illegal or careless management and disposal practices or indirectly through emission and ash handling from medical waste incinerators .

Transportation of medical waste in medical establishments occur in two ways; the first is from the source of generation to an on-site treatment or disposal facility while the second involves from a source of generation to an on-site temporal storage facility before eventual transportation to an off-site treatment and disposal facility. Off-site transportation of medical waste according to Luttrell *et al.* (2003) takes place on land using vehicles, even though there is a likely risk of accidental release of hazardous materials in to the environment. According to Luttrell *et al.*,, the waste is typically contained in high-volume bulk storage tanks or low –volume storage drums and the storage containers and vehicles transporting such wastes should be placarded with the bio-hazard mark while on the transit.

A rapid survey covering 10 hospitals in Mumbai carried out by Hospital Inspection Society of India shows that waste generation vary between 0.6 to 2.1 kg/bed/day.

Table 01: Percentage Constitution Of Hospital Waste

CONSTITUENTS	**APPROX %**
Pathological waste	5
Infectious material	10
General Non-Infectious	50
Kitchen waste	30
Recyclable materials (paper, plastic, metal)	4.5

Components of Bio-Medical Waste

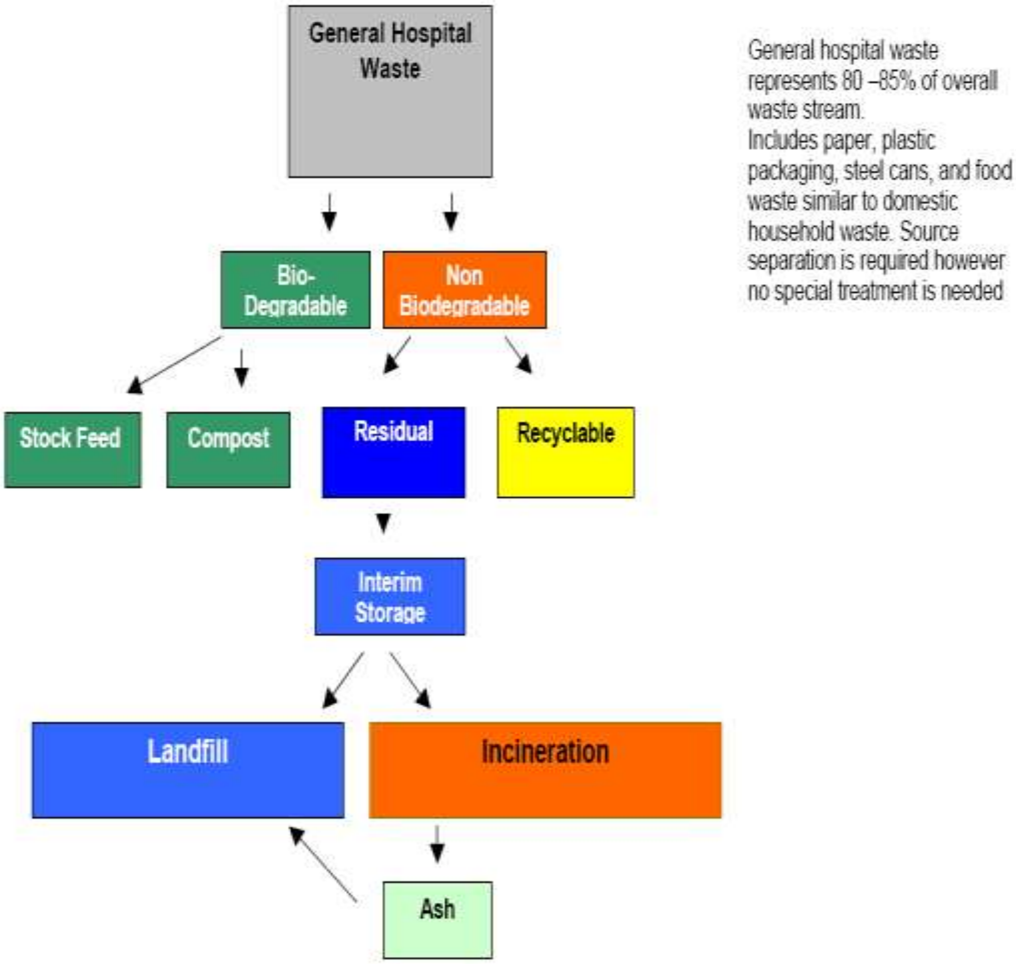
1) Human anatomical waste (tissues, organs, body parts etc)
2) Animal waste (as above, generated during research/experimentation from veterinary hospital etc)
3) Microbiology and biotechnology waste, such as, laboratory cultures, micro-organisms, human and animal cell cultures, toxins etc.,
4) Waste sharps, such as, hypodermic needles, syringes, scalpels, broken glass etc.,
5) Discarded medicines and cyto-toxic drugs
6) Soiled waste, such as dressing, bandages, plaster casts, material contaminated with blood etc.,
7) Solid waste (disposable items like tubes, catheters etc, excluding sharps).
8) Liquid waste generated from any of the infected areas.
9) Incineration ash.
10) Chemical waste.

The average generation of different types of healthcare waste for different categories of hospitals is tabulated below.

Table 2: Percentages of different kinds of waste generated in health care establishments

Hospital Category (bed strength)	**Healthcare waste generation rate (gms./bed/day)**	**General waste (%)**	**Bio-medical waste**			
			Total BMW (%)	**Anatomical waste (%)**	**Sharp Waste(%)**	**Infectious non sharp waste (%)**
251-600	702	70.12	29.88	3.70	1.21	24.97
126-250	678	64.05	35.95	5.49	2.40	28.06
51-125	658	66.08	33.92	5.26	1.82	26.84
Upto 50	782	66.48	33.52	4.98	2.33	26.23
Average	705	66.68	33.32	4.86	1.94	26.52

Source: WBHSDP report, 2002-2003



Study Area:

Mysore is the third most populous city in the State of Karnataka, India. Located at the base of the Chamundi Hills about 146 km (91 mi) south-west of the state capital Bangalore, it is spread across an area of 128.42 km^2 (50 sq.mi). According to the provisional results of the 2011 national census of India, the population is 8,87,446. Mysore City Corporation is responsible for the civil administration of the city, which is also the headquarters of the Mysore district and the Mysore division.

MATERIALS AND METHODS

Subheading

Field work and data collection for the study was carried out in Mysore city. Mysore city was selected because it contains a significant number of health care establishments offering clinical services.

Sample collection and analysis

Bottom ash samples were collected from the incinerators early in the morning when the operator was preparing the unit for start-up plastic spoons were used to collect the samples which were then poured and securely locked in to plastic containers. The collected samples were digested with the acid mixture to make metal ions to dissolve. The liquid solution was analyzed for heavy metals through ICP-MS.

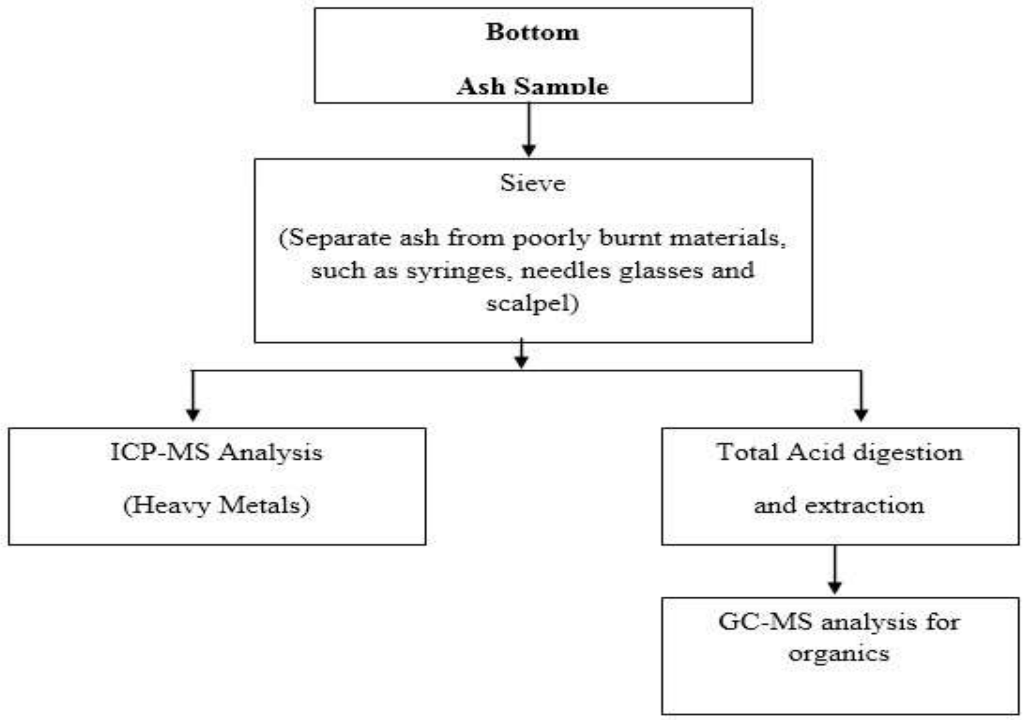


Figure 1: Methodology flow chart for analysis of heavy metal and organic compounds in bottom ash samples.

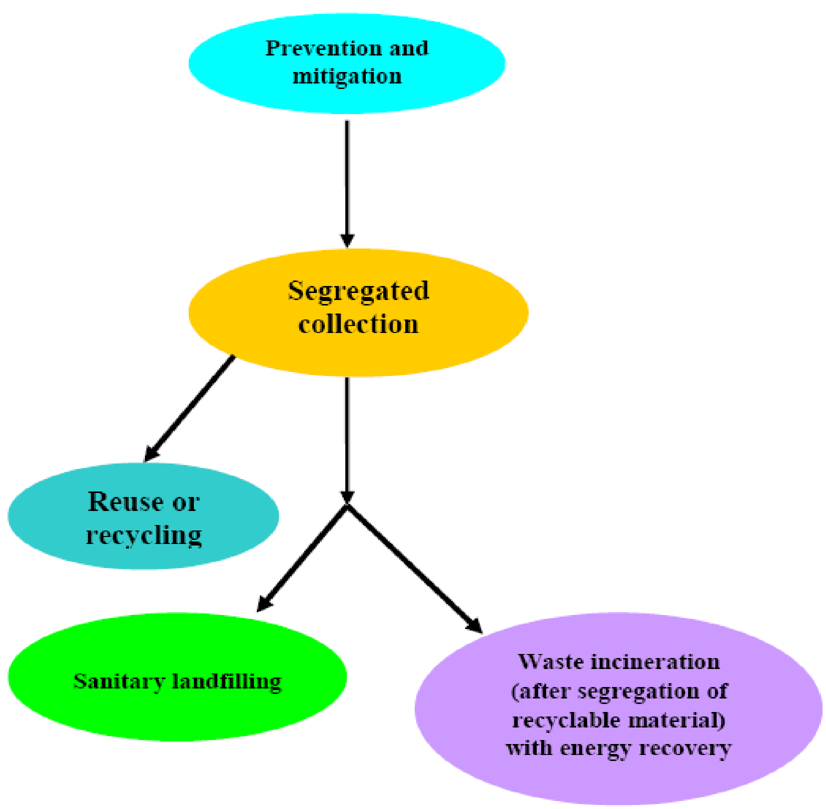


Fig 2.2: Biomedical waste management implementation

RESULTS AND DISCUSSION

Results of the concentration of trace metals and organic compounds in bottom ash from hospital waste incinerators in Mysore are summarized in table-1. Findings from an exploratory morbidity study and from an HIA (Health Impact Assessment) prospectively conducted to establish needs and prerequisites for a hospital waste management policy for Mysore are also included.

ICP analysis quantified Cr, Cu, Fe, Mn, Ni, Pb, Zn, Mg and Ca in bottom ash sample from waste incinerators, while As, Cd, Co, Sb and Ag were below the detection limit as shown in table-1 calcium had the highest mean concentration of 118250 Mg/kg while Pb had the lowers mean concentration of 10 Mg/kg.

Table-1:Mean and Standard deviation for heavy metals in bottom ash samples from three hospitals waste incinerators in Mysore.

Heavy metals	**Concentration (mg/kg)**	SD
Cu*	8	1
Fe	4900	19
Mn	1.0	2
Ni	2.0	12
Pb*	1.0	1
Zn*	2870	13
Mg	6190	17
Ca	118	43
As*	BDL	B
Cd*	BDL	B
Sb	BDL	B
Ag	BDL	B
Co	BDL	B

One of the specific aims of this study was to investigate the entire pathway of hospital waste management in Mysore. The main result in this area is characterized by the short-comings associated with segregation, collection, transportation, temporal storage and treatment and disposal. Similar situations have been reported in Nigeria (Oke, 2008), where infectious and non-infectious waste are collected in the same dustbin; Botswana (Ketlogetswe *et al.*,2004), where disposal techniques vary from one centre to another and Iran (Taghipour and Mosaferi,2009), where segregation is weak and ineffective. These studies suggest that a holistic approach needs to be adopted to successfully manage hospital waste in developing countries. Patil and Shekdar (2001) identified short-comings in the existing hospital waste management system in India. The biggest problem in effective hospital waste management in developing countries lies with insufficient resource allocation, lack of training and appropriate skills, risk awareness, public apprehensions and misguided information on exposure, incinerator capacity and the increasing need for a solid and sustainable national health care strategy (HCWS, 2008). These problems arise due to the absence of qualified staff and insufficient training of those available on issues related to efficient hospital waste management and the hazards that might emerge from their inappropriate handling (Tsakona, 2007).

Hospital waste incinerators may emit a number of pollutants depending on the waste being incinerated and the state of the incineration unit. These pollutants include particulate matter, acid gases, toxic metals and organic compounds of incomplete combustion such as, dioxins and furans. and carbon monoxide, as well as sulfur oxides and nitrogen oxides (Ossama *et al.*,2005). In our study, heavy metals such as Cr, Cu, Fe, Mn, Ni, Pb, Zn, Mg and Ca in bottom ash samples from waste incinerators were detected.

According to Lee and Huffman (1993), toxic metals in hospital waste are not destroyed during incineration; they instead change their chemical and physical states and are released via gaseous and solid by-products. Metals such as Ca, Mg, Zn, Pb, Ni, Mn, Fe, Cu and Cr were identified in ash samples in our study. The solubility and mobility potentials of the aforementioned metals are vital for activity in environmental media. Solubility is dependent on factors such as the concentration of the metal, chemical species, pH, redox potential and ionic strength of the soil

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solution. The mechanisms of action of carcinogenic metals according to Beyersmann (2002) are still far from being elucidated completely. Nickel, Cr and other carcinogenic metals such as Cd and Co are known to enhance mutagenicity and carcinogenicity by directly acting on geno-toxic agents (Beyersmann, 2002)

Treatment and disposal of hospital waste in Mysore as previously mentioned involve the use of rudimentary incinerators, open dumps, and poorly constructed landfills for solid wastes while liquid waste is flushed to suck-away pits via toilets and sinks. Disease vectors such as flies, mosquitoes and rodents, which potentially transport germs in to households in close proximity, are attracted to such sites. Clouds of visibly black smoke and fly ash from the incinerators, through mass air movements deposit pollutants around the households and on to the waste dumps. Despite the small sample size and short period of data collection, the results show a picture of the exposures and health risks for children living in such sites. It is evident from the findings that poor hospital waste treatment and disposal methods can enhance morbidity in the community even though there is insufficient evidence of them causing morbidity. The findings further indicate that a simple intervention technique such as relocation of the treatment, disposal and dump site can significantly reduce morbidity, especially in children, in communities neighboring such sites.

CONCLUSION

Studies have shown that about three fourth of the total waste generated in health care establishments is non-hazardous and non-toxic. Some estimates put the infectious waste at 15% and other hazardous waste at 5%. Therefore with a rigorous regime of segregation at source, the problem can be reduced proportionately. Similarly, with better planning and management, not only the waste generation is reduced, but overall expenditure on waste management can be controlled. Despite the fact that poor treatment and disposal of hospital waste poses potential hazards to environmental and public health, it has attracted little attention within the spectrum of environmental risks and public health research. Our study identified shortcomings associated with the current hospital waste management process in Mysore. The waste management system needs a complete overhaul, with improvements during collection, segregation, transportation, temporal storage and treatment and disposal. Living in close proximity to a poor hospital treatment and waste disposal site can be a major underlying factor in poor child health, especially as it enhances respiratory, intestinal and skin infections. The high relative risk for respiratory infection can be associated with the emissions resulting from the uncontrolled and frequent burning of hospital waste in the open pits and sub-standard incinerators. Inappropriate measures were applied for hospital waste treatment and disposal at the region of study; a situation that is familiar with the other primary healthcare clinics and referral hospitals in Mysore. Open and safe landfills, surface dumps and sub-standard incineration were common. In view of these problems, affordable and practicable technology solutions are required in the region in particular and Mysore as a whole. Relatively low cost small-scale incinerators can be used at rural primary healthcare centers while an integrated hospital waste management system; with a centralized larger-scale double chambered air-control incinerator can be used at the bigger urban hospitals. With a robust segregation culture, such a system guarantees cost-effectiveness and the incinerator (through constant maintenance) will provide compliance with emission and operational requirements.

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