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Introduction
INTRODUCTION

Medical care is an essential aspect for human life on the earth. It may involve various levels of treatment such as a minor wound treatment to a major operation. The hospitals function in such a way that the necessary medication to a patient will be provided to cure the disease. Meanwhile, the hospitals produce different kinds of wastes in due functioning, which include tissues, body parts, chemicals, pharmaceuticals, medical devices and radioactive materials. The medical waste or hospital waste thus produced in a hospital tends to create environmental pollution in all the major environmental components viz., air, water and soil. This type of pollution is exposed to healthcare workers, waste handlers, patients, visitors and all the employees, which can lead to infections, toxic effects and injuries. Production of bulky amounts of potentially infectious and hazardous waste and improper management of waste generated in health care facilities cause a direct health impact on the large community (Praveen et al., 2012). Pathogens present in the waste can enter and remain in the air for a long period in the form of spores or as pathogens. This can result in hospital acquired infection or occupational health hazard. Hospital waste also causes water pollution. If the waste is dumped either in low lying areas or in water bodies, then it can cause severe water pollution. During the medical services the used bandages, syringes, human tissues, used culture media containing microorganisms are generally dumped in the open bins on the road side or low lying areas or directed into the water bodies (Dwivedi et al., 2006). The liquid waste generated in hospitals when let into sewer can also lead to water pollution, if
not properly treated. Certain treatments and disposal options can also result in water pollution. Water pollution may also happen as a result of biological, chemical and radioactive substances.

Hospital is the place, which is frequently accessed by the people irrespective of age, sex, caste, religion, region and even nationality. To take care of its aim of reducing health problems, eliminating potential risk and treating sick people, the healthcare service unavoidably produces waste which itself is hazardous to health (Mathur et al., 2009). The waste generated during the entire course of healthcare activities is special in terms of its composition, quantity and their potential hazardous effect as compared to waste of other places, which requires special attentiveness for its management (Tenglikar et al., 2009). In some developing and industrialized countries, the outbreaks of cholera are periodically reported. Sewers of hospitals where cholera patients are treated are not always connected to efficient sewage treatment plants and sometimes municipal sewer networks may not even exist (Majlessi, 2001). Pollutants can easily reach the water resources in the environment causing environmental aquatic pollution and human health problems (Ekhaise et al., 2008). The use of disinfectants and drugs which are discarded through sinks normally lead to pollution of water bodies (Alder et al., 2000). The chemicals used for the staining and preservation of slides and for the sterilization and cleaning of equipment and surroundings are potentially harmful to the laboratory technician and the environment (Aluyi et al., 2006). The pathogens present in the waste can leach out and contaminate the ground water or surface water. Harmful chemicals present in the biomedical waste such as heavy metals can also cause water pollution. Poor land filling methods may cause water pollution through the leachates, which lead to eutrophication and
alter the parameters such as BOD, COD, pH and DO. Quantum of hospital waste depends upon use of consumables and practice of segregation. More of consumables used, greater will be the infected waste generated. Ineffective segregation will give rise to higher content of infected waste. There are two basic aims of hospital waste management and these are disinfection at the earliest and disposal of biomedical waste in eco-friendly manner. Hospital waste generation has become a prime concern due its multidimensional ramifications as a risk factor and management of hospital waste is a global humanitarian issue today (Veda Hegde et al., 2007).

Hospitals are considered as high risk places because of being located within municipal and human societies (Pruss, 1999). Wastewater from hospitals is of similar quality to municipal wastewater, but also potentially contain various hazardous components like enteric pathogens, including bacteria, viruses and helminthes, small amounts of chemicals from cleaning and disinfection operations, pharmaceuticals and also radioactive isotopes, which may easily reach water resources (Kummerer, 2001). The hospital waste is any waste generated in the hospitals during various processes viz., diagnosis, treatment procedures, research activities, testing/laboratory analysis, etc. The waste contains soiled bandages, culture dishes, surgical gloves, tissues and interments. World Health Organization (2005) has categorized “Hospital Waste” into general waste, infectious waste, pathological waste, radiological waste, chemical waste, pharmaceutical waste and pressurized waste. Proper handling and disposal of biomedical waste entails the sequential steps of handling, segregation at the point of generation, storage, disinfection, mutilation, transportation and disposal. Worldwide, the waste management function is dealing with a considerable rise in environmental and legal standards, best
practices, occupational health and safety, quality management, and the need for increased efficiency. The Government of India felt the need to regulate biomedical waste generated in healthcare facilities throughout India and hence ratified the Biomedical Waste (Management and Handling) Rules on 20th July, 1998. Subsequent amendments were introduced in 2000 and 2003. The health sector’s mandate is to prevent and cure disease. Realizing the impact of biomedical waste on the environment, the Indian Society of Hospital Management was established in April 2000 in order to address the issues and concerns of hospital waste at the national level.

Although reliable records of the quantity and nature of healthcare wastes and the management techniques to adequately dispose of these wastes has remained a challenge in many developing countries of the world, it is believed that several hundreds of tones of healthcare waste are deposited openly in waste dumps and surrounding environments, often alongside non-hazardous solid waste (Alagoz and Kocasay, 2007). It is generally acknowledged that the items of waste corresponding to the category of “non risk or general waste” constitute about 80 to 85% of HCW (WHO, 1999; Adegbita et al., 2010) which can be disposed through the regular municipal waste disposal system.

Hospital waste is not only hazardous and pollute the environment but dangerous for human beings, animals and plants in other ways also. Every day, numerous hospitals and other medical institutions churn out millions of tons of waste. An alarming percentage of the waste lies on open space creating environmental problems. Health care wastes are hazardous in nature. These damage the environment even at low concentration. Hence it is necessary to take precautionary measures so that hazardous components in the waste are rendered harmless through proper treatment by technology.
and safe disposal methods. Globally, hospital waste is regarded as hazardous, therefore, it has to be treated accordingly (Ross et al., 2011). There is also evidence of environmental and population effects of a poorly managed hospital waste. (Giusti et al., 2009) The non-risk waste comprises of other types of garbage like foodstuff leftovers, cardboards, packages, etc., (Hashmi et al., 2003).

The wastes generated from health care units are generally classified as infectious and non infectious. The infectious health care wastes are termed as hospital wastes and are considered to be potentially hazardous in nature. The disposal of untreated health care wastes mixed with non infectious hospital wastes or other general municipal wastes poses an environmental threat and public health risk. Indiscriminate disposal of untreated health care waste is often the cause for the spread of several infectious diseases. It was also responsible for the hospital acquired diseases to the health care personnel who handle these wastes at the point of generation. Moreover, this is equally harmful to persons involved in the health care waste management i.e., segregation, storage, transport, treatment and disposal. Apart from the above, a good amount of health care wastes such as disposable syringes, saline bottles, I.V. fluid bottles etc. are picked up by rag pickers and are recycled back into the market without any disinfection. It is imperative, therefore, to adopt an appropriate environmentally safe method for the disposal of the health care wastes. Findings of different studies reported that knowledge on healthcare waste type and diseases transmission through contact of infectious waste had an influence on practice of healthcare waste management. (Abah et al., 2011) This leads to environmental and societal effects.
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Hospital waste generation has become the prime concern due to its multidimensional ramifications as a risk factor to the health of patients, hospital staff and also extending beyond the boundaries of the medical establishment to the general population (Gordon et al., 2004).

Biomedical waste has been an increasingly important global issue over the last few years as an augmentation in health care facilities and concomitant increase in waste production. It has to be disposed off by taking utmost care so that it does not pollute or contaminate the environmental components such as soil, air and water. Such strategies in disposal of biomedical wastes have been adopted in developed countries (Rabeea Zafar, et al., 2013). The problem with medical waste lies in the fact that it is not handled and treated according to its type, which leads to hazardous working conditions for hospital personnel and exorbitant investment in technology that creates more problems. Where such wastes are not managed and disposed of by appropriate methods, they constitute serious threats to human health and the environment, and generate an important issue in terms of public health. It is therefore necessary to have wastes separated where they are produced (Rahman et al., 2009). Proper management of hospital waste will minimize the risk to the health and safety of staff, patients, the public and the safety of the environment, which includes prevention, segregation, handling, transportation and disposal of waste (Subramaniam, 2012). But in a developing country like India not much attention has been bestowed on proper and safe disposal of bio-waste. Despite legislation, most of the medical waste in India is dumped in the open and collected with the general waste (Goddu et al., 2007).
According to WHO report (1999), 85% of the hospital wastes are actually non-hazardous, 10% are infective (hence hazardous) and remaining 5% are non infectious but hazardous.

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The proper management of biomedical waste has become a worldwide humanitarian topic today. The hazards of poor management of biomedical waste have aroused the concern world over, especially in the light of its far-reaching effects on human, health and the environment (Singh et al., 2012). Despite the fact that current medical waste management practices vary from hospital to hospital, the problematic areas
are similar for all healthcare units and at all stages of management (Tsakona et al., 2007). Improper management practice impacts both directly and/or indirectly the healthcare staffs, patients and hospital environment (Patwary et al., 2009). Hospital acquired infections have been estimated at 10% of all fatal/life-threatening diseases in the South-East Asia region and have been identified as one of the indicators for the management of waste (Ozbek et al., 2004). The sustainable management of healthcare waste (HCW) has continued to generate increasing public interest due to the health problems associated with exposure of human beings to potentially hazardous wastes arising from healthcare (Ferreira, 2003; Da Silver et al., 2005). Hospitals and medical facilities will need to assess the problem and put forward a management strategy that is suitable to their economic circumstances and that can be sustained based on local technology. The WHO (2002) estimates that over 20 million infections of Hepatitis B, C and HIV occur yearly due to unsafe injection practices (reuse of syringes and needles in the absence of sterilization).

Sharp objects have the highest rate of causing injuries to hospital staff and transmission of infections (Akter et al., 2000). Besides, a scientifically designed landfill can further strengthen the integrated healthcare waste management system whereas a poorly designed and managed landfill can also lead to ground water contamination. It is important to dispose off such waste properly to avoid its dangerous effects (Saini et al., 2004). The effect of mismanagement of hospital waste is enormous and drastic. Hospital waste management means the management of waste produced by hospitals using techniques that will check the spread of diseases. In developing countries, awareness regarding hospital waste management in terms of its segregation, collection, storage,
transportation and disposal is lacking. Studies in Pakistan show that around 2.0 Kg of 
waste/bed/day is produced out of which 0.1- 0.5 can be categorized as risk waste (Hashmi 
et al., 2003). Regular training of HCWs on healthcare waste management had a great role 
on practices of healthcare waste management (Deneke, 2011). Safe disposal and 
subsequent destruction of medical waste is the key step in the reduction of illness or 
injury through contact with this potentially hazardous material and in the prevention of 
environmental contamination (Blenkham, 2006). Recent epidemiological studies indicate 
that a person who experiences one needle stick injury from a needle used on an infected 
source patient has risks of 30%, 1.8% and 0.3% respectively of becoming infected with 
HBV, HCV and HIV (WHO, 2011). Improper disposal of health care waste poses a great 
risk to humans, worldwide. It contaminates the natural environment (air, water, soil, 
fauna and flora) and the manmade environment, thereby affecting the wellbeing and 
health of humans. All over the world there is evidence of major health effects related to 
improper disposal of healthcare waste (Patil et al., 2001). The waste is increasing in its 
amount and type due to advances in scientific knowledge and has an impact on human 
lives (Rao et al., 1994). The disposal methods, which may be conditioned by proportions 
is of recycled, degradable and non-degradable materials (Tanksali et al., 2013). 

Overlaying the proper management of medical waste is the increasing attention on 
reducing the medical waste stream through pollution prevention activities. Balancing 
these issues is a challenge that requires a commitment from the highest levels of 
management and from staff entrusted to carry out the medical waste handling activities 
throughout the hospital (Gray Davis et al., 2002).
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Healthcare waste management should be supported through appropriate education, training and the commitment of the healthcare staff, management and healthcare managers (Savan Sara Mathew et al., 2011). According to Ministry of Health and Social Welfare (2006) hospital waste management includes all activities involved in waste generation, segregation, transportation, storage, treatment and final disposal of all types of waste generated in the hospital facilities, stages of which require special attention. This will ensure that input activities and outputs for the safe handling and disposal of healthcare waste are in place.

Most Health Care Facilities (HCF) in developing countries have outdated waste management procedures (Bos and Izadpanah, 2002). Hence, improvement of waste management in HCFs is urgently needed for safeguarding the population, eliminating occupational health hazards and protecting the environment. It is imperative that all BMW materials are ideally segregated at the point of generation, properly treated and disposed off securely. Hospital waste poses a significant impact on health and environment. It can be said that there is an urgent need to raise awareness and education on medical waste issues. Proper waste management strategy is needed to ensure health and environmental safety. It is therefore advised that all stakeholders and the health sector harness ways on proper waste management and the need to collect information and examples from developed countries, which has sound medical waste management system.

Hospital wastes have negative influence on the microbiological and physicochemical parameters on the environment. The microbial load as well as the high density of the physiochemical parameters suggests that the activities of hospital wastes in the environment is a major health and environmental threat, which therefore call for a proper regulatory system on disposal of hospital waste in the world.
Therefore, biomedical waste has to be disposed off by taking utmost care so that it does not pollute or contaminate the environmental components such as soil, air and water. Such strategies in disposal of biomedical wastes have been adopted in developed countries. If this comes into effect then a private or government party has to get involved in collection, transportation and treatment of biomedical waste. A charge should be levied on the health care facilities based on the number of beds occupied by the patients. Individual incineration treatment facility in the hospital is too costly and also not practicable. Therefore, a critical analysis concerning the biomedical waste disposal is very essential and it is the need of the day.

**Hospital waste management – Indian Scenario**

It is interesting to note that India is one of the first countries to recognize hospital waste as a problem. India is also one of the first countries in the world to bring legislation in this direction. But even today people are not aware of the problems of biomedical waste management. Studies on biomedical waste are yet in an infant stage.

The first comprehensive rule on biomedical waste management called “Hospital waste management rules” was introduced in 1976 by the Government of Andhra Pradesh. Later on the biomedical waste managing and handling rules of 1998 came into effect and is supposed to be a very good legislation. It is more practical in its approval and can be implemented without much difficulty. Several standards and guidelines have been published for hospital waste management in India since 1989. Although technologies for management of hospital waste are available in India, the awareness and implementation among the authorities on this is limited.
A number of empirical studies have therefore attempted to examine the medical waste management practices in a number of hospitals (Askarian et al., 2004; Rao et al., 2004; Patil and Pokhrel, 2005; Silva et al., 2005; Taru and Kuvarega, 2005). Also, based on the recommendations of the World Health Organization for evaluation of hospital waste management in developing countries, (WHO, 2001) a data form and questionnaire were developed. The waste produced in the course of health care activities carries a higher potential for infection and injury than any other type of waste (Chauhan et al., 2002; Joe and Krisanan, 2004).

A few studies on BMW management from India have established that hospitals did not manage BMW properly (Patil and Pokhrel, 2005). After the BMW guidelines were explained, observations indicate that proper management of BMW has improved and that the segregation of BMW is much better than before (Agrawal and Singh, 2005). According to CAG (Civic Action Group) report, Government of India, 2009, there was poor management, poor awareness and lack of commitment from the top management regarding waste management practices in healthcare establishments.

In Karnataka, biomedical waste disposal is still under evolving stage as the waste management rules are implemented and monitored by KSPCB and the State Government. As per State Of Environment Report (SOER-2003) the adoption of BMW management practices have not fully evolved due to many problems. In Karnataka at present only about 254 hospitals have introduced waste management practices, which include puncture proof containers, sharps, treatment of chemicals and needle pit for sharps disposal.
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Objectives

The present investigation addresses the issue of segregation, handling and disposal of hazardous wastes in four selected hospitals of Mysore city. The objectives include:

1. Survey with respect to number and types of hospitals functioning in Mysore city.

2. Quantification of biomedical waste generated in each hospital.

3. To study classification and disposal methods adopted by each hospital.

4. To study the impact of biomedical waste on the quality of soil at the incineration site and waste water and ambient air within the hospital premises.