



Review

Medical waste management – A review



Elliott Steen Windfeld, Marianne Su-Ling Brooks*

Department of Process Engineering and Applied Science, Dalhousie University, PO Box 15000, Halifax, NS B3H 4R2, Canada

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ABSTRACT

This paper examines medical waste management, including the common sources, governing legislation and handling and disposal methods. Many developed nations have medical waste legislation, however there is generally little guidance as to which objects can be defined as infectious. This lack of clarity has made sorting medical waste inefficient, thereby increasing the volume of waste treated for pathogens, which is commonly done by incineration. This review highlights that the unnecessary classification of waste as infectious results in higher disposal costs and an increase in undesirable environmental impacts. The review concludes that better education of healthcare workers and standardized sorting of medical waste streams are key avenues for efficient waste management at healthcare facilities, and that further research is required given the trend in increased medical waste production with increasing global GDP.

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* Corresponding author.

E-mail address: Su-Ling.Brooks@dal.ca (M.S.-L. Brooks).

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1. Introduction

Medical waste management is one of the many complex and demanding challenges facing humanity as the global population swells and the demand for medical services increase. Medical waste is classified by the World Health Organization (WHO) as: “waste that is generated in the diagnosis, treatment or immunization of human beings or animals.” Medical waste that is not properly handled and disposed of represents a high risk of infection or injury to healthcare personnel, as well as a lesser risk to the general public through the spread of micro-organisms from healthcare facilities into the environment (Brichard, 2002; Mohee, 2005).

Medical waste disposal is an issue of considerable scale. As the world's top medical waste producing nation, the United States alone creates over 3.5 million tonnes of medical waste per year with an average disposal cost of \$790 per tonne (Lee et al., 2004). Medical waste production in the developing world is rising quickly due to improved access to medical services, which allow ever-greater numbers of people to receive modern medical care. The trend away from multi-use medical devices towards safer, single-use medical devices is further adding to the production of medical waste in developing nations. These combined trends are causing a rapid increase in the amount of medical waste that requires safe disposal in developing nations (Mbongew et al., 2008). In the developed world, a rapidly aging population is the major driver of increasing medical system usage, and this rising medical system usage is producing a corresponding increase in medical waste production (Canadian Senate Committee, 2002).

This review will give an overview of the issues related to medical waste disposal. Firstly, the composition and sources of medical waste in multiple jurisdictions around the world will be addressed. This will be followed by a discussion of both binding legislation and medical waste management guidelines in these regions. Next, current medical waste handling practices will be described, with a specific focus on in-facility collection, separation, transportation and disposal methods. Issues with common incineration disposal methods will be discussed, followed by alternate treatment possibilities, and the need for reducing the quantity of non-infectious medical waste in the infectious medical waste stream. Finally, recommendations for improvement strategies involving both better education for healthcare workers and standardizing in-facility waste receptacles will be proposed. This review will show that the amount of infectious waste produced and the associated harm caused can be reduced through improved point-of-disposal waste sorting, standardization of waste disposal streams and through better education of healthcare workers.

2. Medical waste definition

The United States Medical Waste Tracking act of 1988 defines medical waste as “any solid waste that is generated in the diagnosis, treatment, or immunization of human beings or animals, in research pertaining thereto, or in the production or testing of

biologicals” (United States Congress, 1988). It is estimated by the World Health Organization (WHO) that 20 percent of these medical wastes can be classified as hazardous materials that may be infectious, toxic, or radioactive (Brichard, 2002).

However, there is no globally agreed upon definition of medical waste, which poses a challenge from a comparative standpoint, as changing definitions make a meaningful comparison between countries, or even between regions within countries, quite difficult. Further, the absence of a standard definition of medical waste has led to a lack of standardization of medical waste streams and disposal receptacles, as discussed later in this review (Insa et al., 2010).

Generally, there are four terms used when discussing medical waste, and all are often used interchangeably, with no universally accepted definition for each term (Rutala and Mayhall, 1992). These are: hospital waste, medical waste, regulated medical waste and infectious medical waste. In order to provide clarity and consistency throughout this review, the term *medical waste* will be used to refer to all waste that is generated at any healthcare or healthcare-related facility, which is consistent with the definition of medical waste given by the United States Environmental Protection Agency (U.S. EPA, 2012a). The term *infectious medical waste* will refer to the subset of waste generated at healthcare facilities that is unsuitable for disposal in a municipal solid waste system due to pathogenic concerns.

3. Medical waste generation

The amount of medical waste generated at different healthcare facilities is of obvious interest, with many studies done on the subject. The quantity and composition of medical waste generated is dependent on many factors, with a medical waste study focusing on Italian hospitals finding that the type of sanitary service offered greatly impacts the amount of infectious waste produced (Liberti et al., 1996). The study found that as much as 52% of overall infectious medical waste production comes from short-term patients in rehabilitation service, followed in descending order by analytical laboratories (23%), surgeries (14%), dialyses (7%) and first aid (4%). A similar study done in Taiwan found the dialysis unit to generate the greatest amount of infectious medical waste (23%), followed by the intensive care unit (17%), the emergency care unit and the outpatient clinic (12% each) (Cheng et al., 2009).

In evaluating medical waste generation, it is helpful to use a common basis for quantification, so that data from different regions can be compared. The following sections present an analysis of medical waste production for different countries based on various indicators.

3.1. Use of a waste production metric

The selection of an appropriate metric for comparing healthcare facilities and medical waste production levels is challenging. The most common metric for quantifying the amount of medical waste

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