Safety Science 49 (2011) 1200–1207

Contents lists available at ScienceDirect

Safety Science

journal homepage: www.elsevier.com/locate/ssci

# Assessment of occupational and environmental safety associated with medical waste disposal in developing countries: A qualitative approach

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ARTICLE INFO

*Article history:*
Received 30 December 2010
Received in revised form 8 March 2011
Accepted 1 April 2011
Available online 22 April 2011

*Keywords:*
Medical waste
Healthcare establishments
Qualitative assessment
Occupational safety

ABSTRACT

A carefully designed survey of medical waste management was undertaken in Dhaka, the capital city of Bangladesh. A range of sampling strategies and data gathering techniques were used. The data gathering techniques included observation, formal structured interview and informal dialogue. Sampling strategies included formal representative sampling for fixed populations and adaptive sampling for roaming populations was developed. Data were collected from healthcare establishments (HCEs) and other waste disposal operatives.

Operatives dealing with waste were frequently found to be untrained, and without even a basic understanding of the hazards involved. Personal protective equipment was inadequate in most cases which led to frequent accidental injuries. No HCE was found to have adequate storage facilities for hazardous waste. Thus scavengers were able to gain access to items such as syringes and expired medicines, which they repackaged and resold. The lack of correctly controlled internal storage may be linked to the observation that employees at many HCEs offered contaminated items for sale to scavengers and recycling operatives. In many cases there was no attempt at segregation, but in some cases there was segregation at the point of use, but subsequent remixing with general waste, indicating a lack of management and education rather than a lack of will. In either case, hazardous waste was dumped in city corporation bins, and disposed of on general landfill sites. As well as exposing the waste to scavengers, this could potentially contaminate ground water, especially as the dumps were located in areas subject to frequent flooding.

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## 1. Introduction

Medical waste may play an important role in the transmission and intensification of disease (Tsakona et al., 2007; Chaerul et al., 2008). This is a growing concern in developing countries (Shinee et al., 2008). Hazards associated with waste produced by healthcare establishments (HCEs), and the increased potential for infection and injury, have been frequently described (Marinkovic et al., 2008; Hoyos et al., 2008; WHO, 2004). There is particular concern that an informal sector dealing with the recycling of medical waste components may contribute to transmission of disease, especially among waste collectors, scavengers and recycle-operators.

Medical waste is defined as any solid or liquid waste that is generated from treatment of human beings in a hospital or clinic, from clinical diagnosis and pathological testing and from medical research (WHO, 2002). It comprises sharps, non-sharps, blood, body fluids, dressing materials, surgically removed body tissues, chemicals, pharmaceuticals, medical devices and radioactive materials (Lee and Huffman, 1996; WHO, 2002). The waste generated from HCEs both as hazardous and non-hazardous are considered as medical waste in this study.

Many countries maintain stringent management systems for handling and safe disposal of medical waste to minimize the risk (Chaerul et al., 2008; Woolridge et al., 2008; Duan et al., 2008; Zimmer and McKinley, 2008). In developed countries, technologies such as autoclaving and incineration are used for treatment and final disposal of medical waste. However, in developing countries, medical waste has not received adequate attention (Almuneef and Memish, 2003), particularly when it is disposed of together with the domestic waste (Patil and Pokhrel, 2004). As a consequence it may be a cause of disease amongst waste cleaners, waste pickers, collectors, and recycling waste operators (Becher and Lichtnecker, 2002). Furthermore, it has been reported that medical waste presents an increasingly high risk to doctors, nurses, technicians, drain cleaners, sweepers, hospital visitors and patients due to disorganized management (Massrouje, 2001). Risk minimization for medical waste has become a major concern worldwide. In most countries there is a growing awareness that the uncontrolled hazardous medical waste generation may create the potential for the spread of disease (Chen et al., 2006).

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0925-7535/$ - see front matter © 2011 Elsevier Ltd. All rights reserved.
doi:10.1016/j.ssci.2011.04.001

The rapid growth of a disorganized healthcare sector in Dhaka City, Bangladesh has resulted in an environmental health hazard (Ahmed et al., 2006; Rahman et al., 2007; Patwary et al., 2009a,b). According to the Bangladesh Directorate General of Health (DG Health report, 2005), there are more than 840 healthcare establishments situated in Dhaka City. Patwary et al. (2009a) reported that 37 ± 5 tonnes of medical waste, including domestic and recyclable waste, is generated from hospitals, clinics and other healthcare establishments (HCEs) on a daily basis in Dhaka. A number of reports published by development agencies, such as the World Health Organization (WHO), and the International Centre for Diarrhoeal Disease and Research in Bangladesh (ICDDRB) have shown that there is a high incidence of cholera, typhoid, dysentery, infective hepatitis, polio and dengue among people who live in Dhaka (WHO, 2000; Anon, 2002; Ahmed and Chowdhury, 2003; Andersen and Pettersson, 2003). The incidence is higher in areas where a high number of hospitals, clinics and diagnostics centres are located, and Dhaka City Corporation (DCC) has thus recognized these areas as a "red zone" for these diseases (Rahman et al., 2008). The scale of problem is large and the need for detailed and accurate research is urgent.

Most studies have been focused on quantification of medical waste generation. Few have addressed the environmental and behavioural context in developing countries and limited have done so in Bangladesh. We fill this gap by examining environmental context and occupational safety amongst medical waste operatives, in Dhaka, Bangladesh. Previous research typically has not been focused on relationships between occupational safety and behavioural context using a qualitative approach combined with an environmental interpretation and explanation. The aim of this research was to observe the processes for waste disposal in Dhaka and to investigate the potential risks to environmental safety, particularly for the individuals who are working with medical waste.

## 2. Methodology

Qualitative research methods were applied to examine the behaviours of workers involved in the control and disposal of medical waste. Data were obtained using an observational approach and informal dialogue. In some cases (as described below) this was followed up by the use of a questionnaire and in-depth interview with closed and open questions (Hague, 1993) in an attempt to study the skills and knowledge that inform the observed behaviours.

Fieldwork was started by social network mapping, adopting an observational approach (Jorgensen, 1989), over a 5 months period in 2006. This technique is normally used in field based data collection procedures to elucidate relationships between a community and its environment. Initial observation suggested three significant and distinct target groups:

1. Employees of the various departments in the Health Care Establishments. This group comprises three significant subgroups.
   (a) Individuals working directly or indirectly involved in patient care. This includes medical unit staff, laboratory staff, Ambulance staff, HCE kitchen staff, and other support staff.
   (b) Individuals transferring waste from inside bins to road side bins.
   (c) Individuals working for mortuary departments.
2. DCC waste collectors, employed by DCC to collect waste from road side bins and to transport it to designated dumping places.
3. Operators and other support staff at official medical waste treatment centres.

Having identified these potentially significant groups, each group was sampled according to a sampling plan appropriate to that type of population.

### 2.1. Group one

The population of HCEs in Dhaka was defined by a list supplied by the Directorate General of Health. A representative sample of 69 HCEs was chosen as described in Patwary et al. (2009a). A total of 168 questionnaires were administered at 69 HCEs. One key participant was chosen at each of 21 clinics and 44 diagnostic centres. A sample of participants was chosen from different wards and departments at each of the four hospitals included in the study based on the size of the hospital (public hospital A: $n = 60$; public hospital B: $n = 29$; private hospital A: $n = 9$; private hospital B: $n = 5$). Knowledgeable key informants were selected within each HCE or department, based on their willingness to participate, and on their expertise and position (Rich and Ginsburg, 1999). Informed consent was obtained from each participant.

### 2.2. Group two

This is a large and diverse group. An "adaptive sampling for roaming population" approach was developed which was developed by a combination of 'adaptive sampling' (Thompson and Collins, 2002; Chaudhuri et al., 2004) and a street-based sampling (Clements et al., 1997; McMahon et al., 2003) approach to study this group. Most of the group members would be expected to have little no regular contact with medical waste, so a purposive/authoritative sampling technique was chosen, focusing on those operators working mainly with roadside bins adjacent to the HCEs. Twelve participants were selected and interviewed following a similar approach to that used for HCEs.

### 2.3. Group three

The total population of this small group was found to be 8 employees. All of these agreed to be participants and gave informed consent and were interviewed following a similar approach to that used for HCEs.

Thus a total of 188 participants were surveyed across the three groups.

## 3. Precaution of data collection and ethical issues

Ethical considerations are essential to any form of data collection in a humanitarian operation. Collecting information for any purpose, including monitoring, assessments or surveys, can put people at risk not only because of the sensitive nature of the information collected, but also because simply participating in the process may cause people to be targeted. The risks can range from physical violence to social marginalization and are often unknown to the individual soliciting the information. Therefore, participants were treated fairly and with dignity. Because the research involved an intrusion into the private lives of the participants, the researcher and FIs were always respectful, polite and reliable to the respondents. This helped to built rapport between interviewer and respondents.

Proper training of field personnel represents a critical aspect of quality control. Before conducting the study, ten Field Investigators (FI) were recruited from different universities based upon their previous experience regarding the field level data collection. It was noted that almost all of the FIs had already received training on the use of standardized protocols to ensure safe and ethical collection of data, and to ensure compatibility among different

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