

Medical Waste Management in the Tertiary Hospitals of Bangladesh: An Empirical Enquiry

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Abstract

This study analyzed different aspects of medical waste management of tertiary hospitals of Bangladesh. Following simple random sampling technique, a total of 45 key informants were interviewed, structured observation was conducted in order to collect primary data from nine tertiary hospitals at six divisions in Bangladesh. In addition, microbial analysis was carried out to assess the impact of effective and sustainable medical waste management. The findings of this study show that on average 641 kg/day and 1.00 kg bed/day medical waste was generated in tertiary hospitals. About 27% tertiary hospitals segregated infectious wastes in the words, while about 18% hospitals segregated at the time of generation and about 9% hospitals did it at the time of collection. Furthermore, in 27% cases, treatment for infectious and sharp wastes was found to have been done. Only about 11% hospitals used incinerator for treatment of pathological wastes and 16% used other methods of disinfection. The study revealed that non-government hospitals managed medical wastes better than government hospitals. The cross infection rate was much higher in government hospitals than that of the non-government hospitals. Solid waste analysis, open-plate airborne pathogen analysis, and swab analysis reported to have contained different pathogenic bacteria and fungi. Different pathogenic bacteria such as Staphylococcus sp., Klebsilla sp., Pseudomonas sp., Proteus sp., E. coli, Fecal coliform, Salmonella sp. were commonly found in the lab analysis.

Key Words: Medical waste management, microbial analysis, nosocomial infection, tertiary hospital

Introduction

Medical waste has been considered as one of the major health and environmental management issues in Bangladesh over the last three decades. Poor management, lack of handling knowledge and unscientific disposal of various health-care wastes pose serious direct and indirect public health threats to health-care personnel, nurses, technicians, waste workers, hospital visitors, patients, surrounding communities and the environment as well (WHO, 1999; Tamplin et. al., 2005). It is a common observation in mega cities of Bangladesh that poor scavengers, women and children collect some of the medical wastes (e.g. syringe-needles, saline bags, blood bags etc.) for

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reselling despite the deadly health risks. It has been reported that the re-use of syringes can even cause the spread of infections such as AIDS and hepatitis (Tamplin et. al., 2005; Amanullah and Uddin, 2008-2009).

Medical wastes account for a very small fraction, about one percent of the total solid wastes generated in Bangladesh (World Bank, 2002). According to the Dhaka City Corporation's research report, 3700 metric tons of wastes are generated per day in Dhaka City and about 200 tons are hospital waste of which 40 tons are infectious wastes (Bangladesh Observer, 2000). However, when this small amount is not handled properly, it gets mixed with domestic solid waste, and the whole waste stream becomes potentially hazardous. Until recently, there was no effective system for proper medical waste management in Bangladesh to protect environmental health hazards. A good number of national and international studies reported that there have been very limited good practices of dumping or of disposal of health-care wastes in Bangladesh. It has been reported that most of the hospitals, except a few private hospitals, dispose health care wastes along the road sides as the solid and commercial wastes are disposed (World Bank, 2002; Uddin, 2007; Pescod and Saw, 1998; Amanullah and Uddin, 2008-2009).

While health care facilities in industrially developed countries have followed certain safety standards to minimize the health risk resulting from medical waste, the situation of risk minimization is not satisfactory at all in Bangladesh. In Bangladesh, it is reported that most of the waste handlers are from lower socio-economic condition with large family size, lower level of education and knowledge. They mostly handle the medical wastes without using necessary equipment (World Bank, 2002; Uddin, 2007). Wastes are usually stored inside the hospital without bothering the dire consequences. The present mode of hospital wastes disposal is to dump the waste in the dustbin in or outside hospital premises and out skirts of the city for onward disposal by municipal authority (Hasan, et. al., 2008). The municipal authority generally dumps those hazardous alone with other wastes stream on vacant land in the name of disposal. Thus at each stage of disposal every authority creates some loopholes in creating health problem among the hospital patients, employees, waste collectors, and people around the dumping ground (Amanullah and Uddin, 2008-2009; Becher and Lichtnecker, 2002).

Bangladesh is one of the most densely populated south Asian countries with more than 150 million population overburdened with medical wastes, industrial wastes, municipal solid wastes, sanitation congestion, lack of water supply, air pollution, traffic jam, and with all, an obvious unsustainable environment. Research in the areas of medical waste management has been wide nationally and internationally. However, exploring the dynamics of medical waste management scenario especially in the tertiary hospitals in Bangladesh has so far been overlooked. In this context, this study is a modest endeavor to examine the current situation of medical waste management and level of awareness related to impact of medical waste and its management; to explore the factors affecting medical waste management practices and examine the applicability and limitations of the existing guidelines and legislations regarding medical waste management.

Methodology

Procedures and sample

This cross-sectional study was designed to analyze the medical waste management situation of tertiary level government and non-government healthcare institutions at six divisions in Bangladesh. The study used both qualitative and quantitative tools for data collection. Primary data were collected by interviewing key informants such as medical doctors, hospital administrators, medical staffs, nurses, cleaners, waste workers and mass people residing in and around the dumping site. In addition, field observation was carried out to complement the overall findings.

Table 1: Sample distribution by District and Division

Division	District	No. of tertiary hospital selected	No. of key informant interviewed
Dhaka	Dhaka	1	5
	Kishoregong	1	5
Chittagong	Chittagong	1	5
	Comilla	1	5
Rajshahi	Rajshahi	1	5
	Bogra	1	5
Khulna	Khulna	1	5
Sylhet	Sylhet	1	5
Barisal	Barisal	1	5
Total		9	45

Multistage sampling method and simple random sampling were followed to select study locations and samples from six administrative divisions in Bangladesh namely Dhaka, Khulna, Rajshahi, Chittagong, Sylhet and Barisal. Firstly two districts from each division were randomly selected. Secondly from each district one tertiary hospital (except Jessore, Moulavi Bazar and Patuakhali, where no tertiary health-care facility is present) was selected following simple random sampling technique. Eventually, five respondents from each sampled tertiary hospital were selected using simple random sampling technique for data collection.

Data analysis and ethical issues

Descriptive statistics and frequencies were computed for selected variables. Quantitative data were analyzed using the Statistical Package for Social Science (SPSS) version 12. Voluntary participation of the respondents as well as the confidentiality of their information was strictly maintained. Informed oral consent from each respondent was obtained. Any hint of coercion was strictly avoided in both getting their consent and interviewing. Privacy during the interview process was safeguarded.

Methods of microbial analysis

In order to assess the impact of effective and sustainable medical waste management practices, microbiological analysis of medical waste was performed. Solid waste samples from different wards of health facilities, dustbins, outside hospitals, swabs from different places inside health-care facilities using swab sticks, and aerial exposure using different media plates were collected in an air tied sample collecting box aesthetically. The specimens were placed in different media following instructions of the laboratory research guide with the help of other research scientists working in the lab. Total bacteriological and fungal load were counted and identification of bacteria and fungi was done following the specific guidelines. Solid waste samples were collected by sterile sample collecting bags. Air borne samples were collected by open plate's method. Previously sterilized Petri plates containing Potato Dextrose Agar (Sharf, 1965), Plate Count Agar (APHA, 1965), 110 Staphylococcus medium (APHA, 1965) and Baird Parker Agar medium (Barnett, 1960) were exposed for 20 minutes in each sampling site. Swabs were collected from floors of different wards of hospitals, OT tables, ICUs, post-operative units, cabins, walls of the ward etc. Microbiological analysis of collected solid medical waste samples, aerial exposure samples and swab samples was carried out in Bangladesh Centre for Scientific and Industrial Research (BCSIR) and Institute of Public Health (IPH) laboratory in Dhaka.

Results of the Study

Quantity and Categorization

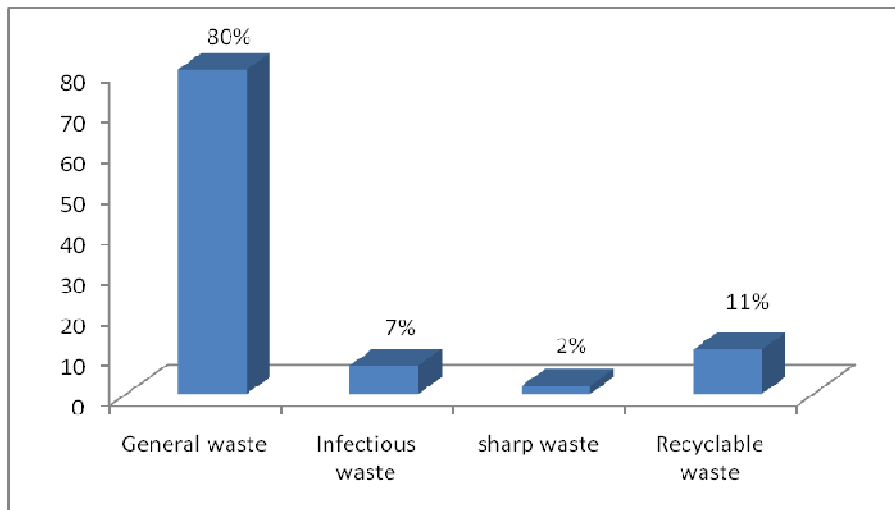
It was found that the tertiary hospitals generated general wastes such as food residues, vegetables/rubbishes, paper, cans and other metals, infectious wastes- pathological wastes, contaminated dressing materials, bandages, sticking plaster, gloves, disposable medical items, contaminated packaging and other soiled wastes (wastes contaminated with blood and other body fluids), sharps (used syringes, used hypodermic needles, needles, surgical blades and blood lancets broken bottles and glasses) and recyclable wastes (plastic items) and small quantities of pharmaceuticals.

The study found that on average 641 kg waste is generated per day in the tertiary hospitals in Bangladesh. On average 1 kg waste was generated per day per bed out of which 79 percent consisted of general waste, 8 percent were infectious waste, 3 percent were sharp and 10 percent were recyclable waste. The generation of medical waste per day ranges from 0.76 kg to 1.16 kg per bed. The Dhaka Medical College Hospital generated the highest quantity of total waste with 1.16 kg/day/bed of which general waste was 0.96 kg/day, infectious waste was 0.11 kg/day/bed; sharp was .04 kg /daybed and recyclable waste was 0.12 kg/day/bed. The study reported that Bajitpur Medical College generated the lowest quantity of waste.

Table-2: Distribution of waste generation from hospitals by types and amount

(Kg/day/bed)	Mean	SD	Minimum value	Maximum value
Total waste	1.00	0.103	0.76	1.16
General waste	0.79	0.08	0.62	0.96
Infectious Waste	0.08	0.021	0.04	0.11
Sharp waste	0.03	0.003	0.02	0.04
Recyclable waste	0.10	0.008	0.09	0.12

Among the government tertiary hospitals under this study, Dhaka Medical College Hospital (DMCH) produced highest quantity of waste; the reason might be the highest patient-load that was 3 to 4 times of its bed capacity with increasing attendant's crowding in relation to the number of patients. It is a tertiary level government hospital, which, besides its normal patients, provides services to the referral patients from all over the country, since it is less expensive and has got the opportunity of having multiple departments for treatment for mostly all types of diseases.

**Figure-1: Distribution of generated wastes by types**

It was found that about 27% tertiary hospitals segregated pathological wastes in the wards, while about 18% cases, segregation took place at the time of generation and for about 9% cases it was done at the time of collection. About 51% of the sample hospitals segregated sharp equipment in the wards of which about 31% hospitals used to segregate sharp wastes at the time of generation in wards and other places; and about 20% hospitals segregated at the time of collection. About 20% hospitals segregated general wastes, of which about 13% cases, it was done at the time of collection and about 7% cases, segregation took place at the time of generation. In case of recyclable waste, about 49% hospitals had segregation practices, of which about 31% cases, wastes were segregated at the time of collection and about 18% cases it was done at the time of

generation. None of the hospitals were found using colour coded container for segregation. Waste was normally kept in 'balti', bins, buckets, bags and in other containers.

In tertiary hospitals, mostly (78% cases) wastes (both hazardous and non-hazardous) were collected by respective city corporation or municipal authority together with municipal solid wastes. In very few cases (11%) it was done by local NGO/NGOs and about 11 percent health care facility itself collect hospital waste. Almost all tertiary hospitals, irrespective of government and non-government, left their wastes (mixed waste) in the nearer municipal dustbins and assigned respective staffs from city corporation/municipality collected it from the dustbins.

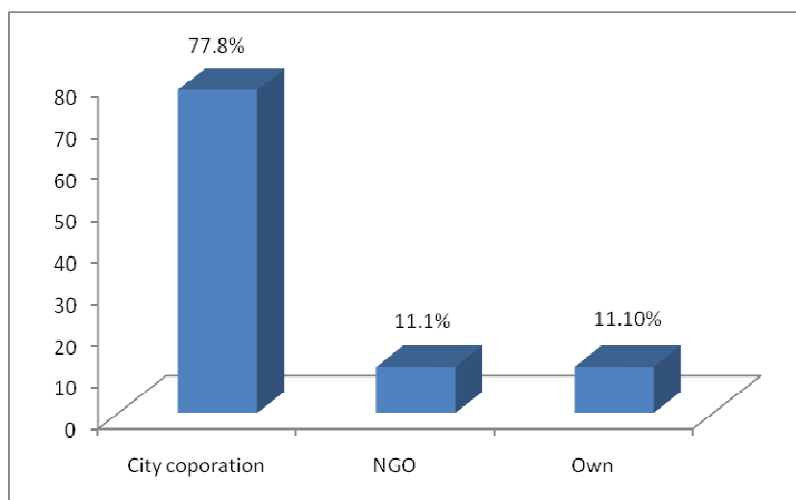


Figure-2: Waste collection by types of organization

In all category hospitals, biomedical wastes were collected and handled by both permanent and temporary stuffs (Sweepers or Cleaners). In many cases particularly in government hospitals, due to inadequate number of sweepers or cleaners, sometimes temporary cleaners were employed on daily basis for this job. Moreover as these temporary cleaners have no fixed responsibility and receive insufficient salary, they do the job improperly and irregularly.

In all studied government healthcare facilities and most of the non-government health care facilities (HCFs), all types of wastes were transported to the temporary storage or dustbin outside hospital premises using trolleys or 'balti' or plastic bins or big bowls (for small amount) without any disinfection. Permanent or temporary/daily-basis sweepers or cleaners or 'ayas' or ward boys were mostly performing the internal waste transportation activities. Some NGOs were found carrying out the job of biomedical waste segregation, disinfection and collection activities in some private HCFs. In case of external (e.g. off-site) transportation, all sorts of biomedical wastes were collected from the municipal dustbins and city skirts and transported to municipal dumping site by City Corporation or Municipal authority with unprotected open track spreading bad odour and creating public nuisance. In tertiary hospitals, only in 27% cases, treatment for infectious and

sharp wastes was found to be done. Only about 11% hospitals were found using ‘incinerator’ for infectious waste treatment and 10% used needle cutter for ‘cut or breaking’ of sharps and about 16% were found using disinfection processes in different ways for recyclable wastes before final disposal.

More than half of the hospitals were reported to handle infectious waste in naked hands, about one third were used to handle infectious wastes using gloves, masks and other protective measures in special cases and only 18% of the HCFs reported to use gloves and masks always. In case of sharp equipments, about three fourth of the HCFs were found to have handled it by naked hands, only one hospital reported using gloves and masks in special cases and only 16% HCFs were found using gloves and masks always as protective measures.

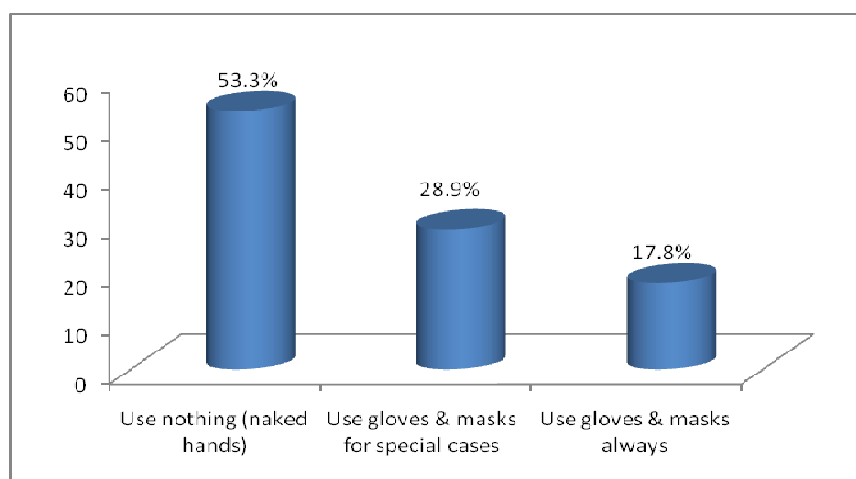


Figure-3: Protective measures taken for handling infectious wastes in tertiary hospitals

Results of Microbial Analysis of Biomedical Waste

Solid waste analysis, open-plate airborne pathogen analysis, and swab analysis from study hospitals were reported to contain different pathogenic bacteria and fungi. *Staphylococcus sp.*, *Klebsilla sp.*, *Pseudomonas sp.*, *Proteus sp.*, *E. coli*, *Fecal coliform*, *Salmonella sp.* were common pathogenic bacteria found from microbiological analysis of samples collected from healthcare facilities. These bacteria are responsible for causing pneumonia, meningitis, urinary tract infection, wound infection, respiratory infection (*Klebsilla spp.*, *proteus*), typhoid fever, paratyphoid fever, gastroenteritis (*salmonella spp.*), diarrhea (*E. coli*), sore throat, scarlet fever, rheumatic fever, impetigo (*streptococci spp.*), wound infection, ear infection, septicemia (*pseudomonas*) etc. to human and responsible for nosocomial infection. There were some harmful fungi like *Aspergillus spp.*, *Penicillium spp.* and *Mucor spp.* found in the collected samples. They have allergic effects (Severo and Hertz, 1978; Thurston and Cysewsk, 1979; Ford and Friedtman, 1967) of human. Prevalence of *Aspergillus sp.*, *Penicillium sp.*, *Mucor sp.* is common in environment and spores of some species are responsible for allergic infection of human and

animals. *Aspergillus* sp. specially causes allergic aspergillosis in both man and animal. These pathogenic bacteria can lead to pathological dysfunction of human body (Ray et. al., 2005; Sigsgaard et. al., 1994). One study (Aker and Tränkler, 2003) showed the presence of *Salmonella* spp., *shigella* spp., *Streptococci* spp., coliform, fecal coliform *Vibrio* spp./ *Aeromonas* spp. from pathological analysis of hospital waste sample collected from dustbin near hospitals and dumpsites at Dhaka city. The study found these pathogens along with *Mycobacteria* and *Amoeba* from medical waste collected from disposal bins and from waste water collected from hospital's drainage and laboratory basins.

Guidelines and Medical Waste Management Policies in Bangladesh

Only about 9% hospitals was found following 'guidelines', of which 4.4% was reported to follow their own guidelines and about 4.5% was found following government guidelines (e.g. manual). Though there were some manual and training handbooks for the same but due to lack of government initiatives, those were yet to be implemented to the healthcare facilities. Few non-government hospitals claimed to have their own guidelines but they could not show or submit any written guideline document. In fact, there is no specific legislation directly related to the handling, transportation or disposal of medical waste in Bangladesh. In the Environmental Conservation Act (1995) wastes are classified under Section 2 (1) as "any liquid, solid and radioactive substance that is discharged, disposed, or dumped which may cause adverse/negative change to the environment". All these procedures were very general for all kind of establishments and not specific for management of medical waste. However, very recently the shortcoming has been addressed by the Government of Bangladesh through enacting '*the Medical Waste Management and Administration Act 2010*' and framing '*the Medical Waste Management Rules 2010*' to improve the management of waste disposals by government and private hospitals and clinics (MoF, 2010). Besides, formulation of 'Solid Waste Management Rules 2010' is now at final stage. The existing Bangladesh Environment Conservation Act 1995 describes the powers entrusted upon the Director General of the Department of Environment. In order to enforce this Act, the Environment Conservation Rules specify the power and functions of the Department of Environment and the responsibilities of the industries to ensure conservation of eco-systems. The rules categories industries and other potentially polluting activities based on their impact and location and establish procedures for issuing Environmental Clearance Certificates prior to start-up of such activities.

Officials of DGHS mentioned that some initiatives were taken for preparing few documents under the supervision of Director General of Health i.e. manual for medical waste management in Bangladesh, 2000, Pocket book of medical waste management for Nurses and Technologists, Research study-1, Strategic plan for Medical Waste Management etc. But most of them never crossed the hospital boundaries. The Ministry of Environment and Forest drafted the Hazardous Health Care Waste Management Rules 2003, which were almost similar in structure and function to that of Bio-medical Waste (Management & Handling Rules), 1998 in India. However, it was yet to be notified. In this Act, there were provisions of penalizing similar to that of India. One of the senior doctors from a renowned tertiary hospital stated, "Solid waste management (which

includes solid bio-medical waste) is mostly entrusted on local government bodies. The responsibility of solid waste collection and disposal lies with the City Corporations and Municipalities. The City Corporation and Pourashava Ordinance, 1977 is the only local law that consists some idea for disposal of solid waste management in Bangladesh.”

Discussion and Conclusion

The findings of this study show that on average 641 kg/day and 1.00 kg bed/day medical waste was generated in tertiary hospitals. In terms of generation of pathological wastes, about 27% tertiary hospitals segregated wastes in the wards, while about 18% hospitals segregated at the time of generation and about 9% hospitals did it at the time of collection. In terms of treatment of infected and sharp wastes, the study found that only 27% cases in the studied hospitals treatment for infected and sharp wastes was done. In about 11% of the hospitals incinerator was used and in about 16% cases other methods of disinfection were practiced in the tertiary hospitals. The study findings indicated that non-government hospitals managed medical wastes better than the government hospitals. The cross infection rate was much higher in government hospitals than that of the non-government ones. Solid waste analysis, open-plate airborne pathogen analysis, and swab analysis reported to contain different pathogenic bacteria and fungi. The most common pathogenic bacteria such as *Staphylococcus sp.*, *Klebsilla sp.*, *Pseudomonas sp.*, *Proteus sp.*, *E. coli*, *Fecal coliform*, *Salmonella sp.* were found in the lab analysis.

The study findings indicated that no guidelines for the proper management of medical wastes are strictly followed in the tertiary hospitals of Bangladesh. The segregation of wastes at the point of generation is very minimal. Most tertiary hospitals dispose off their wastes to the nearest municipal dustbins. It is also found that some medical staffs even earn some money by selling used syringes and other medical wastes. Most of the healthcare staffs are not aware of the proper management of wastes. Adequate and effective waste-management facilities are absent. Besides, the budget is meager to effectively implement safe disposal of hospital wastes.

Hospitals and other health care and research institutions in Bangladesh produce large quantities of hazardous wastes. In most cases, waste handling is left to the poorly educated and lowest category of workers having no training and minimum guidance and supervision. As a result, it is the normal scenario that hazardous waste mixes with non-hazardous municipal solid wastes and get deposited untreated in the road-side municipal dustbin or within the premises of the health care institutions leaving serious health risk to the individual and threats to the environment. In reality, the situation gets worst by simply storing it to dustbins, drains, canals or finally dumping to the outskirts of the city without proper segregation. Only few hospitals achieved some practice of infected waste segregation. It is possibly due to lack of awareness and skill of the people engaged in waste handling and hospital management. The problem is worsening with the rapidly growing hospitals, clinics, diagnostic centers, laboratories, and nursing homes without proper planning.

The mandates for the essential health functions like medical waste management are fragmented between various government departments and between the public and private sectors (Ministry of Health and Family Welfare, Ministry of Environment and Forest, NGOs like PRISM, Bangladesh, Prodipan and SAPNA). A more coherent approach is required to ensure that all the players involved in medical waste management are to coordinate and cooperate. To some extent, the Ministry of Health and Family Welfare undertook this responsibility in Bangladesh.

References

- Akter, N. and Tränkler, J. 2003. 'An Analysis of Possible Scenarios of Medical Waste Management in Bangladesh', *Management of Environmental Quality: An International Journal*, Vol.14, No. 2, pp. 242-255.
- Akter, N., Zakir, H., Tränkler, J. and Parkpian, P. 2002. 'Hospital Waste Management and Its Probable Health Effect: A Lesson Learned from Bangladesh', *Indian Journal of Environmental Health*, Vol. 44, No. 2, pp.124-137.
- Amanullah, ASM. and Uddin, J. 2008-2009. 'Dynamics of Health Behavior Regarding Hospital Waste Management in Dhaka, Bangladesh: A Dysfunctional Health Belief Model', *International Quarterly of Community Health Education*, Vol.29, No.4, pp. 363-380.
- American Public Health Association (APHA). 1965. Standard methods for examination of water and waste water (12th eds).
- Bangladesh Observer, 2000. Medical waste disposal, dangerous indifferences, February, 25.
- Barnett, H.L. 1960. Illustrated Genera of Imperfect Fungi, Burgess Publishing Company, U.S.A.
- Becher, S., Lichtnecker, H. 2002. 'Immunological aspects and affections of rubbish collectors caused by Bioaerosols', *Journal of Occupational Health*, Vol. 44, pp. 125-130.
- Ford, S. and Friedtman, L. 1967. 'The pathogenic fungi and the pathogenic actinomycetes', In J. W. Rippon (edt), *Medical Mycology* pp. 697-699.
- Hassan, M. M., Ahmed, S. A., Rahman, K. A. and Biswas, T. K. 2008. Pattern of medical waste management: existing scenario in Dhaka City, Bangladesh, BMC Public Health.
- Ministry of Finance (MoF), 2010. *Budget Speech 2010-2011*. The Government of People's Republic of Bangladesh.
- PESCOD, M.B.** and Saw, C.B. 1998. Hospital Waste Management in Four Major Cities, A Synthesis Report, UWEP working document-8.
- Ray, M.R., Choudhury, S. R., Mukherjee, G., Roy, S. and Lahiri, S. T. 2005. 'Respiratory and general health impairments of workers employed in a municipal solid waste disposal at an open landfill site in Delhi', *International Journal of Hygiene and Environmental Health*, Vol. 208, pp. 255-262.
- Severo, L.C. and Hertz, J.L. 1978. 'The pathogenic fungi and the pathogenic actinomycetes', In J. W. Rippon (edt), *Medical Mycology*, Vol. 32, pp. 697-699.
- Sharf, J.M. 1965. Recommended methods for the microbiological examination of foods. American Public Health Association, inc. New York, pp. 180.
- Sigsgaard, T., Malmros, P., Nersting, L. and Petersen, C. 1994. 'Respiratory disorders and atopy in Danish refuse workers', *American Journal of Respiratory and Critical Care Medicine*, Vol. 149, pp. 1407-1412.
- Tamplin, S.A., Davidson, D., Powis, B. and O'Leary, Z. 2005. 'Issues and options for the safe destruction and disposal of used injection materials', *Waste Management*, Vol. 25, pp. 655-665.
- Thurston, J.R. and Cysewsk, S.T. 1979. 'The pathogenic fungi and the pathogenic actinomycetes', In J. W. Rippon (edt), *Medical Mycology*, pp. 697-699.
- Uddin, J. 2007. Public Health Implications of Hospital Waste Management: A Study on Some Selected Hospitals in Dhaka Metropolitan Areas. An unpublished research monograph submitted to the Department of Sociology, University of Dhaka, Bangladesh.
- World Bank, 2002. *Health Facility Waste Management Study in Bangladesh*. Dhaka: World Bank.
- World Health Organization (WHO, 1999). *Safe Management of Wastes from Health-care Activities*. WHO, Geneva.