

# Healthcare Waste Management; Its Impact: A Case Study Of The Greater Accra Region, Ghana.

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**ABSTRACT:** Hospital waste management is an imperative environmental and public safety issue, due to the waste's infectious and hazardous character. In recent years, hospital waste management has become a growing issue of concern with the increasing evidence suggesting health hazards related to health care waste (HCW) inflicted upon the service providers, patients and the community as a whole. Ghana, a developing country, has little information on the healthcare waste generate, how it is handle, and its disposal. The study analysed the healthcare waste management practices in the Greater Accra Region, Ghana. The study involved 120 healthcare centers in the region. A total of 150 healthcare estate officers and waste management workers. Site visits, interviews, and survey questionnaires were implemented to collect information regarding different medical waste management aspects, including medical waste generation, separation, collection, storage, transportation, and disposal. Results from the study shows 8221.2kg waste per bed per day {1.2kg bed<sup>-1</sup> day<sup>-1</sup> \*6,851 beds} are generated. An analysis per the population size of Ghana (25million) as against a projection estimate by 2025 shows that, healthcare waste will increase greatly, hence the need for strategic focus on it management as accepted internationally. Comparing the finding of the waste generation rate to other studies Greater Region of Ghana has a much higher generation rate of healthcare waste. In conclusion, healthcare centres in the Greater Accra Region do not abide to the accepted healthcare waste management policy of Ghana. It is recommended that laws of best standard of healthcare waste management should be passed and enforced by the Ministry of Local Government, to improve the current situation and to protect the environment and human health.

**Keywords:** Environment, Healthcare facilities, Waste management.

## INTRODUCTION

A study done by Tsakoma et al in 2007 indicated that, medical wastes are of substantial importance due to their potential as environmental hazards and their risks to human health. This type of waste contains infectious waste, toxic chemicals and heavy metals, and may contain substances that are genotoxic or radioactive. 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. The most authentic definition from the WHO characterizes healthcare waste (HCW) as those wastes generated from hospitals, medical centres, healthcare establishments and research facilities in diagnosis, treatment, immunization and associated research. WHO has divided HCW into ten categories and the definitions for these waste categories are listed in many documents. The major sources of HCW are hospitals, medical clinics, dispensaries, healthcare camps, medical and biomedical laboratories, medical research centres, mortuary and autopsy centres, animal research and hospitals, blood banks and so on. Poor healthcare waste management (HCWM) results in adverse effects on the environment and the public health.

The most commonly noted issues in appropriate HCWM are often safe disposal of wastes, occupational health and safety for healthcare workers and illegal scavenging. Safe disposal of HCW consists of four key stages such as segregation, collection and storage, treatment, transport and safe disposal (WHO, 2008) where national legislation must be followed. Four major categories of HCW recommended for organizing segregation and separate storage, collection and disposal are: sharps, whether infectious or not; non-sharps infectious waste; general waste; and hazardous waste. Collection, storage and treatment of these wastes differ from each other. Incineration, disinfection, sterilization, plasma arc and land filling have been adopted for the treatment of HCW in different parts of the world. In most of the developing countries infectious, pathological wastes and sharps are incinerated rarely with required air pollution control/open burned and the ash is disposed along with the municipal waste. Chemical liquid wastes are claimed to be collected and treated through the hospital effluent treatment system, and disposed into municipal sewers. However, the efficacy of the treatment is uncertain. Pharmaceutical wastes (including expired medicine) are often left unattended. Among healthcare wastes, sharps are of major concern to all healthcare staff alike, doctors, nurses, midwives healthcare workers, recyclers and the community at large. Needle stick injuries during disposal and recovery of used sharps are possible and have to be totally prevented. In most of the developing countries, the sale of used sharps and plastics is profitable. Hence, there is a potential for illegal reuse of used sharps which cause a risk to the entire community (Mujeeb et al., 2003). Hospitals and other healthcare facilities are responsible for the delivery of patient care services. In the process of delivering this healthcare waste is generated. According to WHO (2000a) the incorrect management of healthcare waste can have direct impacts on the community or individuals working in health care facilities and natural environment. The safe

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management of healthcare waste may be achieved by ensuring care in dealing with the healthcare waste. Hence it is the ethical responsibility of management of hospitals and health care establishments to have concern for public health. Safe handling, segregation, storage, subsequent destruction and disposal of healthcare waste ensure mitigation and minimization of the concerned health risks involved through contact with the potentially hazardous material, and also in the prevention of environmental contamination. According to the study by WHO (2011), Waste and by-products cover a diverse range of materials, as the following list illustrates (percentages are approximate values):

- Infectious waste: waste contaminated with blood and its by-products, cultures and stocks of infectious agents, waste from patients in isolation wards, discarded diagnostic samples containing blood and body fluids, infected animals from laboratories, and contaminated materials (swabs, bandages) and equipment (such as disposable medical devices)
- Pathological waste: recognizable body parts and contaminated animal carcasses;
- Sharps: syringes, needles, disposable scalpels and blades, etc.;
- Chemicals: for example mercury, solvents and disinfectants;
- Pharmaceuticals: expired, unused, and contaminated drugs; vaccines and sera;
- Genotoxic waste: highly hazardous, mutagenic, teratogenic or carcinogenic, such as cytotoxic drugs used in cancer treatment and their metabolites;
- Radioactive waste: such as glassware contaminated with radioactive diagnostic material or radio therapeutic materials;
- Heavy metals waste: such as broken mercury thermometers.

Infectious and anatomic wastes together represent the majority of the hazardous waste, up to 15% of the total waste from health-care activities. Sharps represent about 1% of the total waste but they are a major source of disease transmission if not properly managed. Chemicals and pharmaceuticals account for about 3% of waste from health-care activities while genotoxic waste, radioactive matter and heavy metal content account for around 1% of the total health-care waste.

### Healthcare Waste Management in Ghana

Healthcare in Ghana have been caught up with the dilemma of disposal of their waste in a safe manner. Various methods have been adopted by these healthcare facilities for the disposal of waste for example, burial, treatment with chemicals, mixing with domestic refuse and careless dumping in overgrown environment by mothers etc. these methods of disposal have proved extremely unhygienic and at times scavengers manage to excavate the buried waste and scatter them all over in the most unhygienic manner. The stench that emanated from the burial of placentas, limbs etc. especially after rainfall are unbearable and awful within most healthcare facilities environments. In Ghana, there is now a serious topical

issue about health care management. This has come about due to the awareness that a higher source of infection could start from careless handling of healthcare waste, a survey of healthcare facilities in Ghana has revealed inadequate waste treatment facilities. Environmental Protection Authority (2002a). The result is for example, amputated parts find their way mixed up with public refuse (EPA, 2002). At the landfill sites, many of the scavengers collect healthcare wastes such as syringes, which are sold for use as rollers for the hair. These activities expose many the scavengers as well as the residents of the health facilities and those living around the landfill sites (Kwawukume, 2005).

### Dangers of Improper Disposal of Health Care Waste

Transmission of disease through infectious waste is the greatest and most immediate threat from healthcare waste. If waste is not treated in a way that destroys the pathogenic organisms, dangerous quantities of microscopic disease-causing agents—viruses, bacteria, parasites or fungi—will be present in the waste. These agents can enter the body through punctures and other breaks in the skin, mucous membranes in the mouth, by being inhaled into the lungs, being swallowed, or being transmitted by a vector organism (World Health Organization, 1992). People who come in direct contact with the waste are at greatest risk. Examples include healthcare workers, cleaning staff, patients, visitors, waste collectors, disposal site staff, waste pickers, drug addicts and those who knowingly or unknowingly use “recycled” contaminated syringes and needles. Although sharps pose an inherent physical hazard of cuts and punctures, the much greater threat comes from sharps that are also infectious waste. Again, healthcare workers, waste handlers, waste pickers, drug addicts and others who handle sharps can, and have, become infected with HIV/AIDS and hepatitis B and C viruses through pricks or reuse of syringes/needles. These infections may be fatal (Johannessen, 2000). Contamination of water supply from untreated healthcare waste can also have devastating effects. If infectious stools or bodily fluids are not treated before being disposed of, they can create and extend epidemics, since sewage treatment in Africa is almost non-existent. For example, the absence of proper sterilization procedures is believed to have increased the severity and size of cholera epidemics in most parts of Africa during the last decade.

### Chemical and Toxic Threats

Chemical and pharmaceutical wastes, especially large quantities, can be health and environmental threats. Since hazardous chemical wastes may be toxic, corrosive, flammable, reactive, and/or explosive, they can poison, burn or damage the skin and flesh of people who touch, inhale or are in close proximity to them. If burned, they may explode or produce toxic fumes. Some pharmaceuticals are toxic as well (Johannessen, 2000). When chemical and pharmaceutical waste is disposed of in unlined landfills, especially unlined pits, these wastes may contaminate ground and surface water—particularly when large quantities are disposed of. This can threaten people who use the water for drinking, bathing and cooking, and damaging plants and animals in the local ecosystem. Burning or incinerating healthcare waste, while often a

better option than disposal in an unlined pit, may create additional problems. Burning or incineration of healthcare waste may produce toxic air pollutants such as Nitrogen Oxides (NO<sub>x</sub>), particulates, dioxins and heavy metals and distribute them over a wide area. Dioxins and heavy metals are of particular concern (Prüss and Townend, 1998). Dioxins believed to be potent cancer-causing agents, do not biodegrade, and accumulate in progressively higher concentrations as they move up the food chain (WHO, 1999). Heavy metals such as mercury and cadmium are toxic and/or cause birth defects in small quantities and can also concentrate in the food chain. Disposable pressurized containers pose another hazard for incineration, as they can explode if burned. In fact, disposal of large quantities of hazardous chemicals and pharmaceuticals is a serious problem. In most of Africa, no methods are available to small-scale facilities that are safe and affordable (Prüss and Townend, 1998).

### Emerging Issues of Health Care Waste Management

There is no proper waste management system in place in most developing countries. On-site incineration, autoclaving, and steam disinfection are a few processes currently in use for treating very small amounts of hazardous wastes. Countries found to practice incineration are Brazil, Argentina, Peru, India, Pakistan and Bangladesh etc. Clinical waste incinerators, particularly in developing and poorer countries, often operate under sub-optimal conditions. Most of the cases the percentage of incinerators that were functioning poorly or not operational (HCWH, 1999). Most medical administrations usually focus on installing disposal technologies such as incinerators and do not implement a "practice" of waste management within the hospital. Over 6500 incinerators were installed in the US alone in the 1980s (Agarwal, 1998). Chronic problems both relating to very high toxic levels as well as difficulties in operating a sophisticated engineering technology in a medical setting have given rise to a debate which attempts to define a clean technology for medical waste disposal. There are some techniques practiced by different countries all over the world such as: Incineration, Autoclave Disinfection, Microwave Disinfection, and Mechanical/Chemical Disinfection. Each of this technique has limitations in terms of technological aspect, environmental condition and waste composition. Burning and incineration of medical and municipal waste have been linked to severe public health threat and pollution resulting in the release of toxic dioxin as well as mercury and other toxic substances. These substances produce a remarkable variety of adverse effects in humans at extremely low doses (Basset et al., 2006). Putrefaction occurs in portions of refuse, which have not been fully burnt and add to air pollution through foul smells. Sanitary landfill can lead to pollution of ground water if not properly managed. However, most of the developed countries have defined policy and regulations to handle and manage medical waste such as Germany, France, Canada, and USA. Unfortunately, health care waste management is not yet carried out with a satisfactory degree of safety in many parts of the globe especially in the underdeveloped world (Stanley et al., 2011). In Nigeria, the lack of will by policy makers and implementation groups to adopt current technology in Health Care Waste management is an emerging challenge

towards HCW management. The Health Care system is not developed in Nigeria, and by extension Health Care Waste Management.

### PROBLEM STATEMENT

After a number of hospital visits and consultation with key stakeholders, the research team identified a major issue in healthcare waste management that Ghana faces. Currently in Ghana, poor healthcare waste treatment methods and practices are creating serious environmental problems in cities and local communities, exposing residents and neighbours to foul odours, smoke, air pollutants, contaminated water, and toxic ash from surrounding healthcare facilities. These hazards also pose risk to the health and safety of health workers, waste collectors and patients in the health facilities. Medical waste generated in hospitals in Ghana is treated using the traditional De Montfort medical waste incinerator. Due to the lack of treatment solutions, some small hospitals and clinics turn to the larger hospitals like Korle-Bu Teaching Hospital for assistance. Korle-Bu's incinerator is under-capacity, and cannot handle the medical waste generated at the hospital. This results in medical waste being disposed of without proper treatment. Disposing of untreated bio-hazardous medical waste poses serious health risks to the people of Ghana, as mentioned above. Waste incineration produces very toxic emissions (dioxins, furans and heavy metals, etc.) into the environment which in the long-term have very significant negative environmental and health effects. The incinerator technology, according to the Ghana Environmental Protection Agency, should be a temporary method for the treatment of the waste. These findings are supported by the WHO (World Health Organization, 2011) and HCWH (Health Care without Harm) and other organizations. Hospitals in Ghana are required to acquire better methods for treating the waste in the long term. However, access to more efficient and environmentally sustainable treatment technologies are lacking due to the availability of capital funds for upfront equipment acquisition, as most hospitals in Ghana are run on very tight and limited budgets. In order to improve healthcare waste management and develop a management strategy for the healthcare centres in Ghana as a whole, it is important to understand and evaluate current practices in medical waste management, hence the study.

### OBJECTIVES OF THE STUDY

The objectives of the study are to:

- Perform an overview of the healthcare waste management situation in the Greater Accra Region of Ghana.
- Gather and evaluate information on healthcare waste generation, separation, collection, storage, transportation, and disposal.

### METHODOLOGY

#### Study Sample and Recruitment

A cross-sectional study on the current situation of healthcare waste management and its impact on the environment and society was conducted in the Greater Accra Region in Ghana. The study took a maximum of six months to collect data from the 120 healthcare centers in the

region. The healthcare centers involved a teaching hospital, specialist's hospitals, General hospital, clinics and herbal hospitals. Six (6) environmental protection agency workers were recruited as research assistants and trained for 2 weeks for the purposes of the study. Research assistants explained the objectives of study and obtain participants' consent. One-one Interview and administrating of questionnaires as well as observations were used in gathering data. All questionnaires were scrutinized and mistakes corrected by the researcher assistants. Secondary data was reviewed.

### Data Collection and Analysis

Data collected was entered and analyzed using STATA. There were four kinds of data collection and analysis done in this study and each data collection addresses each of the research objective: 1) systematic review on current healthcare waste management in the Greater Accra Region; 2) Assess the impact of the current waste management situation on the environment and the society; 3) Investigate the type waste treatment or disposal option implemented by the healthcare centre; and 4) Estimate the volume of healthcare waste generated per day per healthcare centre.

## RESULTS AND DISCUSSION

### Generation Rate of healthcare waste

Results from the study shows 8221.2kg waste per bed per day {1.2kg bed<sup>-1</sup> day<sup>-1</sup> \*6,851 beds} are generated. An analysis per the population size of Ghana (25million) as against a projection estimate by 2025 shows that, healthcare waste will increase greatly, hence the need for strategic focus on its management as accepted internationally. A comparison of results was done with other study through literature review. In 2006, a study performed in the Sylhet city in Bangladesh by Kaiser et al shows that, the average generation rate of medical wastes was about 0.934 Kg/bed-day, Abdulla et al. (2008) indicated that the weighted average generation rate was 0.83 Kg/bed-day in northern Jordan and Abd El- Salam (2010) reported an average generation in El-Be- heira Governorate, Egypt, of about 2.07 Kg/bed-day. Greater Region of Ghana has a much higher generation rate of healthcare waste as compared to the above study sites with the expectation of the study done in Egypt. In Marinovic et al. (2008) report, it was revealed that the generation of healthcare waste depends on the size and the type of the healthcare centre, but also that it differs from economic situation of a country. Furthermore, the use of disposable instruments and packaging materials rather than the use of reusable items in the healthcare centres in developed countries has increased the amount waste generation. One important component of a waste characterization program involves the determination of the composition of the wastes. A sound understanding of the contents of the waste stream is helpful in the development of realistic waste reduction and recycling programs.

### Classification of healthcare waste

A waste audit conducted in the 120 healthcare centres shows that there are different components of healthcare waste in the region. The percentage distribution of the

composition of the healthcare wastes are presented in table 1.1 below: non-infectious waste 80-95%, sharps 1%, pathological waste 10-15%, chemical/pharmaceutical waste 3% and pressurized cylinders and other are less than 1%.

**Table 1.1:** Classification of healthcare waste

Waste type	Percentage of total waste stream
Non- infectious regular waste	80-95%
Sharps waste	1%
Potential infectious waste and pathological waste	10-15%
Chemical or pharmaceutical waste	3%
Pressurized cylinders, broken thermometer, dioactive waste	<1%

### Survey Waste Audit, 2013.

It was revealed in the study of Pruss et al. in 1999 that 10% - 25% of healthcare wastes was termed as infectious, pharmaceutical, radioactive and chemical wastes, Galtier et al. in 2002 indicated, 15% - 20% of healthcare wastes in France to be infectious-hazardous wastes and Lee et al (1996) shown 15% was considered as infectious and hazardous wastes in the United States of America. From literature and the study findings, infectious waste turn to be low as compared to non-infectious. However, when these infectious waste are not properly management, the dangers poses will cost huge financial lost and death of human beings as well as animals. About 83% of the healthcare centres visited do not segregated their waste. 17% of the healthcare centres segregated their waste. Segregation among the 20 healthcare centres are done for non-infectious waste and infectious waste, summing all waste which falls under these categories.

### Colour Coding and waste segregation

Colour coding of waste containers and plastic bags be used to facilitate efficient segregation of waste as according to the healthcare policy manual of the Ghana Health Services (2006) is Black for general waste, Yellow for infectious waste and Brown for hazardous waste. None of the 120 healthcare centres visited were using these colours for their bins or carrier bags. Black polythene bags were used by majority of the healthcare centres to lining bins ranging from blue, red to black bins. This however, makes collection of healthcare waste inefficient. Waste contractors lump all the waste together since they cannot make out which bin or carrier bag is infectious or non-infectious. Information from waste contractors also indicated that, there is no specific vehicle to collect the different stream of waste generated at the healthcare centres. A truck assigned to a specific healthcare centre picks all waste generated, been it infectious or non-infectious. Disposal of majority of these waste are done in open dump site and uncontrolled landfill site in the Greater Accra Region of Ghana. Waste

Treatment or Disposal Option Implemented by the Facilities  
The study also showed that, just about five healthcare centre use incineration mode of treatment. Almost all the other healthcare facilities uses open burning, and landfilling mode of treating solid waste and open gutter dislodging for the liquid healthcare waste.



**Fig 1:** healthcare waste burial/burning



**Fig 2:** Healthcare waste disposal/mixed with domestic waste

### Observation from the study

Throughout the healthcare facility visits, there were activities performed by the facilities and issues which serve as a catalyst in the current situation of healthcare waste management, hence the difficulties in using best standards. These include;

- Absence of a national policy, guidelines and standard operating procedures.
- Different systems in place for waste segregation
- No colour coding in place and wastes were not labelled
- Containers for waste were unacceptable and were sub-standardized
- Vehicles for transporting waste were inadequate
- Storage sites for waste within the facilities were open, accessible to unauthorized persons and animals, breeding grounds for flies, rodents and other insects
- Little or no treatment of the hazardous waste
- Final disposal of waste were unacceptable; burying, open burning, in some cases infectious waste were dumped on open grounds

### CONCLUSION

Ghana is a developing country, as such it will have more hospital setting up all the ten regions. There strict measures should be put in place by the Ministry of Local Government to ensure safe and best standard option of healthcare waste management are practised from the generation point to the final disposal point. Again, ministry should assess all the treatment options for healthcare waste and select one acceptable technology per the conditions of Ghana and recommend to all healthcare centred for their use. Finally, it is recommended that laws of best standard of healthcare waste management should be passed and enforced by the Ministry of Local Government, to improve the current situation and to protect the environment and human health.

### REFERENCES

- [1]. A. Pruss, E. Giroult and P. Rushbrook, "Safe Management of Wastes from Healthcare Activities," World Health Organization, Geneva, 1999.
- [2]. Agarwal, R. (1998). Medical waste Disposal. Issues, Practices and Policy. An Indian and

- International Perspective. Seminar on Health and the Environment. Centre for Science and Environment. New Delhi. India.
- [3]. Akter, N., R. E. Acott, S. A. Chowdhury, (1998). Medical Waste Disposal at BRAC Health Centres: An Environmental Study. BRAC Research, Research and Evaluation Division, 75 Mohakhali C/A, Dhaka 1212
- [4]. Akter, N., N. M. Kazi, A. M. R. Chowdhury (1999). Environmental Investigation of Medical Waste Management System in Bangladesh With Special Reference to Dhaka City. BRAC, Research and Evaluation Division, 75 Mohakhali, Dhaka 1212, Bangladesh.
- [5]. Asaduzzaman, M., & S.A. Hye, (1997). When both market and state fail: The crisis of solid waste management in urban Bangladesh. In crisis in Governance. A review of Bangladesh's Development 1997. Centre for policy dialogue. Univercoty Press Limited. Dhaka, Bangladesh.
- [6]. BAN & HCWH. (1999). Medical Waste in Developing Countries. An analysis with a case study of India, and A critique of the Basel -TWG guidelines. Basel Action Network (BAN) secretariat, Asia\_Pacific Environmental Exchange, 1827 39th Ave. E., Seattle, WA. 98112 USA.
- [7]. Bangladesh Environmental lawyers Association. (1996). The environmental preservation act 1995. Unofficial English Version. Bangladesh, Dhaka.
- [8]. Bangladesh Environmental Lawyers Association. (1996). Environmental Policy, 1992 and Environmental Action Plan. Prepared for BELA Training Programme, Bangladesh, Dhaka.
- [9]. Basse, B. E., Benka-Coker, M. O., & Aluyi, H. S. A. (2006). Characterization and management of solid medical wastes in the Federal Capital Territory, Abuja Nigeria. African Health Sciences, 6(1), 58-63.
- [10]. C. C. Lee and G. L. Huffman, "Medical Waste Management/Incineration," Journal of Hazardous Materials, Vol. 48, No. 1-3, 1996, pp. 1-30. doi:10.1016/0304-3894(95)00153-0
- [11]. Drauschke, Stefan (1999 website). Clinical Waste Policy in Germany. KEG Sonderabfall-Entsorgungsgesellschaft mbH, Am Schlangengraben 20, 13597 BERLIN, GERMANY.
- [12]. Eigeheer E., & U., Zanon. (1991). "O que fazer os residuos hospitaleres. Proposta para classificacao, embalagem, coleta e destinacao final". Arquivos Brasileiros de Medicina, Vol. 65, No. 3, 1991.
- [13]. Glasson, J., R., Therivel, & A. Chadwick, (1994). Introduction to environmental impact assessment. UCL Press Limited. London, England.
- [14]. Islam, Md. N., Mahmud, S., N., Karim, F. & A. Ahmed. (1993). Monitoring and evaluation report of women's health and development programme. Number 15: Evaluation of TB laboratory operations in women's health and development programme of BRAC. Research and Evaluation Division, BRAC, Dhaka, Bangladesh.
- [15]. Johannessen, L. M. (2000). Healthcare Waste Management Guidance Note. Anchor Team, The World Bank, 68, Available at: <http://wbln0018.worldbank.org/hdnet/hddocs.nsf/c0d65c5ea6fcb4688525670c004d14c2/0d87e869807f2f69852568d20054e66b>.
- [16]. L. Galtier and C. Bekaert, "Healthcare Waste Management on an International Scale," Appropriate Environmental and Solid Waste Management and Technologies for Developing Countries, Vol. 1, ISWA 2002, Istanbul, 2002, pp. 289-294.
- [17]. Murtagh & Associates. (1997). Material safety data sheets. 160 Bay Court Winchester, VA, U.S.A
- [18]. Ministry of Environment and Forest of Bangladesh. (1995). National Environment Management Action Plan (NEMAP). Bangladesh, Dhaka
- [19]. Nurunnabi, A. S. M. (1997). Waste management practices in city. The Daily Star, March 29th, 1997, Dhaka, Bangladesh.
- [20]. M. S. Kaiser Alam Sarkar, M. A. Haque and T. A. Khan, "Hospital Waste Management in Sylhet City," ARPN Journal of Engineering and Applied Sciences, Vol. 1, No. 2, 2006.
- [21]. M. M. Abd El-Salam, "Hospital Waste Management in El-Baheira Government, Egypt," Journal of Environmental Management, Vol. 91, No. 3, 2010, pp. 618-629. doi:10.1016/j.jenvman.2009.08.012
- [22]. M. E. Birpinar, S. B. Mehmet, et al., "Medical Waste Management in Turkey: A Case Study of Istanbul," Waste Management, Vol. 29, No. 1, 2009, pp. 445-448. doi:10.1016/j.wasman.2008.03.015
- [23]. M. Tsakona, E. Anagnostopoulou and E. Gidaracos, "Hospital Waste Management and Toxicity Evaluation: A Case Study," Waste Management, Vol. 27, No. 7, 2007, pp. 912-920. doi:10.1016/j.wasman.2006.04.019
- [24]. N. Marincovic, T. Pavic, K. Vitale, N. J. Holcer and A. Dzakula, "Management of Hazardous Medical Waste in Coatia," Waste Management, Vol. 28, No. 6, 2008, pp. 1049-1056. doi:10.1016/j.wasman.2007.01.021

- [25]. Park, K. (1994). Preventive and social medicine. M/s Banarsidas Bhanot Publishers, Jabalpur, India.
- [26]. Prüss, A., & Townend, W. K. (1998). Teacher's Guide- Management of wastes from health-care activities,. World Health Organization, Geneva, 227 pages. Available at, [http://www.who.int/environmental\\_information/Information\\_resources/worddocs/HCteachguid/health\\_care\\_wastes\\_teacher.htm](http://www.who.int/environmental_information/Information_resources/worddocs/HCteachguid/health_care_wastes_teacher.htm).
- [27]. R. Y. Gai, L. Z. Xu, H. J. Li, C. C. Zhou, J. J. He, S. Yo-shihisa, W. Tang and K. Chushi, "Investigation of Health- care Waste Management in Binzhou District, China," Waste Management, Vol. 30, No. 2, 2010, pp. 246-250. doi:10.1016/j.wasman.2008.08.023
- [28]. Stanley, H. O., Okpara, K. E., Chukwujekwu, D. C., Agbozu, I. E., & Nyenke, C. U. (2011). Health care waste management in Port Harcourt Metropolis. American Journal of Scientific and Industrial Research, 2(5), 769-773.
- [29]. WHO, (1999) (web site). Guidelines for safe disposal of unwanted pharmaceuticals in and after emergencies. Essential Drugs and Other Medicines Department, World Health Organization, Avenue Appia 20, CH-1211 Geneva 27, Switzerland.
- [30]. World Bank. (1991). Environmental assessment sourcebook. Volume II: Sectoral Guidelines. World Bank Technical Paper No 140, Environmental Department, The World Bank. Washington, DC.
- [31]. WHO. (1999). Health Care wastes. Available at, [http://www.who.int/water\\_sanitation\\_health/Environmental\\_sanit/MHCWHanbook.htm](http://www.who.int/water_sanitation_health/Environmental_sanit/MHCWHanbook.htm).
- [32]. World Health Organization, Geneva. (1992). Managing medical wastes in developing countries: report of a Consultation on Medical Wastes Management in Developing Countries, Geneva, Available at, <http://whqlibdoc.who.int/hq/1994/>
- [33]. WHO\_PEP\_RUD\_94.1.pdf.
- [34]. World Health Organization, "Safe Management of Waste from Health Care Activities," Western Pacific Regional Office Preparedness, WHO, Geneva, 2003, pp. 58-64.