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Qualitative analysis of bio medical waste in the private hospitals of Allahabad city

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Abstract
In pursuing the aim of to become less amount in health problems and enhancing the quality of care, healthcare facilities indispensably created waste that may itself be hazardous to health. Proper management of biomedical waste is not only a legal, but also a social responsibility of all kinds of hospitals and healthcare units. The on-site segregation of waste generation is the first and foremost important step in healthcare waste management. It is most important of ensuring that hazardous wastes or infectious wastes and healthcare general wastes or non-infectious wastes should keep separated and stored in appropriate color-coded containers. If there is failure of this important step, then it will turn non-hazardous waste into hazardous wastes. From some previous study and research, it is concluded that 0.5 to 2.0 kg/ bed/ day hospital waste is generated in India.

Keywords Bio medical waste, healthcare, management

Introduction
According to Hospital waste management and handling rules 1998, the waste should be segregated in bags/containers at the point of generation prior to its storage, transportation, treatment and disposal. This as to safeguard the occupational health of BMW workers. Hospitals are currently incinerating wastes or dumping waste in municipal bins. The waste contains mercury and other heavy metals, chemical solvents, preservatives (formaldehyde etc.) which are carcinogens. Plastics when combusted produce dioxins and other pollutants which pose serious human health problems not only to the waste handlers in the hospitals but to the general public directly indirectly in touch. Good segregation practices thus should be emphasized so that it helps in decreasing the volume of total biomedical waste. Thus, strict waste segregation of biological and chemical hazardous (less than 10% of the waste stream will result in clean solid waste stream (90%) that can be easily, safely and cost is effectively managed by recycling, composting and land filling the residues. The segregation of infectious and hazardous portion of hospital waste is essential. Clear guidelines on segregation of infectious and hazardous waste from the non-hazardous waste at source should be laid down. The hospital waste should be segregated into different containers/bags at the point of generation.

Infectious Non sharp Waste; Includes soiled bandages, dressings, soiled cotton, blood bags, glove gowns, masks soaked with blood, gauge, catheters/bags with Blood Gauge, catheters/bags with blood, hemodialysis tubing suction containers, IV liners, and bags with blood etc. and should be put into red bags.

Infectious non sharp waste plays a major role in transmission of infections to healthcare workers, visitors and patients and therefore should be segregated properly and put into red bags. In case hospital waste does not have a facility to treat the waste (not chemically treated) it has to be sent from its final storage point to common treatment facility (CTF). Transportation of such waste should be done in authorized carriers, as per guidelines of the hazardous waste transportation rules to the CTF.

The infectious sharp waste should be immediately segregated into a puncture proof sharp box made of thick plastic or metal. The containers should have narrow neck so that sharps once put in cannot be removed by accident. It is advisable that these be secure with an attached lid through which containers can be emptied periodically into a central location area. The lid must have locks-the keys of which should be kept responsible central authority.

Following procedure is recommended for disinfection of needles and syringes after use and before disposal till the facility of incineration or autoclaves becomes available.

- The needles and syringes should be separated by using needle cutter or burner.
- Both the needle and syringe tips should be mutilated so that they cannot be re-used.
- Immerse the mutilated needles and syringes in 1% hypochlorite solution kept in puncture proof plastic containers for at least half an hour.

- Even syringes should be disinfected before their disposal

After the treatment of infectious waste, the disinfected waste can be disposed-off in several ways as given below: -

- The resultant residue of treated infected waste can be deposited safely in a special containers and land filled.
- Human blood and body fluids should be diluted with disinfectant, and buried in puncture proof containers.
- Isolated waste after suitable on-site treatment should be disposed of in secured landfill.
- Liquid waste should be disinfected, diluted, neutralized, and discharged in special drains.
- Incinerated ash after treatment (if testing has shown it to be non-hazardous on environmental regulations) should be deposited in secured landfill.

Material Method

The Bio-Medical Waste (Management and Handling) Rules, 1998 norms state that, at no point of time the bio-medical waste should be mixed with ordinary garbage. However, it has been the case for years as the entire bio-medical wastes find place in the compost yards of the Corporation. So, the Allahabad Corporation has decided not to collect garbage from private hospitals and nursing homes which are not signing up the common biomedical waste treatment facility project. Following the action made by Allahabad Corporation, most of the hospitals from 200 beds signed MoU with the Corporation. To know the quantity and characteristics of hospital waste generation, a study was carried in one of the hospitals in Coimbatore. The hospital founded in 1975 is perhaps the most benevolent of the Trust's projects with a great scope of achieving the mission's prime objective namely "Service to Humanity". The hospital has now grown into an all under one roof hi-tech medical complex with 400 beds and covering all specialties.

The hospital is well equipped with modern Intensive Coronary Care Unit (ICCU), Intensive Pulmonary Care Unit (IPCU), Complete diagnostic and treatment facilities, Modern Kidney Transplant Unit with Hemodialysis Machine working at very low cost. The hospital also has its own Pharmacy that serves round the clock and is always well stocked. 24 Hours Cardiac Care and Accident Care Ambulance unit is also available. A canteen is also attached for the use of patients and other visitors. The hospital is running with fully qualified and experienced consultants/ Super specialist Doctors, 46, Junior Doctors, 49, Staff Nurses, Technicians, Pharmacists and other hospital menial staffs totaling 580 numbers.

All incineration-based technologies are capital intensive and also costly to operate. In addition, concerns about emission control, ash disposal, long term regulatory issues, have not been fully addressed. During the incineration process some of the ash floats out with the hot air which is called fly ash. Both the fly ash and the ash have high concentrations of dangerous toxins such as dioxins and heavy metals, disposing of this ash is a problem. The biomedical waste that is burnt in the incineration process, can be recovered and recycled. In fact, at present, is kept as the last resort and is used mainly for treating the infectious waste. In addition, the qualities of municipal waste of a typical Chhattisgarh City make them less suitable for disposal by incineration as compared to other simpler composting technologies. With a rise in the population, the amount of waste generated is increasing which becoming unmanageable. The local corporations have adapted different methods for the disposal of the rejects – open dumps, landfills, and sanitary landfills.

Pyrolysis is the process disposal of wastes with heat in an oxygen deficient atmosphere. In a paralytic's gasification facility, waste would be preprocessed to remove materials, such as metals, that cannot be decomposed. The waste would then be dried and transported to a chamber where it would be exposed to radiant heat tubes in an oxygen-free atmosphere. The heat reduces the waste into basic components: gases, (methane, ethane, hydrogen, and carbon monoxide); liquids (oil and tar); and solids (char and carbon black). The gases can be cleaned and used as a fuel for other purposes or transferred back to the chamber where it would be used to heat the radiant tubes. Solid residues are land-filled. There is reason to believe that pyrolysis can provide more complete combustion than mass burn or RDF technologies. More complete combustion reduces the levels of some pollutants in emissions from the facility. (Mani SK, Bansal AK, Chakraborty S, Bansal R, Batra N, Kumar U.; 2004)

However, the overall status of waste treatment and disposal in private hospitals was much better than in government hospitals because in private hospitals infectious waste was separately collected. For collection of general waste each bed was provided a separate basket wrapped with a biodegradable plastic bag. After collection waste was temporarily disposed of in a separate container which was lying on a separate storage area with properly locked system. No open dumping around hospital premises was observed. These differences regarding waste collection and disposal system shows the better waste management system of private hospitals than government hospitals

Table 1: Category of waste as per schedule I of the BMW Rules

Option	Waste Category
Cat. No. 1	Human Anatomical Waste (human tissues, organs, body parts)
Cat. No. 2	Animal Waste Animal tissues, organs, Body parts carcasses, bleeding parts, fluid, blood and experimental animals used in research, waste generated by veterinary hospitals/ colleges, discharge from hospitals, animal houses)
Cat. No. 3	Microbiology & Biotechnology waste (wastes from laboratory cultures, stocks or specimens of micro-organisms live or attenuated vaccines, human and animal cell culture used in research and infectious agents from research and industrial laboratories, wastes from production of biological, toxins, dishes and devices used for transfer of cultures)
Cat. No. 4	Waste Sharps (needles, syringes, scalpels blades, glass etc. that may cause puncture and cuts. This includes both used & unused sharps)
Cat. No. 5	Discarded Medicines and Cytotoxic drugs (wastes comprising of outdated, contaminated and discarded medicines)
Cat. No. 6	Solid Waste (Items contaminated with blood and body fluids including cotton, dressings, soiled plaster casts, line beddings, other material contaminated with blood)
Cat. No. 7	Solid Waste (waste generated from disposable items other than the waste sharps such as tubing, catheters, intravenous sets etc.)
Cat. No. 8	Liquid Waste (waste generated from laboratory & washing, cleaning , house-keeping and disinfecting activities)
Cat. No. 9	Incineration Ash (ash from incineration of any bio-medical waste)
Cat. No. 10	Chemical Waste (chemicals used in production of biological, chemicals, used in disinfect ion, as insecticides, etc)

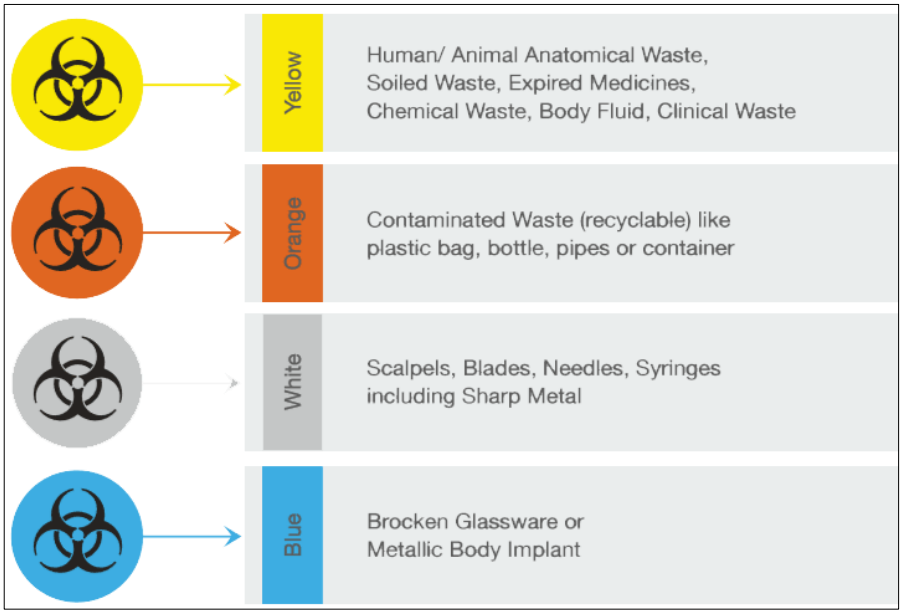

Fig 1: Bio- Medical Waste Management Rules, 2016

Storage, Transportation and Final Disposal of Hospital Waste

In government hospitals on asking about the storage of this waste researcher came to know that after collection of this waste it is openly dumped around hospital premises. After 3-4 days when this area become filled TMA van collect and transported this waste for final disposal at XYZ

Whereas in private hospitals respondents told to the researcher that after collection of waste from each ward, for temporary storage we have separate container and trolley outside the hospital building, sweepers throw-off all of the hospital waste in "Blue color" container and "Yellow color TMA trolley". Respondents also told that, every early morning TMA vans collect all of these wastes from these containers from the private hospitals, then get mixed with municipal waste and transported for finally dispose at a biggest waste dumping site of Allahabad. Private hospital's administration told to the researcher that TMA collect this waste on monthly charges around 7000-10,000 Rupees (approx.; 70 to 100US$).

In the case of government hospitals, after the collection of waste from each ward it was openly dumped around hospital premises making identical garbage heaps. To collect the recyclable products from these garbage heaps there was an open access for scavengers. TMA is a government organization and therefore, due to lack of strict monitoring by the hospital administration usually, after 3-4 days TMA vans collect this waste and transport it to the final disposal site. During summer and rainy seasons, these open garbage heaps produce mosquitoes and house flies. On other hands private hospitals, due to strict monitoring by hospital administration, waste primarily stored in containers and trolleys are regularly transported by TMA to the final disposal site. To prevent the access of scavengers, waste storage area was completely locked. Moreover, to prevent ill smelling production, some chemical sprays were used by the sanitation staff. Due to regular transportation of waste, hospital area was found completely clean and tidy. These differences illustrated that in private hospitals the waste management practices regarding storage, transportation and disposal were much better than in government hospitals.

Result and Discussion

Qualitative analysis methods of biomedical waste were applied to evaluate the behaviors of workers who are involved in the process of disposal and control of medical waste. Data are collected by using an observational approach and some questionnaires. In some cases, qualitative analysis is depending on the skills and knowledge and observed behavior of the staffs and workers who handled the waste management. Fieldwork was started by adopting an observational approach, over one-year period in 2013-2014. The qualitative analysis of biomedical waste is normally used in field-based data collection procedures to elucidate relationships between a community and its environment. In the study of qualitative analysis of biomedical waste suggested the following significant observations: -

- Employees of the various departments in the Health Care Establishments.
- 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.
- Individuals transferring waste from inside bins to road side bins.
- Individuals working for mortuary departments.
- DCC waste collectors, employed by DCC to collect waste from road side bins and to transport it to designated dumping places.
- Operators and other support staff at official medical waste treatment centers. Having identified these potentially significant groups, each group was sampled according to a sampling plan appropriate to that type of population.

Following data analysis shows different types of qualities of waste *i.e.* both government and private hospitals generates biodegradable wastes and non-biodegradable wastes in kg/year and also shows their comparison between private hospitals and government hospitals:

Table 2: Qualitative analysis of waste in private hospitals

S. No.	Private hospitals	Total solid waste (kg/yr.)	Biodegradable waste (kg/yr.)	Non-biodegradable waste (kg/yr.)
1	Heart line cardiac center	1925	1426.5	498.5
2	Yash Lok hospital & research center	11107.5	8837.5	2270
3	Parvati hospital	8091.5	6127	1964.5
4	Anand hospital	12220.5	9001.5	3219
5	Bharat hospital and orthopedic research center	3265	2582	683
6	Nazareth hospital	26272	20335.5	5936.5
7	Tamanna hospital	5920.5	4650	1270.5
	Total	68802	52960	15842

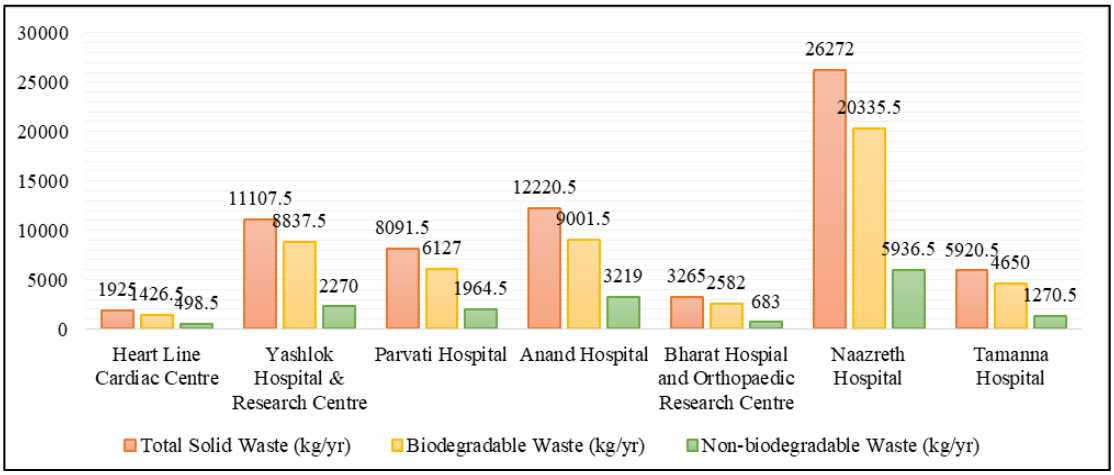

Fig 2: Waaste quantity and Hospitals

Qualitative analysis of waste generation in private hospitals

Above figure showed the data of quality of biomedical waste in all private hospitals. There were seven private hospitals which are included in the survey for the research work. These hospitals are collected their waste on the source of generation and store the waste into different kinds of color-coded bags. These bags are carried out by the workers of the common treatment facilities. These hospitals do not have their own treatment facilities so, they transferred all types of wastes to the common treatment facilities (FERRO) of the Allahabad city.

In above figure, it shows that the Nazareth hospital has the maximum quantity of qualitative medical waste i.e. 20335.5 kg/year biodegradable waste, 5936.5 kg/year non-biodegradable and the total waste 26272 kg/year is observed. And the heart line cardiac center hospital has the minimum quantity of qualitative waste in the year i.e. 1925 kg/year is total waste, 1426.5 kg/year biodegradable waste and 498.5 kg/year non-biodegradable waste is observed. In Yash Lok hospital the total waste quantity 11107.5 kg/ year, 8837.5 kg/ year biodegradable waste and 2270 kg/ year non-biodegradable waste, in Parvati hospital total quantity of waste is 8091.5 kg/ year, 6127 kg/ year biodegradable waste and 1964.5 kg/ year non-biodegradable waste, in Anand hospital the total waste is 12220.5 kg/ year, 9001.5 kg/year biodegradable waste and 3219 kg/ year non-biodegradable waste. Similarly, the quantity of biodegradable waste was observed 2582 kg/ year and non-biodegradable waste 683 kg/ year in the Bharat hospital and in the Tamanna hospital biodegradable waste quantity 4650 kg/ year and non-biodegradable waste quantity 1270.5 kg/ year.

The quantity of waste is totally depending upon the number of patients to the hospital and number of surgeries has been done in the hospitals. Qualitative waste includes all waste which is generated by the patients and in their treatment.

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