Biomedical Waste Management Practices and Awareness Level amongst the Hospital Staff: A Case Study of Northern Railway Central Hospital, New Delhi

A dissertation submitted in partial fulfillment of the requirements for the award of

Post Graduate Diploma in Health and Hospital Management

by
Dr. Archana Babu
Roll No- 6

International Institute of Health Management Research
New Delhi-110075
August 2010

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August 2010

Certificate of Internship Completion

Date:

TO WHOM IT MAY CONCERN

This is to certify that Dr. Archana Babu has successfully completed her 3 months internship in our organization from February 1, 2010 to April 30, 2010. During this intern she has worked on "**Biomedical Waste Management Practices and awareness level amongst the hospital staff-A case study of Northern Railway Central Hospital"…** under the guidance of me and my team at Northern Railway Central Hospital, New DelhiWe wish her good luck for her future assignments

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Certificate of Approval

The following dissertation titled **"Biomedical Waste Management practices and awareness level amongst hospital staff-A case study of Northern Railway Central Hospital, New Delhi"** is hereby approved as a certified study in management carried out and presented in a manner satisfactory to warrant its acceptance as a prerequisite for the award of **Post- Graduate Diploma in Health and Hospital Management** for which it has been submitted. It is understood that by this approval the undersigned do not necessarily endorse or approve any statement made, opinion expressed or conclusion drawn therein but approve the dissertation only for the purpose it is submitted.

Dissertation Examination Committee for evaluation of dissertation

Name	Signature
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Certificate from Dissertation Advisory Committee

This is to certify that **Dr. Archana Babu,** a participant of the **Post- Graduate Diploma in Health and Hospital Management**, has worked under our guidance and supervision. She is submitting this dissertation titled **"Biomedical Waste Management practices and awareness level amongst hospital staff-A case study of Northern Railway Central Hospital, New Delhi"** in partial fulfilment of the requirements for the award of the **Post-Graduate Diploma in Health and Hospital Management**.

This dissertation has the requisite standard and to the best of our knowledge no part of it has been reproduced from any other dissertation, monograph, report or book.

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ABSTRACT

Hospitals are health care institutions providing patient care services. It is the duty of hospitals to look after the public health. This may directly be through patient care or indirectly by ensuring a clean, healthy environment for their employees and the community. In the process of health care, waste is generated which usually includes sharps, human tissues or body parts and other infectious materials also referred to as ''Hospital Solid Waste'' and ''Bio-medical Solid Waste''

Looking into the existing scenario of biomedical waste management, a study was conducted in NRCH regarding biomedical waste management. The objectives of the study were:

a) To study the current biomedical waste management practices adopted in the NRCH.

b) To assess the awareness level amongst the doctors and paramedical staff about the biomedical waste management.

c) To find out the deficiencies in the system

The study was conducted in two steps- The 1st step was to conduct an observational survey to determine the methods of segregation, transportation and kerbside storage practices of waste followed in the hospital. The second step was to conduct a cross-sectional survey to assess the awareness level amongst the doctors and paramedical staff regarding BMW management.

The survey was conducted amongst the medical and paramedical staff which included doctors, nurses and sanitary staff of maternity, pediatric, orthopaedic, surgical medical and general wards. Sample size was 30 each for doctors nurses and sanitary staff Questionnaire was used as a survey instrument for data collection. 5 point scale was used in the questionnaire as-a)Agree b)Disagree c)Somewhat agree d)Somewhat disagree e)Not Aware. The responses of the respondents were then converted into awareness level as- a) Poor b) Below Average c) Average d) Good e) Excellent.

Findings:.

1)The observational survey of the biomedical waste management practices of NRCH revealed that all the generators of biomedical waste adopt universal precautions and appropriate safety measures while doing therapeutic and diagnostic activities and also while handling the biomedical waste.

2) Unstructured interviews with various members of waste management authority of the hospital revealed that the hospital does not have any well planned awareness and training program regarding biomedical waste management. The new staff generally learns the tips from the senior staff through day to day practices.

3) The hospital authorities have outsourced the final disposal of waste. These outsourced agencies are the firms authorized by Delhi Pollution Control Community (DPCC).

4) Results of awareness survey amongst medical and paramedical staff showed that awareness regarding biomedical waste management were at 77.9% for doctors, 53.9% for nurses and 21.7% for the sanitary staff members.

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On his lovable and selfless attitude
On preliminary and priceless contribution
Emerge in my heart the tears of joy and gratitude
And I am indebted to Him forever

Words are inadequate to express my innermost feelings of profound gratitude, indebtedness and reverence for my esteemed guides Dr.D.P. Pande, Dr. Atul Gupta and Mr. Pawan Taneja. This study bears my name but the indebtedness and credit goes to my esteemed guides, whose keen interest and personal attention has been instrumental in forwarding this project work. Their constant encouragement, constructive criticism and apt suggestions have helped me to accomplish this work in its present form.

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ABBREVIATIONS

NRCH Northern Railway Central Hospital
BMWM Biomedical waste management

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A. INTERNSHIP REPORT

1. INTRODUCTION TO THE ORGANISATION

The Northern Railway Central Hospital is located in Connaught Place, the heart of Delhi. It is one of the top institutions of India. The foundation stone of Northern Railway Central Hospital was laid in 1955 by the Hon'ble Shri Lal Bahadur Shastri, the then Railway Minister of India. The hospital was inaugurated by Hon'ble Shri Babu Jag jivan Ram ji in 1957. In 1970 the hospital was recognised by Medical Council of India for junior residency. In 1973, 1978, 1989 new wings were added on Chelmsford Roadside. In 1990 the hospital was recognised by N.B.E in broad specialities. The hospital has a bed strength of 416 with total number of doctors at 63 and paramedical staff of 660. The hospital is a referral centre for the employees of Northern Railway and patients are received all over the country. Patients are treated in various departments of the hospital like medicine, surgery, orthopaedics, gynaecology, paediatrics, ENT, ophthalmology and dental.

Table 1

BASIC PERFORMANCE DATA OF THE HOSPITAL

Item	**Average yearly**
OPD Attendance	5.5 lakhs
IPD Attendance	16500
Major and Minor operations	9500
Trivial operations	11000
No. of deliveries	600
No. of deaths	400

Table 2

STAFF POSITION

Cadre	**Total sanction post**	**Vacancy**
Nursing Staff	173	33
Lab Staff	30	5
Pharmacist	25	2
OT Asstt.	37	8
Cook	7	1
Dialysis Technician	2	2
Group D Staff	242	75

My internship programme in the hospital consisted of two parts

1. Observational study of general management of the hospital

2. In-depth study of biomedical waste management practices of the hospital and assessment of awareness level amongst doctors and paramedical staff.

OBSERVATIONAL STUDY OF GENERAL MANAGEMENT OF THE HOSPITAL

In the OPD the daily attendance was around 1200-1500. Patients complained of long waiting time before they could meet their doctor. This was because of manpower shortage in comparison to the daily OPD attendance. On studying the Emergency department of the hospital it was found that it received all the accidents and medical emergencies. The casualty also dealt with medico legal cases though they do not constitute a substantial proportion of the workload. Patients coming to the casualty department were either

a) treated and sent home or
b) referred for specialist opinion or admitted or
c) kept under observation in the casualty department itself or
d) underwent minor surgery and was discharged

On analysing the severity of emergency in various speciality groups ,it was found that a large proportion of patients attending the casualty department did not constitute real clinical emergencies. These patients inundate the casualty departments to the detriment of real emergency cases who actually require the urgent attention of the personnel manning the department. The reasons for the casual use of the emergency department may be many, some of them being not everyone has a family physician, or the family doctor was not available, for example on holidays, the patient feels that the hospital has better facilities for the treatment or finds the treatment in the casualty cheaper. The patient may find the hospital more convenient to visit or just wants another opinion

The pharmacy department was studied quite closely. It has grown in stature with each passing year since its inception. It has built up the reputation of well organised working setup, up to date records, spontaneous service, through hard working and dedicated staff. The pharmacy department is fully responsible for the complete change of drugs and dressing material of the hospital and all the related matters.

The Main Centralized Drug Stores for the hospital supplied drugs to various wards/ emergency/operation theatres/departments through the hospital issue counter. The delivery of drugs to the respective nursing stations was under the direct supervision of pharmacist. Drugs were also issued to OPD, drug distribution centre and injection room. Drug information was given to nursing staff, paramedical staff and technicians. In

addition the department was responsible for organising regular meetings of the Drugs Verification Committee, Drug Committee, and departmental meetings from time to time for updating the policies and procedures related to the drugs. The opportunity to participate in the pharmaceutical conferences, constant interaction with other institutions for updating of knowledge was always promoted. Drug information for the medical, paramedical or technical staff or patients is readily available and provided at various points by the pharmacy department

During my internship in the hospital I did an in-depth study of biomedical waste management practices of the hospital and also assessed the awareness level amongst the doctors and paramedical staff of the hospital. For studying the current practices of biomedical waste management in the hospital, various wards of the hospital were visited and an observational study was made. If I had queries regarding any matter I would talk to the doctors, nurses and attendants of the wards and thereby cleared my doubts. The sanitary inspector of the hospital also provided various data required for the study for e.g. amount of waste generated per day in the hospital, percentage waste generated under each category and the ways in which the waste is finally disposed off.

For assessing the awareness level of doctors and paramedical staff, a questionnaire was distributed and thereby an analysis was made. The results of the study have been discussed in detail in the dissertation report.

3. REFLECTIVE LEARNING DURING THE INTERNSHIP PROGRAMME

Doctors, nurses, paramedical staff, ministerial staff and other supportive staff of the hospital is the main strength of the hospital. Even though they are in shortage as compared to the work but still they are ready to accept all the challenges.

a) Cost effective

The hospital is quite cost effective. A study done shows that not only the central hospital but the railway medical services cost less per person in contrast to any government institute.

b) Captive clientele

The hospital has a fixed clientele. This is an advantage because the hospital is familiar and aware of their need and history and thereby provides best possible environment for the follow-up, research and outcome of the treatment

c) Lack of team spirit

Some specialists in Northern Railway Central Hospital work for individual excellence. They take support of apex hierarchical beneficiaries and refuse to work as a cohesive team.

They are an excellent resource at individual level but injurious to the system. There is a need to infuse team spirit for working for Northern Railway Central Hospital, making it a brand where individuals are not superior than Northern Railway Central Hospital as a whole.

d) Patient satisfaction

Over the time, the patient satisfaction has decreased. There is no monitoring of patient satisfaction. There is no patient grievance committee who can give an ear to the difficulties of the patients.

e) Finance Control

Till date, there is no proper budgeting. Distribution of finance is not uniform over all specialities. No cost analysis of the patient admitted in the hospital is done.

f) Quality Control

No thought given ever to the concept of quality control.

g) No security system

Northern Railway Central Hospital is devoid of any sort of security system. Railway protection force is posted but they disappear in case of any smell of the problem or are busy collecting medicine for themselves and their officers. Stray dogs and even cows can be seen inside the premises. Sometimes drug addicts or unwanted persons are seen using the facilities. The premises are unsafe for the staff on night duty. Thefts are reported even in the daytime in the presence of Railway Protection Force.

WHAT SHOULD BE DONE?

a) Hospital information system

A proper hospital information management system should be installed. This will help to access all the information at finger tip. This will ensure proper time management and will help in covering up man power crisis. It will also restrict pilferage and ensure proper budget and savings. All reports, X-rays and store information will be available online.

b) Secure and patient friendly hospital

OPD section should be independent from the IPD area. A secure IPD area should be there with a proper waiting hall for the patient attendants. Full fledged kitchen should be there under catering supervisor so that out station patients are benefited.

c) Ergonomics

Work should be allotted as per the capability of the staff and it should not be imposed. Good working environment should be provided. Full fledged library for doctors and paramedical staff with internet connection should be provided.

d) Delegation of power

Delegation of power will induce feelings of self actualisation which can be imbibed in to the doctors. Disaster management team needs to be constituted which will decrease the response time in case of crisis. Division of labour will make things work fast and curtail babudom.

e) Standard Operating Procedures

SOPs for every department need to be developed by the department themselves. Justified and correct use of medicine needs to be done. Allow the specialist to write brand medicine but must write generic name in bracket on the drug slip.

f) Cost analysis and quality control

Cost analysis should be done and compare it with actual cost and improve where needed. For the purpose of quality control standards should be laid down for every event and make sure that it is attained.

g) Department of Hospital Administration

This department should be constituted and doctors with right aptitude and knowledge should be appointed with adequate representation from specialists from Northern Railway Central Hospital. This department will be instrumental for providing the best working environment for the specialists and give them maximum time for their specialized work.

f) Protocol team at Northern Railway Central Hospital

There is a need to appoint protocol team at Northern Railway Central Hospital from existing staff, so that the technical staff, nursing staff and specialists are not burdened with receiving and seeing off protocol duty and arranging medicine etc. for apex hierarchical people visiting the hospital in the capacity of beneficiaries.

B. DISSERTATION REPORT

1. INTRODUCTION

1.1 Introduction

Hospital is one of the complex institutions which is frequented by people from every walk of life without any distinction between age sex race and religion. this is over and above the normal inhabitants of hospitals i.e patients and the staff. All of them produce waste which is increasing in its amount and type due to advances in scientific knowledge and is creating its impact. Waste generated in the process of healthcare are composed of variety of wastes including hypodermic needles, scalpels ,blades, surgical cottons, gloves, bandage, clothes , discarded medicines and body fluids human tissues and organs chemicals etc. Other wastes generated in healthcare settings include radioactive wastes, mercury containing instruments, PVC plastics etc. These are the most environmentally sensitive healthcare by products and need a greater attention which has to be monitored. World Health Organisation states that 85% of hospital wastes are actually non hazardous whereas 10% are infectious and 5% are non infectious but they are included in hazardous waste. This range is dependent upon total amount of waste generated. These wastes now threaten the public since the health care foundation are situated in the heart of the city and therefore medical waste if not properly managed can cause dangerous infections and poses a potential threat to the surrounding environment, persons handling it and the public. As per the reports from developed countries approximately 1-5 kg of waste is generated per bed per day whereas 1-2 kg per bed per day is the figure from developing countries. In India it is estimated to be 2kg per bed per day. Improper handling of solid wastes in the hospitals may increase the air borne pathogenic organisms which could adversely affect the hospital environment and community as well. The current status of employees' awareness about biomedical waste management will help the authorities to create strategy for improving the status in future. For proper biomedical waste management lot of seminars workshops and symposia are needed for awareness of medical and paramedical staff. The presented study was conducted to study the biomedical waste management practices and awareness level amongst the medical and paramedical staff of Northern Railway Central Hospital about biomedical waste management

1.2 Definition and Categories of Biomedical Waste

Biomedical Waste means any waste which is generated during the diagnosis treatment or immunization human beings or animals or in research activities pertaining thereto or in the production or testing of biologicals, including categories mentioned in the schedule 1 of the Biomedical Waste (Management and Handling) Rules 1998.

Category No 1: Human Anatomical Waste

This includes human tissues, organs and body parts.

Category No 2: Animal Waste:

This includes animal tissues organs, body parts carcasses, bleeding parts flied, bleed and experimental animals used in research, Waste generated by veterinary hospitals and colleges, discharge from hospitals, and animal houses.

Category No 3: Microbiological and Biotechnology Waste

This includes wastes from laboratory culture, stocks or specimens of micro organism lice or attenuated vaccines, human and animal cell culture used in research and infections agents from research and industrial laboratories wastes from production of biological, toxins, dishes and devices used for transfer of cultures.

Category No 4: Waste Sharp

This comprises of needles, syringes, scalpels, blades, glass etc that may cause puncture and cuts this includes both used and unusable sharps.

Category No 5: Discarded Medicines and cytotoxic drug:

This includes wastes comprising of outdated and discarded medicines.

Category No 6: Solid Waste

It comprises of items contaminated with blood and body fluids including cotton dressings, soiled plaster carts, linens, bleedings other material contaminated with blood.

Category No 7: Solid waste

This includes wastes generated from disposable items, other waste shoups, such as tubings, catheters, intravenous sets etc.

Category No 8: Liquid waste

This includes waste generated from laboratory and washing, cleaning, housekeeping and disinfecting activities.

Category No 9: Incineration Ash

This consists of ash from incineration of any biomedical waste

Category No 10: Chemical Waste

This contains chemicals used in production of biologicals and chemicals used in disinfection, in insecticides etc.

1.3 Biomedical Waste Management Process

Handling segregation, mutilation, disinfection storage, transportation and final disposal are the vital steps for safe and scientific management of biomedical waste in any establishment. The key to minimization and effective management of biomedical waste is

segregation and identification of the waste. The most appropriate way of identifying the categories of biomedical waste is by sorting the waste in to colour ceded plastic bags or containers. BMW should be segregated into containers bags of the point of generation in accordance with Schedule II of Biomedical Waste (management and handling Rules)1998 as given in table 1

Colour Coding	**Waste categories**
1. Yellow	Cat.1 Human anatomical waste
	Cat.2 Animal waste
	Cat.3 Microbiology waste
	Cat.4 Soiled waste
2. Red	Cat.3 Microbiology waste
	Cat.6 Soiled waste
	Cat.7 Soiled waste (tubes)
3. Blue/White	Cat.4 Waste sharps
	Cat.7 Plastic disposables
4. Black	Cat.5 Discarded
	Cat. 9 Incineration ash
	Cat.10 Chemical wastes

General waste like garbage, garden refuse etc should join the stream of domestic effuse sharps should be collected in puncture proof containers. Bags and containers for infection waste should be marked with biohazard symbol. Highly infections waste should be sterilized by autoclaving. Cytotoxic wastes are to be collected in leak proof containers clearly labelled as cytotoxic waste. Needles and syringes should be destroyed with the help of needle destroyer and syringes cutters provided at the point of generation. Infusion sets, bottles and gloves should be cut with curved scissors. Disinfection of sharps, soiled plastic and rubber goods is to be achieved at point of generation by usage of sodium hypochlorite with minimum contact of 1 hour. Fresh solution should be made in each shift. On site collection requires staff to close the waste bags when they are three quarters full either by tying the neck or by sealing the bag.

Biomedical waste should be transported within the hospital by means of wheeled trolleys containers or carts that are not used for any other purpose. The trolleys have to be cleaned daily. Off site transportation vehicle should be marked with name and address of carrier. Biohazard symbol should be painted on the vehicle. Suitable system for securing the load during transport should be ensured. Such a vehicle should be easily cleanable with rounded corners. All disposable plastic should be subjected to shredding before disposing off to vendor. Final treatment of biomedical waste can be done by technologies like incineration, autoclave, hydroclave or microwave.

1.4 Current Issues in Management of Healthcare Waste

There are two main issues at present:-

a) The 1998 legislation by the Govt. Of India.

b) Implementation of the same at individual healthcare establishment level as well as whole town or city level.

The legislation has fulfilled a long standing necessity. Now this sector has got clear cut guidelines which should be able to initiate a uniform standard of practice throughout the country. It would be necessary to implement proper biomedical waste management system for each and every hospital, nursing home, pathological laboratory etc. Comprehensive management system for each and every health care establishment has to be planned for optimal techno-economic viability. At the same time the final disposal for the whole town must not be lost sight of.

1.5 Legal Aspects and Environmental Concern

Indiscriminate disposal of infected and hazardous waste from hospitals, nursing homes and pathological laboratories has had to significant degradation of the environment leading to spread of diseases and putting of the people to great risk from certain highly contagious and transmission prone disease vectors. This has given rise to considerable environmental concern.

The first standard on the subject to be brought out in India was by the Bureau of Indian standard (BIS) IS 12625: 1989 entitled 'Solid Waste-Hospitals-Guidelines for Management' but it was unable to bring about any improvement in situation. In this scenario, the present study assumes great significance.

1.5.1 Biomedical Waste (Management and Handling Rules 1998)

The central govt. has notified these rules on 20th July 1998 in exercise of section 6, 8 and 25 of the Environmental (Protection) Act 1986, prior to that the draft rules were gazetted

on 16th October,1997 and public suggestions/comments were invited within 60 days. These suggestions were considered before finalizing the rules.

1.5.2 Scope and Application of the Rules

These rules apply to all those who generate collect, receive store transport treat dispose or handle biomedical waste in any form. According to these rules, it shall be the duty of every occupier of an institution generating BMW, which includes hospitals, nursing homes, clinics, dispensaries veterinary institution, animal houses pathology lab, blood banks etc. to take all steps to ensure that such wastes are handled without any adverse effect to human health and environment. They have to either set up their own facility within the time frame or ensure requisite treatment at a common waste treatment facility. Every occupier of an institution, which is generating, collecting, receiving, storing, transporting, treating, disposing and/or handling BMW in any other manner except such occupier of clinics, dispensaries, pathological, laboratories, blood banks etc, which provide treatment/service to less than 1000 patients per month shall make an application in prescribed form to the prescribed authority for grant of authorization to carry on the work. Whenever an accident occurs concerning BMW it has to be reported to this authority. Each state and Union territory (UT) government shall be required to establish a prescribed authority for this purpose. The respective governments would also constitute advisory committee to advise the Govt. with respect to implementation of these rules. The occupiers or operator can also appeal against any order of the authority if they feel aggrieved to such other authority as the Govt. of the state/UT may think fit to constitute.

1.5.3 Environmental Concern

The following are the main environmental concerns with respect to improper disposal of BMW management.

a) Spread of infection and disease through vectors (fly, mosquito, insects etc.) which affect the in-house as well as surrounding population.

b) Spread of infection through contact/injury among medical/non medical personnel and sweepers/rag pickers especially from the sharps (needles, blades etc.)

c) Spread of infection through unauthorized recycling of disposable items such as hypodermic needles, tubes, blades, bottles.

d) Reaction due to use of discarded medicines.

e) Toxic emissions from defective/inefficient incinerators.

f) Indiscriminate disposal of incinerator ash/resides.

1.5.4 Health Care Associated Infection

According to Wenzel R.P. (1997), management of health care waste is an integral part of hospital hygiene and infection control. Health Care waste should be considered as a reservoir of pathogenic microorganisms which can cause contamination and give rise to infection. If the waste is inadequately managed, these microorganisms can be transmitted by direct contact, in the air or by a variety of vectors. Infection waste contributes in this way to the risk of nosocomial infections, putting the health of hospital personnel and patients at risk. Health Care Associated Infections are preventable. As per the findings of Hygiene Standard Institute (2007) improved compliance to hygiene has been shown to reduce the number of infection outbreaks in health care facilities, transmission of antimicrobial resistant organisms e.g. Methicillin- resistant Staphylococcus aureus (MRSA) and overall infection rates.

2. REVIEW OF LITERATURE

Review of literature

The Government of India (Notification, 1998) specifies that Hospital Waste Management is part of hospital hygiene and maintenance activities. This involves management of a range of activities, which are mainly engineering

functions, such as collection, transportation, operation/treatment of processing systems, and disposal of waste. However, initial segregation and storage activities are the direct responsibility of nursing personnel who are engaged in the hospital. If the infectious component gets mixed with the general non-infectious waste, the entire mass becomes potentially infectious (Info Nugget, 2003). Before the notification of Bio-Medical Solid Waste (Management and Handling) Rules 1998, waste from houses, streets, shops, offices, industries and hospitals was the responsibility of municipal or governmental authorities, but now it has become mandatory for hospitals, clinics, other medical institutions and veterinary institutions to dispose of bio-medical solid waste as per the Law. The onus lies on hospitals and other health care institutions to ensure that there are no adverse health and environmental consequences as a result of their waste handling, treatment and disposal activities.

The actual biomedical waste management situation in the democratic developing country like India is grim. Lakshmi (2003), in the leading national newspaper of the country, reports that even though there are Rules stipulating the method of safe disposal of Bio-medical Waste (BMW), hospital waste generated by Government Hospitals is still largely being dumped in the open, waiting to be collected along with general waste. According to World Health Organization (BiomedicalWastes, 2004) the human element is more important than the technology alone. Almost any system require treatment and disposal that is operated by well-trained and well-motivated staff provides more protection for staff, patients and the community, than an expensive or sophisticated system that is managed by staff who do not understand the risks and the importance of their contribution (Biomedical Wastes, 2004). The study conducted by the Central Pollution Control Board (CPCB), an apex pollution monitoring body on incinerators in Delhi Hospitals, concludes that the incinerators were found to spew a high level of deadly residues and toxic emissions such as cancer-causing dioxins and furans besides chemicals which cause neonatal abnormalities, reproductive and skin disorders, endocrine disruption and suppression of the immune system, reports Krishna of The Independent Media Center India (2004). He also notes that there is also even prevalence of reuse/recycling of biomedical waste being practiced due to: (i) lucrative monetary returns and (ii) lack of awareness about the

problems associated with biomedical wastes. The crux to all of this may be due to a lack of awareness and appreciation amongst medical staff and residents, as well as the public; inadequate existing facilities, and lack of strict enforcement of the rules in light of the enormous population of the country. Biomedical waste management is a special case wherein the hazards and risks exist not just for the generators and operators but also for the general community (Sandhu and Singh, 2003). There are about 1.6 million health care workers at approximately 27,500 health care facilities in India (Shah et al., 2001).Waste management has become a critical issue as it poses potential health risks and damage to the environment, which has taken a central place in the national health policy and is attracting a considerable international interest. India participated in the United Nations Conference on the Human Environment held at Stockholm in June, 1972, where decisions were taken to take appropriate steps for the protection and improvement of human environment. Therefore, the Environment (Protection) Act 1986 (EPA) was formed under the Ministry of Environment and Forests, which is the most comprehensive Act on the Indian Statute Book relating to Environment Protection (Jaswal and Jaswal, 2000). It is general legislation for the protection of environment,

enacted under article 253 of the Constitution, which came in force on 19th November 1986. In July 1998, the Government of India Environment (Protection) Act 1986 (Rule 29 of 1986) issued a Notification on Biomedical Waste (Management and Handling), Rules 1998, indicating the Rules for the Management and Handling of bio-medical solid waste. It defines ‘‘Biomedical waste’’ as any waste, which is generated during the diagnosis, treatment or immunization of human beings or animals or in research activities pertaining thereto or in the production or testing of biologicals, and including categories mentioned in Schedule I (1998). Looking into the existing scenario of biomedical waste management in the country it was thought to undertake a study to: (i) assess the human factor in handling and treatment of clinical waste, i.e., to study the existing modus operandi and its compliance with the Standard Procedures of the Biomedical Waste Management Rules as per EPA 1986 and (ii) quantitatively determine the amount of non-infectious and infectious waste in various blocks of a recently built, multi-speciality, high-technology hospital known for its most advanced diagnostic and surgical specialities.

3. AIMS AND OBJECTIVES

3.1 Aims and objectives

The objectives of this study are

1) To study the current biomedical waste management practices followed in Northern Railway Central Hospital.

2) To assess the awareness level about biomedical waste management amongst the doctors and paramedical staff

3) To find out the deficiencies in the system and to suggest the remedial measures to bring about correction in the system.

3.2 Rationale of this study

Hospital waste management is a part of hospital hygiene and maintenance activities. In fact only 15% of hospital waste is hazardous. But when hazardous waste is not segregated at the source of generation and mixed with non hazardous waste, then 100% waste becomes hazardous. The question then arises that what is the need for the study of management of hospital waste. The reasons are:-

1. Injuries from sharps leading to infection to all categories of hospital personnel and waste handler
2. Nosocomial infections in patients from poor infection control practices and poor waste management.
3. Risk of infection outside hospital for waste handlers and scavengers and at time general public living in the vicinity of hospitals.
4. Risk associated with hazardous chemicals and drugs to the persons handling waste at all levels.
5. "Disposables" being repacked and sold by unscrupulous elements without even being washed.
6. Drugs which have been disposed off being repacked and sold off to unsuspecting buyers.
7. Risk of air, water and soil pollution directly due to defective incineration emissions and ash.

So the rationale for this study is to assess the current practices of biomedical waste management followed in the hospital and if there is any lag between the ideal practices and the current practices. If the lag is there, what are the reasons for it and how can it be corrected.

3.3 Limitations of the Study

Despite the efforts made to make the study as precise and objective as possible, certain limitations have crept into the study.

1. The study was conducted on a sample selected from the Northern Railways Central Hospital only. Extending the study to other Railway hospital was not possible due to limited time at the disposal of the investigator. More generalized results would have been obtained from the study if a large sample from other Railway Hospital was used.
2. The study concentrated on issues related to biomedical waste management only. The study could be further expanded by focusing on issues related to Hygiene, Environment, Sanitation, safety and Health.
3. The study was biased because the hospital staff did not come out with true responses regarding biomedical waste management due to the fear of higher authorities.

4. METHODOLOGY

4.1 Materials and Methods

The study was conducted in Northern Railway Central Hospital which is a 392 bedded hospital with a work force of 125 doctors, 173 nurses, 201 attendants and 141 sweepers. The study was conducted in two steps- The 1st step was to conduct an observational survey to determine the methods of storage and segregation at word or department level, internal transportation and kerbside storage of waste. For studying the current practices of biomedical waste management in the hospital I contacted the in-charge of biomedical waste management of the hospital. He briefed me on the various details of waste management practices carried out in the hospital He also revealed the past and present data regarding the amount of waste generated daily in the hospital, amount of waste under each category and various segregation, transportation and storage practices followed in the hospital. After acquiring the theoretical knowledge about waste management practices I went to various wards like medicine, surgery, orthopaedics, maternity paediatrics etc to do an actual study of the same by observation and questioning. For solving my queries regarding waste management practices I was always helped by doctors, nurses and sanitary staff on duty. The second step was to conduct a cross-sectional survey to assess the awareness level amongst the doctors and paramedical staff regarding BMW management

4.2 Survey instrument

Questionnaire was used as a survey instrument for data collection. It consisted of 12 questions that were simple to understand and assessed the knowledge and awareness level of medical and paramedical staff of Northern Railway Central Hospital .A 5- point scale was used in the questionnaire as-a)Agree b)Somewhat Agree c)Disagree d)Somewhat disagree e)Not Aware. The responses of the respondents were then converted into awareness level as- a) Poor b) Below Average c)Average d)Good e)Excellent.

4.3 Scope of the survey

The survey was conducted amongst the medical and paramedical staff which included doctors, nurses and sanitary staff of maternity, paediatric, orthopaedic, surgical medical and general wards

4.4 Pilot testing of the questionnaire

Pilot test of the survey instrument was done on 15 staff members who included 5 each of doctors, nurses and sanitary staff. This was done to ensure that the questions were

unambiguous and flowed well. Pilot survey was successful and therefore there was no change in the questionnaire.

4.5 Sample size

Questionnaires were distributed randomly to 150 staff members, 50 each to doctors, nurses and sanitary staff members. Out of 150 questionnaires, 107 questionnaires were filled completely and correctly. Out of 107 questionnaires received back, 35 were from doctors, 40 from nurses and 32 from sanitary staff members. For the purpose of standardization of results, only 30 filled questionnaires from each category were considered for data analysis.

4.6 Data analysis

Responses of the staff members were assigned the scores as-

1	for	Poor	(Agree/Disagree)
2	for	Below Average	(Not Aware)
3	for	Average	(Somewhat agree/Somewhat disagree)
4	for	Good	(Somewhat agree/Somewhat disagree)
5	for	Excellent	(Agree/Disagree)

Actual scores for each question were calculated by adding up the individual scores given by each respondent to that particular question. Mean analysis of of scores calculated for each question was done. Awareness level for each question was calculated as percentage. Overall mean and percentage level of awareness of each category of staff was also calculated from the same data.

If the mean score was

a) More than 3- Staff had good awareness

b) More than 4- Staff had excellent awareness

c) Less than 3- Staff had average awareness

d) Less than 2- Staff had poor awareness

5. RESULT & DISCUSSION

5.1 Quantity of BMW generation

During the observational survey it was found that about 200 kg of general waste was generated per day from the entire hospital. About 33kg of Infections waste was generated per day from the entire hospital. About 13 kg of sharps and Rubber tubing waste was generated from the entire hospital. The study therefore showed that 81.3% of total solid waste generation in the hospital is general wastes, 13.4% is the infection wastes and 5.2% is the sharps wastes and rubber tubing wastes.

5.2 Current BMW Management practices

5.2.1 Management of Sharps Waste

A good level of awareness and comparatively safe practice for segregation of sharps waste were in place. Almost all the wards had been provided with a needle cutter/destroyer. The needles were destroyed in the needle cutter and then dipped in hypochlorite solution. After every 2-3 days, the destroyed needles were put in the red bag and carried away by the waste collectors. In all the wards, the sharps containers usually were bigger in size and replacements were not done until they were full. By doing so, it took around 3-4 days and at some places even a week to replace a fresh sharps container during this period, all the sharps wastes remained untreated within laboratories, dressing rooms etc. and this may not be a safe practice, considering multiplication of micro organism and humid and hot weather prevalence in Delhi.

5.2.2 Segregation, packaging and transportation of BMW

Most of the wards and departments of the hospital did practice segregation of waste. But it was lacking at other places. Both wastes i.e infectious and non infectious wastes were collected often in same containers without segregation. Though separate containers were kept for the segregation of infectious, non infectious and general wastes but the level of segregation was not satisfactory due to lack of awareness and defined policy on BMW management. There was lack of container colour coding system for segregation. The wards were provided mostly with black plastic bags. Red and yellow bags were not available to the staff. The usage of biohazard symbol was not common. The covered container for segregation was also not common. In most of the wards, liner over the container was not used therefore spillage of wastes could be ruled out while unloading wastes from the container. Trolleys, wheel carts etc. for

transportation of BMW were not provided. Wastes were carried by hand exposing waste handlers to risks

5.2.3 Management of Liquid Wastes

Liquid Wastes, either infectious or other generated from the hospital were disposed into ground without any treatment through soak pits which ultimately found their way into the ground water aquifers. This led to a big risk of contamination of ground water which was used at times for drinking purposes also. Fluid Effluent Treatment plant had been proposed for the hospital but it will take a long time to get actually installed.

5.2.4 Management of Mercury Wastes

The hospital is still using mercury containing health care products like sphygmomanometer, thermometer, gastrointestinal tubes, oesophageal dilators dental amalgams for tooth filling and other electronic sensing devices. Mercury in these products is leaked out when these products are accidentally or intentionally broken and misused. The hospital did not have any policy on the management of the mercury wastes. If the mercury containing instruments were broken accidentally the mercury released was mixed with the infectious waste which was later incinerated or was mixed with general waste which would go for land fill. Discussions with dental surgeon revealed that about 2gms of mercury on an average were released into environment as wastes for every dental filling by mercury amalgam.

5.2.5 Safety Measures followed for handling of HCW

During the study it was seen that all the generators of biomedical waste adopted universal precautions and safety measures while doing therapeutic and diagnostic activities and also while handling the biomedical waste.

- Waste collectors and waste transporters were unaware of the nature and risk of the waste.
- Though protective gear like aprons, latex gloves, masks and rubber boots had been provided to the waste collectors, but it was found that they used only masks and latex gloves.
- There were no written instructions provided regarding the procedures to be adopted in the event of spillage or accidents.
- Workers were protected by vaccination against tetanus and hepatitis B.

5.2.6 Training programmes

Hospital did not have any well planned awareness and training program for all the category of personnel including administrators (medical, paramedical and administrative) A biomedical waste committee was in place which was headed by senior DMO Administrator and Assistant Nursing officer (ANO). A seminar or meeting was held by this committee once in 4-5 months in which the knowledge of medical & paramedical staff regarding handling of BMW was brushed up. But there were no policies for the training of new staff regarding BMW (handling and management) rules. The new staff generally learned the tips from the senior staff through day to day practices.

5.2.7 Storage and containment of biomedical waste

Biomedical Waste was stored in the plastic containers which didn't have sufficient strength. Though in other wards it was found that metal containers were used which had sufficient strength to resist ripping, tearing or bursting under normal conditions of use. But at most places it was found that the containers weren't securely closed so as to prevent leakage or exploration of solid or liquid wastes during storage handling or transport.

- Sharps were contained for storage, transportation, treatment and subsequent disposal in leak proof, rigid, puncture resistant containers that were taped, closed or tightly lidded to preclude the loss of contents.
- Reusable containers used for shipment of BMW were not washed and decontaminated each time they were emptied.
- Reusable pails, drums dumpsters or bins used for containment of BMW ideally shall not be used for other purpose except after being decontaminated. But this practice was not followed in the hospital.
- The different categories wastes from different departments and different wards were collected at one common waste collection centre within the campus of the hospital. This area was properly fenced and there was category wise storage of the wastes. Proper sheds having impervious flooring were available for storage. The storage area was properly secluded from the main areas of the hospital. It was always under lock and key and a particular official had been assigned the responsibility of the keys. Accessibility to cats and dogs wasn't there. But proper warning labels were missing from the storage site.

5.2.8 Final Disposal of the waste

The hospital authorities had outsourced the final disposal of waste. These outsourced agencies were the firms authorized by Delhi Pollution Control Committee (DPCC). Presently the NRCH had a contract with one such firm known as Biotic Solutions. Earlier other firms had signed the contract like Synergy Waste Management and Biocare Technological Services. The contract with these firms was renewed every year. To check the waste management practices of the hospital, the DPCC conducts an inspection once or twice a year. Mostly the visit is a surprise visit but sometimes it can also be a communicated visit.

5.2.9 Record Keeping and Documentation of Biomedical Waste

The hospital kept a record of amount of waste generated per day in the hospital. This record included amount of waste generated in yellow bags, red bags and black bags. The hospital authorities submitted annual report to the prescribed authority in the form II as under by 31st January of every year subsequently this information is compiled and sent to Central Pollution Control Board.

5.2.10 Accident reporting:

Under Rules 12, the officer in charge is required to report in the prescribed form III, whenever any accident like needle stick injury occurs in the institution or facility during handling or transportation of waste. Accident reporting includes:-

a. Date and time of accident
b. Sequence of events leading to accident
c. The waste involved in accident
d. Assessment of the effects of the accident on human health and the environment.
e. Emergency measures taken
f. Steps taken to prevent the recurrence of such an accident

Date_____

Signature_____

Place_____

Designation _____

But during the study it was found that the practice of accident reporting wasn't followed in the hospital.

5.3 AWARENESS SURVEY REGARDING BIOMEDICAL WASTE MANAGEMENT IN DOCTORS

The awareness level of doctors was highest at **86.6%** regarding accident reporting and remedial measures to be taken after the accident. The awareness level of doctors dipped to a minimum of **63.3%** regarding final disposal of waste. Mean score calculated for the awareness level of doctors was **3.5** which indicated that the doctors have **a good level of awareness**

Table 3

Awareness regarding	**Max. Score**	**Actual Score**	**Mean Score**	**Awareness level**
1. Meaning of biomedical waste	150	120	4	80%
2.Relation between improper disposal of BMW and risk to the health	150	125	4.16	83.3%
3.Effects of improper disposal of needles and syringes	150	126	4.2	84%
4.Segregation practices of BMW	150	106	3.5	70.6%
5.Transportation practices of BMW	150	102	3.4	68%
6.Storage practices of BMW	150	110	3.6	73.3%
7.Final disposal of BMW	150	95	3.1	**63.3%**
8. Labelling of BMW containers	150	122	4.06	81.3%
9.Accident reporting and remedial measures taken	150	130	4-3	**86.6%**
10.Biomedical waste (Management and Handling) Rules 1998	150	128	4.26	85.3%
11.Waste minimization techniques	150	115	3.8	76.6%
12.Importance of protective clothing during handling of BMW	150	124	4.13	82.6%

5.4 AWARENESS SURVEY REGARDING BIOMEDICAL WASTE MANAGEMENT IN NURSES

In case of nurses the awareness level peaked at **63.3%** regarding the importance of protective clothing during handling of waste whereas the awareness level was minimum at **45.3%** regarding Biomedical waste (Handling and Management) Rules 1998. Mean score was calculated at **2.6** which indicated that the nurses had **average level of awareness**.

Table 4

Awareness regarding	**Max. Score**	**Actual Score**	**Mean Score**	**Awareness level**
1. Meaning of biomedical waste	150	82	2.7	54.6%
2.Relation between improper disposal of BMW and risk to the health	150	73	2.4	48.6%
3.Effects of improper disposal of needles and syringes	150	77	2.5	51.3%
4.Segregation practices of BMW	150	86	2.8	57.3%
5.Transportation practices of BMW	150	89	2.9	59.3%
6.Storage practices of BMW	150	91	3.0	60.6%
7.Final disposal of BMW	150	75	2.5	50%
8. Labelling of BMW containers	150	79	2.6	52.6%
9.Accident reporting and remedial measures taken	150	87	2.9	58%
10.Biomedical waste (Management and Handling) Rules 1998	150	68	2.26	**45.3%**
11.Waste minimization techniques	150	69	2.3	46%
12.Importance of protective clothing during handling of BMW	150	95	3.16	**63.3%**

5.5 AWARENESS SURVEY REGARDING BIOMEDICAL WASTE MANAGEMENT IN SANITARY STAFF

The awareness level of the sanitary staff was highest at **30%** regarding importance of protective clothing during handling of waste and minimum at **14.6%** regarding Biomedical waste(Handling and Management) Rules 1998. Mean score was calculated at **1.09** which indicated that the sanitary staff had **poor level of awareness.**

Table 5

Awareness regarding	Max. Score	Actual Score	Mean Score	Awareness level
1. Meaning of biomedical waste	150	42	1.4	28%
2.Relation between improper disposal of BMW and risk to the health	150	41	1.3	27.3%
3.Effects of improper disposal of needles and syringes	150	25	0.8	16.6%
4.Segregation practices of BMW	150	35	1.16	23.3%
5.Transportation practices of BMW	150	37	1.2	24.6%
6.Storage practices of BMW	150	33	1.1	22%
7.Final disposal of BMW	150	29	0.9	19.3%
8. Labelling of BMW containers	150	28	0.9	18.6%
9.Accident reporting and remedial measures taken	150	29	0.9	19.3%
10.Biomedical waste (Management and Handling) Rules 1998	150	22	0.7	**14.6%**
11.Waste minimization techniques	150	26	0.8	17.3%
12.Importance of protective clothing during handling of BMW	150	45	1.5	**30%**

5.6 COMPARISON OF RESULTS OF AWARENESS SURVEY REGARDING BIOMEDICAL WASTE MANAGEMENT IN DOCTORS, NURSES AND SANITARY STAFF

The results of awareness survey showed that the doctors, nurses and sanitary staff respectively have **77.9%, 53.9%and 21.7%** overall awareness about biomedical waste management. This shows that people with higher level of education have greater awareness about this particular subject.

Table 6

Awareness regarding	DOCTORS	NURSES	SANITARY STAFF
1. Meaning of biomedical waste	80%	54.6%	28%
2.Relation between improper disposal of BMW and risk to the health	83.3%	48.6%	27.3%
3.Effects of improper disposal of needles and syringes	84%	51.3%	16.6%
4.Segregation practices of BMW	70.6%	57.3%	23.3%
5.Transportation practices of BMW	68%	59.30%	24.6%
6.Storage practices of BMW	73.3%	60.6%	22%
7.Final disposal of BMW	63.3%	50%	19.3%
8. Labelling of BMW containers	81.3%	52.6%	18.6%
9.Accident reporting and remedial measures taken	**86.6%**	58%	19.3%
10.Biomedical waste (Management and Handling) Rules 1998	85.3%	45.3%	14.6%
11.Waste minimization techniques	76.6%	46%	17.3%
12.Importance of protective clothing during handling of BMW	82.6%	**63.3%**	**30%**

Overall awareness amongst doctors: 77.9%

Overall awareness amongst nurses: 53.9%

Overall awareness amongst sanitary staff: 21.7%

6. CONCLUSION

&

RECOMMENDATIONS

CONCLUSION

The NRCH is severely lacking in actions to dispose off its waste and uphold its statutory responsibilities. This is due to lack of education awareness and trained personnel to manage the waste in the hospital, as well as the paucity of the funds available to proper waste management system. The result of the study demonstrate the need for strict enforcement of legal provisions and better environmental management system for the disposal of biomedical waste A policy needs to be formulated based on "reduce, recover, reuse and dispose". The study concludes that healthcare waste management should go beyond data compilation, enforcement of regulations and acquisition of better equipment. It should be supported through appropriate education, training and commitment of the healthcare staff, management and healthcare managers within an effective policy and legislative framework.

Recommendations

Segregation of infections waste

Segregation of infections waste should be done at the point of origin. Distinct clearly marked containers or plastic bags should be used for infections waste. Universal biological hazard symbol should be used on infections waste containers. Responsibility for waste segregation should never be conferred on anyone who is untrained in the medical field unless explicit instructions are given for specific wastes. The segregation of waste at the paint of generation reduces the amount of subsequent exposure that the staff receives in handling the waste. It also serves to curtail the spread of pathogens by concentrating the infectious waste.

Waste Minimization:

Waste minimization practices should be encouraged amongst the hospital staff. Less waste results in less handling, smaller chance of exposure, lower incinerator emissions and reduced possibility of a toxic release. Methods recommended for waste minimization are reducing the amount of waste generated at the source itself, recycling of the waste generated from the hospital and finally reusing the items generated from recycling. Various recycling methods should be adopted by the hospital authorities like steam sterilization and gas sterilization.)

Proper storage of the hospital waste

Good quality bags should be used for the storage and transportation of the waste. The bags should be sealable to prevent leakage or egress of micro organisms. They should be safe to transport, and strong enough to resist internal or external mechanical damage. Waste should be stored for a minimum period of time and access to the storage area should be minimum. Universal biological hazard symbol should be posted on the storage area door and other waste containers in the hospital

Implementation of BMWM plan in the hospital

A written plan is a tangible evidence of a serious commitment to safely manage infectious and hazardous waste. The plan should outline the current procedures as well as proposal for improving waste management. It should focus mainly on the infectious wastes—the most problematic area. It should be prepared by the person or committee responsible for waste management. It must identify functional responsibilities for all the procedures. It should be approved by the organization administrator responsible for planning, when it is completed. It should be updated regularly.

Training and supervision of the staff

The hospital should have written policies on waste handling procedures and the people responsible for implementing these policies should be clearly identified The waste handling procedures should be made known and readily to all personnel concerned and not only to those at senior level. Basic training in waste handling procedures should be given to all new personnel in service.

Basic content of training programmes should include information on:

- The hazards of health care waste
- The method of preventing the transmission of nosocomial infections related waste handling.
- The safety procedures for dealing with chemical pharmaceutical and radioactive waste and sharps.
- Proper waste segregation, handling, packaging, transport and disposal.

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Annexure 1

QUESTIONNAIRE

1) Any waste which is generated during the diagnosis treatment or immunization of human beings or animals or in research activities is called as biomedical waste
a) Agree
b) Disagree
c) Somewhat agree
d) Somewhat disagree
e) Not aware

2) Improper biomedical waste management leads to risk to the health of employees of the hospital, patients receiving treatment and visitors to the hospital.
a) Agree
b) Disagree
c) Somewhat agree
d) Somewhat disagree
e) Not aware

3) Improper disposal of needles and syringes may lead to transmission of diseases like Hepatitis and AIDS
a) Agree
b) Disagree
c) Somewhat agree
d) Somewhat disagree
e) Not aware

4) Items contaminated with blood and body fluids go into yellow bag
a) Agree
b) Disagree
c) Somewhat agree
d) Somewhat disagree
e) Not aware

5) During the transportation of biomedical wastes within the hospital premises, route of the trolley should be predefined and spillages from the trolley should be avoided
a) Agree
b) Disagree
c) Somewhat agree
d) Somewhat disagree
e) Not aware

6) Protective clothing worn by biomedical waste handlers including gloves masks aprons and boots protect against the risk of disease transmission
a) Agree
b) Disagree
c) Somewhat agree
d) Somewhat disagree

e) Not aware

7) Symbol used to label the biomedical waste container is



a) Agree b) Disagree c) Somewhat agree d) Somewhat disagree e) Not aware

8) If there is an accidental needle stick injury immediate remedial measures should be taken and immediate reporting of the incident should be done to the concerned authorities
a) Agree
b) Disagree
c) Somewhat agree
d) Somewhat disagree
e) Not aware

9) Biomedical waste management practices of our country are governed by Biomedical waste management (handling and management) Rules 1998.
a) Agree
b) Disagree
c) Somewhat agree
d) Somewhat disagree
e) Not aware

10) Waste minimization should be done by reduction, recycling and reuse of the waste
a) Agree
b) Disagree
c) Somewhat agree
d) Somewhat disagree
e) Not aware

11) Storage practices of biomedical waste does not have any effect on the environment

a) Agree
b) Disagree
c) Somewhat agree
d) Somewhat disagree
e) Not aware

12) Incineration and recycling are the only techniques for final disposal of waste.

a) Agree
b) Disagree
c) Somewhat agree
d) Somewhat disagree
e) Not aware