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JOURNAL OF THE INDIAN SOCIETY OF HOSPITAL WASTE MANAGEMENT

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JOURNAL OF THE

Indian Society of Hospital Waste Management

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PRESIDENTS PAGE

Dear Friends,

It is 10 years of continuous quality work of ISHWM, and all of us are proud!

ISHWM has been relentless in the pursuit of best practices in healthcare waste management and has had support from many Government and Semi-Government agencies, including DST, CSIR, MCI, ICMR, NRDC. We are trying to get continuous support from the MoEF. This is necessary since ISHWM plays important role of spreading awareness through regular conferences / seminars / workshop / projects. It is hoped that the required support from the MoEF may become available. We would welcome support from the pollution control boards and committees, and most importantly from the CPCB. ISHWM was allotted a project to conduct external audit in selected hospitals in Delhi and the project has highlighted some very important issues.

The Society could not host the annual conferences in the years 2008, and 2009 due to reasons beyond control. We had the annual general body meetings and workshop. But we are marching ahead and expect to cover lost ground.

Our web site www.medwasteind.org has undergone some further refinement and it is user friendly. Revised members list is yet to be uploaded on the site. There has been delay on this score as members have not provided the latest contact details. Hence, members are once again reminded to feed in the latest information at least the email ID so that they can be contacted. It is important to remain in touch for interaction of ideas and scientific discussion. A discussion board has been launched on the society's web site and members as well as others can take advantage and have healthy discussion / clarification on issues / points pertaining to healthcare waste management. I am sure members will find it interesting once they start interacting with all on discussion board.

This year we have witnessed unprecedented rainfall in many parts of the country, and consequential increase in occurrence of communicable diseases, specially swine flu and dengue. If not the only reason waste mismanagement has a definite role here. Once again waste management is a preventive strategy and results may not manifest immediately, but I am sure all will agree with the age old adage 'prevention is better than cure'!

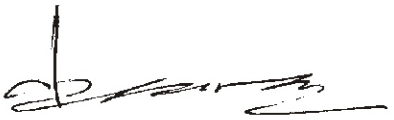
Hospitals and other healthcare institutions are yet to develop 'in house' monitoring system whereby system related to waste management is developed to ensure risk management and worker's safety. Waste is one aspect but the other and more important part is system development for healthcare waste management. It is unfortunate that in house system development is still lacking in most of hospitals and other healthcare facilities. There has been no strategy for healthcare waste management in the rural areas. We are still in the phase of developing effective system at the urban areas. Increasing population demand more and more hospitals and it would be in the interest of the society to indulge in forward planning for developing and nurturing healthy society with healthy mind and body. History is replete with examples where a country has stolen a march over others on application of research findings, and good research results come out of healthy mind. Healthcare wastes contain chemicals and metallic waste which impinge on human health and therefore it may be necessary to take proper care of healthcare wastes to

allow flowering of human mind in all its dimensions. Development of homo sapiens has been a complex evolution over millennia but destruction may not be so. Unless care is taken now we may face disasters. Scientists have discovered 4 ice ages in the past. I only hope we are not veering towards another one!!

My heart says 'no….' My mind ……. confused! But with human ingenuity I am sure things will turn in favour of continued human existence with healthy body and mind; and sharper intellect!!

I wish all members of ISHWM family the very best !

Jai Hind!



(Lalji K Verma)

"HONOURS AND AWARDS

Dr Arvind Lal of Lal Path Labs, Delhi had the double honour of being conferred the prestigious award of Padma Shri by the Hon'ble President of India and the Honorary rank of Brigadier by the Ministry of Defence."

EDITORS PAGE

Dear Readers,

It is twelve years since BMW rules came into force in our country. Has the necessary impact been possible? If not, where is the gap? Is legislative approach supported by training support? Have the issues of worker safety addressed? Do we have relevant technologies to manage health care waste? Are sufficient funds allocated by health care institutions for safe HCWM systems? An introspection appears necessary.

Since the publication of Vol 7 and 8 of Journal of ISHWM in September 2009, we see few good developments. Firstly, Government of India Ministry of Environment and Forests is undertaking revision of BMW Rules of 1998. Secondly, guidelines on management of Mercury are being developed by CPCB. Thirdly, we see many governments, especially Government of Gujarat considering accreditation of their Primary Health Care System. Health care settings where NABH accreditation in place already difference is observed in total management of health care including health care waste management and infection control. Also, we see establishment of more common biomedical waste management facilities in the country in many states of India. Another interesting area is Government considering facilities for environmental monitoring of dioxins and furans in Trivandrum, Nagpur and New Delhi.

While these are good developments, unaddressed areas include quality of management in common biomedical waste facilities, usage of standard equipments, and maintenance of temperature, worker safety and hazardous ways of working in common biomedical waste facilities. Secondly, management of health care waste in small health care settings, liquid waste management in district hospitals, rural hospitals where there is no underground drainage. Thirdly, training and capacity building in HCWM and Infection control continues to be a neglected area. Health care waste management in indigenous system of medicine, Veterinary science and research institutes is less known and there is a need to commission a study on these areas. ISHWM continues to advocate strengthening of unaddressed areas through this Journal and its activities.

ISHWM is proud that its members are contributing in their own way in their areas of work. We are happy that this issue of journal (Vol 9 Issue 1 September 2010) is being released on the occasion of tenth annual conference. This issue has a special focus on Health Care Waste Management in the context of Dental Health care settings. Apart from a review article Dr D Pushpanjali, Professor and HOD Community Dentistry of MS Ramaiah Dental College, a very resourceful information on types of waste, tips for intervention in different departments of Dental Health care settings is presented by Dr Sreenivasa Murthy, Vice Principal of the same institution in their article 'Dental Health care Waste Management', list of useful resource materials and news from capacity building attempts are compiled. We hope that Dental Heath Profession will find this very useful.

Readers will find it very interesting to read articles on infection control: 'A prospective study to demonstrate blood pressure cuffs as a potential source of infection in hospitals and disinfection techniques to prevent the same' Dr Asima Banu of Bangalore Medical College, Bangalore. It is interesting to note that Lok Adalat played a very interesting and supportive role in setting up liquid waste management in two major government set ups. Interview with Mr.Yellappa Reddy, Noted Environmentalist and Member of Lok Adalat and article by Dr Asima Banu, Dr Riyaz Basha and Dr

Subhash of Bangalore Medical College reveal that effort of Lok Adalat is worth replicating in other States.

'Ecofriendly treatment of biomedical wastes using epigeic earthworms' by M.S. Dinesh, Geetha K.S., Vaishnavi V., Radha D. Kale and V. Krishna Murthy from Department of Biotechnology, PES Institute of Technology, throws open a different avenue for the management of Health Care Waste. Air Marshal Dr LK Verma gives a clarion call to consider to rethink on the whole issue of health care waste management creation of a separate body - 'Waste Management Authority of India' which in order to be effective must be autonomous, and also perform advisory role to the government, and healthcare facilities.

We wish to inform you that you will find a small note by WHO PAHO in this issue. The note was sent by Mr.Alexander Hildebrand who works with WHO PAHO at Equador, now.

An interesting training and capacity building exercise was conducted in collaboration with WHO SEARO for 8 countries of SEARO region by HCWM Cell last year. Report and learnings is planned for next issue.

There is need for more active participation by the readers, members of ISHWM to make this Journal become an indexed Journal as well come out more frequently at least two issues per year. Ideas or funding, increasing more participation from members, Ideas for making the Journal better, is invited.

Food for thought for our readers - should we avoid using the word “waste” as it is actually “resource”. Is there an alternative word for “waste” with a positive connotation? We request the leaders to reflect and help us by writing to us. We wish to reach your reflections to our readers.

I am grateful to all readers, all who provided support for editing and bringing out this issue of the Journal. My immense thanks to ISHWM for the confidence imposed on me and all members of HCWM Cell, Department of Community Medicine, MS Ramaiah Medical College, and Bangalore since ISHWM was founded till date.

Dr S. Pruthvish

Vijayadashami 2010

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ORIGINAL ARTICLE

ECOFRIENDLY TREATMENT OF BIOMEDICAL WASTES USING EPIGEIC EARTHWORMS

M.S. Dinesh[1], Geetha K.S. [2], Vaishnavi V.[3], Radha D. Kale[4] and V. Krishna Murthy[5]

ABSTRACT

Introduction: Biomedical waste (BMW) treatment by incineration and disposal of the resultant ash in landfills is the most widely used process. There is growing interest to adopt alternative technologies.

Objectives: The present study was carried out to evolve an environmental friendly method to treat biodegradable part of biomedical waste collected from local hospital using vermicomposting.

Materials and methods: Biomedical waste was collected after onsite treatment with 5%NaOCl as a safety measure. It was subjected to initial decomposition process by mixing with cow dung slurry in the culture tubs maintained in the vermiculture unit of the laboratory. Initially decomposed BMW was fed to epigeic earthworms in monoculture and polyculture practices to screen suitable vermicomposting method. Natural composting was considered as control. Two cycles of vermicomposting was done using fresh BMW each time. Nutrient levels and storage studies of vermicompost and natural compost were also carried out. Statistical analysis was worked out to find out the most suitable treatment method.

Results and Conclusion: Results revealed that the vermicomposting of BMW was comparatively more efficient than natural composting. The performance efficiencies of earthworms in different treatments were as follows: Eisenia fetida > Mixed culture> Eudrilus eugeniae > Perionyx excavatus. It was also found that repeating the same set of earthworms for successive cycle showed improved rate of vermicomposting. Since the complexity and toxicity levels of BMW produced at different hospitals vary, it is recommended to treat BMW by vermicomposting using a mixed culture of all three epigeic earthworms. It is also essential to gradually expose them to the waste to make them adapt to this toxic material. Vermicomposting with proper handling of BMW can be an energy efficient ecofriendly approach for reducing and recycling of this hazardous waste.

Keywords: Biomedical wastes, Epigeic earthworm species, Vermicomposting, Ecofriendly treatment.

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INTRODUCTION

The progressive increase in the world population is the cause for generation of large volumes of organic wastes. Evolving of suitable methods for disposal of bio-degradable solid wastes from different sources is essential to overcome increasing environmental and economic problems. According to an estimate, India produces about 3000 million tons of wastes annually and nearly 60% of this constitutes decomposable organic waste. With the increase in the need for health care in a rapidly changing society, the role of hospitals/nursing homes have become prominent. The waste generated in these institutions is increasing over the years in its quantum and type [1]. 'Bio-medical waste' or any waste which is generated during the diagnosis, treatment or immunization of human beings or animals, research activities or in the production or testing of biologicals [2,3].

Hospital generated BMW are of two kinds - non-hazardous and bio-hazardous. Examples of non-hazardous waste include non-infected plastic, packaging material, paper etc. Bio hazardous waste consists of (a) Infectious wastes like sharps, non sharps, plastic disposables, liquid waste, etc. and (b) Non infectious wastes like radioactive waste, discarded glass, chemical waste, cytotoxic waste and incinerated waste [4]. Although 75-90% of the BMW is non-hazardous and harmless as any of the other municipal waste, the remaining 10-25% is hazardous to humans or animals and deleterious to environment [5,6]. Inappropriate handling of BMW may have serious public health consequences and a significant impact on the environment. Major hospitals contribute substantially to the quantum of generated BMW. Smaller hospitals, nursing homes, clinics, pathological laboratories and blood banks also have major contribution to BMW.

The common methods adopted for BMW disposal are incineration and land filling. However, these methods are considered more expensive and less ecofriendly due to their negative impact on the environment [7-9]. Hence, alternative technologies are being encouraged for effective and environment friendly BMW treatment. The production of compost using earthworms is called as vermicomposting. This method has been adopted in many instances, for example in the treating paper wastes, agricultural wastes, industrial wastes and domestic wastes but its use in treating BMW has not been explored well [10-13].

OBJECTIVES

The objectives of the present study are as follows:

1. Employing three commonly available epigeic earthworms namely Eisenia fetida, Eudrilus eugeniae and Perionyx excavatus for vermicomposting of biodegradable and infected BMW collected from a local hospital.
2. Carrying out different vermicomposting strategies using these earthworms (single and mixed culture) and to assess the most efficient method for ecofriendly management of BMW.
3. Alongside, comparing efficacy of treating BMW by natural aerobic microbial composting (maintained as control) with vermicomposting.
4. Subjecting earthworms to two cycles of vermicomposting (45 days each) to check whether there is an improvement in efficacy of BMW treatment.

MATERIALS AND METHODS

Three replicates were maintained for each of the treatments. Methodology for one of the replicates has been detailed below. The entire study was carried out for a period of about 6 months.

1. **Collection of bio-medical wastes:** Bio-medical waste (45kg) was collected from K.S. Hospital, BSK 3rd Stage, Bangalore, India and was used as and when required for the experimentation. For each of the cycle of vermicomposting, 20 kg of BMW was utilized and 5 kg of BMW was used as control (natural composting). Only the biodegradable matter of the infected BMW was considered for the experiment.. This included blood stained cotton pieces, pus and body fluids, antiseptics/antibiotics used for dressing of wounds, spilled liquid and tissues collected from operation tables. They were subjected to the preliminary treatment onsite to reduce the probable hazardous effect. Similar procedures were followed in previous literature [14].
2. **Preliminary on-site treatment of BMW:** The BMW used for the experiment was chemically sterilized on-site using 5% of 1N NaOCl as suggested in previous works [15]. This was done to disinfect the BMW before subjecting it to vermicomposting and natural composting.
3. **Primary decomposition of disinfected BMW:** Following the chemical treatment, the disinfected BMW was made palatable or more suitable for the earthworm species to feed [16]. Primary decomposition of BMW was carried out in laboratory for a period of 15 days as follows:

   3.1 Preparation of cow dung slurry: A homogenous mixture of cow dung slurry was prepared at 1:4 (w/v) ratios by mixing 250 g of cow dung with 1 L of distilled water. Five liters of the slurry was prepared and maintained in five separate containers containing 1L slurry in each forf further use.

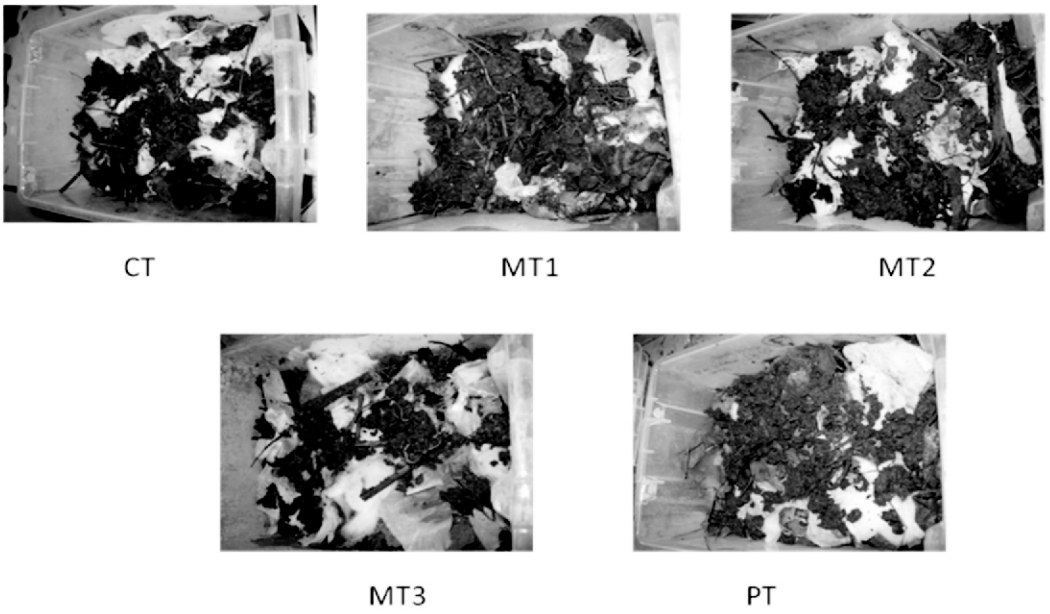
   3.2 Mixing of BMW with cow dung slurry: To each of the five containers with 1L cow dung slurry, 5 kg of BMW was added and mixed (at 5:1, BMW : Cow dung slurry ratio w/v). The mixture was allowed to undergo primary decomposition for a period of 15 days in the laboratory. The same procedure was carried out to prepare the control tank. It was also done to facilitate the consumption of BMW by epigeic earthworms during the process of vermicomposting. The process of preliminarily on-site treatment and primary decomposition was carried out for every fresh batch of BMW used for vermicomposting [17].

4. Tank preparation:

   4.1 Preparation of tanks for vermicomposting and natural composting [18]: Four plastic tanks were maintained to carry out the process of vermicomposting. Each tank used for the experiment measured 1M long, 0.5M broad and 0.5m deep. A tank containing only 5kg primary decomposed BMW but without introduction of any earthworm species was maintained as control and allowed to undergo natural composting for a period of 45 days. The mix used for the study to begin with was measured for pH, moisture content and temperature. The initial measured pH was 6.3, temperature 250 C and 60% moisture.

   4.2 Collection of suitable epigeic earthworms: The epigeic earthworm species namely Eisenia fetida, Eudrilus eugeniae and Perionyx excavatus were used for the study. These species were collected from the Department of Agricultural Microbiology, University of Agriculture, GKVK,Bangalore560065.

   4.3 Release of earthworms into tanks: To each of the four tanks maintained for vermicomposting, 5kg of primarily decomposed BMW (previously prepared and maintained in laboratory) was added. Three tanks were used as monoculture tanks (single species per tank) while one was used as a polyculture tank (all three species in tank). Hundred adult earthworms each of Eisenia fetida, Eudrilus eugeniae and Perionyx excavatus were released into the monoculture tanks respectively. The polyculture tank had 33 adults of each of E. fetida, E. eugeniae and P.excavatus. After the first cycle of vermicomposting, the recovered/survived earthworms (both adult and juveniles) from the respective tanks were used for another cycle of vermicomposting (45 days) using fresh primarily decomposed BMW (Figure 1)



.Figure 1: BMW for Vermicomposting

Note: CT Control Tank; MT1 Monoculture Tank 1 (Eisenia fetida); MT2 Monoculture Tank 2 (Eudrilus eugeniae); MT3 Monoculture Tank 3 (Perionyx excavatus);
PT Polycuture Tank (with all three species).

5. Comparative study of BMW treatment methods used in the present study:

5.1 Earthworm growth: After the completion of each of the two cycles of vermicomposting, average individual weight of earthworms, number of recovered cocoons, adults and juveniles were recorded along with total earthworm biomass. The harvested compost was weighed and the yield from each tank was recorded. Physical and chemical properties of vermicompost and natural compost were also estimated [19-23].

5.2 Storage studies on Harvested Vermicompost and Control: Harvested natural compost/vermicompost from each tank was stored in clean polyethene bags and checked for microbial pathogens namely E.coli, S.aureus, S.typhi, P.aeruginosa, B.cereus, B.subtilus and Klebsiella species. Enumeration of the pathogens in harvested compost and vermicomposts was done for a period of 30 days with an interval of 10 days using standard techniques and growth media [24,25].

6. Statistical Analysis: The results are reported as mean±S.D. The entire study was carried out in triplicates and results have been reported as mean±S.D, n=3. In the graphs only the mean values have been considered for plotting. T - test was performed to understand the significance of the results.

RESULTS AND DISCUSSION

1. Earthworm growth parameters: All the results for the various parameters analyzed followed a similar trend (Table 1). There was an increase in growth of earthworms irrespective of the species (mono, poly). The earthworms on introduction into waste ingest the same as feed and assimilate a part of the same for

their growth and reproduction [26, 27]. Compared to the first cycle, the following cycle showed an increase in all the parameters. This shows that prior adaptation to any given material is essential for them to accept as feed and to continue their life cycle. With respect to performance by individual species, the following order was observed: E.fetida > E. eugeniae > P.excavatus. Performing t-test to analyze the significance of the results proved these interpretations. This indicates that E. fetida can adapt to different organic wastes and has higher levels of tolerance to the toxins [28]. Although this trend was maintained in polyculture tank as well, mixed culture showed comparatively lower values than in monocultures. This could be due to the competition among the three species [29].

Table 1: Growth Parameters of three species of earthworms in BMW treatment

Earthworm Growth Parameters	MT 1	MT 2	MT 3	PT		
	Eisenia fetida	*Eudrilus eugeniae*	*Perionyx excavatus*	*Eisenia fetida*	*Eudrilus eugeniae*	*Perionyx excavatus*
Av. Individual Adult Worm Weight (g)						
Intial (g)	0.7±0.02	3.0±0.01	0.4±0.01	0.7±0.02	3.0±0.01	0.4±0.005
After 1st Vermicomposting Cycle (g)	0.9±0.01	3.1±0.01	0.45±0.025	0.88±0.01	3.15±0.02	0.45±0.01
After 2nd Vermicomposting Cycle (g)	1.5±0.01	3.55±0.02	0.55±0.02	1.45±0.02	3.45±0.01	0.5±0.006
Av. Individual Length (cm)						
Intial (cm)	8.0±0.03	15.0±0.04	4.0±0.02	8.0±0.01	15.0±0.04	4.0±0.01
After 1st Vermicomposting Cycle (cm)	11.5±0.5	18.5±0.03	7.4±0.06	11.4±0.03	18.4±0.02	7.4±0.02
After 2nd Vermicomposting Cycle (cm)	11.7±0.02	18.6±0.02	7.5±0.05	11.6±0.02	18.5±0.03	7.5±0.02
No. of Adult Worms						
Intial	100.0±0.0	100.0±0.0	100.0±0.0	33.0±0.0	33.0±0.0	33.0±0.0
After 1st Vermicomposting Cycle	80.3±1.52	60.0±1.0	19.6±0.57	23.3±0.57	17.3±1.52	4.3±1.52
After 2nd Vermicomposting Cycle	640.3±2.08	300±1.0	47.6±0.57	183.6±1.52	78.0±1.0	6.0±0.0
No. of Cocoons						
Initial	0.0	0.0	0.0	0.0	0.0	0.0
After 1st Vermicomposting Cycle	240.0±1.0	60.6±1.52	40.3±0.57	67.0±2.0	16.6±0.57	5.0±1.0
After 2nd Vermicomposting Cycle	640.6±1.52	240.3±0.57	64.0±2.0	126.6±1.52	56.0±1.0	7.0±0.0
No. of Juviniles						
Initial	0.0	0.0	0.0	0.0	0.0	0.0
After 1st Vermicomposting Cycle	570.3±0.57	240.3±1.52	40.3±0.57	168.0±1.0	64.3±2.08	5.6±0.57
After 2nd Vermicomposting Cycle	1330.0±3.0	600.0±2.0	56.0±1.0	270.3±1.52	112.3±0.57	6.0±1.0
Total Worm Biomass (g)						
Initial (g)	70.0±0.02	300.0±0.01	40.0±0.03	23.0±0.02	99.0±0.01	13.0±0.01
After 1st Vermicomposting Cycle (g)	157.5±0.04	298.0±0.03	13.6±0.02	45.4±0.04	81.71±0.03	2.4±0.02
After 2nd Vermicomposting Cycle (g)	1159.5±0.03	1344±0.05	34.4±0.05	296.7±0.06	322.28±0.05	3.6±0.03

Note:

1. All Values are in mean±S.D, n=3
2. t-test results are as follows:

   (i) $P(MT1) = 0.010$; $P(MT2) = 0.021$; $P(MT3) = 0.032$; $P(PT) = 0.014$

   The above values show the level of significance in the variation of growth parameters after first vermicomposting cycle.

   (ii) $P(MT1) = 0.007$; $P(MT2) = 0.008$; $P(MT3) = 0.009$; $P(PT) = 0.007$

   The above values show the level of significance in the variation of growth parameters after second vermicomposting cycle.

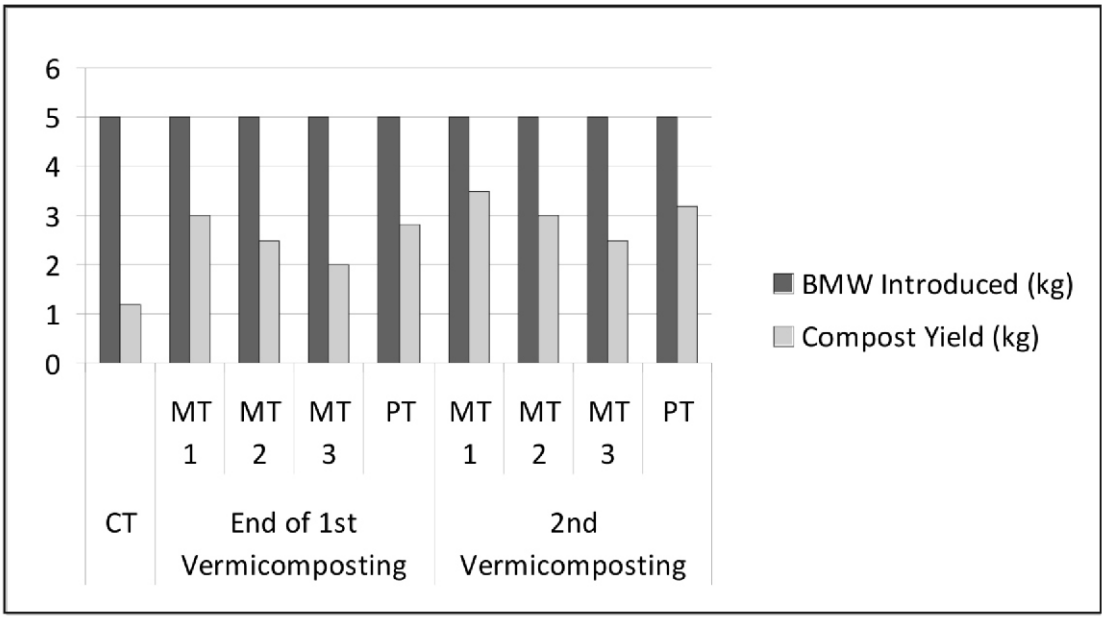
1.1 Average individual weight of adult earthworms: When compared to the initial value, the increase in weight ranged between 0.05-0.2kg and 0.1-0.8kg after the first and second cycle of vermicomposting respectively. Compared to the first vermicomposting cycle, the second cycle showed a better increase of this factor by 0.15-0.6. E. fetida showed highest increase (0.2-0.8kg) followed by E. eugeniae (0.1-0.55) and P. excavatus (0.05-0.1), in monoculture tanks. When these species were considered in a mixed culture, their respective values were lowered by 2%-10% than when used as a monoculture.

1.2 Number of adults, juveniles and cocoons: Subsequent to the first vermicomposting cycle, percent recovery of adults in single culture tanks was as follows E. fetida (80.3%), E. eugeniae (60%) and P. excavatus (19.6%). In the mixed culture tank, percent recoveries of these species were 70.6%, 52.4% and 13.0% respectively. Reduction in number of adult worms of all three species may be due to their inabilities to adapt and feed on the toxic BMW substrate. The difference in the number of survived earthworms among the three species could be related to the species-specific composting behavior or to specific tolerance to the changing microenvironmental conditions in vermicomposting subsystem [29]. Number of juveniles and cocoons before and after the end of first cycle is given in table 1. The recovered earthworms from the first cycle were used to carry out the second cycle of a fresh BMW batch. Since the juveniles of first cycle were produced in the environment of BMW, they were also used for the second cycle along with the survived adults. The percent recoveries of adults, juveniles after the second vermicomposting cycle were as follows E. fetida (797.3%, 233.2%), E. eugeniae (500%, 209.1%) and P. excavatus (242%, 138%). In polyculture tanks these values were (787.9%, 160%), (450.8%, 154.9%) and (139%, 107%) respectively. There was an increase in the adult numbers after the second cycle probably because the adults (survivors of first cycle) were able to withstand the toxic BMW while the considered juveniles (also from first cycle) grew into adults by the end of the 45 day period of the second cycle. Number of cocoons at the end of second cycle is given in table 1. The increase in their number may be attributed to higher rate of reproduction.

1.3 Total Biomass: From table 1 it can be noted that there is a decrease in biomass of E. eugeniae and P. excavatus (single and mixed culture) after the first cycle due to low survival rates of these earthworms upon sudden exposure to complex BMW as feed. E. fetida (single and mixed culture) showed an increase in biomass indicating that it is more capable of surviving and reproducing in a toxic surrounding. Increase/decrease in biomass could be attributed to the combined effect of the amount of readily available nutrients in BMW and the potential of the earthworms to ingest the material [30]. The biomasses of all species increased after the second cycle E. fetida (738%), E. eugeniae (451%) and P. excavatus (252%). In polyculture tanks these values were 652%, 394% and 150% respectively.

2. Compost Yield: Figure 2 shows that both control tank and all the different vermicomposting tanks showed reduction in weight of waste [31]. Weight of compost from control tank is 1.7-2.5 and 2.0-2.9 times lesser than the weight of vermicomposts obtained from the first and second cycles. The weight of vermicompost from each tank (after the second cycle) increased by about 0.5kg. Vermicompost weight decreased by 0.5kg from monoculture tanks of E. fetida to E. eugeniae to P. excavatus while that of the polyculture tank was similar to the single culture tank of E. fetida for both the cycles of vermicomposting [32].

Figure 2: Compost Yields

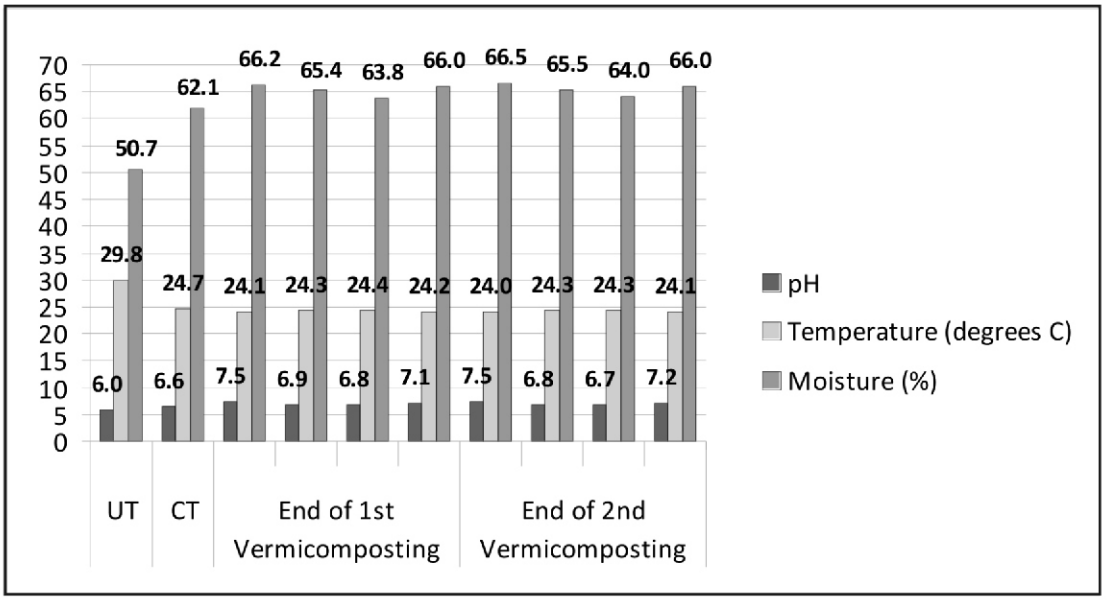


Note: CT Control Tank; MT1 Monoculture Tank 1 (Eisenia fetida); MT2 Monoculture Tank 2 (Eudrilus eugeniae); MT3 Monoculture Tank 3 (Perionyx excavatus); PT Polycuture Tank (with all three species).

3. Analysis of important physico-chemical parameters: All the physical and chemical characteristics follow a similar trend. Characteristics of the vermicomposting tanks are better than the control tank undergoing natural composting; both treatments having better characteristics than the untreated BMW. The results improve after the 2nd cycle of vermicomposting when compared to the 1st cycle. The trend followed (irrespective of the vermicomposting cycle) is: Monoculture tank with Eisenia fetida > Polyculture tank > Monoculture tank with Eudrilus eugeniae > Monoculture tank with Perionyx excavatus.

3.1 pH, Moisture content, and Temperature: The values of these factors for untreated BMW, control tank (at the end of composting period) and the different vermicomposting tank (at the end of vermicomposting period) is shown in Figure 3. At the start of composting and vermicomposting a pH of 6.3, moisture content of 60% and temperature of 25C was recorded. At the end of composting as well as vermicomposting processes, there was raise in pH to neutral and an increase in the moisture content was observed. Fares et al. [33] found the increased pH at the end of the vermicomposting and composting process and they attributed this change to progressive utilization of organic acids and increase in mineral constituents of waste. The moisture content of 6070% was proved having maximal microbial activity, while 50% moisture content was the minimal requirement for rapid rise in microbial activity. Vermicompost samples during the present study showed higher moisture content than the compost and substrate, which may be due to their high absorption capacity, and also because of assimilation rate by microbial population indicating the higher rate of degradation of waste by earthworms [34]. Temperature of the substrate was lowered at the end of composting (by 5.1C) and vermicomposting (by 5.4C-5.8C). This could be because the compost and vermicompost enters the maturation stage thereby causing a cooling effect. It may also be attributable to the regular sprinkling of water [35]. Increase in pH and moisture content and lowering of temperature is highest in the monoculture tank with E. fetida due to the observed higher rate of feed (BMW mix) by this species.

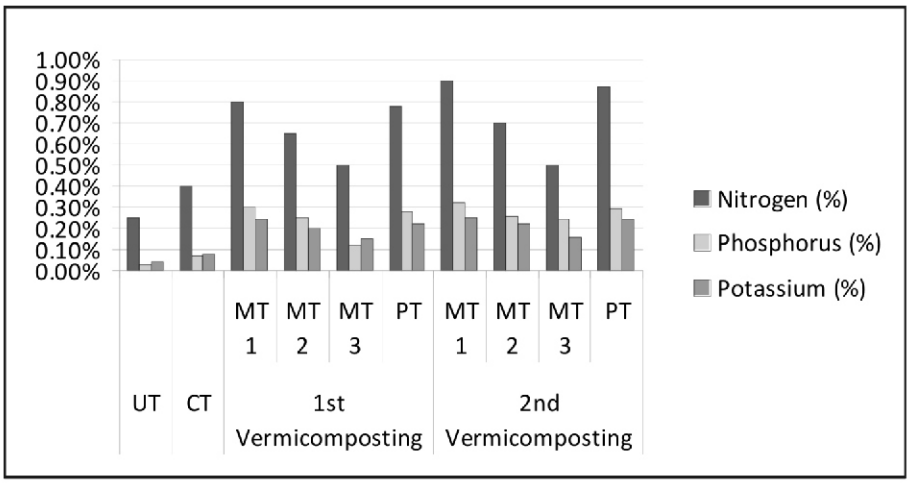
Figure 3: Physical Parameters (pH, Temperature, Moisture Content)



Note: UT Untreated BMW; CT Control Tank; MT1 Monoculture Tank 1 (Eisenia fetida); MT2 Monoculture Tank 2 (Eudrilus eugeniae); MT3 Monoculture Tank 3 (Perionyx excavatus); PT Polycuture Tank (with all three species).

3.2 Nutrients Levels: Total Nitrogen (N), Phosphorus (P), Potassium (K) and Organic Carbon (OC): (Figure 4, 5) Composting and vermicomposting of BMW improves the total N content by 0.15% and 0.65%-0.25% respectively. Monoculture tank of E. fetida showed highest increase of about 0.55%-0.65%. This was followed by the increase seen in polyculture tank (0.53%-0.62%). In all the tanks, second cycle of vermicomposting improved the amount of N by 0.05-0.1%. The increasing trend of N in the vermicomposts produced by the earthworm species in the present study can be corroborated with the ?ndings of earlier reports [36].

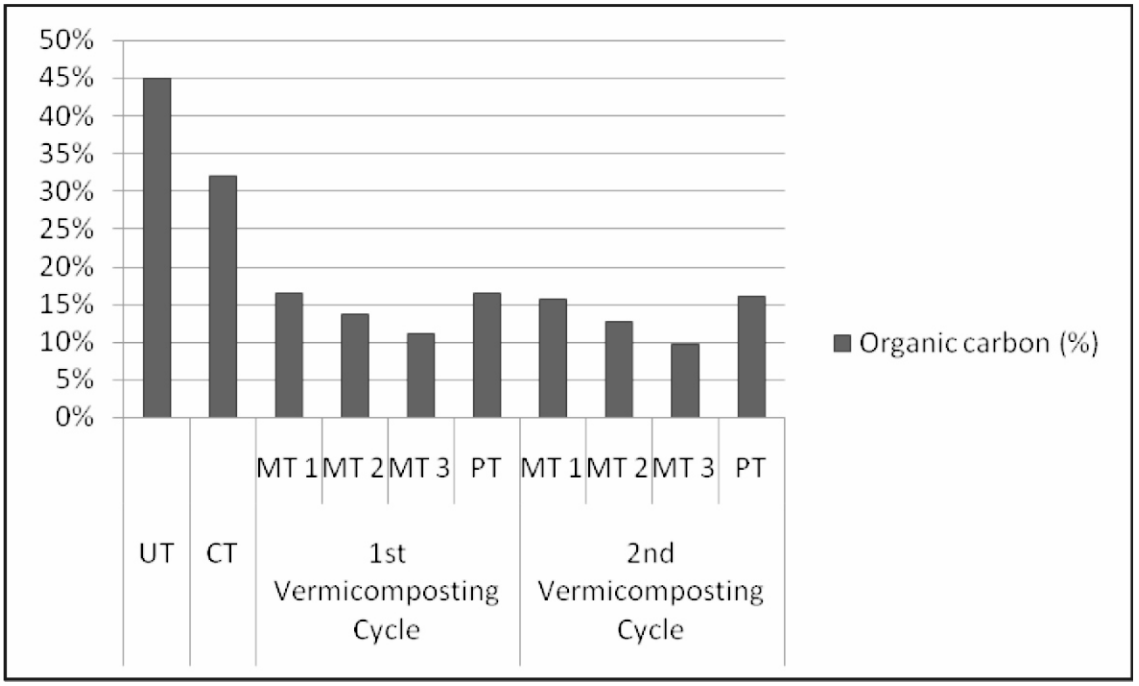
Figure 4: Amounts of N, P and K



Note: UT Untreated BMW; CT Control Tank; MT1 Monoculture Tank 1 (Eisenia fetida); MT2 Monoculture Tank 2 (Eudrilus eugeniae); MT3 Monoculture Tank 3 (Perionyx excavatus);

PT Polycuture Tank (with all three species).

Figure 5: Amount of OC



Note: UT Untreated BMW; CT Control Tank; MT1 Monoculture Tank 1 (Eisenia fetida); MT2 Monoculture Tank 2 (Eudrilus eugeniae); MT3 Monoculture Tank 3 (Perionyx excavatus);

PT Polyculture Tank (with all three species).

In the control and the experimental tanks percentage of P improved by 0.04% and 0.25-0.29% respectively was noticed. The single culture tank of E. fetida and the mixed culture tank showed a maximum increase of 0.27%-0.29% and 0.25%-0.26% respectively for available P. Difference in percentage P between the two cycles of vermicomposting was about 0.01%-0.12%. Results comply with previous studies wherein casts showed higher P levels than the substrate [17,37]. The enhanced P level in vermicompost suggests phosphorous mineralization during the process. The earthworms during vermicomposting convert the insoluble P into soluble forms with the help of P-solubilizing microorganisms through phosphatases present in the gut, making it more available to plants [28].

Trend in percentage K was similar to the other two nutrients. Composting increased the value of percentage K by 0.04% while the vermicomposting showed an increase of 0.11%-0.21%. Following the second cycle of vermicomposting, the value increased by 0.01%-0.02%. The polyculture tank produced values lesser (by 0.01%-0.02%) than the values by the most efficient single culture tank of E. fetida (increase in %K=0.20%-0.21%). Vermicomposting proved to be an e?cient process for recovering higher K from organic waste [12,37]. The present ?ndings corroborated to those of Kaviraj and Sharma [38], who demonstrated higher K concentration in the vermicompost prepared from municipal solid wastes.

Figure 5 shows levels of OC. After composting as well as vermicomposting the values of organic carbon reduced compared to the untreated substrate. This result is consistent with the findings of Tognetti

et al. [39], Garg and Kaushik [17]. Reduction in OC during vermicomposting was higher than during composting by a value of 15.4%-20.9%. It is to be noted that unlike the trend for other nutrients, the trend followed by vermicomposting tanks for amount of reduction of OC is: Monoculture tank with Perionyx excavatus (33.9%-35.3%) > Monoculture tank with Eudrilus eugeniae (31.3%-32.2%) > Monoculture tank with Eisenia fetida (28.5%-29.2%) > Polyculture tank (28.4%-28.9%). The organic carbon is lost as carbon dioxide through microbial respiration and mineralization of organic matter indirectly causing increase in total N [40]. The reduction of OC was higher in vermicomposting compared to the ordinary composting process, which may be due to the fact that earthworms have higher assimilating capacity. The di?erence between the carbon losses of the vermicompost processed by the epigeic species could be due to the species-speci?c di?erences in their mineralization e?ciency of OC.

4. Storage studies on harvested compost and vermicomposts: BMW used for the study was of infectious category of hospital wastes. Hence, it showed uncountable levels of common human pathogens like E.coli, S.aureus, S.typhi, P.aeruginosa, B.cereus, B.subtilus and Klebsiella species. When the waste was subjected to composting and vermicomposting, the harvested compost from the control tank and all the experimental tanks (single and mixed culture tanks for both vermicomposting cycles) showed a tremendous reduction in the pathogen numbers (Table 2). Only a few studies by other workers have shown that the suppression of pathogens by vermicompost or disease suppression in the presence of earthworms. Disease suppression by compost has been attributed to the activities of competitive or antagonistic microorganisms as well as the antibiotic compounds present in the vermicompost.

Table 2: Storage Studies on Harvested Composts and Vermicomposts

Pathogens	Organism Count in CFU/g x 10^2 - DAY 1								
	CT	1st Cycle of Vermicomposting				2nd Cycle of Vermicomposting			
		PT	MT1	MT2	MT3	PT	MT1	MT2	MT3
E.coli	8.0±1.0	4.6±1.52	4.6±0.57	5.3±0.57	5.6±1.52	3.6±0.57	3.6±0.57	4.6±0.57	4.6±1.52
S.aureus	10.6±0.5	3.6±0.57	3.3±0.57	4.0±0.0	5.3±0.57	2.6±0.57	2.3±0.57	3.0±0.0	4.3±0.57
S.typhi	9.6±1.52	4.3±0.57	3.6±1.52	4.0±0.0	4.0±1.0	3.3±1.52	2.6±1.52	3.0±0.0	3.6±0.57
P.aeruginosa	8.3±0.57	3.6±0.57	2.3±0.57	4.0±0.57	4.3±1.52	2.6±0.57	1.3±0.57	3.6±1.52	2.3±1.52
B.cereus	9.0±1.0	2.0±1.0	2.0±1.0	2.6±0.57	2.0±1.0	1.6±0.57	1.3±0.57	1.6±0.57	2.0±1.0
B.subtilus	6.6±0.57	2.0±0.0	2.0±0.0	2.0±0.0	3.0±0.0	2.0±1.0	1.0±0.0	1.0±0.0	3.0±0.0
Kblebsiella sp.	9.3±1.52	1.3±0.57	1.0±0.0	2.3±0.57	2.6±0.57	1.0±0.0	1.0±0.0	1.3±0.57	1.6±0.57

Pathogens	Organism Count in CFU/g x 10^2 - DAY 10								
	CT	1st Cycle of Vermicomposting				2nd Cycle of Vermicomposting			
		PT	MT1	MT2	MT3	PT	MT1	MT2	MT3
E.coli	8.0±1.0	4.3±1.52	3.6±1.52	5.3±0.57	5.3±1.52	3.3±0.57	3.6±1.52	4.3±0.57	4.3±1.52
S.aureus	9.3±0.57	3.3±0.57	3.0±0.0	4.0±0.0	4.0±0.0	2.3±0.57	2.0±0.0	3.0±0.0	4.0±0.0
S.typhi	8.3±1.52	4.3±0.57	3.3±1.52	4.0±0.0	4.0±1.0	3.0±0.0	2.3±1.52	3.0±0.0	3.6±1.52
P.aeruginosa	8.0±0.0	3.3±0.57	1.6±0.57	3.6±0.57	4.6±0.57	2.3±0.57	1.3±1.52	3.6±0.57	4.6±0.57
B.cereus	8.6±0.57	1.0±0.0	2.0±1.0	1.6±0.57	2.0±0.0	1.3±0.57	1.3±1.52	1.6±0.57	2.0±0.0
B.subtilus	6.3±1.52	2.0±0.0	2.0±0.0	2.0±0.0	3.0±0.0	2.0±1.0	1.0±0.0	1.0±0.0	3.0±0.0
Kblebsiella sp.	7.6±1.52	1.0±0.0	1.0±0.0	1.0±0.0	2.3±0.57	1.0±0.0	1.0±0.0	1.0±0.0	1.3±0.57

Pathogens	Organism Count in CFU/g x 10^2 - DAY 20								
	CT	1st Cycle of Vermicomposting				2nd Cycle of Vermicomposting			
		PT	MT1	MT2	MT3	PT	MT1	MT2	MT3
E.coli	7.6±0.57	4.3±1.52	3.3±0.57	5.0±1.0	5.0±1.0	3.3±1.52	3.3±1.52	4.3±1.52	4.3±1.52
S.aureus	8.6±1.52	3.3±1.52	3.3±1.52	4.0±0.0	4.0±0.0	2.0±1.0	2.0±0.0	3.0±0.0	4.0±0.0
S.typhi	8.3±0.57	4.3±1.52	2.0±0.0	4.0±1.0	4.6±0.57	3.0±1.0	2.0±0.0	3.0±0.0	3.3±1.52
P.aeruginosa	7.0±0.0	3.3±1.52	1.3±0.57	3.3+0.57	4±0.0	2.0±0.0	1.3±1.52	3.3±0.57	4.3±0.57
B.cereus	8.0±1.0	1.0±0.0	2.0±1.0	1.0±0.0	1.0±0.0	1.3±1.52	1.3±1.52	1.3±0.57	2.0±0.0
B.subtilus	6.0±1.0	2.0±0.0	2.0±0.0	2.0±0.0	3.6±0.57	2.0±1.0	1.0±0.1	1.0±0.0	3.0±0.0
Kblebsiella sp.	6.0±0.0	1.0±0.0	1.0±0.0	1.0±0.0	2.0±0.0	1.0±0.0	1.0±0.0	1.0±0.0	1.3±0.57

Pathogens	Organism Count in CFU/g x 10^2 - DAY 30								
	CT	1st Cycle of Vermicomposting				2nd Cycle of Vermicomposting			
		PT	MT1	MT2	MT3	PT	MT1	MT2	MT3
E.coli	7.3±0.57	4.0±1.0	3.6±1.52	4.0±0.0	4.6±0.57	3.3±1.52	3.3±1.52	4.3±1.52	4.3±1.52
S.aureus	8.3±0.57	3.0±0.0	2.6±0.57	4.0±0.0	4.0±0.0	2.0±0.0	2.0±0.0	3.0±0.0	4.0±0.0
S.typhi	6.6±1.52	4.0±1.0	1.6±0.57	3.6±0.57	4.3±0.57	3.0±0.0	2.0±0.0	3.0±0.0	3.3±1.52
P.aeruginosa	7.0±0.0	3.0±1.0	1.6±1.52	3.3±0.57	4.0±0.0	2.0±0.0	1.3±1.52	3.3±0.57	4.3±0.57
B.cereus	7.0±1.0	1.0±0.0	2.0±1.0	1.0±0.0	1.0±0.0	1.3±1.52	1.3±1.52	1.3±0.57	2.0±0.0
B.subtilus	5.0±0.0	2.0±0.0	2.0±0.0	2.0±0.0	3.3±0.57	2.0±1.0	1.0±0.1	1.0±0.0	3.0±0.0
Kblebsiella sp.	6.0±0.0	1.0±0.0	1.0±0.0	1.0±0.0	2.0±0.0	1.0±0.0	1.0±0.0	1.0±0.0	1.3±0.57

All Values are in mean±S.D, n=3

t-test values are as follows: P(E.coli) = 0.03 ; P(S.auerus) = 0.01 ; P(S.typhi) = 0.02 ; P(P.aeruginosa) = 0.02 ; P(B.cereus) = 0.008 ; P(B.subtilus) = 0.04 ; P(Kbelbsiella sp.) = 0.007

Note: CT Control Tank; MT1 Monoculture Tank 1 (Eisenia fetida); MT2 Monoculture Tank 2 (Eudrilus eugeniae); MT3 Monoculture Tank 3 (Perionyx excavatus); PT Polycuture Tank (with all three species).

Earthworms not only create aerobic environment in the waste that inhibits action of anaerobic pathogens but also release coelomic fluid into the casts which show antibacterial activities. Upon storage of these casts in polyethene bags, there was no increase in the microbial levels, thereby indicating that the casts inhibited the proliferation of microorganisms. Vermicomposting, especially of the second cycle, reduced the pathogen levels more than normal composting. Among the different vermicomposting treatments in pathogen reduction: Monoculture tank with E. fetida > Polyculture tank > Monoculture tank with E.eugeniae > Monoculture tank with P. excavatus. Values of t-test test proved the above observations. These studies comply with the findings of Mathur et al. [41].

CONCLUSION

The present study reveals that vermicomposting is a efficient and ecofriendly technique for management of biomedical wastes, in comparison to normal composting. A study carried out using different species of earthworms independently and as mixed culture for vermicomposting of BMW showed that E. fetida is more efficient than the other two epigeic earthworm species E. eugeniae and P. excavatus. A mixed culture of all the three species was as efficient as that of E. fetida. It is advisable to maintain a polyculture of earthworms to treat BMW since all three species work in unison to decompose the waste and even if one of the species fails to survive in the toxic and complex BMW environment, the surviving species would be able to carry out the process efficiently.

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ORIGINAL ARTICLE

A STUDY ON HOSPITAL WASTE MANAGEMENT AT A RURAL HOSPITAL IN MAHARASHTRA

ABSTRACT

Introduction: Improper management of biomedical waste has serious implications for public health and the general environment. The present study was carried at Pravara Rural Hospital (PRH) attached to Pravara Institute of Medical Sciences, Maharashtra to study existing system of hospital waste management, characterization of waste and to measure the amount of waste produced. Methods: A questionnaire developed by Central Pollution Control board, Ministry of Environment and Forests, India was used for collection of data. Training was given to health workers. Observations were made regarding the prevailing systems of hospital waste collection, segregation, transportation and disposal at PRH. Collection and weighing of wastes was carried out with the help of a standardized weighing machine daily morning for three consecutive days. Results: It was found that there was no segregation of the waste starting from generation to disposal; there was no separate committee for the management of the hospital waste and most of the waste was incinerated. Total infectious waste produced by PRH was 231gm/pt/day and the non-infectious waste was 280gm/pt/day. Also, PRH produced around 511.18gm/pt./day of waste on average.

Key Words: Hospital waste management; biomedical waste; segregation of waste; waste disposal; infectious waste

INTRODUCTION

Biomedical waste generated primarily from health care establishments is a relatively recent issue and it has become a matter of great concern as its improper management could have serious implications for public health and the general environment. The proper management of biomedical waste is still in its infancy all over the world. There is a lot of confusion among generators, operators, decision-makers and the general community about the safe management of bio-medical waste. Hospital waste management in India has become an intractable problem1. Since the late 1980's increased attention has been focused on medical waste, its handling and safe disposal. Various public and environmental health regulations have been enacted at National and State levels such as Ministry of Environment and Forests, biomedical waste management and handling rules2.

Although, quality control in health care has become essential, quality assurance in hospital waste management is also important because both are complimentary to each other in achieving "health for all". But it is possible that the realization may not be so universal as regards hospital waste management.

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The present study which was carried at the 750 bedded Pravara Rural Hospital (PRH) a tertiary care hospital attached to the Pravara Institute of Medical Sciences, Loni, Maharashtra, is an attempt to explore the level of hospital waste management in quantity and quality keeping in view of the Biomedical waste (Management and handling) rules, 1998 (second amendment 2000). The objectives were 1) To study existing system for collection, segregation, storage, transportation and disposal of hospital waste at PRH, 2) To characterize the Hospital waste as per Bio Medical waste (Management and Handling) Rules 1998, 3) To measure the amount of Hospital waste (Infectious /Non-infectious) generated per patient per day.

MATERIALS AND METHODS

To conduct the study on hospital waste management at PRH a prior permission was sought from the Medical Superintendent of the hospital. The study was conducted with the help of medical (M.B.B.S.) students in their final year. Ten such students were selected who were informed about aims and objectives of the study and were given necessary instructions. The questionnaire developed by Central pollution Control board, Ministry of Environment and Forests, India was used for collection of data. Before collection of data regarding hospital waste categories and quantity; observations were made regarding the prevailing systems of hospital waste collection, segregation, transportation and disposal at PRH. Subsequently, in order to collect data on biomedical waste categories and their segregation in accordance with the “Bio-Medical waste (Management and Handling) rules, 1998 (amended in 2000)”2; a prior information and training session of health workers (e.g. doctors, paramedical, nursing staff, attendants, sweepers, ward boys, etc.) was conducted.

The waste from yellow, blue and red containers was considered as infectious and a separate container for general noninfectious wastes such as coverings of disposables, packing material, paper, etc. was used in each department under study. A preliminary survey was conducted to decide upon the inclusion criteria for various departments and feasibility of the study. Departments which produced less than half a kg of waste per day were excluded from the study. The waste collected in black container i.e. genotoxic, chemical, pharmaceutical waste etc. was not considered under the study. Pamphlets displaying information regarding waste handling and management were exhibited in each department included in the study. Collection and weighing of wastes was carried out with the help of a standardized weighing machine daily morning at 7.00am, for three consecutive days. Health workers were supervised every day as per a predetermined schedule thrice a day; for segregation and handling of wastes as desired. Procurement of implements/equipments for the study was done from the hospital e.g. buckets, coloured containers as per waste segregation guidelines, gloves, weighing machine, disinfectant solution etc. The departments included in the study were Outpatient departments of Surgery, Orthopedics, Gynecology and Obstetrics & Central clinical Laboratory (CCL) and; wards of medicine (male & female), surgery (male & female), Maternity, Paediatrics, Orthopedics; Intensive care unit; Casualty and Major Operation theatres. Suggestions based on the study were passed on to the management of the hospital for the implementation of proper practices of waste management in the hospital.

RESULTS

I: Observations regarding the prevailing methods of collection, transportation and disposal of hospital wastes

Collection of hospital waste

The method of collection was more or less similar in wards, out patient departments, operation theatres, central clinical laboratory, casualty and intensive care unit. Each ward was divided into 8-10 cubicles having 4-8 beds in each cubical. In every cubical a small bucket or a cardboard box was kept as a dustbin. All the waste, such as used needles, syringes, swabs, I.V. sets, broken vials were put in the same basket. Each ward was provided with a bigger dustbin of capacity 50L and smaller dustbins were emptied into it. The same process was followed in other departments also but it was a little bit different in central clinical laboratory. In CCL the infected needles and syringes were kept separately in a container with 1% sodium hypochlorite solution. General waste was kept separate. In the morning, the general waste, syringes and needles were put in large buckets. The blood, urine, and stool samples were drained into basins after use without proper disinfection. Every morning between 8-9 a.m. all of these large buckets were carried by the sweepers to bullock cart standing outside behind the hospital. A majority of the sweepers did not use any personal protective measure.

Transportation

The means of transport of the waste was by bullock cart. The waste from all departments was dumped into a single bullock cart. It had no covering on the sides as well as on the top. So by the time, it reached the site of incineration a part of the waste had already spilled over. Saline bottles from all these wastes were separated out near the cart for auction.

Disposal

Disposal of waste was by incineration. When the bullock cart reached the site of incineration the waste from the cart was emptied on the ground. Then the operator transferred the waste into incinerator. Combustion went on from 10 a.m. to 1 p.m. everyday. No attempt was made to evaluate whether the incineration was complete or not. The smoke outlet did not have filter and had no appropriate height. Ash from the incinerator was thrown on the area nearby.

Cobalt used at the hospital's oncology department after use being a radioactive waste was sent back in appropriate recommended containers to Bhabha Atomic Research Centre, Mumbai for its final disposal.

General Observations

1. There was no separate committee for the management of the hospital waste.
2. No segregation of the waste starting from generation to disposal.
3. Lack of awareness among the sweepers and bullock cart driver about personal protection.
4. Bullock cart was not covered from the top as well as sides, so spillage occurred.
5. Majority of the waste was subjected to incineration. The ash from the incinerator was thrown in the area nearby.

II. Observations regarding characterization of hospital waste after segregation.

Table no. 1 depicts that average waste collected in hospital wards/OT in all yellow, red and blue container was 205.82 gm/pt./day, 96.36 gm/pt./day and 14.64 gm/pt./day respectively. Major OT produced highest amount i.e. 4041.35 gm of waste/pt/day followed by ICU and maternity wards. The maternity ward was found to be the bulk producer of waste per day out of all hospital wards i.e. 38.6 kg per day. As far as the waste from individual containers was concerned for yellow container, ICU produced the highest waste/pt/day i.e. 953.33gm/pt/day; for red container Major OT and for blue container ICU produced the highest.

Table-1: WASTE COLLECTED IN VARIOUS CONTAINERS FROM HOSPITAL WARDS/OT

Container	Yellow		Red		Blue		TOTAL
Wards/OT (no. of pts.)	waste (gm)	Waste/ patient /day	waste (gm)	Waste/ patient /day	waste (gm)	Waste/patient/day (gm)	Waste/ patient/ day (gm)
ICU (15)	14300	953.33	9400	626.66	2900	193.33	1733.33
MAJOR O.T. (28)	22500	803.57	90008	3214.57	650	23.21	4041.35
SURGERY (112)	12600	112.5	15700	140.17	115	1.02	253.73
MEDICINE (83)	1100	13.25	3300	39.75	1300	15.66	68.67
MATERNITY (64)	34000	531.25	4000	62.50	600	9.37	603.12
CASUALTY (29)	5700	196.55	2500	86.20	330	11.37	294.13
ORTHOPAEDICS (56)	8400	150	1000	17.85	1000	17.85	185.71
PAEDIATRICS (94)	94	400	4.25	1450	15.42	150	1.5921.28
TOTAL (481)	99000	205.82	46350	96.36	7045	14.64	316.82

Table -2 shows that average waste collected in hospital OPDs in all yellow, red and blue containers was 53.02 gm/pt./day, 17.03 gm/pt./day and 9.92 gm/pt./day respectively. CCL produced highest amount i.e. 484.63 gm of waste/pt/day followed by Orthopedics and Surgery OPDs. The surgery OPD was found to be the bulk producer of waste per day out of all OPDs i.e. 7.8 kg per day. As far as the waste from individual containers was concerned for yellow and red containers, Orthopedics OPD produced the highest waste/pt/day i.e. 132.26 gm/pt/day and 40.32 gm/pt/day respectively and for blue container Surgery OPD produced the highest.

Table-2: WASTE COLLECTED IN VARIOUS CONTAINERS FROM HOSPITAL OPDs.

Container	Yellow		Red		Blue		TOTAL
OPDs (no. of pts.)	Total waste (gm)	Waste/ patient/ day (gm)	Total waste (gm)	Waste/ patient/ day (gm)	Total waste (gm)	Waste/ patient/ day (gm)	Waste/ patient/ day (gm)
ORTHOPAEDICS (31)	4100	132.26	1250	40.32	160	5.16	**177.74**
SURGERY (77)	4200	54.55	1400	18.18	2300	29.87	**102.59**
OBSTETRICS & GYNAECOLOGY (65)	1900	29.23	1500	23.08	180	2.82	**55.07**
CCL (100)	4276.3	42.76	500	5.00	70	0.7	**484.63**
TOTAL (273)	**14476.3**	**53.02**	**4650**	**17.03**	**2710**	**9.92**	**79.98**

It can be seen from Table -3 and Fig. 1, that wards/OTs produced the infectious and noninfectious wastes in a varied combination. i.e. Surgery and Medicine wards produced highest amount of waste per day most of which was non infectious; on the contrary, waste produced by Major OTs was mostly infectious. Table -3 also depicts that ICU was the major producer of total hospital waste per patient per day and non-infectious waste per patient per day as well. Fig. 2 shows the average waste per patient per day collected from wards and OTs. It was highest for ICU and lowest for the Pediatrics ward. Fig.3 show the proportion of infectious waste to the non-infectious waste from ward/OTs. Bulk i.e. 57% of the total waste from wards plus OTs was non-infectious.

Table-3: TOTAL INFECTIOUS & NON-INFECTIOUS WASTE FROM HOSPITAL WARDS/OTs

WASTE (TYPE)	INFECTIOUS WASTE		NON-INFECTIOUS WASTE		TOTAL WASTE	
Wards/OT (no. of pts.)	Infectious wastes (gm)	Waste/ patient/ day (gm)	Non-infectious wastes (gm)	Waste/ patient/ day (gm)	Grand Total Waste (gm)	Total Waste/ patient/ day (gm
ICU (15)	26600	1733.33	23700	1580	50300	3353.33
MAJOR O.T. (28)	32150	4041.35	11200	400	43350	1548.21
SURGERY (112)	28415	253.73	77000	687.5	105415	941.20
MEDICINE (83)	5700	68.67	57800	696.38	63500	765.06
MATERNITY (64)	38600	603.12	7500	117.18	46100	720.31
CASUALTY (29)	8530	294.13	7000	241.37	15530	535.51
ORTHOPAEDICS (56)	10400	185.71	11200	200	21600	385.71
PAEDIATRICS (94)	2000	21.28	11300	120.21	13300	141.48
TOTAL (481)	**152395**	**316.82**	**206700**	**429.72**	**359095**	**746.55**

Fig.-1: Infectious and non-infectious waste in hospital wards/OTs

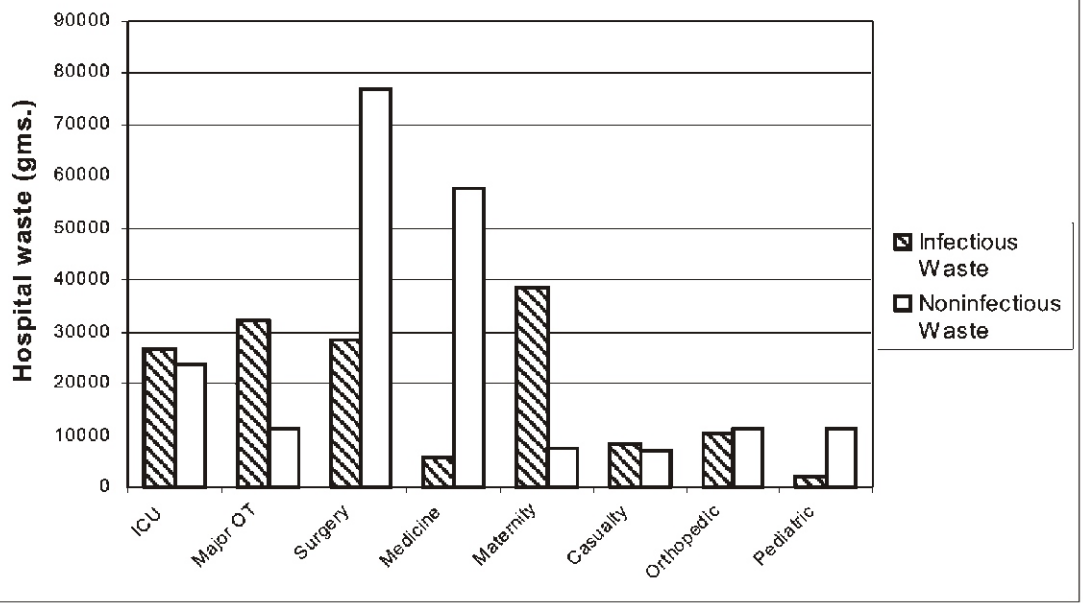
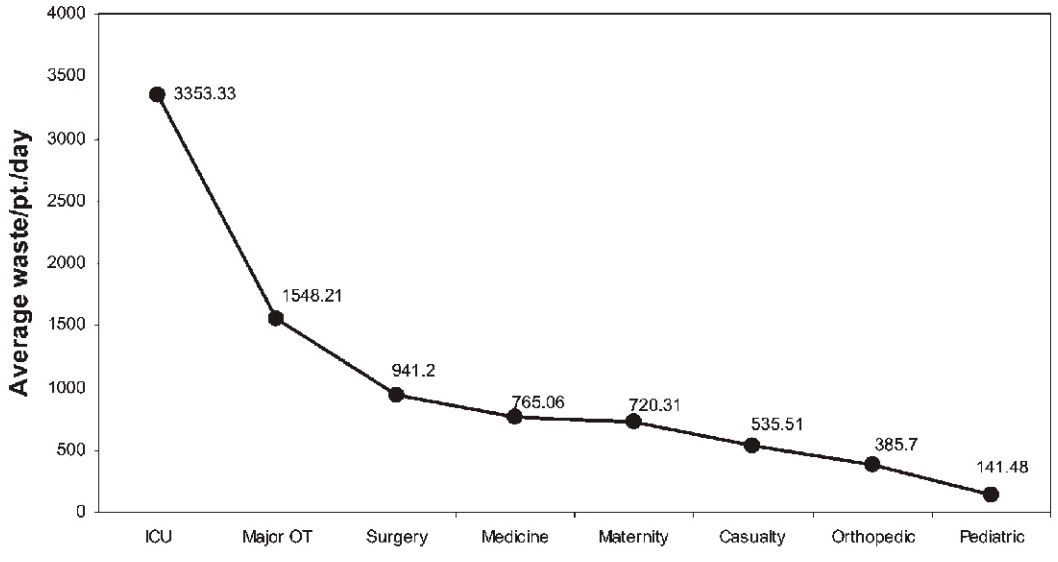
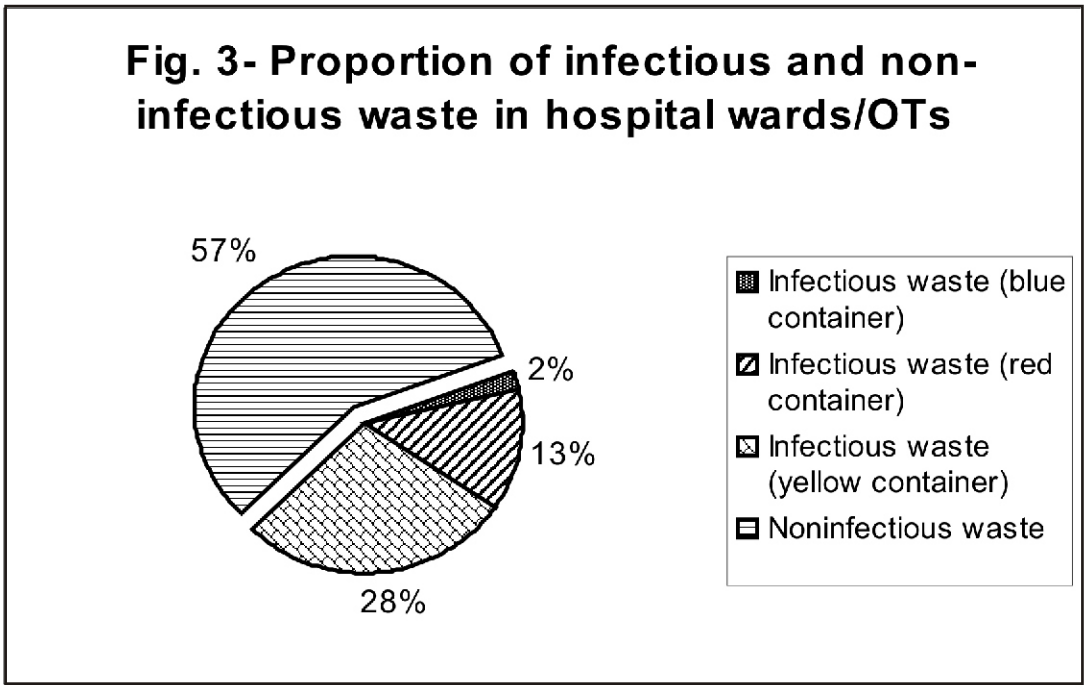


Fig. 2- Average waste collected per patient per day in hospital wards/OTs.



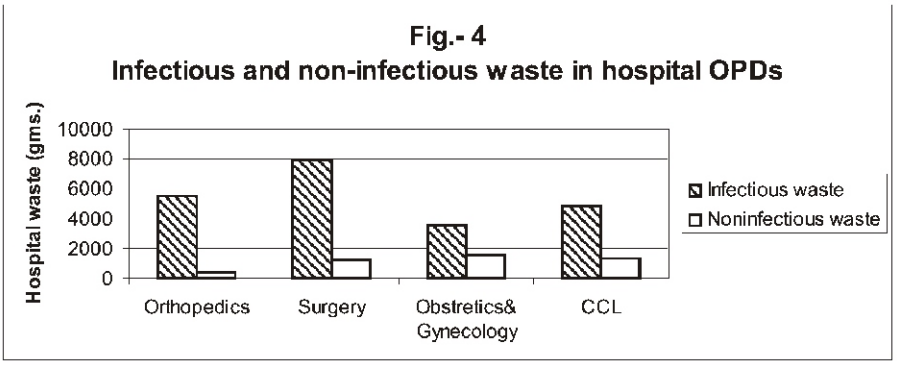


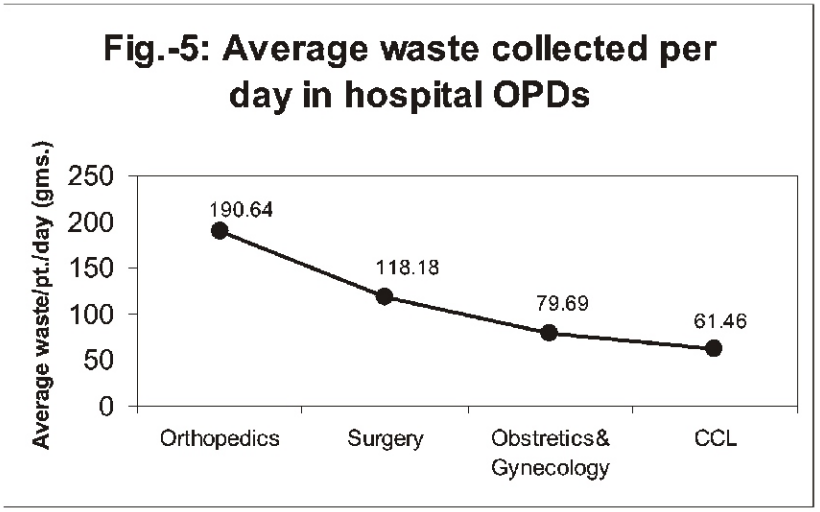
It is well seen from Table-4 and Fig.-4 that, surgery OPD produced highest amount of infectious waste while obstetrics and gynecology OPD produced highest amount of noninfectious waste. As far as waste produced per patient per day was concerned the Orthopedics OPD followed by Surgery OPD produced highest amount of infectious waste and total waste. Where as Obstetrics and Gynecology OPD produced highest noninfectious waste per patient per day. Fig. 5 shows the average waste per patient per day collected from OPDs. It was highest for Orthopedics OPD and lowest for the CCL.

Table-4: TOTAL INFECTIOUS & NON-INFECTIOUS WASTE FROM HOSPITAL OPDs

WASTE (TYPE)	INFECTIOUS WASTE		NON-INFECTIOUS WASTE		TOTAL WASTE	
OPDs (no. of pts.)	Infectious waste (gm)	Waste/ patient/ day (gm)	Non-infectious waste (gm)	Waste/ patient/ day (gm)	Grand Total waste (gm)	Total Waste/ patient/ day (gm)
ORTHOPAEDICS (31)	5510	177.74	400	12.90	5910	190.64
SURGERY (77)	7900	102.59	1200	15.58	9100	118.18
OBSTETRICS & GYNAECOLOGY (65)	3580	55.07	1600	24.61	5180	79.69
CCL (100)	4846	48.46	1300	13	6146	61.46
TOTAL Patients (273)	**21836**	**79.98**	**4500**	**16.48**	**26336**	**96.46**

Fig.- 4
Infectious and non-infectious waste in hospital OPDs





It can be seen that, highest proportion of waste produced by OPDs was infectious i.e. around 83% as compared to the 17% of non-infectious waste. Table -5 shows that average waste produced per patient per day in Pravara Rural Hospital wards and OTs under study was 746.55 gm/pt./day and that in OPDs was 96.46gm/pt./day. Total infectious waste produced by PRH was 231gm/pt/day and the non-infectious waste was 280gm/pt/day. Also, the departments under study at PRH produced around 511.18gm/pt./day of waste on average.

Table-5: COMPARISON BETWEEN TOTAL WASTES OF WARDS/OTs & OPDs

	WARDS/OTs	OPDs	Total
TOTAL INFECTIOUS WASTE (gm/day)	152395	21836	174231 (231gm/pt/day)
TOTAL NON-INFECTIOUS WASTE (gm/day)	206700	4500	211200 (280gm/pt./day)
GRAND TOTAL (gm/day)	359095	26336	385431
TOTAL NO. OF PATIENTS	481	273	754
WASTE/PATIENT/DAY (gm/day)	**746.55**	**96.46**	**511.18**

DISCUSSION

The overriding aim of hospital waste management regulations is to protect innocent people from exposure to infectious diseases or direct injury. However the tendency among the waste generators i.e. hospitals to take a blanket approach to these policies has resulted in creation of many problems. Hospitals are themselves showing inertia in dealing with the problem. The wastes are therefore currently not segregated but discharged in a mixed condition to the site of disposal, separating only the saline bottles, which are sent for auctioning. The present study at Pravara Rural Hospital depicted the same scenario at the start of the study. Similar are the findings of other studies reported by Sharma V (1993)3, Patil AD (2001)1, Basu N (1996)4, Jain AB (1998)5, Gupta S (2006)6 and Khajuria A (2007)7. As per national standards no single disposal technology can take care of all types of medical waste. Incineration alone does not solve the problem. It is just an overkill technology whose aim is sterilization and not disinfection.

At Pravara Rural Hospital the generation of waste from departments under study was found to be 511gm/pt./day. Similar are the findings in other studies by Patil AD (2001)1, Basu N (1996)4 and Pruthvish S. et al (1996)8. Even higher figures of waste generation has been quoted from a study from hospitals in Mumbai to be 1130gm/pt./day.9

Field experience suggests that inclusion of Health Care Waste Management planning within the health care institutions is the first step towards encouraging the development of better hygienic practices and optimizing the operations of existing waste disposal system.10 As documented by Almuneef M (2003)11 in a study at King Fahad National Guard Hospital, Riyadh, Saudi Arabia presence of hospital waste management plan and written policy improves the cost effectiveness and efficient use of resources. The cost of waste disposal was reduced at least by 50% after implementation of such a policy at the hospital. The present study showed lack of hospital waste management committee or a documented waste management and disposal policy at the PRH. No techniques of segregation and proper transportation of the waste were observed. Similar are the findings of Sharma V (1993)3 in a study at a 500 bedded multidisciplinary hospital attached to a Medical college located in a rural area and Patil AD (2001)1.

Even if the segregation of waste at the point of generation is effective, but, if the waste handlers are mixing it together as they collect it, then the ultimate value of segregation is lost. Hence segregation should be followed in the collection also. In addition to this, worker's safety is of utmost importance in waste management strategy. Hence it is necessary that a training programme should be in place which will be ensuring use of proper hospital waste disposal techniques by the health personnel. Absence of such mechanism is evident from the present study at PRH and similar are the findings of Patil AD (2001)1 and Kishore J et al (2000)12, Waseem Q (2007)13.

RECOMMENDATIONS

Segregating the waste from collection to disposal, according to defined scientific principles & effective management necessarily starts from the level of doctors and nurses. Segregation of waste can be done at PRH in different coloured containers in accordance with Schedule-II of Bio Medical waste (Management and Handling) rules, 1998 (amended in 2000) notified by Ministry of Environment And Forests, Government of India. If the benefits of segregation are to be realized, then there must be a separate transportation and disposal of categorized waste with appropriate method. Colour code for a vehicle carrying infectious waste and properly labeled closed containers to identify infectious and noninfectious waste should be observed. The routing of waste should be considered, so as to minimize the risk of exposure; and the vehicle should not be over burdened with the waste. It is recommended that various

hospital waste disposal procedures/techniques should be in operation at PRH after proper segregation; which will reduce the cost of disposal and will avoid air pollution; as most of the waste was being incinerated at PRH. Disposal of incinerator ash at PRH should be done by deep burial method, which have minimum depth of 2 meters and a layer of soil of minimum 10 cm should be present over the waste. Proper education and training of the workers would determine the effectiveness of the methods used for disposal of hospital waste. An ongoing training schedule should be in place to train & monitor health care worker including the waste handlers to ensure the proper method of segregation, collection, transportation and final disposal of waste at PRH. As already discussed earlier it is recommended to form a Hospital waste Management Committee at PRH. The members of the committee will be Medical Superintendent, Chief Matron, and Head of the Departments of Microbiology, Gynecology, Medicine, Surgery and other clinical departments. This committee will formulate the policies on waste disposal, conduct training and monitor the hospital waste management system at PRH. A comprehensive waste management plan can be established by defining components and their interrelationship with each other. These components are segregation, containment, transport, workers safety, treatment, disposal etc.14 Finally, it is advised to perform a “waste audit” at PRH in order to determine the current status of waste characteristic and costs of its disposal. Waste minimization audit is a systemic procedure for identifying ways to reduce waste. Reducing hospital waste besides lowering the total volume would lower the total cost per kg of its disposal.

SUMMARY & CONCLUSIONS

The present study was conducted at Pravara Rural Hospital, Loni, Maharashtra with an aim to characterize and quantify the waste generated at the hospital. It was found that there was no segregation of the waste starting from generation to disposal; lack of awareness among the sweepers and bullock cart driver about personal protection; no separate committee for the management of the hospital waste; no proper cover over the bullock cart for transportation of waste at the top as well as sides, so spillage occurred; most of the waste was incinerated without segregation and the ash from the incinerator was thrown on the area nearby the incinerator. Finding regarding amount and characterization of waste at wards/operation theatre and various OPDs depict that, major OT produced highest amount of infectious waste i.e. 4041.35 gm of waste/pt/day followed by ICU and maternity wards. The maternity ward was found to be the bulk producer of waste per day out of all hospital wards i.e. 38.6 kg per day. Out of the OPDs examined CCL produced highest amount i.e. 484.63 gm of waste/pt/day followed by Orthopedics and Surgery OPDs. Surgery OPD produced highest amount of infectious waste while obstetrics and gynecology OPD produced highest amount of noninfectious waste. The surgery OPD was found to be the bulk producer of waste per day out of all OPDs i.e. 7.8 kg per day. ICU was found to be the major producer of total hospital waste per patient per day and non-infectious waste per patient per day as well. Bulk of the waste i.e. 57% of the total waste from wards and OTs was non-infectious. On the contrary, out of the total waste from OPDs 83% was found to be infectious. Average waste produced per patient per day in Pravara Rural Hospital (PRH) wards and OTs under study was 746.55 gm /pt. /day and that in OPDs was 96.46gm/pt./day. Total infectious waste produced by PRH was 231gm/pt/day and the non-infectious waste was 280gm/pt/day. Also, departments under study at PRH produced around 511.18gm/pt./day of waste on average.

Segregation of waste as per the colour codes of containers given in prevailing biomedical waste handling rules; use of appropriate methods for transportation and disposal of wastes; ongoing education and training of waste handlers and all health workers to ensure proper segregation, collection, transportation, worker's safety, treatment and proper disposal of waste; formation of hospital waste management committee that will formulate policies, conduct training and monitor the hospital waste management system and conduction of a waste minimization audit, are some of the recommendations based on the above study.

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ORIGINAL ARTICLE

BLOOD PRESSURE CUFFS: A POTENTIAL SOURCE FOR INFECTION IN HOSPITALS AND THEIR DISINFECTION TECHNIQUES.

ABSTRACT

Blood pressure (BP) cuffs are one of the most re-used pieces of medical equipment and the cuff can be a real source of cross contamination and subsequent infection: no other piece of hospital equipment other than BP cuff is used more often without adequate disinfection. This study evaluated the contamination of BP cuff. A total of 4 swabs were collected from each BP cuff, first swab from BP cuff before disinfection, second swab from patients arm after disinfection, third swab from patients arm after recording blood pressure and fourth swab from the BP cuff after disinfection.The samples were inoculated in appropriate media and the isolates were identified. Antibiotic sensitivity test was also done. It was found that 54.7% of the tested BP cuffs were positive for microbial contamination. The organisms isolated were, Staph sp. (87.8%) , Gram negative bacilli (9.76%) and fungi (2.44%); revealed a general level of contamination. The specimen collected from the patients arm after recording blood pressure showed 56% growth. The antibiotic sensitivity test revealed a high degree of resistance in the isolated microbes. Imipenem and Meropenem (100%) appeared to be the most active antibiotics against the majority of isolates. The disinfectant spirit sprays were highly effective at removing or inactivating 78.7% of microbial contamination. With a rapid increase of resistant microbes in the hospitals, it is more important that routine cleaning of these surfaces with disinfectants like spirit should be encouraged.

KEYWORDS: BP cuffs, Bacterial contamination.

INTRODUCTION

Hospital acquired infections (HAI) have been identified as one of the most serious patient safety issues in health care. HAIs are transmitted due to the fact that hospitals house large numbers of people who are sick and whose immune systems are often in a weakened state. The occurrence of HAI's continue to escalate at an alarming rate.HAIs have increased by 36% (from) in the last 20 years[1].They have a significant impact on both patients and the health system. For patients, the impact of such infections can range from longer hospital stays to more serious conditions that may require surgery or result in negative long-term health effects. In severe cases, HAIs can cause death.Harbath et al found that atleast 20% of HAI's and as much as 70% are preventable depending on the site and type of infection[2]. In the hospital environment, surfaces with which hands come in contact are often contaminated with nosocomial pathogens, and may serve as vectors for cross-transmission. The role of medical devices, such as bronchoscopes, stethoscopes, sphygmomanometer cuff, ventilator etc in the transmission of HAIs has long been recognized, however, the evidence that environmental and medical equipment surfaces play a role in the transmission of HAIs has been weak.

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Blood pressure cuffs (BP cuffs) have been found to be a major source of cross contamination between patients [3]. Blood pressure measurement is a key component of patient management. Almost all patients receiving medical care will have their blood pressure taken. BP cuff is one of the most re-used pieces of medical equipment and the cuff can be a real source of cross contamination and subsequent infection. BP cuffs are often falsely perceived as innocuous and not requiring vigorous sanitization between patients. While not penetrating dermis, BP cuffs are made of fabric on which organisms may persist for significant period of time.

Blood pressure cuffs are included in the noncritical category of medical devices [4]. Noncritical describes the category of medical items or surfaces that carry the least risk of disease transmission because they touch only unbroken or intact skin. Use of BP cuffs on sites which are dry and cracked, increases the possibility of transmission of microorganisms.

BP cuffs contaminated with pathogenic organisms can result in nosocomial infections by two mechanisms [4]:

1) The hands or gloves of healthcare workers can become contaminated via contact with contaminated BP cuffs and thus lead to the indirect transmission of infection.

2) These organisms can be acquired by patients directly from the BP cuffs.

Previous studies done in western countries have shown that following organisms have been isolated from BP cuffs [3][5]:

1. Staphylococcus aureus - MRSA (Methicillin resistant Staphylococcus aureus) and MSSA (Methicillin sensitive Staphylococcus aureus),
2. Clostridium difficle,
3. Enterobacter spp,
4. Pseudomonas aeruginosa,
5. Acinetobacter baumannii,
6. Serratia marcescens,
7. Diphtheroids.

These have the potential to produce opportunistic infections when introduced to critically ill patients who are susceptible to disease [6].

Spirit can be used as a disinfectant in this case. It has a wide microbicidal activity and is non corrosive. It also has limited residual volume due to evaporation, which results in brief contact time, and less interference with the electronic surfaces.

Hence this study is undertaken to determine the microbial contamination of the sphygmomanometer cuffs, their role in infection transmission, and use of adequate disinfectant like spirit to prevent transmission of infections. This study also indicates an urgent need to educate hospital staff about the potential risk associated with the use of sphygmomanometer cuffs.

As early as 1969 an Australian study identified the blood pressure cuff as a reservoir for bacteria, and that

no other piece of hospital equipment was used more often without adequate disinfection [7]

Inspite of this, no study has been undertaken in India till date. To the best of our knowledge, this is the first study done in India, so our data shall be compared with foreign studies.

MATERIALS AND METHODS

This prospective study was carried out in the Department of Microbiology, Bowring and Lady Curzon Hospital, Bangalore Medical College and Research Institute. The 75 BP cuffs used in the wards, OPD's and ICU of 4 attached teaching hospitals of BMCRI were sampled in the study.

Collection of specimen and transport: A total of 4 swabs were collected from each BP cuff. The first swab labelled as 'A' was collected from the inner side of BP cuff (the surface that comes in contact with the patient's arm) using a sterile cotton swabs. The sterile cotton wool swabs were made wet with sterile peptone water and specimens were collected by rotating the swabs over the cuff. Immediately the swab was placed in a sterile tube. The second swab labelled as 'B'was taken from the patients arm from the site where cuff is tied, after disinfecting the arm with spirit and leaving it for 5 minutes till it evaporated completely. BP cuff was tied to the patient's arm to record the blood pressure. The third swab labelled as 'C' was taken from the patient's arm after recording the blood pressure. The inner side of the BP cuff was cleaned by spraying with spirit and was left for about 5 minutes and the fourth swab labelled as 'D' was taken from the cleaned portion of the cuff. The swabs were transported immediately to the lab for microbiological analysis.

Culture and Antibiotic Sensitivity Test

The swabs were inoculated into the culture media according to the standard procedure. The culture media used were MacConkey's media, Blood agar and Sabourauds Dextrose agar. They were incubated at 37^0C for 48 hours. If there was no growth then it was incubated for 72 hours more and SDA was incubated for 2 weeks before considering it to be negative. The isolated organisms were identified by conventional methods. Antibiotic sensitivity test was performed on all bacterial isolates against 15 antibiotics (representing different class of antibiotics) by Kirby Bauer's disc diffusion method on Mueller-Hinton agar by using CLSI guidelines. Zones of incubation were measured after 24 hours of incubation at 370C to the nearest millimeter with a slide gauge.

Statistical Methods: Descriptive statistical analysis has been carried out in the present study. Results on continuous measurements are presented on Mean SD (Min-Max) and results on categorical measurements are presented in Number (%). Significance is assessed at 5 % level of significance. 95% Confidence Interval has been computed to find the significant features. Confidence Interval with lower limit more than 50% is associated with statistical significance. Overall Probability of infection was computed and cumulative probability of Infection was also computed.

RESULTS

It was seen that none of the personnel using Blood Pressure [BP] cuffs had the practice of cleaning the BP cuffs after use. Healthcare staff's perception towards contamination of BP cuff was examined. 10% of healthcare staffs cleaned the BP cuffs randomly. Majority of them used physical methods like dusting, without any special consideration for microbial disinfection. 30% thought that BP cuffs carry germs and 70% believed that it can be potential transmission vehicles for pathogens. Mostly, 100% of the healthcare staff did not wash their hands before using the BP apparatus. This shows a potential way of cross contaminating the cuffs, and hence the patients again.

Table 1: Incidence of infection for swabs (swab A) taken from the inner side (the surface that comes in contact with the patient's arm) of BP cuff.

Infection	Number (n=75)	%	95%CI
No growth	34	45.3	34.57-56.55
Growth	41	54.7	43.45-65.43
1. Staphylococcus aureus[MRSA]	26	34.7	24.88-45.95
2. Staphylococcus aureus [MSSA]	8	10.7	5.50-19.66
3. Staphylococcus citreus	2	2.7	0.7-9.21
4. Staphylococcus spp / E. coli	2	2.7	0.7-9.21
5. Staphylococcus spp / Klebsiella	1	1.3	0.2-7.17
6. Aspergillus niger	1	1.3	0.2-7.17
7. Klebsiella species	1	1.3	0.2-7.17

It was found that 54.7% of the BP cuffs were positive for microbial contamination before disinfection. Most of these isolates were bacteria and some fungi. Staphylococcus aureus (82.93%) was the most commonly observed contaminant, followed by Klebsiella sp, E.coli, Staphylococcus citreus (14.63%). 76.47% of isolated staphylococcus were resistant to methicillin. Aspergillus niger (2.44%) was also isolated from the BP cuff.

Swabs collected from patients arm after disinfection with spirit with a contact period of 5minutes did not yield any microorganisms. The specimen collected from the patients arm after recording blood pressure showed 56% growth. Most of these isolates were bacteria. Staphylococcus aureus (80.95%) was the most commonly observed contamination, followed by Klebsiella sp, Bacillus sp., Pseudomonas aeruginosa, E.coli, Staphylococcus citreus (16.67%). Aspergillus niger (2.38%) was also isolated from the BP cuff.

The specimen obtained after disinfecting the cuff with spirit yielded 21.3% of growth. Most of them were Staphylococcus aureus (87.5%). Klebsiella species (12.5%) was also isolated from the cuff.

Table 2: Incidence of infection for swabs (swab C) taken from patients arms after recording the blood pressure.

Infection	Number (n=75)	%	95%CI
No growth	33	44.0	33.33-55.25
Growth	42	56.0	44.75-66.67
• 1.Staphylococcus aureus [MRSA]	26	34.7	24.86-45.95
• 2.Staphylococcus aureus [MSSA]	8	9.3	5.50-19.66
• 3.Bacillus species	1	1.3	0.2-7.17
• 4.Klebsiella species	2	1.3	0.2-7.17
• 5.Escherichia coli	1	1.3	0.2-7.17
• 6.Pseudomonas aeruginosa	1	1.3	0.2-7.17
• 7. Staphylococcus spp. / Aspergillus	1	1.3	0.2-7.17
• 8. Staphylococcus citreus	1	1.3	0.2-7.17
• 9. Staphylococcus spp / E. coli	1	1.3	0.2-7.17

Table 3: Incidence of infection for swabs (swab D) taken from the inner side of the BP cuff after cleaning with spirit with a contact period of 5 minutes.

Infection	Number (n=75)	%	95%CI
No growth	59	78.7	68.12-86.42
Growth	16	21.3	13.58-31.88
• Klebsiella species	2	2.7	0.7-9.21
• Staphylococcus aureus[MSSA]	6	8.0	3.72-16.37
• Staphylococcus aureus[MRSA]	8	10.7	5.50-19.66

Table 4: Probability of infection at each stage of sampling.

Stage	Infection (n=300)	Prob of Infection	Cum . prob of infection
A. Swabs taken from the inner side (the surface that comes in contact with the patient's arm) of BP cuff.	41	0.137	0.137
B. Swabs taken from patients arm after disinfection with spirit and leaving for 5 minutes.	0	0	0.137
C. Swabs taken from patients arm after recording the blood pressure.	42	0.140	0.277
D. Swabs taken from the inner side of the BP cuff after disinfecting with spirit and leaving for 5 minutes.	16	0.053	0.330

The above table shows the probability of infection before and after disinfection with spirit. The antibiotic sensitivity tests revealed a high degree of resistance in the isolated microbes. Imipenem (99%) and Meropenem (99%) appeared to be the most active antibiotics against the majority of isolates, followed by Cephalothin (85.71%), Gentamycin (83.33%), Ampicillin / Sulbactum (82.35%), Ciprofloxacin (81.8%), Clindamycin (66.67%), Kanamycin (62.5%), Norflox (62.5%) and Chloramphenicol (60%) which were found to be relatively effective. High resistance rates were observed for all antibiotics studied. Staph. sp. was commonly isolated, they showed a very high resistance to all the tested antibiotics. Vancomycin (100%), Linezolid (100%) and Teicoplanin (95%) were the most active antibiotics.

DISCUSSION

The present study showed that it is very important to disinfect the BP cuffs after use as most of the samples collected from the BP cuff before disinfection yielded growth of potentially pathogenic micro-organisms and following disinfection with spirit, 78.7% of the samples yielded no organisms. We also observed that most of the isolates from BP cuffs were transferred to the patients arm while recording the Blood Pressure.

De Gialluly, et al [3] showed in their study that a level of contamination was observed on 92 (45%) of inner sides of 203 BP cuffs. Walker, R. Gupta, J. Cheesbrough [5] recovered viable organisms from the 24 cuffs sampled. Potential pathogens were isolated from 14 cuffs (58%). In a study by Base-Smith, [6] BP cuffs from various inpatient settings were found to have bacterial colonization rates of 81-100%. In our study, we found a colonization of 41 (54.7%) of BP cuffs, which is the colonization rate for our hospitals. To the best of our knowledge there are no studies from India to compare the data from Indian hospitals and this is a pioneering study.

De Gialluly, et al [3] also found that 20 of these microorganisms were Staphylococcus aureus, including 9 methicillin-resistant strains. In our study also, we found that Staphylococcus aureus (82.93%) was the commonest isolate, of which 76.47% were Methicillin resistant(MRSA), which is very high, and shows the probable contamination of the cuffs by hospital acquired strains of MRSA as, common human pathogens such as MRSA, can survive for prolonged periods upto several months on hospital surfaces and fomites[4].A study has shown that 56% of S.aureus isolated from device associated HAIs were MRSA, and these investigators concluded that 3 of 26 patients who became colonized with MRSA while in ICU acquired MRSA from environment[4].

We found that after disinfection of the patients arm with spirit, no microbes were isolated, but swabs taken after recording the blood pressure yielded 56% micro-organisms, of these 95% of the microorganisms were same as those organisms isolated from the BP cuffs, when antibiograms were compared. In addition we also isolated 2 other organisms which were not present on the cuffs initially like Pseudomonas aeruginosa and Bacillus species. These may be from the health workers hand, as they did not have the practice of hand wash or disinfection of hands in-between patients that adds to the burden of HAIs. Though BP cuffs have been classified as non critical items of patient care, the fomites and the inanimate surfaces, especially those frequently touched by hand, can contribute to the spread of healthcareassociated pathogens. It is evident from our study that organisms from the cuffs were directly transferred to the patients arm, which is direct transmission, and also there is indirect transmission from worker's hands or gloves that become contaminated by touching contaminated surfaces. Organisms that have been linked to transmission via contaminated environmental surfaces and medical equipments include MRSA, Vancomycin Resistant Enterococci (VRE), Klebsiella spp, Acinetobacter spp etc. These organisms pose clinically important antimicrobial resistance problems and are among the most common causes of HAIs in intensive care units [8] [9].

Increasing rates of drug resistant Super bugs such as MRSA and VRE make it imperative that the spread of pathogens from patient to patient be contained. The study by Walker, Gupta, and Cheesbrough (2006) reinforce these facts when they found multiple pathogens on the same cuffs, which was also seen in this present study (7.32%).

Andrew L. Stemicht and Alan Van Poznek showed in their study that spraying cuffs with a topical disinfectant such as entornexidine can reduce their bacterial load by 75% [10]. De Gialluly et al showed in his study that even after cleaning, organisms are still cultured from blood pressure cuffs, especially in areas such as the ICU [3]. In our study, because of the economic constraints, we used the most commonly available disinfectant in our hospitals, surgical spirit, which is also cost effective. After disinfecting with spirit spray, we found that 59 (78.7%) of the BP cuffs yielded no organisms, which is similar to the above study. When we compared the probability of infection, we saw that there was significant decrease in the probability from 0.137 before disinfection to 0.053 after disinfection.

Thus disinfection of the BP cuffs with spirit was highly effective at removing or inactivating most of the pathogens. The risk of transmission from contaminated BP cuffs would be eliminated if staff performed hand hygiene using a simple hand wash after contact with inanimate objects in the patient care environment and simple disinfection of the patients arm as well as the BP cuffs can significantly reduce transmission of the microbes.

CONCLUSION

This research on blood pressure cuff contamination only reinforces previous studies results and the need for more vigilance with the use of equipment. Literature review of the evidence shows the same theme- blood pressure cuffs are vectors for the spread of pathogens.

There is a higher contamination rate of BP cuffs and these BP cuffs can be potential source of infection due to transfer of organisms between the patients. There is both a rapid emergence and increasing prevalence of resistant microbes in the hospital. Spirit is a commonly available disinfectant in the hospitals that can be used to disinfect the BP cuffs, thus preventing infection in a cost effective and easy manner. Hence, it is highly suggested that routine cleaning of these surfaces with disinfectants like spirit should be encouraged.

Prevention is the key to reduce the transmission of pathogens through equipment use, such as the blood pressure cuff.

INTERVENTIONS RECOMMENDED

A. Method of disinfecting BP cuffs: easy, cost effective and time saving.

Things Needed: Cotton balls, Ethyl rubbing alcohol, Soft cloth.

Pour the ethyl alcohol into a bowl. Dip one cotton ball into the alcohol so that it is moistened. Open up the blood pressure cuff. Then, spread it out and place it on a flat surface (preferably a table). Wipe the inside of the blood pressure cuff using the moistened cotton ball. Do so gently while avoiding getting any liquid on the actual measuring unit. Dip a second cotton ball into the ethyl alcohol. Turn the blood pressure cuff over and wipe the outside of the blood pressure cuff. Wipe both sides of the blood pressure cuff with a clean soft cloth to dry the cuff.

B. Good hand hygiene, the importance of which cannot be stressed enough.

C. The CDC (2007) recommends the use of disposables blood pressures cuffs in the guidelines for control of pathogen transmission, but these may not be

possible in our country because of resources constraints.

D. The use of a barrier such as a blood pressure sleeve.

E. Staff education is vital for implementing changes. Infection control officers need to incorporate behavior change interventions that will appeal to the healthcare workers.

F. Patient education in the hospital and in the community is another area where physicians and other providers can help with prevention.

G. Use of standard protocols and Standard operating procedures for disinfection of cuffs as a routine and periodic surveillance and audit.

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ORIGINAL ARTICLE

LIQUID WASTE TREATMENT PLANT IN TERTIARY CARE TEACHING HOSPITALS ATTACHED TO GOVERNMENT MEDICAL COLLEGE.

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Hospital is one of the complex institutions which is frequented by people from every walk of life in the society without any distinction between age, sex, race and religion. This is over and above the normal inhabitants of hospital i.e patients and 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 [1]. The hospital waste, in addition to the risk for patients and personnel who handle these wastes poses a threat to public health and environment [2]. Keeping in view inappropriate biomedical waste management, the Ministry of Environment and Forests notified the “Biomedical Waste (management and handling) Rules, 1998” in July 1998. In accordance with these Rules (Rule 4), it is the duty of every “occupier” i.e a person who has the control over the institution and or its premises, to take all steps to ensure that waste generated is handled without any adverse effect to human health and environment.

Handling of bio-medical waste is proving to be an overwhelming challenge for the government and the health sector. However, within the broader theme of bio-medical waste, liquid bio-medical waste (Waste generated from Laboratory washings, blood, plasma,pus, any discharges from wounds/mucus membranes, Chemicals, Urine and feaces remains of lab samples, spills of sample while carrying(Spills in lab, wound dressings, invasive procedures/delivery/surgery/trauma due to accidents, Waste from toilets, Laundry , wash room and Basins) is emerging as particularly difficult to handle. Liquid biomedical waste is far more mobile and moves to a wider area after entering the subsurface water bodies or underground aquifers.(3) Hospital effluent not only has aberrant physico-chemical characteristics but also has high loads of multiple drug resistant bacteria and discharging of the effluent in a municipal sewage system could be a grave public health hazard(4)

Most existing systems and technologies being used in handling liquid bio-medical waste are failing to address this problem. For instance, the routine exercise of pouring biomedical liquid waste is being questioned for posing higher infection threat to medical staff due to its susceptibility to spilling, splashing and aerosolising. Liquid bio-medical waste, if untreated, contains a wide variety of material that poses health hazards.

According to the Biomedical Waste (Management and Handling) Rules 1998, liquid pathological and chemical waste should be appropriately treated before discharge into the sewer. Pathological waste must be treated with chemical disinfectants, neutralised and then flushed into the sewage system. Chemical waste should first be neutralised with appropriate reagents and then flushed into the sewer system. (3)

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Experience of Government tertiary care teaching Hospital in setting up of ETP

Bangalore Medical College & Research Institute located on K R Road near the city market in Bangalore is an autonomous institute of the Government of Karnataka. Four major teaching hospitals are attached to this institution. These hospitals and the facilities provided by the Institution caters to half of the population of Bangalore City and surrounding areas. The bed strength is around 2500.

Name of the hospital	Bed strength	Land area
Victoria Hospital	1000beds	43.3 acres
Vanivilas Hospital for Maternity &Child health	536beds	
Minto Ophthalmic Hospital	300beds	
Bowring and Lady Curzon Hospital	686 beds	13.2 acres

All these hospitals have been built in the Pre independence era and buildings are quite old. Keeping in mind the concerns for environment BMCRI proposes to set up a liquid waste treatment plant to treat its effluent before it is discharged into the sewers

- Difficulties in setting up of ETP in these hospitals

1) All the Hospitals coming under the control of BMCRI are nearly 100 years old. Therefore, no records are available either in this institute or in the hospitals to locate the water & sewerage pipes. The water & sewerage pipes are also nearly 100 years old & no replacement of these pipes have been carried out except for plugging of leakage whenever it occurs. This was the Major difficulty for establishment of ETP.

2) Victoria Hospital campus is spread over in 43 acres of land and a number of buildings are located in this campus. Vani Vilas Hospital, Minto Regional institute Of Ophthalmology, Govt. Dental College, and recently established Nephro Urology Institute are also located in this campus. Further out of the grants sanctioned by Central as well as state Govt. many buildings are coming up emergency block, Trauma Centre, Superspeciality block, Nursing College & Hostel, Super speciality block of Minto Hospital are also under construction in the premises. Bowring & Lady Curzon Hospital is older than Victoria Hospital and spread over 13.3 acres of land. Numerous new constructions such as BDA block, Multi storied building, OPD block, Quarters, PG Hostel are coming up in the premises. At present there are multiple out lets for draining of sewerage from these hospital campuses. In pursuance of this it has become increasingly

difficult to locate the sources of draining of various individual blocks. Therefore, it was absolutely essential to locate sewerage line and bring them to a final common point of drainage from where it could be connected to the ETP for treatment.

3) Initially water audit was carried out and after such audit it was found that the water consumption was quite high. It was therefore, decided to request Bangalore Water Supply and Sewerage Board(BWSSB) to inspect and find out the reasons for such high consumption. The BWSSB after inspection has suggested replacement of water & sewerage pipes to avoid any hidden leakage in the system and thereby reducing wastage of water and bring down its consumption.

Process of Liquid waste treatment

- The hospital, hither-to, were practicing disinfection at source of liquid waste generated from laboratories, blood banks and operation theatres with 1% sodium hypochlorite and then being discharged to the sewerage lines of BWSSB as per the BMW rules.
- Following the directives of KSPCB these measures were further strengthened by identifying points for disinfection at source in all the attached hospitals of BMCRI. Proposals indicating the points for disinfection at source by using with 1% sodium hypochlorite were submitted to KSPCB and approval was received. The particulars of points so identified is given below:

a. Victoria Hospital Mortuary, Blood Bank, O.T.Complex, Laboratory and Burns Ward.

b. Bowring Hospital Blood Bank, Mortuary, Labour Ward, Laboratory and O.T.Complex.

c. Vani Vilas Hospital Labour Ward -3, Minor O.T., Central Lab, OT Complex.

d. Minto Ophthalmic Hospital OT Complex and Laboratory.

Photograph Of Disinfection At source

- Karnataka State Pollution Control Board, had issued notices to the hospitals for not establishing the treatment plants for treating the Bio Medical Liquid Waste on the directions of the Hon'ble Lok Adalat of High Court of Karnataka in one of Public Interest Litigations. Hon'ble Lok Adalat has set a deadline to install the treatment plant in all these hospitals without fail. The establishment of ETP was required in these hospitals for recycling and reuse of treated water from the liquid waste generated.
- Based on the above facts a meeting was held in the chambers of Principal Secretary to Govt. HF&W (ME) and a decision was taken that a works of relaying water pipes and sewage lines for reduction of water consumption and establishment of ETP for treatment and recycling of waste water should be entrusted to BWSSB.

The capacities of the proposed plants are 1000 KLD for Victoria, Vani Vilas and Minto hospitals and 300 KLD for Bowring. This was calculated based on the requirement of 450litres per bed per day.

Although different technologies were available for LWETP s Extended aeration and activated sludge technology was chosen because of its reliability and cost. As time given by Hon'ble Lokadalat was very short pre fabricated sheets were used for wastewater treatment plants and these were proposed by considering the following advantages.

a) Aesthetics and Environment friendliness
b) No foul smell/ Odour
c) Minimum Sludge production
d) Well established sludge to avoid further digestion of sludge
e) Optimum cost of Operation and Maintenance
f) Ease of Operation and high level of system reliability
g) Quick installation with minimum disturbance at site.

Advantages of LWETP

- By the establishment of LWETP's at these two hospitals precious potable water to an extent of 1.715 MLD could be saved which is a major saving and it cannot be measured in any form.
- Necessary arrangements are being made by this institute and Hospital authorities for utilizing this treated water for reuse flushing, gardening and construction.
- The sludge generated could be used as manure for landscaping and gardening or for construction purposes

Principle and Functioning of ETP:

Bar screens: For screening and removal of coarse suspended solids from the effluent while it passes through the bar scanner.

Oil and grease Trap: Removes the floating oil and grease from the effluent.

Equalization tank: Collects and equalizes the raw effluent.

Aeration tank: Mixes the effluent and provides excess of air (oxygen). The aerobic bacteria in the biomass oxidize the suspended and dissolved organic matter. The organic matter is biodegraded by the bacterial mass. Complex carbon compounds are degraded and CO2 generated. Complex organic nitrogen compounds are degraded to form ammonia, nitrite and nitrates.

Clarifier tank: Separates suspended biological material. Part of the sludge is returned to aeration tank to provide biomass for the treatment and excess is flown to sludge drying bed.

Filter feed tank: The treated effluent is stored before passing to pressure sand filter.

Pressure sand Filter: Removes the fine suspended mater from the treated effluent.

Chlorine contact tank: Chlorine is added continuously to inactivate the microbial population.

Clean treated effluent water tank: Holds water before lifting to high-level storage tanks.

Photograph Of Effluent treatment plant

Details to be furnished for setting of liquid biomedical waste treatment facility

1. Master plan of the hospital/Campus
2. Detailed survey of the drainage pattern and sewer lines
3. Lab reports showing the characteristics of the effluent
4. Source of water, Quantity consumed per day and type of use (Domestic / laboratory /cleaning / kitchen/laundry etc)
5. Current practices for liquid waste management in Blood banks /OTs/ Laborotaries / wards

Each department in the hospital to furnish the following details

1. Name of department/ floor/ward
2. No of patients
3. No of rooms
4. No of Bathrooms
5. No of sinks
6. No of water closets
7. No of times mopped per day
8. Name of disinfectant and quantity used per day
9. Quantity of waste water generated per day

Details of kitchen:

1. Sequence of washing/frequency of washing
2. Peak hour of washing

3. Quantity of water used per wash
4. Name of the detergents/ combinations used
5. Quantity of detergent used per wash
6. Waste disposal method
7. Usage of gas /electricity

Laundry

1. Sequence of washing/frequency of washing
2. Kgs of clothes per wash
3. Quantity of water used per wash
4. Name of the detergents/ combinations used
5. Quantity of detergent used per wash
6. Waste disposal method

Other Details:

1. Total No of Doctors
2. Total No of Nurses
3. Total No of Admin Staff
4. Other staff
5. Total No of Beds
6. Average waste water output/day
7. Total No of Outpatients per day
8. Total No of Security Person
9. Total No of Cleaning Staff
10. Total Area
11. Total Built-up Area
12. Any personnel staying in quarters & Number

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IN PERSPECTIVE

MANAGING HOSPITAL WASTE IS DIFFICULT : HOW DIFFICULT ?

Managing hospital waste has become difficult. But how and why this is perceived to be difficult is examined in this article.

It is over a decade since the Bio-Medical Waste (Management and Handling) Rules ware promulgated. During these years no substantial change has taken place, though there have been pockets of success. WHO aided pilot projects (10 of these) has somewhat helped to inculcate awareness, but the health care providers still find it difficult to implement the Rules. Even the extended deadline is over without desired results/implementation. Why is it taking so much of time?

By and large the governments and the health care providers have gone in for one type of option for treatment of the waste. No health care provider wants or has undertaken a base line survey to collect data regarding quantum of waste and its type being generated, nor about the waste generation points in its premises. Budgetary support is poor in the government run hospitals, and the corporate hospitals, as well as the nursing homes find it convenient to ignore the Rules for monetary consideration.

In India, there are about 6 lakhs hospital beds, over 23,000 Primary Health Centers, thousands of registered nursing homes, countless unregistered nursing homes and dispensaries, and above all a very large number of quacks practicing at every nook and corner of urban and semi-urban locality. The hospitals are-tertiary care hospitals usually associated with teaching colleges, district hospitals (more than 2,000), and health care dispensaries. There are a innumerable pathology laboratories of which hardly any data is available. As true for nursing homes, a large number of these laboratories are not registered. WHO estimates that India is on the verge of having an HIV epidemic. Tuberculosis and HIV combined, is taking great toll on the human health and life. Hepatitis B and C infections are on the rise. Mortality due to Hepatitis C has gone up significantly. No scientific study has been done to determine 'add on morbidity' due to infected waste being thrown on the streets and gutters, but it is anybody's guess that indiscriminate disposal of the infected waste is mainly responsible for the increased morbidity due to communicable and infectious diseases in India. The vulnerable group includes the health care workers, the waste handlers, and the most affected- the rag pickers. Reuse of plastic syringes and other plastic material used in the health care is a thriving business of crores of rupees. More than one million are engaged in rag picking (more than one lakh in Delhi alone). The estimated figure of business on this score in Delhi alone is more than 5 crore per year. It would not be fair to blame the rag pickers only for this as the circle of connivance starts from the hospital staff itself. It thereafter goes to the waste handlers, then to the rag pickers, to the packaging outlets situated in a decrepit area of a 'basti', to the medical shop, and finally sold to the unsuspecting patients or their relatives.

It must be appreciated that laying down a proper hospital waste management system is systemic and not an exercise to find 'end of pipe line' solution. There is no doubt that successful implementation would grossly reduce the morbidity in the society by reduction in the nosocomial infection, and hospital acquired infection. Relatives and friends visiting the hospital are at risk, and proper waste disposal in the hospital would render the atmosphere less infective. Atmospheric pollution being caused by improper disposal of hospital waste remains a matter of great concern. There is no doubt in the mind of any educated or enlightened person that improper hospital waste management is the source of many communicable and infectious diseases. But when it comes to doing anything there is a complete lack of will, and there is a lackadaisical attitude towards the problem. Even the regulatory authorities have to take

the blame for not doing enough to ensure implementation. The confusion starts at the very beginning.

The Municipal Solid Waste (Management and Handling) Rules 2000, and the Bio Medical Waste (Management and Handling) Rules 1998, both take the authority from the same Environmental Protection Act 1986 (29 of 86). Whereas it is clearly mentioned in the Environment Protection Act and the MSW Rules - 2000 that these apply to whole of India, no such mention is there in the Bio-Medical Rules 1998. So there is confusion as to the dictates or the guidelines framed by the central government or any of its agency will be applicable in the whole of India or not. And if so, with what legal force?

The MSW Rules 2000 clearly spells out the responsibility on the part of the municipal corporations/ civic bodies such as Panchyats etc, and the individual citizen. Some of the responsibility on the part of the municipal authorities etc is illustrative. It is the responsibility of the municipal authorities: to a) ensure that no littering on the roads take place, b) organize house to house collection, c) conduct awareness programs, d) devise ways to collect, transport in closed vans, and ensure disposal by any prescribed method such as composting etc. The responsibilities on the part of the citizen are: a) ensure segregation at source and delivery, and b) to avoid littering.

Admittedly the infected waste has to be dealt with differently, but why responsibilities like: a) to prohibit littering on the roads and any area outside the premises of the health care facility, and b) to conduct awareness programs cannot be assigned to the authorities in the Bio Medical Rules itself!

Initially due to public awareness and court's interventions orders were passed that any health care facility having more than 30 beds were required to have incinerator. It was considered that incinerators were the final answer to the problem of biomedical waste. Thankfully with acquisition of better knowledge alternate disposal technologies were also permitted. Otherwise the protruding stacks of the incinerators would have dotted the skyline of Delhi, and other cities. Though now alternative technologies are permitted as per the Bio Medical Rules, it takes a long time to change the mindset of the people, and even now most of the health care providers & decision making authorities talk of incinerator only. When Delhi government wanted to go in for acceptable solutions autoclaves were bought with a lot of fanfare. It was announced that “very soon heaps of IV fluid bottles, syringes and other plastic hospital waste …. may be a thing of past” (Times of India, Oct 19, 1999). 10 years down the line situation has hardly improved. Indiscriminate throwing of the waste is still seen in most of the hospitals. Rag picking and recycling of the plastic hospital waste is still a thriving business of crores of rupees. There is hardly any change in the applied knowledge and awareness. Waste handlers still are without protective clothing and gears. However, some improvements have certainly come about due to common biomedical waste facilities coming up at different parts of the country, but there being no standard pattern these facilities place only some of the required equipment, and thus it remains inadequate for comprehensive biomedical waste management

Basing disposal only on one type of system in itself is unscientific. Every disposal system has limitation and therefore can handle only few types of waste. No single technology can scientifically take care of all the ingredients of hospital waste. In any case installing autoclave was devoid of due scientific consideration, and therefore bound to fail. Autoclaves increase the weight and volume of the waste and therefore require a compactor along with. The treated waste was intended to be sent for land burial which is not permitted in cities having population more than 5 lakhs. Even if the treated waste is sent for burial outside the city limits, suitable land would be difficult to find year after year. Therefore a proper deliberation is essential before incurring huge capital investment.

The CAG report (Times of India, Apr 4, 2002) is rather disconcerting. It says many government hospitals did not even apply for authorization whereas the corporate private hospitals did (even now there are many hospitals and nursing homes who have not applied for authorization). Transportation of the infected waste was by wheelbarrows (now the common biomedical waste facilities at least most of them, if not all are using motorised vehicles but cleanliness and separate compartments are still not as desired). No personal protective clothing was provided to the waste handlers (situation remains the same and most disheartening is that the waste handlers in government hospitals in Delhi are contracted labour and the individuals keep changing daily making training and awareness meaningless. Incidentally, the BMW Rules 1998 does not say anything about protective clothing/gear). Instead of the permissible limit of 48 hours, delay in lifting the waste ranged between 3 58 days!

Obviously there is either defiance of rules, or lack of understanding; or sheer callousness.

Now there is a number of Common Waste Treatment Facilities (CWTF) coming up at different cities. Perhaps moves are afoot in Delhi as well. Would that be an answer? Again transportation of infected waste over long distances will be the most difficult part of the scheme. For transporting infected waste, air-conditioned vans with appropriate compartment would be required. Despite the provision in the MSW Rules, covered vans are not provided for transporting municipal waste, and it remains un-enforced. To enforce air-conditioned vehicles for transporting hospital waste would be too much to expect, and only theoretical. Even if enforced it would add to the cost substantially. Hence CWFT would remain a costly option.

Scientifically as well, by the time infected waste is lifted, say by 12 to 48 hours (which will be a miracle, if achieved) the infection would have already spread by proliferation of the bacterial flora, and thru aerosols. Hence spread of nosocomial or hospital acquired infection would have already taken place. The aim to control or prevent spread of infection would thus remain unachieved. Moreover a couple of interesting points of law must also be considered. Firstly, as per the Rules the 'occupier' is responsible to ensure that no harm is caused to the human health by improper disposal of the hospital waste. But once the waste leaves his premises, they would neither have the control, nor have the means to ensure safe transportation and disposal so that no harm comes to the human health or the environment. In case they ensure disinfection on-site then the waste can be lifted, transported, and disposed off as MSW. In this case there will be no requirement of having elaborate arrangements, such as air conditioned vehicles etc. The second point is about the body parts. Without a proper inventory listing and tracking system it will be impossible to track the human body parts (at times it may be a still borne fetus or even corpse of infant.) in medico legal cases. Therefore would not disinfection on site at least for the bigger hospitals be a better, more scientific, and cheaper option? For the smaller hospitals and nursing homes a mobile hospital waste management system can be developed with a bit of R&D effort. The waste can be collected in the mobile system, disinfected at pre-designated points, and at the end of the day the residue may be disposed off at the designated site away from the populated area. The mobile system will have non-incineration alternate technology of waste treatment, and whatever can be recycled after disinfection can be sold to the vendor. Biodegradable disinfected waste can be converted as manure, or bricketted for use as manure or fuel by application of thermal energy under controlled conditions. This perhaps will be a viable solution to the problems being faced by the nursing homes.

Infected hospital waste including hazardous waste can be managed only by a system approach utilizing multi-option of technologies. Therefore to lay down the system, a schematic approach is required. This is a stepwise activity, which must be undergone at each of the health care facility. It is necessary for the hospitals to appoint a waste management committee, which should work in close

coordination with the infection control committee of the hospital. Inculcating awareness and periodic training also should form a part of the responsibility of the committee. The hospital should undertake a base line survey in order to determine the quantum and ingredients of the hospital waste, and determine the points of generation of waste. Educate all classes of health care workers-doctors, nurses, paramedical staff and the waste handlers. It should recommend and ensure protective clothing for all the health care workers. The committee should develop a schematic waste movement and treatment policy, and ensure its implementation. Inventory and data recording should form an integral and repeated task for the committee. Disinfection and mutilation of sharps should be specifically ensured.

In the whole gamut of infection control, accident reporting and taking remedial measure is rather important and must not be left sight of. Safe handling and safe transportation should be ensured. Audit and periodic re-evaluation would be quite helpful in fine- tuning the system. The system so developed should follow the general principles no doubt, but it needs to be 'hospital or health care facility' specific to an extent.

Delhi has acquired a unique distinction of having a mutated variant to its name (as per an article published in the Lancet, and news paper reports Times of India dated August 13, 2010; and other papers). Without entering into controversy of why name it after Delhi there is strong possibility that mutation of microbes may be taking place in hospital wastes. Such concept has been voiced earlier as well (Managing Healthcare Waste a Practical Approach, (2007), ISBN 81-87966-61-0). The DRDO supported project was undertaken to study mutagenic effects in hospital waste in the year 2000 to 2002 which indicated mutation in bacterial flora, but more research is required.

Returning to the question - 'how difficult?' the situation can be summarized as follows: -

a) The rules are not clear-cut,

b) And at places; confusing and unscientific.

c) No agency has been assigned the task of spreading awareness.

d) Even the decision-makers demonstrate lack of knowledge and confusion.

e) Stance of the regulatory authorities and those who lay down the policies has been wavering.

f) There is lack of coordination between the regulatory authorities (pollution control boards/committees) and dept of health who exercise functional control over all healthcare facilities in one way or the other; and lack of will to enforce implementation. In other words there is dichotomy at the top. Rules have been promulgated by the MoEF, but implementation is not within their purview.

g) There is no agency to advise or guide the health care providers.

There is an urgent need to rethink on the whole issue. A separate body needs to be created; such as 'Waste Management Authority of India' which in order to be effective must be autonomous, an also perform advisory role to the government, and healthcare facilities. This body can take care of solid waste management, as well. It is important to note that management of infected hospital and municipal solid waste has to be tackled together to achieve cleaner environment.

It is true that human suffering is not a core issue for our country. But it must be appreciated that healthier body and mind can greatly contribute to the society. Right to life is a fundamental right in the

constitution of India. It includes 'healthy living'. One must aspire to achieve 'Total Health' and not only 'Positive Health'. It should be- 'living with complete absence of pollutants from the body, where life thrives in a clean and healthy environment; and not merely absence of disease or infirmity'.

Air Mshl LK Verma (Rtd)
President ISHWM

IN PERSPECTIVE

Interview with Mr.Yellappa Reddy-Former Secretary to Department of Environment and Forests, Govt of Karnataka and Member Lok Adalat.

Dr S P Suryanarayana (SPS): Sir, we understand Lok Adalat has played an important role in advocating safe and sound management of liquid waste in health care setting. We like to know from you how come Lok Adalat came into picture

Sri A N Yellappa Reddy (ANYR): It was upon the direction of Supreme Court that Lok Adalat came into existence from 2002 onwards with the purpose of sorting out the public issues. Once Lok Adalat receives any complaints from the public it will summon the concerned civic authorities and then question him/her for the lapse in function and will be asked to duly respond to the complaint failing which actions would be taken against the authorities. Lok Adalat is supported by experts from various fields to help them in taking sound decisions. For example when it comes to issues related to health care waste management Lok Adalat is supported by experts in health care waste management from MS Ramaiah Medical College.

We have policies for protecting our natural resources, but the inadequate implementation of this policy has resulted in polluting and contaminating our natural resources for which our community is paying a large price. Hence Lok Adalat functions with the concern for future generations.

Untreated effluents from health care settings which are discharged into the drains are rich in various chemicals which are commonly used as disinfectants in hospitals. They also contain potential pathogens and drugs like antibiotics. When expert were asked to opine about the problems of discharging the effluents untreated into drains they replied that apart from contaminating the natural resources, the pathogens in the effluents develop resistance to antibiotics and they respond to commonly used drugs for which the community will pay a large price. Hence Lok Adalat had to intervene and advocate for the safe and sound management of liquid waste in health care settings

SPS: What step did Lok Adalat take in this direction

ANYR: Knowing the potential hazards of untreated effluents from hospitals Lok Adalat summoned the heads of pollution control board. Facts were placed in front of pollution control board, lapse on the part of PCB was projected, they were asked to file duly signed affidavit in Lok Adalat and were advised to take prompt and necessary action.

SPS: What was the outcome?

ANYR: PCB immediately issued closure order for many hospitals in the city both private and government hospitals, which were not treating their effluents. As a consequence ETP is being put up in many of the hospitals. By this Lok Adalat is hoping to improve the health of the ecosystem.

SPS: What are the learnings to Lok Adalat, government and hospitals?

ANYR: Initially mid level workers from the concerned civic authorities were summoned who were not in a position to take any decisions. Lok Adalat faced some difficulties then, but now heads who are policy makers are summoned and they are made accountable for any lapse in the system and hence they take necessary steps to implement the policy.

Lokadalt needs the support of experts, researchers and institutions. Awareness about the health risk of these untreated effluents is low among health care workers and general public which needs to be addressed with greater importance by the help of media. We also feel that lot of research has to take place especially in developing new technologies to take care of these waste.

Intersystem discipline is coming in government setup. Bureaucrats feel that somebody is there to question them and they no more listen to politicians. A significant proportion of bureaucrats are happy with the developments.

Initially hospital used to curse Lok Adalat. But now they are also happy with the improvements. Doctors being a stakeholder are also made accountable.

SPS: sir do you think that these issues can be dealt with by Lok Adalat of other states. What are your tips for the Lok Adalat of other states?

ANYR: Lok Adalat is meant to listen to public grievances. Every state has Lok Adalat and the issues of safe and sound management of liquid waste in health care setting can be taken up effectively by them. Lok Adalats in other States of India is not taking these issues. Ours can be a model for them. Lok Adalat is a comprehensively evolved system to take care of other systems

In the hearing of Lok Adalat held on 18/09/2010, affidavits were filed by various departments as per the direction of Lok Adalat. These affidavits contained action plans of the respective departments.

Dr.S.P.Suryanarayana, Associate Professor interviewed Sri A N Yellappa Reddy and the Interview was recorded and note prepared by Dr. Arvind, Postgraduate and Mrs. S. Roopa, SDC at the , Dept of Community Medicine, MSRMC.

FOCUS: WASTE FROM DENTAL CARE SETTINGS

DENTAL HEALTHCARE WASTE MANAGEMENT

Dr BV SreenivasaMurthy[1], Dr Indiresha HN[2],
Dr Malasiddappa Metri[3], Dr K Pushpanjali[4]

Introduction :

Health care waste management in Dentistry is a blissfully ignored subject in our country, although the government of India under the provision of the Environment Protection Act,1986 notified Biomedical Waste (Management and Handling) rules on 20th July 1998(BMW1998).

Dental health care wastes are materials that have been generated in dental Establishments (which includes dental clinics, hospitals and dental institutions) which are of no longer required for use and should be discarded. Healthcare service units generate wastes that can be classified into: general non hazardous waste, sharps, infected waste(not containing sharps), chemical & pharmaceutical waste, and other hazardous waste.

Improper handling and disposal of dental waste can cause detrimental effects to the dentist, employees, patients or the people in the immediate vicinity of the dentist who handle the materials, waste handlers or the general public at large, through production of toxins from materials used in a dental procedure or as by products of destruction of these wastes e.g., through incineration.

As healthcare providers, Dental professionals have an ethical and social responsibility towards management of such wastes generated. As per the precautionary Principles in Basel Convention that states that, **"when an activity raises threats of harm to the environment or to human health, precautionary measures should be taken even if some cause and relationships are not fully established scientifically".**

Classification of Dental Office Waste

1. General Waste (non-regulated)
2. Contaminated Waste / Infectious (regulated)
3. Hazardous Waste / Toxic Waste (regulated)

Controlled Strategies with respect to Waste Management in Dental Offices

Certain preventive strategies must be adopted in dental offices to reduce generation of waste, hence minimizing the potential detrimental effect on employee safety and environment.

These include, Product substitution, safe work practices, employee training, and recycling.

Product Substitution: Practices such as use of alternative products with less or non-hazardous components or using technologies that generate less toxic or less volume of waste. Eg., precapsulated amalgam, mercury free restorations, digital radiography, steam sterilization, non-hazardous

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biodegradable detergents, non-chromium containing x-ray system cleaners etc.

Safe work practices : Safe work practices such as good house keeping procedures, routine equipment maintenance, proper storage and labeling, and effective record keeping should be incorporated in to office policy and procedure documents.

Employee training: All employees should be trained regarding the importance of pollution prevention on the job. They also should be trained for handling of hazardous material and waste, including protective equipment, storage, and disposal in accordance with central and state regulations.

Recycling : materials like mercury, zinc, and silver from amalgam, silver from used x-ray fixer, and lead from film backings can be recycled and/or reclaimed.

Impact of Poor Dental Waste Management

Certain risks are associated with poor waste management strategies. They are,

1. Nosocomial infections in patients from poor waste management policies.
2. Injuries from sharps to all categories of hospital personnel and waste handlers.
3. Risk associated with hazardous chemicals and drugs to persons handling wastes at all levels.
4. Risk of infection outside hospitals for waste handling and at times general public.
5. Pollution of water, air and soil with may act as routes of transmission of infection the objective of the guidelines for safe disposal of biomedical waste is to provide an approach to the management that is safe for the waste handlers, the public and the environment as well as being cost effective and practical.

Dental and Healthcare waste that are considered hazardous under current regulations

1. Mercury Containing Waste
- Elemental Mercury
- Scrap Amalgam

2. Silver Containing Waste
- Used X-ray Fixer
- Undeveloped X-ray Film

3. Lead Containing Waste
- Lead Foil
- Condemned Lead Aprons

4. Chemical Waste
- Disinfectants
- Sterilizing Agents
- Laboratory Reagents

5. Infectious Waste
- Blood and Saliva-soaked materials
- Anatomical Waste, Extracted teeth without amalgam restorations

6. Waste Sharps

1. Needles , Scalpels, Reamers, Files, etc.

Regulatory requirements for Hazardous Dental Waste Disposal

I. The water(Prevention and control of pollution)Act,1974
II. The Air(Prevention and control of pollution)Act,1981
III. Environment(Protection) Act,1986
IV. The Hazrdous Wastes(Management and Handling) Rules, 1989

Govt. of India has notified rules on Biomedical Waste Management under Environmental Act (BMW1998). It regulates disposal of biomedical waste and lays down the procedures for collection, treatment, disposal and standards to be complied with. A policy on hospital waste management should be formulated in handling the waste from the point of generation to its final disposal.

Dental Waste differentiation from Medical Waste

1. Dental clinics fall into category of very small quantity generators(VSQG). On an average these dental clinics generate 100Kgs or less, or about 100Ltrs per month of regulated waste. Most of these wastes are contaminated / recyclable.

2. Mercury and lead which are hazardous wastes generated by dental clinics. It should be properly contained and managed. This is most crucial in a dental set-up, where a dentists plays a vital role with regards to environmental safety concerns.

Dental Waste management in different Dental Departments

I. Dept of Oral Medicine and Radiology

a. Syringe- collected, deformed or disposed- recycled

b. Fixer- stored in a separate container-pick up and recycle service or silver reclaiming facility

c. Lead foil- collected in a container and labeled as a biohazard waste- recycling(vendors)

d. Biopsy specimens- collected in a container and labeled as a infectious waste- incineration/deep burial

e. Drugs- stored in container and labeled as cytotoxic-disposed in a secured landfill

II. Dept of Conservative Dentistry and Endodontics

a. Cotton which is soaked in saliva & blood- collected in a container and labelled as infectious waste- incineration/deep burial

b. Silver Amalgam: Amalgam contains mercury which is toxic. Amalgam courts a extraordinary controversy over last 200 years. Dentists and researchers have been debating amalgam, and the debate still continues today. It is interesting to know the debates on amalgam usage as they were termed as amalgam wars (Box). Students across the globe still use amalgam and mercury in their curriculum. They generate immense amount of mercury vapors and waste while undergoing training. This poses hazardous exposures to the students as well can add to eco-pollution. Thus, slowly dentists are moving from a mercury containing amalgam towards other alternative restorative materials which do not contain mercury.

Types of Amalgam Wastes

Non-contact amalgam (scrap): is excess mix leftover at the end of a dental procedure.

Many recyclers will buy this clean scrap.

Contact amalgam: is amalgam that has been in contact with the patient.

1. Extracted teeth with amalgam restorations,
2. Carving scrap collected at chair side,
3. Removal of old amalgam,
4. Amalgam captured by chair side traps, filters, or screens.

Dental Mercury Hygiene recommendations :

Ventilation: Provide proper ventilation in the work place by having fresh air exchanges and periodic replacement of filters, which may act as traps for mercury.

Office design: Use proper work area design to facilitate spill containment and cleanup(formulation and maintainence of a spill kit will be handy in case of accidental spills).

Pre-capsulated alloys: Use pre-capsulated alloys to eliminate the possibility of a bulk mercury spill. Otherwise store bulk mercury properly in unbreakable containers on stable surfaces.

Handling care: Use care in handling amalgam. Avoid skin contact with mercury or freshly mixed amalgam. Avoid dry polishing.

Evacuation systems: Use high volume evacuation when finishing or removing amalgam. Evacuation system should have traps or filters. Check, clean or replace traps and filters periodically .

Masks: Change mask as necessary when removing amalgam restoration

Recycling: Store amalgam scrap under radiographic fixer solution in a covered container. Recycle amalgam scraps through refiners.

Contaminated items: Dispose off mercury contaminated items in sealed bags according to applicable regulations.

Clothing: Wear professional clothing only in dental operatory.

Tooth colored alternatives : Glass ionomer cement, Composite resins,
Resin modified GIC, Polyacid modified composites, Ceramics, etc,.

III. Dept of Periodontics

a. Tissues - collected in a container and labeled as a infectious waste- incineration / deep burial

b. Scalpels and Blades- Disposed as waste sharps

III. Dept of Oral and Maxillofacial Surgery

a. Extracted Teeth: Since extracted teeth are potentially infectious, they are considered regulated waste. To save for educational use, only teeth without amalgam may be heat sterilized, stored and handled as per OSHA regulation.

b. Extracted Teeth with Amalgam: Teeth containing amalgams can be placed in biohazard containers for pickup.

c. Biopsy Specimens: Is stored in a separate container as infectious waste & sent for Incineration.

d. Waste Sharps : Do not overfill, Place sharps containers close to where they will be used. Container should be rigid which cannot be get punctured easily. Do not place your fingers into the sharps container for any reason. When full, follow regulations for disposal in your area.

IV. Dept of Prosthodontics

a. Plaster of Paris, Stone casts, Waxes, Acrylic resin, Impression material- Disinfected, Collected and stored in card board box, Land filled.

b. Gypsum products waste can also be used in cement manufacturing units.

V. Dept of Pedodontics

a. Extracted teeth - Since extracted teeth are potentially infectious, they are considered regulated waste. To save for educational use, only teeth without amalgam may be heat sterilized, stored and handled as per regulation.

b. Space-maintainers and crowns- disinfected with 10% formalin solution -collected and stored in a container can be recycled as scrap metal or disposed off as solid waste.

VI. Dept of Orthodontics

a. Orthodontic bands and arch wires- overnight immersion in 2% glutaraldehyde. can be recycled as scrap metal or disposed off as solid waste.

b. Orthodontic pliers-lubricate the hinges, dip in 1% sodium nitrate solution and autoclave.

VII. Dept of Oral Pathology

a. Tissues - collected in a container and labeled as a infectious waste- incineration / deep burial.

b. Reagents disinfected, diluted and disposed into drains(sewer) for liquids, and secured landfills for solids.

c. Urine / blood samples-disinfect, dilute and collect in a seal-proof container or plastic bag- disposed in sewer or secured landfill.

Dental Unit Water Lines

Liquid waste(except mercury contaminated) from the dental unit water line should be contained at the source in a separate tank and treated with sodium hypochlorite- can be left to the sewage drain.

Tips for Avoiding Excess Dental Waste generation

1. Reduce the generation of waste at the point of source.
2. Instruments that can be sterilized should be reused so that waste generation is minimized.
3. Digitization of all clinical records minimizes paper waste.
4. Use of digital radiography eliminates lead and silver waste.
5. Alternatives to mercury containing restorations should be incorporated in to clinical practice.
6. Best-practice waste management should be incorporated into office policy and ocedure

procedure documents.

7. Sign-boards about Waste disposal and Mercury hygiene should be displayed in work place.

Conclusion:

Proper handling, segregation, treatment and disposal of dental waste are important elements in dental care office infection control program. Correct protocol and best practice adoption will protect dental professionals, patients and minimize eco-pollution.

Dental students should be sensitized about waste management issues, especially relating to mercury and should be properly educated.

Though we have rules it is time that dental professionals take voluntary measures to manage wastes safely with out having any adverse implication and contribute in conserving our environment. It is an ethical responsibility to obtain authorization and consent of the governing bodies and respect legislations.

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Staff and Postgraduates Dept of Conservative Dentistry, M.S.R.D.C,Bangalore

ANNEXURE 1

Amalgam War- I

The first recorded use of the mixture of mercury (quick silver) and silver powder for filling cavities in teeth was in Paris around 1820.

In 1833, two opportunists from England, the Crawcour brothers, brought amalgam fillings to America. They called them "silver" fillings, because silver sounds like jewelry. The Crawcour brothers were ruthless competitors and were soon considered a threat to American dentists. Amalgams were denounced not only as an inferior filling material, but also as a harmful, toxic mixture causing periodontal (gum) disease; erethismusmercurialis (mercury poisoning); and fractured, painful teeth. Many teeth with amalgam restorations were removed.

Amalgam War-II

For the next half century, the use of amalgams was abandoned in the United States. But then, near the turn of the twentieth century, experiments were again performed in an effort to improve these fillings. It was noticed that when different powdered metals were added to the silver filings (powder), the expansion rate was altered. When these new metal alloy mixtures were triturated with mercury, the "silver" fillings no longer were cracking teeth. The metal element that was key in controlling the expansion rate was tin. As a result of this finding, dentists agreed that the perfection of dental amalgam had been obtained. During this period 80% of restorations placed were silver amalgam. It enjoyed popularity as a restoration.

Amalgam War - III

It was not until 1981 that this mercury issue was reopened. Thus began the Third Amalgam War. This time,Mats Hansen, a neurobiologist from Sweden, sent a letter to the National Board of Health of Sweden demanding an unprejudiced evaluation of the hazards of dental amalgam.

It was not until 1986 that, in a Swedish medical journal, that Frieberg, Kullman, Lind and Nylander described a study relating mercury in the central nervous system to dental amalgams. Eighteen cadaver

brain species were analyzed for organic and inorganic mercury. The brain specimen from the cadavers with amalgam fillings had about three times the mercury levels than the brain specimen from cadavers without amalgam fillings. The amount of mercury in the brain samples was directly related to the number of amalgam fillings in the individual. In 1987, Eggleston and others did a similar study with 77 cadavers and demonstrated a positive correlation between the number of occlusal surfaces of dental amalgam and mercury levels in the brain.

Murray Vimy, in 1990 in his animal study on ewes concluded Mercury in blood passes the placental and blood-brain barrier. Many studies conducted earlier had also indicated the release of mercury from amalgams and its accumulation in the brain, kidney, pituitary and other organs, and the conduction of mercury through the circulatory system and placental barrier

ANNEXURE 2

Steps involved in management of Dental Waste

Waste minimization is the first step in managing wastes safely and in a cost effective manner. The primary goal of waste management is reducing, reusing and recycling principles.

1. Segregation - it is defined as separation of different types of wastes by sorting at the source. It minimizes the amount of waste requiring special handling and disposal procedures and reduces the overall costs of disposal. It allows special attention to be given to the relatively small quantities of infectious and hazardous waste.

It is the 'key' to the entire process of scientific waste management as proper sorting and separation into different categories will entail right treatment and disposal.

2. Decontamination

3. Deformation

4. Containment of waste - it is the process which follows segregation.

For the proper disposal, the biomedical waste is collected in plastic bags with different colour codes using minimum number of colours.

5. Labeling and Storage of waste.

6. Transportation and final disposal.

The movement and transport of waste internally and externally is essentially a part of comprehensive waste management system.

a. Intramural (Internal) transport.

It refers to the transport of waste from the point of generation, collection and storage to the point outside, the building, pending the transport to actual site of disposal.

b. Extramural (External) transport.

It refers to the transport from a central collection point outside building, to the site of final disposal.

WHO recommendations of Waste Management

1. All personnel in health care system should be made aware of the potential risk of

mishandling waste.

2. Emphasis should be placed on the need to segregate 'risk' waste pathological, infectious, hazardous chemical from other waste and to use proper packaging and labels.
3. Colour coding of waste bags and container should be adopted for high risk waste.
4. The basic approach to waste management is to reduce the quantity of waste at source in order to reduce the quantity of material entering the waste system.
5. Incineration is the preferred method of disposing of pathological and Infectious waste. Incinerators must be specifically designed to deal with such waste and meet the emission standards.
6. Radioactive waste should be stored until their radioactivity has decayed to the point where they are no longer considered radioactive. The waste is then disposed of as applicable.
7. All health care establishments should have a comprehensive waste disposal plans.

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HealthCare Waste Management Area.

Dept Of Conservative Dentistry & Endodontics , M.S.Ramaiah Dental College & Hospital, Bangalore

FOCUS: WASTE FROM DENTAL CARE SETTINGS

DENTAL HEALTH CARE WASTE: ISSUES AND CONCERNS

Dr. K Pushpanjali[1], Dr. Gautham Sukumaran[2],
Dr. Hemanth T[3], Dr. SS Hiremath[4], Dr. S Pruthvish[4]

INTRODUCTION

Let the wastes of "the sick" not contaminate the lives of "the healthy".

Health care activities provide relief to the sick and eventually generate waste that may lead to adverse health effects. Safe and effective management of waste is not only a legal necessity but also a social responsibility. Unscientific management of waste has diverse ramifications as it affects the health of patients, health care professionals and environment. Generation and management of waste in Dental health care establishments have emerged as a prime area of concern in recent times. Owing to the unique quantum characterization and category of waste generated, the waste stream management in a dental set up seems challenging. The existing legislations does not answer several issues regarding waste management at dental establishments. In this context, we attempt to raise and discuss select issues and concerns regarding Biomedical waste management in a dental health care setting.

ISSUES

Macro areas

- Limited prioritization and involvement from administrative, managerial and senior health care professionals, which has resulted in poor systems/ lack of systems in most settings. Lack of Infection control and waste management committees, SOP's and guidelines in most places serve as direct indicators of the degree of institutional commitment.
- Minimal compliance in implementation of BMW rules, probably due to poor awareness and unfavorable attitudes among dental staff regarding any laws for Biomedical waste management.

Micro areas

- Poor knowledge and unscientific practices among dental staff and practitioners has been reported in the literature reviewed.1
- BMW rules give general guidelines for all categories of Health care establishments without specifications to dental establishments which may be the reason behind poor compliance from dental professionals.

Process areas

- Placement of bin beside every dental chair is a major area of concern as it poses difficulty in segregation.

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5 Professor and Head of Community Medicine, MS Ramaiah Medical College and Hospital, Bengaluru- 560054

- Confusion and attitudinal issues regarding specific roles and job responsibilities of the various faculties across broad dental specialties.

Probable solutions

- There exists a great need for developing and implementing a sound system for management of health care waste in all types of dental establishments. But for some reasons it remains a low priority. Removal of chair side bins and placing 3-4 bins as per the need at one end of the department is reasonable.2
- It requires increased awareness, attitudinal change from dental professionals. A concerned effort in this direction is critical. There is a need to focus on individual training programmes (micro bottom up) and macro top-down (governance and administrative) as solution. Our experience in this area has made us believe in "Judicious use of available resources" and involvement of all levels of workers while planning and implementing for a system to be successful .2
- Continuing dental education programs, training and orientation , formation of Health care waste management cell and committees should be given due considerations.3
- Specialized waste services to manage certain wastes should be made available and Dentists needs to be informed regarding this facility.
- Strict implementation of legislation and having a monitoring system at both generation level and disposal level (common biomedical waste treatment facility centers)

CONCERNS

Amalgam Wastes: The use of amalgam restorations has been a contentious issue for long time with no reasonable action. Mercury hazards is well documented from minamata disease in Japan to multiple sclerosis .4

- The Gazette notification of India published in 2007, Sep 10 New Delhi, prescribes that undergraduates during their training need to perform amalgam restoration as a requirement to be competent.
- During the entire program each student has to perform on average 25-30 restorations in undergraduate program and 20 restorations in their postgraduate program.
- With growing number of dental colleges and clinics the total number of restorations is surely a big figure. Informal discussions among members of dental fraternity revealed that on average 15-20 restorations per day in one dental institution and 2-3 restorations per day in a private dental clinic is performed.
- There are over 300 dental colleges each with 50 - 100 students in our country. But this isn't about arguing over numbers, it's about an opportunity for dental fraternity to make a meaningful commitment to environmental protection in their work areas.

- If mercury and silver is mixed in exact ratio there is going to be no excess mercury. Issue is only when proportion is not followed then for every mg of excess mercury there is mercury waste being generated. On an average about 1 mg of mercury is generated for every restoration that is mixed at 1:2 ratios.
- It is said that less than 1% of the total mercury released into the environment is contributed by Dentists and one third of the mercury load in sewage system is due to dental practice.4
- One of the project carried out showed that mercury to be present in air after pre clinical operative session in a dental institution. The results showed mercury levels in the range of 12.03-32.52 in the air .5
- Recent studies suggests that mercury may have no threshold below which adverse effects do not occur .4

Probable Solutions

- Long term strategy would be a move, towards phasing out mercury.
- Immediate strategy would be strict implementation of mercury hygiene practice.
- Mandatory placing of mercury spill kit.
- Containment of excess mercury as per guidelines.
- Adoption mercury free alternatives.

Learning Lessons

- Most of the western countries the dentists have taken move towards phasing out mercury. Many a places voluntary measures have been initiated to reduce mercury contribution to environment either by shifting to alternate restorative materials or by following mercury hygiene practice.
- They all have a voice in declaring, no regulation is necessary rather we follow best management practices and the issue can be addressed. Point worth to mention here is an example of Delhi declaration on Health Care Waste Management during 6th Annual Conference of Indian Society of Hospital Waste Management Elimination of use of mercury in health care establishments. .

Lead Foil

It is used in X-ray film to protect secondary irradiation and back scatter of x-rays. Any dental establishment is bound to generate lead foil as waste. Each lead foil contains 80% of lead and spectrographic analysis showed lead dioxide to be present in this foil. If not managed properly it can be dangerous as it is a leachate toxic detrimental to the environment and human health. Furthermore if it is incinerated owing to poor segregation efficiency levels can lead to increased lead levels in air ,water and soil. Lead levels as high as 2.6 x 103 mg/l have been reported in leachate samples originating from closed land fill sites.[6]

- The amount of lead waste produced by a dental establishment can be significant.
- As per the literature full mouth radiographic examination can generate as much as 11.2 g of lead.6

- An informal discussion with dental faculty and practitioner revealed that 3-4 lead foil per day in a private Dental clinic and 50-60 lead foil per day in dental institution is generated. The 16 dental institutions and 4000-5000 clinics in Bangalore alone can generate as high as 1,460 gms of lead waste (each lead foil weighs around 0.73 gm).
- It is not the issue of finite statistics regarding the quantum of lead but the resulting unpredictable and infinite consequences arising out of environmental pollution which should be our prime concern.

Probable solutions

- Develop uniform standardized guidelines for safe disposal of lead.
- Adopting digital radiography.
- Lead foils to be contained in air and water tight container.
- Never to mix in general or infected waste container.

Learning lessons

A practical application of principles of waste management; namely containment and reuse was demonstrated by a dental college in Bangalore which utilized all lead foils collected for years and prepared Lead shield out of the same. .It is the need of the hour to identify such practical, widely replicable solutions to the existing problems.

BMW management and handling rules specifies the guidelines and standards for all health care establishment, however, the dental establishments are unique because of the differentiation in the quantum and characterization of the various categories of waste generated. The need of the hour is to develop clear guidelines focusing on dental waste and enable system development to suit the scenario of dental establishments. We have attempted to raise and also answer some questions regarding waste management in dental health care settings. It is imperative that rules and policies alone does not matter, what actually matters is the commitment in the implementation and conservation of our environment.7 We sincerely hope that this discussion would lead to development of 'guidelines' for meaningful implementation of BMW rules, 1998.

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FOCUS: WASTE FROM DENTAL CARE SETTINGS

USEFUL REFERENCES FOR DENTAL HEALTH CARE WASTE MANAGEMENT.

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LETTERS TO THE EDITOR

MORE ARTICLES ON SHARPS MANAGEMENT

Sir,

It is commendable that such a kind of journal is being published which adds on to our current knowledge on biomedical waste management. I appreciate the earnest attempts in bringing out yet another volume on Hospital waste management.

Health care waste management is of serious concern. It will be of grave danger if not addressed to at the earliest. This is more so in the context of an accelerated spreading of Hepatitis B & C, Tetanus, Staphylococcal infections, Enteric infections, HIV/AIDS etc.,.

I work under a small set up where the waste generation is minimal and hence it goes for burial. But nevertheless handling of sharps is the most important of all. I had an opportunity to visit nearby clinics and was not surprised to see that many doctors fail to understand the importance of hospital waste management in their busy schedule. They forget their responsibility towards their staff. This is more so when it comes to handling sharps. Workers safety is ignored in this matter. Many of them are unaware of the biomedical waste (management and handling rules) l998.

I request your good self to consider publishing more articles on sharps management of management of Health Care Waste Management.

In one of your article on capacity building and training in Srilanka it has been highlighted that effort was directed towards training and capacity building of nurses and support staff. That will strengthen the HCWM system. . There is an urgent need for working towards such a step in all health care institutions.

Hoping for inclusion of more articles on Sharps management in the forthcoming issues of the Journal.

Dr. Sunitha Singh
Village: Basthoka, Post: Kajara,
District: Jhunjhunu, State: Rajasthan

WASTE MANAGEMENT IN DISASTER SITUATION

Sir,

Efforts in HCWM till date have been largely focused on organized establishments such as clinics, hospitals, laboratories and other similar establishments. However, consequent to our involvement in several disaster response efforts all over the country since 1971, we have noticed that in these situations safe management of health care waste is an important problem that needs to be addressed. You have earlier reported the problems of accumulation of several tonnes of expired and near expiry drugs at Indonesia, Sri Lanka and Nias Islands Post Tsunami. The recent Sphere Consultations to revise the 'Humanitarian Charter and Minimum Standards in Disaster Response' also had a focus aspects related to HCWM under the Health Section. The National Disaster Management Authority of India in its guidelines for Disaster Response has also addressed the issue of HCWM in disasters. Implementing health care waste management (HCWM) guidelines in disaster situations is a challenge despite guidelines mainly due to strapped resources. Some suggestions include:

1. It is important to explore different disaster situations and provide the necessary resources for HCWM given the varied situation in different disasters only after assessment of the specific situation. Resources such as drugs and equipment also need to be procured for relief only after a ground level needs assessment. Specific SOPs need to be developed and followed.
2. Knowledge dissemination regarding HCWM to service providers and relief infrastructure planners is crucial.
3. Resources such as facilities to segregate and disinfect different types of HCW generated is essential at the field level since a number of relief activities are outreach and camp based activities. Indigenous and simple techniques such as the use of Jerry cans filled with Bleach for containing, disinfecting and disfiguring sharps are needed.
4. Periodic assessment of HCWM needed regards to be done at camps and outreach clinics using standard checklists.

Implementation of sound HCWM practices is definitely the need of the hour in disaster situations and ISHWM can provide the right direction. The dissemination of guidelines in this regard is an important step forward.

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INFORMATION

International collaboration to protect health workers from infectious diseases in Ecuador

The Healthy Hospital Project, an international collaboration, aimed to strengthen Ecuador's capacity to promote healthier and safer hospitals by reducing occupational transmission of infectious diseases. Team members conducted a needs assessment to identify workplace hazards and health risks in three hospitals. A survey of health care workers' knowledge and practices of occupational health (OH) and infection control (IC) revealed positive practices such as a medical waste disposal program and widespread dissemination of health information. Challenges identified included a high frequency of recapping needles and limited resources for workers to apply consistent IC measures. The survey revealed under reporting of needle-stick injuries and limited OH and safety (OHS) training. Therefore, project collaborators organized a training workshop for health care workers that aimed to overcome the identified obstacles by integrating interdisciplinary local, national, and international stakeholders to build capacity and institutionalize work-related infection prevention and control measures. The knowledge transferred and experience gained led to useful hospital-based projects and serves as a basis for implementation of other OHS projects nationwide. International interdisciplinary, inter institutional collaboration in OHS and IC can build capacity to address OHS concerns in health care.

http://revista.paho.org/?a_ID=1487

For details, pl contact: Mr Alexander Hildebrand, WHO Equador, PAHO

NEWS FROM DENTAL PROFESSION

Vokkaligara Sangha Dental College & Hospital(VSDCH), Bangalore organized a Continuing Dental Education programme (CDE) and workshop on “Biomedical waste management & infectious diseases” on 28th and 29th September 2010 respectively under the patronship of Mr. Ramesh (Chairman, VSDCH), Dr. Usha H.L. (Principal, VSDCH), Dr. M. Manjunath (Organizing Secretary), Dr. A.G. Annaji & Dr. Chandan G.D. (Coordinators).

CDE programme comprised of four guest lectures.

Dr. Pruthvish, Prof. & Head, Chairperson, Health Care Waste Management cell, Dept. of Community Medicine MS Ramaiah Medical College & Hospital briefed about the importance of segregation of biomedical waste and various safety measures that could prevent the transmission of infectious diseases in clinical practice.

Dr. Sreenivas Murthy, Prof. & Head, Dept. of Conservative Dentistry & Endodontics, MS Ramaiah Dental College & Hospital enlightened the participants about the methods of handling & management of waste generated in different departments of dental college.

Dr. V. Ravi, Prof. & Head, Dept. of Neurovirology, NIMHANS summarized the guidelines for infection control in dental health care settings. He inaugurated (Electronically) of vaccination camp for Hepatitis B and H1N1.

Finally Dr. Meena, Professor, Dept. of Conservative Dentistry & Endodontics, V.S. dental College & Hospital, updated about the recent sterilization protocols.

The response of the audience which included not only the undergraduates & postgraduates but also the paramedical & clinical staff was immensely positive. Overall the programme was successful in accomplishing its goal of making more and more people aware of the hazards of biomedical wastes and the risk they pose in transmission of infectious diseases & develop a workable Action plan.

The workshop on the second day included interactive sessions by Dr. Pushpanjali, Prof. & Head, Dept. of Public Health Dentistry, MS Ramaiah Dental College & Hospital, and Mr. Ramesh, Member of Karnataka State Pollution Control Board. This was followed by training sessions by Dr. S. P. Suryanarayana and Dr. K. Lalitha, Associate Professors. of Community Medicine, MS Ramaiah Medical College & Hospital, for the attenders and paramedical staff who were given tips in managing biomedical waste. An important outcome was preparation of Action Plan.

Day III of the workshop focused on field visit to M.S.Ramaiah Dental College and Hospital, M.S.Ramaiah Group of Hospitals, Bangalore.

Training on Health Care Waste Management at M.R. Ambedkar Dental College & Hospital, Bangalore

Training is a crucial aspect to successfully upgrade health care waste management practices. The overall aim of training is to develop awareness of the health, safety, and environmental issues relating to health care waste management. It should highlight the roles and responsibilities of each health care personnel involved in the management process of the health care waste. More so, in a dental care setup where the quantity and quality of waste generated is very unique when compared to other health care facilities.

The following one day orientation workshop was organized by the M.R. Ambedkar Dental College and Hospital as part of its Continued Dental Education Programme (CDE) for its entire staff including waste handlers and technicians.

Approach: Lectures and Group activities

Contents: Principles of health care waste management, what happens in no action scenario? Infection control, workers safety, BMW Rules, Management of waste generated specifically in a dental care setup.

Workshop: The participants were divided in to various groups and were asked to prepare an action plan to develop systems and subsystems for sound management of health care waste for their hospital.

Lessons learnt

- Training is essential at all levels of health care personnel in a dental setup
- It is necessary that the waste handlers and dental technicians should have a parallel session in the vernacular language, pictorial presentation is preferred and with more emphasis on workers safety.
- Should have a separate session on waste generated in dental care setup and the issues in their management
- Preparation of action plan by the participants will help in bringing out the concerns in their setup.
- Visit of the participants to their own departments to conduct waste survey and study the current situation analysis

- It is recommended to have video demonstrations to break the monotony of lectures.

Figure 1 Action Plan preparation by participants

Figure 2 Orientation for Waste handlers and Dental Technicians

IGNOU CERTIFICATE COURSE ON HEALTH CARE WASTE MANAGEMENT

INDIRA GANDHI NATIONAL OPEN UNIVERSITY

Indira Gandhi National Open University (IGNOU), the largest open university in the democratic world, was established by an act of Indian Parliament in 1985, and started offering academic programmes in 1987 (Diploma in Management and Diploma in Distance Education with 4528 students). Today, it serves the educational aspirations of about 3 million students in 32 countries, including India, through 22 schools of studies and a network of 65 regional centres. The University offers 348 certificate, diploma, degree and doctoral programmes.

The University has been in existence for only two and half decades. In such a short time, the University has contributed significantly to higher education and continuing professional development in the country catering to the· education of about 20 per cent of total students enrolled in higher education (and more than 50 per cent of total students in distance education) in the country. As a world leader in distance education, it was conferred the Centre of Excellence Award in Distance Education in 1993 by Common Wealth of Learning (COL).

SCHOOL OF HEALTH SCIENCES

The School of Health Sciences was established in the year 1991 as one of the eleven schools of the University. Its prime objective is the development and delivery of programmes in the field of medicine, nursing, paramedics through distance education mode and the maintenance of their academic standards. The Certificate Programme in Health Care Waste Management is one of the important programmes developed in the School for the South-East Asia Countries in collaboration with WHO, SEARO.

CERTIFICATE IN HEALTH CARE WASTE MANAGEMENT

The concern for bio-medical waste management has been felt globally with the rise in deadly infections such as AIDS, Hepatitis and indiscriminate disposal of health care waste. The United Nations through UN Basel Convention on the control of transboundary movements of hazardous wastes and their disposal has classified health care waste as most hazardous waste, after radioactive waste.

According to WHO, the eleven South-East Asia countries together produce some 3,50,000 tons of health care waste per year, close to 1000 tons a day. As it is not segregated at source, all of it is to be considered hazardous despite the fact that only 10-20 per cent is infectious in nature (Health Situation in the South-East Asia Region, 1998· 2000, WHO, 1999).

The main bottleneck to sound health care waste management programme is lack of training and appropriate skills, insufficient resource allocation and lack of adequate equipment. The need to educate different health care professionals/ workers, NGOs and other stake holders was thus identified as a priority. To cater the needs of these health care professionals, IGNOU and WHO, SEARO decided to develop and launch Certificate Programme in Health Care Waste Management in the South-East Asia Region Countries. This programme is a 14 credit 6-month certificate programme, through open and distance learning.

This certificate programme has been developed to create essential knowledge and skills in health care waste and equip the leaders to manage it effectively and safely and also safeguard the community against adverse health impact of health care waste.

OBJECTIVES

- Sensitize the learner about health care waste and its impact on our health and environment.
- Acquaint the learner about the existing legis1ation, knowledge and practices regarding infection control and heath care waste management practices in South· East Asia Region Countries.
- Equip the learner with skills to manage health care waste effectively and safely.

BENEFICIARIES

Doctors, Nurses, Paramedics, Health Managers and other professiona1 workers with a minimum of 10 + 2 Qualification.

PROGRAMME PACKAGE

It is a multimedia package consisting of print material in the form of booklets called blocks, audio-visual materials, teleconferencing and providing counseling by contact sessions where the learners are invited to the Programme Study Centres in India and Partner Institutions in other countries for hands on training. The package will have eight theory blocks, a project and programme guide.

BHM-001 Fundamentals: Environment and Health,
Health Care Waste Management Regulations

Block 1: Understanding Our Environment 1
Unit 1 Introduction to Environment
Unit 2 Environmental Pollutants
Unit 3 Interrelationship of Environment and Health
Unit 4 Waste Management

Block 2: Health Care Waste: Definitions 1
Unit 1 Definitions, Types and Categories of Waste
Unit 2 Principles of Health Care Waste Management
Unit 3 Handling Health Care Waste

Block 3: Need for a Sound Health Care Waste Management 1
Unit 1 Impact of Health Care Waste on Our Environment
Unit 2 Impact of Health Care Waste on Human Health
Unit 3 Safety Methodology, worker Safety and Precautions

Block 4: Current Status of Health Care Waste 1 Management legislation in SEAR Countries
Unit 1 Rules and Legislations
Unit 2 Regulatory Mechanisms
Unit 3 Current Status in India. Thailand. Indonesia. Sri Lanka. Bangladesh
Unit 4 Current Status in Bhutan, DPR Korea, Timor Leste, Maldives, Myanmar, Nepal

BHM·002 Health Cart Waste Management Concepts, Technologies and Training

Block 1 Practical Aspects of Health Care Waste Management 2
Unit 1 Managerial and Administrative aspects
Unit 2 Integrated Infection Control Management
Unit 3 Disinfection and Transportation
Unit 4 Capacity Building. Training and Monitoring

Block 2: Systems and Technologies in Health Care Waste Management 2
Unit 1 Systems Options
Unit 2 Treatment and Disposal of Health Care Waste: Burn Technologies
Unit 3 Treatment and Disposal 01 Health Care Waste: Non burn technology
Unit 4 Innovative Concepts and Possibilities

Block 3: Health Care Waste Management and Emerging Issues 1
Unit 1 Managing Waste Water from Health Care Facilities
Unit 2 Management of Wastes from Immunizations
Unit 3 Occupation and Patient Safety
Unit 4 Success Stories

Block 4: Training Manual for Waste Handlers 1

BHMP-001 Project 4

CREDIT SYSTEM

In IGNOU parlance, the study hours are measured in credit system. One credit is equivalent to 30 learning hours. For example, 14 credits of Certificate in Health Care Waste Management programme means an average student will be required to give 420 hours (14 X 30) of input for this programme which includes theory reading, undertaking a project, hands on training, video viewing, counseling etc.

IMPLEMENTATION PLAN

The programme is implemented through a network of Programme Study Centres (PSCs) in India and Partner Institutions (Pls) located in other South-East Asia (SEA) and other countries. This programme is already on offer in Bangladesh, Nepal & Mongolia. These Programme Study Centres and Partner Institutions are located in health care institutions like medical colleges, hospitals, district and private hospitals, rural health centres, etc. A team of trained teachers called counselors is identified and trained for providing academic counseling and supervising the Programme Study Centres/Partner Institutions. The administrative control will be through the Regional Centres (RCs) of IGNOU located usually at state capitals nationally, by the Partner Institutions, and Indian Consulate in other countries and the School of Health Sciences (SOHS) located at the IGNOU Headquarters, Delhi. India.

EVALUATION

Evaluation will be through theory and project evaluation. 70 per cent weightage will be kept for theory term-end examination and 30 per cent for assignments. 40 per cent minimum

pass mark in each component separately is required for successful completion of the programme.

Term-end examination of theory will be held twice in a year i.e. June and December. There will be no practical examination.

ADMISSION INFORMATION

Admission Fee	**:** Rs. 2600/- in India US$ 400 for other SEA countries
Eligibility	**:** Doctors, Nurses, Paramedics, Health Managers and other professional workers with a minimum of 10 + 2 Qualification
Duration	: Minimum 6 months and Maximum 2 years
Session	: January to June and July to December

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GUIDELINES FOR AUTHORS

Journal of the Indian Society of Hospital Waste Management

1. Journal of Indian Society of Hospital Waste Management publishes orginal articles, case reports, review articles, editorials, contemporary issues / agendas book reviews and other related scientific information towards Safe Management of Health Care Waste.

2. Articles are accepted for publications with the understanding that their contents (all or in part) have not been published and will not be published elsewhere, except in the abstract form or with the consent of the Editor. Journal of Indian Society of Hospital Waste Management does not accept any responsibility for the statements made by the authors. The Editorial Board has the right to introduce such changes in the write-up as may be considered necessary for effectiveness of communication.

3. Following CERTIFICATES (Orginal Single copy) must accompany the articles.

(a) Certificate from Authors

(i) Certified that I / We have not used any information or material from official documents graded 'restricted' and above or any 'classified' information obtained in any my / our official capacity in the preparation of the article.

(ii) Certified that this manuscript contains no matter that is libelous or otherwise unlawful, or invades individual privacy or infringes on any proprietary rights.

(iii) All authors certify that they have made substantive and intellectual contributions to the article and assume public responsibility for its content.

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INDIAN SOCIETY OF HOSPITAL WASTE MANAGEMENT

(Founded 2000, registration under the Societies Registration Act XXI of 1860, Reg No. 36939 of 2000)

The Government of India published a Gazette notification on 20 July 1998 making all personas who generate, collect received, store, transport, treat, dispose or handle medical waste in any form responsible for handling the medical; waste without and adverse effect to human health and the environment. Consequent to the publication of above Gazette Notification on Bio-Medical Waste Management. It is mandatory for all hospitals and health institutions to implement the rules.

Since Hospital Waste Management is a perpetual problem, it was felt that there should be an all India Organization/Society comprising of experts/specialists from various disciplines involved in Hospital Waste Management. This Society should provide conceptual guidance and oversee scientific research for further development.

With this important aspect in mind, the Registrar of Society at Delhi was approached for registration of the 'Indian Society of Hospital Waste Management (ISHWM)' and the Society came into existence on 10th April 2000 and registration under Societies registration Act XXI of 1860 with Registration Number 36939.

The aims and objectives of the Society are as follows:

(a) To promote and advance the knowledge in Environmental Protection with special reference to Hospital Waste Management/ It also envisages promotion and improvement in public health. Protection to the environment, hospital and 'individual through the practice and education in the subject's dealings with the said subject.

(b) The subject of Environmental Protection and Hospital Waste Management involves multidisciplinary approach and involves active participation by specialists of various disciplines such as pathology, Microbiology, Hospital Administration, Preventive & Social Medicine. Therefore, it will function to bring together specialists from various disciplines under a roof with a common goal a personal and environmental protection.

(c) To propagate education and inculcate awareness in hospital as well as general population.

(d) To advance research in various field, connected with Environmental Protection and Hospital Waste Management.

(e) To function as an interface with Industries involved in designation/manufacture of bio -medical waste disposal equipment/appliance for R&D development India.

To fulfill and further the above objectives the Society shall

(a) Hold periodically meetings, seminars, workshops, training courses and annual conference of the members of the Society.

(b) Conduct workshops, training courses etc. separately for the benefit of the beneficiaries such as general public, hospital waste handlers, patient & their relatives.

(c) Publish and circulate a journal on Hospital Waste Management and Environmental protection.

(d) Maintain a Library at the location of the permanent officer as a when established.

(e) Generate funds from all possible sources. The funds so generated will be utilized for advance in the knowledge of disposal of waste and environmental protection. Scholarships and Awards for outstanding contributions will be judged on merit by a special board of officers nominated from time to time.

(f) Propose to the Government the laws and regulations in respect of disposal of waste from the hospitals and environmental protection.

(g) Create and assist State-wise branches to propagate the objectives all over the country in a methodical and systematic manner.

EMBLEM & LOGO

The Emblem of the Society has been aptly designed to convey the message of environmental protection by confining hazardous hospital waste. The concept of the Emblem is:-

Hospital waste management uses four colours namely Green, Black, Yellow and Red (Coding colours) used for bags to collect and dispose off hospital waste.

Hands: The two figures over the top and bottom denote the hands in light brown outlined with black to denote the hands, which stand for the control and management of waste.

Syringe: The syringe has been used as a symbol to represent hospital waste due to its extensive use in clinical practice.

Biohazard: Hospital waste is a serious biohazard hence the universally accepted logo for biohazard appears in the backdrop.

Tree & the Blue background: denote the Eco friendliness, which is very important while disposing of hazardous, waste.

Summary: the Logo depicts the hospital waste (syringe), which is a biohazard to the community being efficiently managed (by hands) in an environmental friendly (tree and blue background) manner.

ISHWM: Indian Society of Hospital Waste Management.

Please visit our **website: medwasteind.org** for details including memberships forms.

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