A study on hospital solid waste - quantification and microbial analysis in a hospital near kanyakumari district

A.V. Ajikumar[1] & S. Godwin Wesley[2]
[1]Research Scholar, [2]Professor Emeritus
Department of Zoology and Research Centre, Scott Christian College (Autonomous),
Nagercoil – 629 003, Kanniyakumari District, Tamil Nadu
[Affiliated to Manonmaniam Sundaranar University, Tirunelveli]
Corresponding Author: A.V. Ajikumar

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ABSTRACT: : *Studies of waste management in Indian hospitals are very low. Too much of biomedical wastes production increase the risk of dangerous diseases which may be transmitted to humans. These wastes treated as general waste and mixed with general waste. This infectious wastes decay and mix with the soil. During rainy season, such dangerous wastes mix with the rain water leading to epidemics such as cholera. Fecal coli forms have been found to be higher even in bore wells near hospitals. In this study quantity of solid waste generated from the hospital was estimated six times at an interval of 3 months (January 2010 to June 2011). During the study period, the solid waste produced in the hospital (from 267 beds) ranged between 490.12±72.63 and 643.53±66.13 kg day^{-1}. The mean healthcare waste generation rate estimated in the present study was 0.48±0.05 to 4.38±0.36 kg bed^{-1} day^{-1}. Total coliforms were found to be in the range of 4±1×10^{7} CFU mL^{-1} and staphylococcal count (3.67±0.58×10^{7} CFU mL^{-1}), Fecal enterococcal count was recorded 5±1.73×10^{7} CFU mL^{-1} and Pseudomonas colonies were present numbers 3.67±1.53×10^{7} CFU mL^{-1}. Concerning Vibrio spp, recorded the value of 3.33±0.58×10^{7} CFU mL^{-1}.*

Key Words:

Introduction

Municipal solid waste management is among the biggest challenges faced throughout the world. In developing countries, sometimes biomedical waste is treated as general waste and mixed with general waste, leading to the spread of dangerous diseases which may be transmitted to humans. Illegal repacking and resale of contaminated hospital utensils lead to hospital- inflicted diseases some of which are HIV/AIDS, hepatitis, etc.

But with judicious planning and management, the risk can be reduced. Studies have shown that healthcare waste consists of 5% hazardous waste and 10% infectious waste and the remaining 85% is noninfectious waste. Handling the 15% waste properly will lead to reduction in such risks (Katoch, 2007). At present, solid wastes generated by hospitals, research centres, community centres, public places, etc. need immediate proper disposal policy.

The World Health Organization estimates that each year there are about 8 to 16 million new cases of hepatitis B virus (HBV), 2.3 to 4.7 million cases of hepatitis C virus (HCV) and 80,000 to 160,000 cases of human immune deficiency virus (HIV) due to unsafe injections and mostly due to very poor waste management systems (WHO, 1999).

Biomedical wastes in hospitals fall under two major categories: non-infectious and bio-hazardous. Constituents of non-infectious waste are non-infected plastic, cardboard, packaging material, paper, etc. Bio-hazardous again falls into two types: (a) *Infectious waste* - sharps, non-sharps, plastics, disposables, liquid waste, etc.; (b) non-infectious waste radioactive waste, discarded glass, chemical waste, cytotoxic waste, incinerated waste, etc. The most appropriate way of identifying the categories of biomedical waste is by sorting the waste into colour -coded plastic bags or containers (Rao *et al*., 2004).

Studies of waste management in Indian hospitals are very low (Lakshmi, 2003; Patil and Pokhrel, 2005). In India, in view of the serious situation of biomedical waste management, the Ministry of Environment and Forests, within the Government of India, ratified the Biomedical Waste (Management and Handling) Rules, in July 1998. Inappropriate managed wastes dumping yards, sludge collecting/disposing sites, and regions meant for storing/ packaging of highly infectious wastes are virtual store houses of different microbes. Untreated infectious wastes decay and mix with the soil. During the mansoon, such

dangerous wastes mix with the rain water leading to epidemics such as cholera. Fecal coli forms have been found to be higher even in bore wells near hospitals.

Materials and methods

Study Area

The hospital from where samples were collected is situated in south India. J S Medical Trust Hospital situated in Nagercoil, Kanyakumari district. A 267 bed hospital, it has various departments which including general medicine, general gynecology, general surgery, ENT, pediatrics, and psychiatry. In addition to this, the hospital offers super specialty services in cardiology, urology, neurology, laparoscopic surgery, pediatric surgery, neonatology as well as gastroenterology.

A general survey of the total solid bio-medical waste produced from each ward from this multi-specialty hospital and number of selective bacteria present in each sample was done and samples were collected. The quantitative analysis of the solid waste in between January 2010 and June 2011 in six quarters, and the microbiological parameters were analyzed between January 2010 and December 2010 in four quarters. During each quarter, samples were collected continuously for a 5-day period. Samples were collected from each sampling unit in different sterilized bottles for further analyses. Per-bed and per-day volume of solid waste generated was assessed.

Sample Collection

In the hospital colour coded high-density polyethylene bags are used for easy identification and segregation of wastes. The samples were transported to the laboratory within 2 h in ice jackets. Solid waste samples were collected from each wards in a sterile zip lock high-quality polythene bags and sealed immediately. During collection, sterile gloves and masks were used. This was conducted in accordance with the United States Environment Protection agency (US EPA) -approved Quality Assurance Project Plan. Each site was sampled five times at 3-month interval, during the period from January 2010 to June 2011. The wastes were quantified and recorded for five continuous days in an interval of 3 months. Wet wastes generated in the hospital kitchen, Children's Park, laundry, rest room and office were also included in this study. Part of these non-infectious general wastes is used for biogas production in the hospital.

Selective bacterial count

Soil samples were collected from waste dumping site and sludge disposal area; selective bacterial analyses were done. MacKonkey agar (Hi-Media, India) was prepared and diluted samples were spread in plates and incubated for estimating of coliforms and fecal enterococcai; shigella salmonella agar (SS) for *Salmonella* spp., mannitol salt agar for *Staphylococcus* spp.; cetrimide agar (or *Pseudomonas* agar) for *Pseudomonas* colonies; and thiosulphate citrate bile salt (TCBS) agar for *Vibrio* spp. The inoculated media were incubated in an aerobic environment for 24 to 48 at 37˚C.

Result and discussion

The quantity of solid waste generated from the hospital was estimated six times at an interval of 3 months (January 2010 to June 2011). During the study period, the solid waste produced in the hospital (from 267 beds) ranged between 490.12±72.63 and 643.53±66.13 kg day^{-1}. The highest quantity of solid (643.53±66.13 kg day^{-1}) waste was recorded in the sixth quarter (April to June 2011). The lowest quantity (490.12±72.63 kg day^{-1}) was collected during the second quarter (April to June 2010). The highest volume of solid waste was generated in the sixth quarter of the study. The southwest monsoon sets in May and continues until September in Kanyakumari district. More rain is associated with the spread of many diseases, leading to the increase in the number of inpatients, and hence to the generation of more solid waste. This is reflected in the higher quantum of waste recorded during the fifth and sixth quarters, which fall within the monsoon season.

The mean healthcare waste generation rate estimated in the present study was 0.48±0.05 to 4.38±0.36 kg bed^{-1} day^{-1}. In the first quarter the highest quantity was recorded in the E-block (ICCU, semi-private, cardiology, private and hemodialysis) private (3.38±0.42 kg bed^{-1} day^{-1}) and the lowest (0.61±0.11 kg bed^{-1} day^{-1}) in the urology section. In the second quarter the highest value was recorded (3.43±0.45 kg bed^{-1} day^{-1}) in NICU and the lowest in the urology division (0.71±0.1 kg bed^{-1} day^{-1}); in the third quarter the highest (3.52±0.33 kg bed^{-1} day^{-1}) in E-block private and the lowest in the urology division (0.5±0.08 kg bed^{-1} day^{-1}). In the fourth quarter the highest volume (2.92±0.45 kg bed^{-1} day^{-1}) was again recorded in NICU and the lowest (0.16±0.03 kg bed^{-1} day^{-1}) in the urology section and in the fifth quarter the highest (4.38±0.36 kg bed^{-1} day^{-1}) in NICU and H-block (MICU, SICU and private) private wards and the lowest (0.73±0.07 kg bed^{-1} day^{-1}) in the haemodialysis section. In the sixth quarter the highest amount was recorded (3.75±0.25 kg bed^{-1} day^{-1}) in NICU and lowest (0.5±0.06 kg bed^{-1} day^{-1}) in the haemodialysis unit. In middle- and low-income

countries the quantum of solid waste generated from hospitals is 0.5-6 and 0.5-3 kg bed^{-1} day^{-1} (WHO, 1999). Altin *et al.* (2003) and Ahmed *et al.* (2014) implied that the quantity of waste produced in a hospital depends on the national income and the type of facility concerned. In high-income countries hospitals produce wastes up to 4-9 kg bed^{-1} day^{-1} and general hospitals up to 1-4 kg bed^{-1} day^{-1}. Tabasi and Marthandan (2013) and Thirumala (2013) also reported that the quantum of waste generation not only depends on the type of hospitals but also on the income of the country. It may also differ based on the management of hospital, i.e. in India, hospital management can be government, semi-government or private. A study conducted in one of the districts of south India showed that government and private hospitals generate wastes around 5-7 and 2-4 kg bed^{-1} day^{-1}, respectively and another study conducted in one of the districts in western India revealed that both private and government hospitals generate around 1-3 kg bed^{-1} day^{-1}. The values reported are extremely high compared to those of the present study. This implies that the hospital studied has a carefully planned system, which leads to the production of minimal wastes.

The mean healthcare waste generation rate estimate in present study is 0.48±0.05 to 4.38±0.36 kg $bed^{-1}day^{-1}$. These values are higher than those reported in Saudi Arabian health centres, the mean waste generated being 0.07 kg bed^{-1} day^{-1} (Al-Zahrani *et al*., 2000). Babu *et al*. (2009) reported that the waste generation rate ranges between 0.5 and 2.0 kg bed^{-1} day^{-1} in Indian hospitals. The lower value of the above-mentioned range is similar to that of this study.

The total amount of non-hospital waste generated from the hospital compound (hospital surroundings such as laundry, canteen, restroom, waiting shed, kitchen, office, playground and others) was estimated. The highest volume was recorded in the fifth quarter (January to March 2011) (330.75±21.53 kg day^{-1}) and the lowest in the second quarter (April to June 2010) (217.8±24.5 kg day^{-1}).Estimating the total quantum of waste including those generated from the wards and surroundings revealed that the highest volume was recorded in the sixth (April to June 2011) quarter (966.53±90.3 kg day^{-1}), followed by the fifth (January to March 2011) quarter (953.2± 73.18 kg day^{-1}).

Taskona (2007) reported that in a 450-bed hospital in Greece, 650 kg of infectious waste and 3250 kg of non-infectious waste are being produced each day; the quantities corresponded to 1.4 kg bed^{-1} day^{-1} of infectious waste, 7 kg bed^{-1} day^{-1} of non-infectious waste and thus 8.4 kg bed^{-1} day^{-1} of total waste. According to WHO report in 1999, average generation rate of hospital waste was 4.1-8.7 kg bed^{-1} day^{-1}.The amount of hospital waste generated in kilogram per bed per day was 2.5 kg in UK, 4.5 kg in USA, 2.3 kg in France, 3 kg in Spain and 1.5 kg in India. These findings are very closely related to the results of this study. In the data of the United States Environmental Protection Agency (US EPA) of America and Japan, Ministry of Health suggested a volume of 1 to 1.5 kg bed^{-1} day^{-1} for hospitals is normal quantity. But waste production has been quoted up to 5.24 kg in developed countries. The average quantity of hospital solid waste produced in India ranges from 1.5 to 2.2 kg bed^{-1} day^{-1} (Manasi, 2017).

Solid waste from hospitals includes bandages, linen and other infectious waste (30-35%), plastics (7-10%), disposable syringes (0.3-0.5%), glass (3-5%) and other general wastes including food (40-45%). The percentage of similarity in the quantum of solid waste generated from wards between different periods (quarters) was analyzed by using the Bray-Curtis Similarity Index (Primer-6 software). The highest similarity (95.5%) was found to be between the third (July to September 2010) and sixth (April to June 2011) quarters and the lowest (79.69%) between the fifth (January to March 2010) and sixth (April to June 2011) quarters. Proper segregation is the best method suggested to reduce the production of more infectious solid wastes.The variation in the volume of waste generated could be due to the differences in resource inputs to health facilities, linearity between visitors and waste generation rate season of the year, availability of different facilities, social status of the patients, waste management, legislative system of the country, and the economic strengths of the country.

The percentage of similarity in the quantity of the solid waste generated per bed per day between different wards and periods (quarters) was analyzed by using the Bray-Curtis Similarity Index (Primer-6 software). The highest similarity of waste produced per bed per day was 95.59% between G-block private and I-block private wards, followed by G-block private and E-block private (95.35%). The lowest similarity (54.51%) was recorded between urology and hemodialysis sections. considering solid waste other than hospital ward wastes, the highest similarity (98.18%) was noted between kitchen and canteen and the lowest (88.12%) between playground and canteen (Figure 5).

As regards the per-bed, per-day samples, the quarter-wise similarity analysis revealed the highest (97.52%) similarity between the first (January to March 2010) and third (July to September 2010) quarters and lowest similarity (92.02%) between the second (April to June 2010) and sixth (April to June 2011) quarters (Table 1). Concerning the other wastes produced, the highest similarity (99.06%) was found between the first (January to March 2010) and third (July to September 2001) quarters and lowest

(89.19%) between the monsoon second and fifth quarters (Figure 5). The data distribution of the waste quantity was analysed using ProUCL software.

Bacteriological studies

Bacteria (total coliforms, fecal enterococci, staphylococci, *Pseudomonas* sp, *Salmonella* sp. and *Vibrio* sp.) were isolated by using selective bacterial media (Figure 2 and 3). Total coliforms were found to be in the range of $4\pm1\times10^7$ CFU mL^{-1} in the waste dumping site-3 to $5.67\pm1.53\times10^7$ CFU mL^{-1} in the sludge disposing site 3 and waste processing/packaging area. Fecal enterococcal count was recorded to be the highest in the waste dumping area-1 ($5\pm1.73\times10^7$ CFU mL^{-1}) and the lowest ($0.67\pm0.58\times10^7$ CFU mL^{-1}) in liquid sludge-3. The highest staphylococcal count ($3.67\pm0.58\times10^7$ CFU mL^{-1}) was recorded in the waste packing area 1 and the lowest ($0.033\pm0.58\times10^7$ CFU mL^{-1}) in the liquid sludge 3. *Pseudomonas* colonies were present in higher numbers ($3.67\pm1.53\times10^7$ CFU mL^{-1}) in the waste packing area 1. In the case of *Salmonella* sp. the highest number ($3\pm1.73\times10^7$ CFU mL^{-1}) was recorded in the waste packing area 1 and the lowest ($0.67\pm0.58\times10^7$ CFU mL^{-1}) in the liquid sludge 3. Concerning *Vibrio* spp, waste packing area 1 recorded the highest value ($3.33\pm0.58\times10^7$ CFU mL^{-1}) and liquid sludge disposing area 1, liquid sludge 3 and waste packing area 2 (Figure 6) recorded the lowest value ($1.33\pm1.15\times10^7$ CFU mL^{-1}).

High count of tested bacterial species (total coliforms, staphylococci, *Pseudomonas* sp., *Salmonella* sp. and *Vibrio* sp.) was noted in the waste-packing area 1, except fecal enterococci. The liquid sludge disposing area 1 recorded higher counts of fecal enterococci. Of all the bacterial species studied, the lowest counts were reported from the liquid sludge-disposing area 3. In the hospital studied, highly infectious waste such as blood samples, operation wastes; human sputum, etc. are kept in a separate area for packing and final disposal (incineration). Medical Council of India regulations imply that the infectious waste should not be dumped in the open. They should not be stored more than 48 hours. This may be the reason why the selective bacterial count was higher in this area. The sludge-disposing area 3 recorded the lowest count. This is because of the fact that sludge is the end product of a long process of wastewater treatment. Various disinfectants and chemicals are added to the wastewater leading to the reduced survival of many bacteria. Coliform bacteria thrive in wet areas. The population of these microbes have also been found to be higher in samples after treatment. *Staphylococcus* sp., *Salmonella* sp. and *Enterococcus* sp. are associated with significant infection in clinical areas or with serious disease outbreaks. The presence of these organisms should generate immediate attention towards cleaning/disinfection practices. Risk assessment would determine a review of existing practices leading to additional cleaning or even closure of a clinical area for deep cleaning if thought appropriate (Vishal *et al*., 2011). *Pseudomonas aeruginosa* is an opportunistic pathogen and is resistant to many antibiotics; it leads to respiratory infection in patients with cystic fibrosis. *Pseudomonas* can spread by contaminated equipment and can be incorporated into piped portable water. It also affects the intestine, eyes and the urinary tract (Hadault *et al*., 2001; Fathi *et al*., 2014).

Escherichia coli, the human pathogen, presents a serious risk of disease. It is present high counts in hospital wastewater and in intestine of living organisms (Guardabassi *et al*., 1998). *Vibrio* sp. is a Gram-negative bacteria causing food-borne infection and is associated with under-cooked foods. This facultative anaerobe leads to gastroenteritis and causes septicemia. *V. cholerae* causes cholera and is transmitted through contaminated water (Faruque *et al*., 2008). *V. parahaemolyticus* is a human pathogen, and causes human diarrhoea or extra-intestinal infections. *Salmonella* spp. are pathogens of humans, and warm- and cold-blooded animals. It causes typhoid and enteric infections. *Salmonella* and *Shigella* sp. have also been isolated from hospital wastes (Tsai *et al*., 1998). *Staphylococcus* sp. is commonly found in the environment and also found in skin, intestine and nasal passages. *S. aureus* is a pathogen of external ear and eye. Coliforms are found in soil, water and influence surface water and is the general indicator of sanitary condition (Tan *et al*., 2008).

Fecal coliforms are present in the gut and feces of warm-blooded animals and are an indicator of animal or human waste. *E. coli* is the major fecal coliform and best indicator of fecal pollution and presence of pathogens. It is present in under-cooked foods and drinking water and affects humans and animals, causing urinary tract and intestinal infections (Tan *et al*., 2008).

Symptomless carriers carry enteropathogens such as *Salmonella* sp., and other bacteria such as *Streptococcus pyogenes*, *Corynebacterium diphtheriae*, *Neisseria meningitidis*, hepatitis B virus, and cytomegalovirus. Contamination of patients by carriers can give rise to an outbreak of disease. In developing countries *Vibrio* is one of disease agents associated with the mixing of sewage and drinking water (Pereira *et al*., 2007). *Salmonella enterica* sv. Typhimurium remains the most frequently isolated in human, swine, avian, and bovine salmonellosis (Popff and Minor, 2013).

The similarity in the bacterial counts present in the sampling sites was analyzed by the Bray Curtis

Similarity Index. The highest similarity (94.26%) was noted between liquid sludge disposing area 2 and waste dumping area 3. The lowest similarity (79.16%) was recorded between waste dumping area 1 and waste packing area 2. Similarity was high (92.61%) between fecal enterococci and coliform numbers. These species were most predominant in the samples. The lowest (34.01%) similarity was noted between coliforms and *Pseudomonas*. The distribution of the bacterial species was analyzed and graphically represented (Figure 2) by using ProUCL.

Figure 1. Distribution of quantity of solid hospital waste collected from different wards.

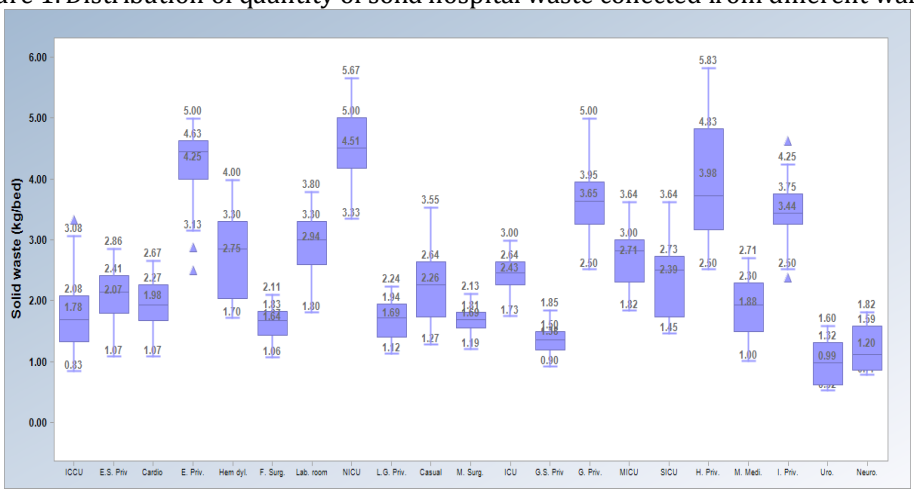

Figure 2. Cluster analysis on the quantity of selective bacterial counts.

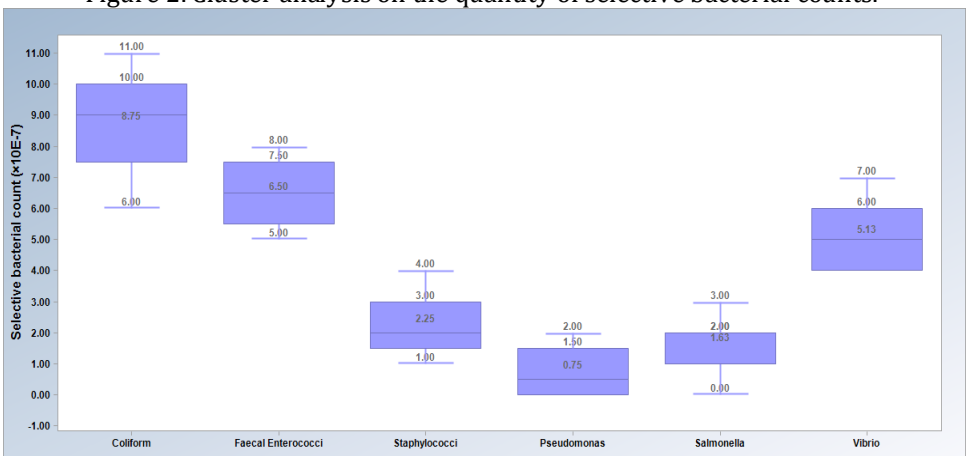

Figure 3. Selective bacterial count in hospital solid waste.

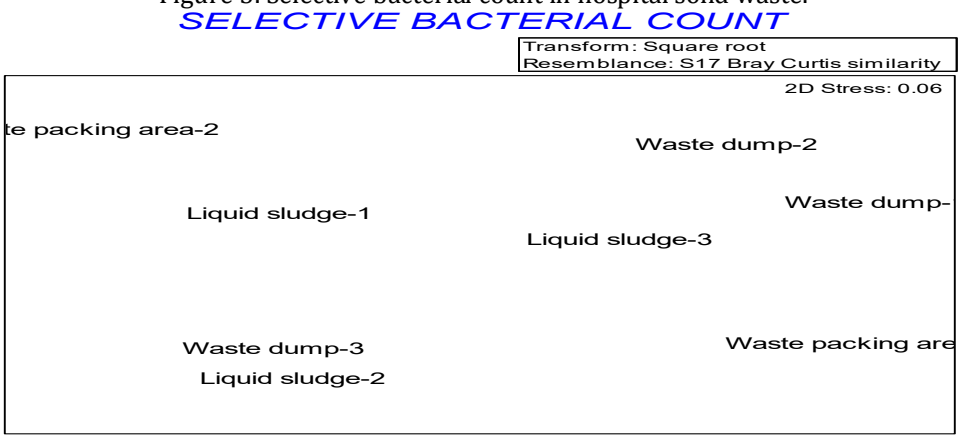

Figure 4. Similarity index of quantity of solid hospital waste collected from different wards.

HOSPITAL SOLID WASTES
Similarity (0 to 100)

SAMPLING SITES	ICCU	E.S. Priv	Cardio	E. Priv	Hem dyl	F. Surgi	Lab room	NICU	L G Priv	Casual	M Surgi	ICU	G. S. Pri	G. Priv	MICU	SICU	H. Priv	M. Med	I. Priv	Uro	Neuro
ICCU																					
E.S. Priv	91.546																				
Cardio	94.664	95.208																			
E. Priv	78.031	82.131	80.958																		
Hem dyl	67.129	70.989	69.881	88.123																	
F. Surgi	90.893	93.244	92.464	76.62	65.808																
Lab room	85.471	90.224	88.915	90.412	79.237	85.545															
NICU	76.551	80.624	79.458	96.641	89.629	75.15	89.217														
L G Priv	93.817	92.972	95.198	77.32	66.463	94.362	85.929	75.845													
Casual	93.069	92.6	93.689	83.887	72.73	90.262	90.481	82.45	91.465												
M Surgi	93.995	93.977	94.217	77.381	66.519	95.815	86.226	75.905	95.641	91.698											
ICU	89.574	94.448	94.266	86.176	74.859	90.068	93.602	84.675	90.336	92.53	90.767										
G. S. Priv	90.743	90.03	90.225	72.648	62.114	94.628	81.416	71.21	93.712	87.468	94.33	85.914									
G. Priv	81.661	85.817	84.63	95.347	84.535	80.227	93.708	94.086	80.939	87.675	81	89.932	76.184								
MICU	88.97	92.008	91.984	88.471	77.337	87.397	93.484	87.251	88.231	94.53	88.047	94.757	83.347	92.452							
SICU	91.029	91.062	93.029	85.214	74.041	89.167	89.284	83.821	90.079	94.338	90.446	93.508	86.681	88.969	93.961						
H. Priv	79.767	83.895	82.715	93.986	86.434	78.344	90.646	95.08	79.05	85.742	79.111	87.724	74.336	94.578	90.587	87.127					
M. Medi	92.854	91.704	92.823	79.523	68.529	90.986	87.714	78.032	93.044	94.009	92.291	91.661	90.425	83.175	90.258	93.361	81.269				
I. Priv	83.134	87.265	86.118	92.975	83.055	81.692	93.636	92.51	82.408	89.059	82.47	90.997	77.623	95.596	94.054	90.565	93.875	84.656			
Uro	85.238	81.025	82.263	64.423	54.571	86.046	72.765	63.067	85.971	79.274	85.908	77.096	89.334	67.771	74.621	77.927	66.019	83.714	69.14		
Neuro	89.9	85.221	87.355	69.059	58.805	89.699	77.657	67.654	91.104	84.313	91.032	82.091	91.275	72.519	79.56	82.94	70.71	88.828	73.93	93.669	

Figure 5. Similarity index of quantity of solid hospital waste collected other than wards.

WASTE (OTHER THAN WARDS)
Similarity (0 to 100)

SAPLING SITES	LAUNDRY	CANTEEN	REST ROOM	PHARMACY	W. SHEAD	KITCHEN	OFFICE	PLAY GROU	SURROUND
LAUNDRY									
CANTEEN	98.064								
REST ROOM	95.857	96.497							
PHARMACY	94.452	93.939	96.467						
W. SHEAD	90.264	90.363	93.306	94.23					
KITCHEN	97.711	98.182	96.048	93.882	90.442				
OFFICE	92.038	92.268	94.498	95.391	96.547	91.832			
PLAY GROU	88.123	88.936	91.28	91.926	95.062	88.521	95.342		
SURROUND	88.803	89.174	91.546	92.514	94.856	89.18	95.366	97.281	

Figure 6. Selective bacterial count in hospital solid waste collected from different sample collection sites.

SELECTIVE BACTERIAL COUNT
Similarity (0 to 100)

SAMPLING AREAS	Waste dump-	Waste dump-	Waste dump-	Liquid sludge	Liquid sludge	Liquid sludge	Waste packir	Waste packir
Waste dump-1								
Waste dump-2	92.353							
Waste dump-3	85.547	86.03						
Liquid sludge-1	85.264	89.491	94.126					
Liquid sludge-2	83.584	82.267	94.255	90.664				
Liquid sludge-3	93.6	92.435	90.002	91.847	90.161			
Waste packing are	91.334	92.138	81.624	83.466	85.612	91.858		
Waste packing are	79.161	83.49	87.744	92.266	88.09	85.905	79.294	

Table 1. Total quantity of solid waste generated in hospital wards (kg bed^{-1} day^{-1}).

Wards	No. of beds	First quarter January to March, 2011	Second quarter April to June, 2011	third quarter July to September, 2011	Fourth quarter October to December, 2011	Fifth quarter January to March, 2012	Sixth quarter April to June, 2012
ICCU	12	1.42±0.35	1.13±0.22	1.41±0.22	1.71±0.25	2.02±0.26	3.02±0.22
E.S. Priv	14	2.41±0.30	1.77±0.23	2.19±0.27	1.46±0.31	2.20±0.15	2.39±0.21
Cardio	15	1.91±0.22	1.31±0.15	1.82±0.29	1.90±0.24	2.42±0.19	2.53±0.16
E. Priv	8	4.38±0.42	4.10±0.73	4.52±0.33	3.28±0.70	4.63±0.23	4.59±0.24
Hem dyl	4	0.75±0.11	0.83±0.14	0.81±0.06	0.49±0.05	0.74±0.07	0.51±0.06
F. Surgi	18	1.90±0.19	1.73±0.24	1.75±0.12	1.39±0.24	1.54±0.17	1.51±0.19
Lab.room	10	3.28±0.29	3.34±0.38	3.34±0.15	2.60±0.25	2.28±0.33	2.80±0.59
NICU	6	4.27±0.64	4.43±0.45	4.34±0.24	3.92±0.45	5.38±0.25	4.75±0.25
L G Priv	17	1.62±0.37	1.31±0.17	1.69±0.26	1.74±0.28	1.75±0.06	2.04±0.21
Casual	11	2.04±0.66	1.76±0.18	1.63±0.31	2.43±0.13	2.32±0.39	3.36±0.22
M Surgi	16	1.69±0.27	1.53±0.24	1.66±0.09	1.55±0.14	1.98±0.14	1.73±0.12
ICU	11	2.31±0.39	2.55±0.29	2.44±0.19	2.14±0.33	2.68±0.10	2.48±0.20
G. S.Priv	20	1.32±0.22	1.37±0.28	1.40±0.10	1.19±0.17	1.33±0.11	1.70±0.15
G. Priv	8	3.95±0.65	3.10±0.52	3.54±0.35	3.31±0.23	3.75±0.29	4.25±0.42
MICU	11	2.31±0.43	2.29±0.40	2.54±0.31	2.95±0.19	2.82±0.19	3.36±0.23
SICU	11	1.73±0.36	2.00±0.39	1.64±0.23	2.66±0.08	3.57±0.08	2.77±0.30
H. Priv	6	3.43±0.89	3.47±0.63	3.11±0.39	3.79±0.48	5.38±0.36	4.71±0.32
M.Medi	14	1.30±0.30	1.94±0.22	1.31±0.38	2.30±0.20	1.89±0.18	2.52±0.14
I. Priv	8	3.03±0.50	3.10±0.60	3.35±0.32	3.78±0.54	3.84±0.24	3.50±0.15
Uro	25	0.62±0.11	0.72±0.10	0.60±0.08	1.16±0.03	1.51±0.08	1.32±0.16
Neuro	22	0.86±0.06	0.98±0.13	0.87±0.07	1.50±0.12	1.73±0.07	1.25±0.22

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