Assessment of Bio-Medical Wastes Disposal and Management in Some Major Hospitals of Mysore City, Karnataka.

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Abstract

Medical care is vital for our life and health, the waste generated from medical activities represents a real problem of living nature and human world which includes the newly seen, hospital-inflicted diseases. All round technological progress has led to increased availability of health related consumer goods, which have the potentiality to produce more waste. Proper handling, treatment and disposal of biomedical waste play a vital role in hospital infection control programme. The disposals of bio-medical wastes have been studied at various hospitals like, Krishnarajendra Hospital (K.R.Hospital), J.S.S. Hospital, Apollo Hospital and Kamakshi Hospital from the month of January to April 2013 by analysing the procurement lists. The average waste generated /day in K.R., J.S.S., Apollo and Kamakshi hospital was 84.62,51.18,50.69 and 41.14 kg, average number of patients /day were 338.07,853.00,140.83 and132.73 and the beds capacity is 1050,1200,250 and 200 respectively. Various issues like sources, container and colour coding types, qualitative and quantitative composition of infectious wastes and proportions of different categories of wastes handling, treatment and disposal methods have been examined. One way analysis of variance test has been carried out to determine the possible interrelationship between the wastes originating from different departments of different hospitals. The proper disposal methods have not been employed in Kamakshi Hospital, J.S.S. Hospital, and K.R. Hospital when compared to Apollo Hospital. In addition, the differences in the infrastructure were examined and the consequences for waste segregation and disposal methods were also discussed under economic and ecological aspects. For this existing problem, proposed systems of bio-medical waste management are described to improve the disposal practices. A waste management strategy has also been proposed.

Key words: Bio-medical waste, public health, colour coding, infectious waste, disposal options.

1. Introduction

Disposal of bio-medical wastes has emerged as a major problem in India. The public is increasingly concerned over improper disposal of hazardous wastes and bio -medical wastes are still handled and disposed together with domestic wastes, thus creating a great health risks to both the public and the environment. Hospitals are known for the treatment of sick persons but, we are unaware about the adverse effects of the garbage and filth generated by them on human health. The waste is increasing in its amount and type due to advances in scientific knowledge and has an impact on human lives [16].There are quite a few research reports on the biomedical waste disposal [2,4,5,6,7,10,13,17,18]. Most of them have dealt with the effects and consequences of unmanaged hospital wastes in major cities.

Mysore city with a large population of about 11 lacks has many private as well as government hospitals that generate huge amounts of wastes every day. Disposal techniques are not perfect. Newer technologies are not adopted and therefore waste disposal methods have suffered leading to various problems in and around the Mysore city. There is no rational decision on waste management is possible until the generation and composition of solid waste is perfectly known. The disposal methods, which may be conditioned by proportions is of recycled, degradable and non-degradable materials [12, 20,21]. Hence, the present study was undertaken to know the disposal practices of bio-medical wastes, to suggest proper disposal methods and management of bio-medical wastes in four major hospitals of Mysore City K.R. hospital, J.S.S. hospital, Apollo hospital and Kamakshi hospital.

2. Materials and Methods

The work is carried out by different techniques adopted to choose the ways and means for the collection of data in Mysore city pertaining to of solid waste. The study consists of collection of data from primary and secondary sources related to the generation, administration, collection, transportation, disposal of solid wastes generated and its impact on human life if not properly disposed it will lead to epidemic diseases for the human health. The primary data regarding the generation and disposal of solid wastes have been collected from the different localities of the sample households in the study area by using personal investigation, questionnaire and interview regarding the segregation and disposal and transportation from their houses per day. The secondary data regarding the topic have been collected from the available studies that have been taken from the internet, e-journals and related to the transportation of solid wastes. In a similar way

consulted the environmental engineers of the Mysore city corporation, who are having the data on different themes pertaining to the paper.

2.1 Study Area

Mysore city occupies an important location in the larger context of southern part of the Karnataka State at 12'18 N latitude and 76'12' E longitude. Mysore city lies in a saucer shaped basin flaked by Chamundi Hills on the south east. It is in the interfluent between two rivers Cauvery and Kabini. The city of Mysore is next only to Bangalore in importance as a growing urban centre in Karnataka. It is described as a "Garden city "and "City of Palaces". The city is spread over an area of 87 sq. km and it is situated in an undulating surface. The present study has been carried out in the status of biomedical waste management of some selected important hospitals of urban environment at Mysore from the month of January to April during the year 2013 to understand the problems and perspective associated with biomedical waste management in the city.

The present study was carried out in various major hospitals like Krishnarajendra (Government K.R hospital), J.S.S., Apollo and Kamakshi hospital of Mysore respectively. Average number of total waste bags generated was studied for a period of four months that is, January, February, March and April of the year 2013. The average generation of various infectious waste items per hospital unit area was recorded. Observations were also made on the separation of wastes, collection of various recyclable plastic and glass wares by sweepers during sweeping. The average number of patients per day (A), average waste per capita per day (C) and average solid waste generated per day at each source (S) at each hospital was calculated using the standard formula, at each hospital was also calculated by using the prescribed formula,[15].The obtained data were analyzed and the overall means were compared using DMRT (Duncan Multiple Range Test). The different alphabets indicated as superscripts under each column/rows were found to be significant under the Duncan Multiple Range Test.

2.2 Data collection techniques

Before actual study, permission was obtained from the authority. A questionnaire was designed and pretesting of the same was done for validity. Date and time were fixed up. All interns and house-staffs were consulted for the study. The participants were informed about the purpose of the study and their informed verbal consent was taken. They were assured

about their confidentiality and anonymity. They were given option that they may or may not join in the study. Name of the hospitals, beds capacity, waste generation during one month, waste class, type of container , colour coding, average number of different total waste bags generated from the four major hospitals during four months (Average total bags per day per month),average number of individual waste bags generated from all four major hospitals (Average no. bags per day per month).Waste generation at various sources in four major hospitals (Generation rates kg/bed/day) and finally qualitative and quantitative composition of infectious wastes in percentage by weight in four major hospitals were analysed and presented**.** Finally, the collected data were tabulated and interpretations were done by proper statistical method (Percentage).

3. Results and Discussion

The data on the bed's capacity and patients of each hospital was obtained from the hospital records that is, 1050 beds at K. R. hospital, 1200 beds at J.S.S hospital, 250 beds at Apollo hospital and 200 beds at Kamakshi hospital (Table 1) and waste coding, type of container and colour of waste bags used in the hospital for disposal (Table 2). Average weight of individual waste bags generated from four major hospitals of Mysore city in the month of January, February, March and April 2013 (kg/ day) presented in the Table 4, 5, 6 and 7. Total weight of individual waste bags generated from four major hospitals of Mysore city in four months represented in figures are 3, 4, 5 and 6.

K.R. hospital the average generation per capita per month was observed to be 2656 kg/month (Table 1). In January the different color codes of waste bags weight as yellow, red and blue bag has been recorded as 46.27, 7.38, 35.10, February was observed to be 43.68, 8.48, 35.34, March was 43.98, 8.93,34.79 and in April it was observed as 43.90, 8.71, 35.93 kg/day respectively . The average generation per capita per day in the health center was observed to be 0.25 kg and the number of patients admitted in K.R. Hospital is about 338.5 per day. The waste generated per day at each study site was found to be 84.62 kg in K.R. hospital (Table 8) and the number of personals who have used protective clothing worn by waste handle have been recorded as glove 22%, apron 30%, mask 9% (Table 11).

The average generation per capita per month in J.S.S. was observed to be 2077.50 kg/month (Table 1). In January the different color codes of waste bags weight as yellow, red and blue bag has been recorded as 25.20, 6.21 ,22.72, February was observed to be as 28.89, 6.40 , 24.57,March was 28.70, 6.07, 23.12 and in April it was observed as 28.38,

5.60, 21.93 kg/day respectively. The average generation per capita per day in the health center was observed to be 0.06 kg and the number of patients admitted in J.S.S Hospital is about 853 per day. The waste generated per day at each study site was found to be 51.18 kg in J.S.S hospital (Table 8) and the number of personals who have used protective clothing worn by waste handle have been recorded as glove 40%, apron 10%, mask 2%.

The average generation per capita per month in Apollo was observed to be 1745 kg/month (Table 1). In January the different color codes of waste weight bags as yellow, red and blue bag has been recorded as 23.74,6.89,25.86, February observed to be, 25.82, 12.66, 23.78, March is 27.87, 9.03, 22.80 and in April it was 27.26, 8.13 ,22.76 kg/day respectively. The average generation per capita per day in the health center was observed to be 0.36 kg and the number of patients admitted in Apollo Hospital is about 140.83 per day. The waste generated per day at each study site was found to be 50.69 kg in Apollo hospital (Table 8) and the number of personals who have used protective clothing worn by waste handle have been recorded as glove 70%, apron 80%, mask 30%.

The average generation per capita per month in Kamakshi was observed to be 1296 kg/month (Table 1). In January the different color codes of waste weight bags as yellow, red and blue bag has been recorded as 22.39,3.39,15.28, February was observed to be 21.49, 3.29, 14.18, March was 18.91, 5.57, 18.22 and in April it was observed as 18.71,5.73,18.71 kg/day respectively. The average generation per capita per day in the health center was observed to be 0.31 kg and the number of patients admitted in Kamakshi Hospital is about 132.73 per day. The waste generated per day at each study site was found to be 41.14 kg in Kamakshi hospital (Table 8) and the number of personals who have used protective clothing worn by waste handle have been recorded as glove 40%, apron 82%, mask 20% (Table 11).

Figure 1 and 2 showing the average percentage of patients per day and waste generation rate (kg/day) from the four hospitals of Mysore city. It is apparent that the percentage of patients visit in K.R. hospital was about 47 %, J.S.S. hospital was 36%, Apollo and Kamakshi was 12% and 5% respectively. The waste generation rate was high in K.R. followed by J.S.S, Apollo and least in Kamakshi which depends the number of patients and beds capacity in the Hospital. In the present study observed that the Government hospitals the rate of waste generation was high due to less attention given in respect to importance and option adopted for disposal and management strategies. The similar observation was made

by[3,12, 14,19]. Figure 3, 4, 5 and 6 showing the total weight of individual waste bags generated from four major hospitals of Mysore city in from January to April-2013 (kg/month). The waste generation rate in yellow bags was maximum in K.R. hospital in the month of March (1363 kg/month) which is followed by April (1317 kg/month) February and January (Figure 3and 4) similar observation and generation rate was noticed in blue and red bags this may be due to the number of patients admitted in the hospitals has increased in March and April. In J.S.S, Apollo and Kamakshi the rate of generation of waste in different colour bags in month wise was depicted in Figure 3-6. The Government of India (Notification, 1998) specifies that hospital waste management is part of hospital hygiene and maintenance activities, which are mainly engineering function, such as collection, transportation operation, treatment of processing system and disposal of waste. However, initial segregation and storage activates are the direct responsibility of nursing personnel who are engaged in the hospital. If the infectious component gets mixed with the general non-infections waste, the entire mass becomes potentially infections [9, 11].

Difference color-coding bags for segregation was one of the most important parts of BMW management rule which was known by 70.30% of observation of our study. Very less importance was reported in K.R.hospital when compared to Apollo hospital. Deo *et al*.,[8] showed that only 28.62% of paramedical and 20.23% of medical staff knew about this issue, whereas 74% of Puducherry study participants did not know about color coding of the BMW bags [1,8]. Very high knowledge was seen in a study at Johannesburg Hospital by Ramokate and Basu among doctors and nurses 96% knew about various types of bins. From our study it was seen that there was a gap of knowledge about segregation and color-coding bins which needs correction.

The observations show that there was no information of any collection of recyclable plastic comprising of glucose bottles, spirit bottles. It was observed that all four studied hospitals have used personal protective clothing including; glove, apron, mask. The qualitative and quantitative composition of infection waste has been tabulated in the table 9 and 10. The methods used in this present study may be useful for measuring and predicting potential scenic activities of biomedical waste management in Mysore. The study has investigated the spatial measures for estimating a combination of factors such as collection, segregation, transportation and disposal of biomedical waste in Mysore city. The corporation must follow the intergraded approach to have effective implementation of management of medical waste. Therefore, more effective management of waste should

be provided in Mysore. The medical waste should be monitored and checked effectively. Alternative mode of collecting, transportation and disposal of waste shall be strengthened covering all the areas. While the segregation and transportation of recyclable material would also leads to reduction in quantity of waste for final disposal and healthy environment. The hospital of Mysore might need to look for better solution of managing waste disposal at site in a frequent interval. These measures do not cost much and are very effective in reducing degradation waste.

Effective and strict implementation by Mysore City Corporation and master plan should be enforced. In future for 2019-20 shows there will be increase in the amount and the waste in the hospitals. All the four hospitals studied had varied results during the four months of study, it was observed that Kamakshi hospital had lower disposal during February and March months ; J.S.S hospital had the higher disposal during February and March. It is obvious that, J.S.S hospital and K.R hospital had highest amount of disposal because these are general hospitals and are recognized centers for accident victims. The reasons for such great variations may because these hospitals are located at all entrances of Mysore City. A large number of villagers also depend on the nearest hospitals. Some hospitals like, J.S.S hospital, Apollo hospital are super specialty hospitals, in addition to being general and therefore the number and type of patients coming into the hospitals differs considerably. Total 9 types of sources of wastes generation have been shown, K.R. hospital, J.S.S hospital, Apollo hospital and Kamakshi hospital where almost all types of diseases are treated and hence generation of waste bags are definitely high. However, the problem is not waste generation but waste management. Table 3 indicates the average number of waste bags generated from the four hospitals studied; it was observed that, yellow, blue and red bags show significant waste bags for four months during the course of study.

3.1 Methods of waste transportation

Biomedical waste to be transported all the four hospitals by means of wheeled trolleys, containers or carts that are not used for any other purpose. The trolleys have to be cleaned daily. All attempts should be made to provide separate service corridors for taking waste matter from the storage area to the collection room. Preferably these corridors should not cross the paths used by patients and visitors. The waste has to be taken to the common storage area first, from where it is to be taken to the treatment/disposal facility. Off-site transportation vehicle should be marked with the name and address of carrier. Biohazard symbol should be painted on it in Apollo, J.S.S, K.R hospital which was not found in

Kamakshi hospital. Suitable system for securing the load during transport should be ensured. The waste bags generated from the four hospitals studied; it was observed that, yellow, blue and red bags show significant waste for four months during the course of study. The vehicle should be easily cleanable with rounded corners. The transportation of waste should be as per a defined path was observed in all the four hospitals. As in the course of observation the protection measures like using gloves, masks and shoes were not used in the staff of all the hospitals except Apollo hospital.

3.2 Technology options for biomedical waste treatment

The environmental regulations actually mandate the treatment of infectious medical waste on a daily basis if it is stored at room temperature. A number of treatment methods are available. The final choice of suitable treatment method is made carefully, on the basis of various factors, many of which depend on local conditions including the amount and composition of waste generated, available space, regulatory approval, public acceptance, cost, etc

3.3 Waste Treatment options

The bio-medical waste (Management & Handling) rules, 1998' has elaborately mentioned the recommended treatment and disposal options according to the 10 different categories of waste generated in health care establishments in Schedule I of the rules. A review of the above schedule shows that there is no single technology, which can take care of all categories of biomedical waste. A judicious package has to be evolved for this purpose.

3.4 Autoclave Treatment

This is a process of steam sterilization under pressure. It is a low heat process in which steam is brought into direct contact with the waste material for duration sufficient to disinfect the material. There are three types of autoclaves, Gravity type, Pre-vacuum type and Retort type. In Gravity type, air is evacuated with the help of gravity alone. The system operates with temperature of 121degree centigrade and steam pressure of 15 psi. For 60-90 minutes. Vacuum pumps are used to evacuate air from the Pre-vacuum autoclave system so that the time cycle is reduced to 30-60 minutes. It operates at about 132 degree centigrade. Retort type autoclaves are designed to handle much larger volumes and operate at much higher steam temperature and pressure. Autoclave treatment was adopted in J.S.S, Apollo and Kamakshi hospital to certain extent. Autoclave treatment has been recommended for microbiology and biotechnology waste, waste sharps, soiled and solid wastes. Autoclave sterilizes and disfigures the waste.

3.5 Hydroclave Treatment

Hydroclave is another innovative system for steam sterilization similar to autoclave. It is a double walled container, in which the steam is injected into the outer jacket to heat the inner chamber containing the waste. Moisture in the waste evaporates and steam builds up the steam pressure to 35-36 psi. The chamber is slowly rotated by a strong shaft connected to a paddle which turns the waste continuously against the hot wall which mixes and as well as fragments the same. In the absence of enough moisture, additional steam is injected. The system operates at 132degree centigrade and 36 psi steam pressure for sterilization time of 20 minutes. The total time for a cycle is about 50 minutes, which includes start-up, heat-up, sterilization, venting and depressurization and dehydration. The treated material can further be shredded before disposal. The expected volume and weight reductions are up-to 85% and 70% respectively. The hydroclave can treat the same waste as the autoclave plus the waste sharps this method of treatment has been adopted in K.R. hospital. The sharps are also fragmented. This technology has certain benefits, such as, absence of harmful air emissions, absence of liquid discharges, non-requirement of chemicals, substantial reduction of volume and weight of waste.

3.6 Microwave Treatment

It is a wet thermal disinfection technology; this process heats the waste from inside out and provides a high level of disinfection. In this method initially the waste is shredded and allowed to enter conventional microwave generators, which heat the material to95-100deg.C.and uniformly disinfect the material during a minimum residence time of 30 minutes and further it is again shredded and then disposed. This technology has certain benefits such as absence of harmful air emissions, absence of liquid discharges, non-requirement of chemicals, reduced volume of waste, operator safety. But the main drawback of this system is its high investment cost. According to the Cat 3, Cat 6 and Cat 7 are treated by microwave. Microwave treatment technology has been implemented in all the four hospitals was observed and managing the waste through this significantly.

3.7 New strategies of management

Keeping the above fact in mind, the following management strategies are proposed to overcome the problem of improper disposal of bio medical wastes.

i. Segregation of bio-medical wastes should be done at the source of generation as per the categories mentioned in the rule.

ii. The classification of the bio-medical waste with respect to color coding container has to be done.

iii. The transportation of bio-medical waste is to be done through desiccated vehicle specially constructed for the purpose.

iv. All the generations of bio-medical waste should adopt universal precautions and appropriate safety measures while doing the therapeutic and diagnostic activities and also handling the bio-medical wastes.

v. Training should be conducted to all categories of staff in appropriate language /medium and in an acceptable manner.

vi. The annual reports, accidents reports as required under bio-medical waste rule should be submitted to the concerned authority as per B.M.W. rules formula.

vii. Establish effective and sound recycling policy for plastic recycling and get in touch with authorized manufactures.

viii. There should be co-ordination between hospitals and outside agencies or non government organizations.

3.8 Suggestions:

i. To set up a central agency this can formulate a course in Hospital Waste Management and award a degree to the successful candidates. This course must be more practical oriented rather than theory and candidates must be directly exposed for the problem.
ii. Each hospital depending upon the size must have a team of such qualified persons only who are capable of managing hospital wastes.
iii. Any other private or government sponsored agency which has all facilities of hospital waste management may be authorized to carry out this process.
iv. Separate land far away from dwellings must be allotted for waste disposal where, air pollution control standards are strictly maintained.
v. All hospitals generating any kind of waste must be registered and regularly monitored by a government agency.

3.9 Recommendations

From the results and observations were made from four hospitals the importance of training regarding biomedical waste management cannot be overemphasized; lack of proper and complete knowledge about biomedical waste management impacts practices of appropriate waste disposal.

Based on this observation the following recommendations are proposed:

(i) Strict implementation of biomedical waste management rules is the need of the hour

(ii) It should be made compulsory for healthcare facilities to get their healthcare personnel trained from accredited training centres. These training sessions should not become merely a one-time activity but should be a continuous process depending upon the patient input in different healthcare facilities,

(iii) Training of sanitary staff should be specially emphasized, and

(iv) It should be ensured that the injuries happening to the healthcare personnel are reported to the person in-charge of biomedical waste management or to the biomedical waste management committee, and they report it in the prescribed format to the pollution control board.

4. Conclusion

Bio-medical waste management programme cannot successfully be implemented without the willingness, devotion, self-motivation, cooperation and participation of all sections of employees of

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Table **1.** List of hospitals and bed's capacity selected for the study.

Name of the hospitals	**Beds capacity**	**Waste generation during one month**
Krishnarajendra hospital (KRH)	1050	2656.00 kg / month
J.S.S. hospital (JSSH)	1200	2077.50 kg/month
Apollo hospital (APH)	250	1745.00 kg/month
Kamakshi hospital	200	1296.00 kg/month

Table **2.** Type of container and colour coding for hospital waste disposal.

Waste class	**Type of container**	**Colour coding**
Human anatomical wastes	Plastic bags	Yellow
Animal wastes	-do -	- do -
Microbiology and biotechnology wastes	- do -	Yellow / Red
Wastes sharp	Plastic bag	
	Puncture proof containers	Blue / White
Discarded medicines and cytotoxic wastes	Plastic bags	Black
Solid Bio – medical waste -	- do -	Yellow
Solid (Plastic) Disposable tunings	Plastic bag	Blue/White
Chemical wastes (Solid) -	- do -	-do –

Table **3.** Average weight of biomedical waste generated from four major hospitals during January to April - 2013(kg/ day).

	K.R. hospital	**J.S.S. hospital**	**Apollo hospital**	**Kamakshi hospital**
January	74.77	65.80	51.00	47.10
February	29.16	19.58	20.73	12.98
March	29.23	19.29	11.56	14.22
April	29.51	18.63	19.38	14.38

Table 4. Average weight of individual waste bags generated from four major hospitals of Mysore city in the month of January (kg/ day).

	Red bags	**Blue bags**	**Yellow bags**
K.R hospital	7.38	35.10	46.27
J.S.S hospital	6.21	22.72	25.20
Apollo hospital	6.89	25.86	23.74
Kamakshi hospital	3.39	15.28	22.39

Table 5. Average weight of individual waste bags generated from four major hospitals of Mysore city in the month of February (kg/ day).

	Red bags	**Blue bags**	**Yellow bags**
K.R hospital	8.48	35.34	43.68
J.S.S hospital	6.40	24.57	28.89
Apollo hospital	12.66	23.78	25.82
Kamakshi hospital	3.29	14.18	21.49

Table 6. Average weight of individual waste bags generated from four major hospitals of Mysore city in the month of March-2013 (kg/ day).

	Red bags	**Blue bags**	**Yellow bags**
K.R hospital	8.93	34.79	43.98
J.S.S hospital	6.07	23.12	28.70
Apollo hospital	9.03	22.80	27.87
Kamakshi hospital	5.57	18.22	18.91

Table 7. Average weight of individual waste bags generated from four major hospitals of Mysore city in the month of April -2013 (kg/day).

	Red bags	**Blue bags**	**Yellow bags**
K.R hospital	8.71	35.93	43.90
J.S.S hospital	5.60	21.93	28.38
Apollo hospital	8.13	22.76	27.26
Kamakshi hospital	5.73	18.71	18.71

Table 8. Solid wastes generation in four major hospitals of Mysore city.

	Average no. patients/day (A)	**Average waste Capacity day (C)**	**Average waste Generated/day S=AxC**
K.R hospital	338.07	0.25	84.62
J.S.S hospital	853.00	0.06	51.18
Apollo hospital	140.83	0.36	50.69
Kamakshi hospital	132.73	0.31	41.14

Table 9. Waste generation at various sources in four major hospitals of Mysore city (Generation rates kg/bed/day).

Sources	K.R hospital	J.S.S hospital	Apollo hospital	Kamakshi hospital
Medical	16.50	27.90	10.00	8.50
Surgical	10.00	17.50	13.80	9.50
Orthopaedic	9.00	10.50	5.90	3.90
Cardiac	4.50	6.00	6.80	4.00
CCU	5.30	15.30	9.00	7.50
Neurology	2.50	4.00	4.20	3.10
Urology	2.00	3.90	4.30	-
ENT	14.15	13.50	4.10	-
EYE	9.50	11.90	3.90	2.70
Skin	6.90	8.30	4.60	-
Burns	7.30	7.40	6.00	-
Accidental	7.00	11.30	7.00	6.40
Blood Bank	13.00	18.70	9.00	7.00
Dental	8.70	14.60	7.00	5.90
First Aid	6.30	29.50	11.30	9.80

Table 10. Qualitative and quantitative composition of infectious wastes in percentage by weight in four major hospitals of Mysore city**.**

Infectious wastes	K.R hospital	J.S.S hospital	Apollo hospital	Kamakshi hospital
Metallic Ware	2.45	4.50	2.60	1.30
Disposable Needle	1.20	3.20	2.30	1.20
Surgical Blade	1.00	2.50	2.00	1.00
Plastic Ware	30.00	42.50	20.00	17.20
Disposable Syringe	4.10	7.20	5.80	5.20
Drip Set	4.50	7.80	4.20	3.70
Urine Bag	25.00	4.90	3.00	2.60
Ryle Tube	3.60	4.20	1.00	1.00
Blood Bag	4.10	4.30	2.50	2.00
Kidney Tubing	1.00	2.10	1.00	0.50
Rubber	12.20	9.20	7.00	5.60
Catheter	3.00	4.10	6.90	6.80
Gloves	3.50	4.10	0.90	0.80
Cotton	19.00	31.80	25.00	22.88
Cloth Ware	31.50	52.00	19.50	12.50
Bandage Cloth	1.80	4.80	2.80	1.80
Gauze	2.50	3.90	2.80	2.00
Tape Role	3.50	7.40	2.00	1.40
Gynae Mask	1.00	1.50	3.80	1.20

Table 11. Type of personal protective clothing worn by waste handle in four hospitals in Mysore city.

Personal protective clothing	K.R hospital	J.S.S. hospital	Apollo hospital	Kamakshi hospital
Glove	22%	40%	70%	40%
Apron	30%	10%	80%	82%
Mask	10%	2%	30%	20%

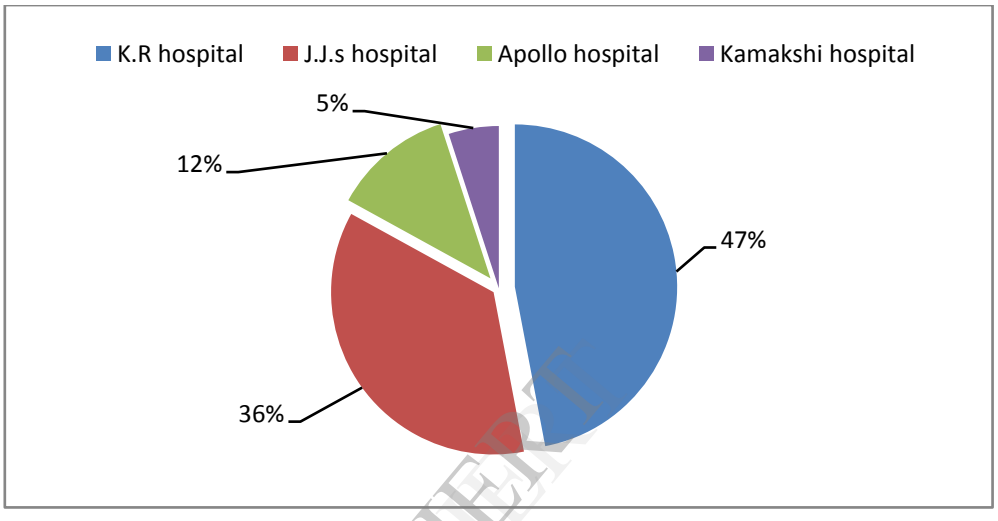

Figure 1. Average percentage of patients per day in four hospitals of Mysore

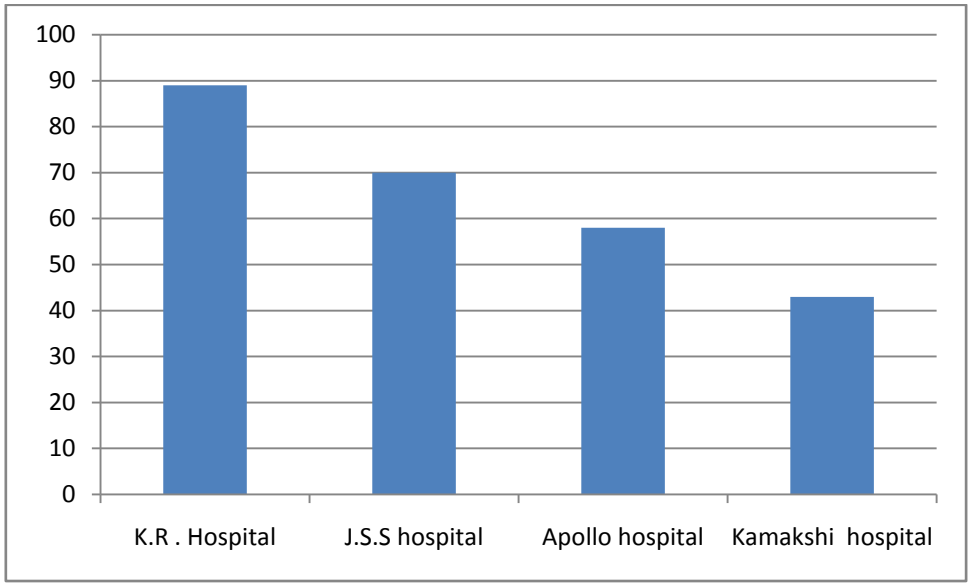

Figure 2. Average waste generated per day in four hospitals of Mysore city (kg /day)

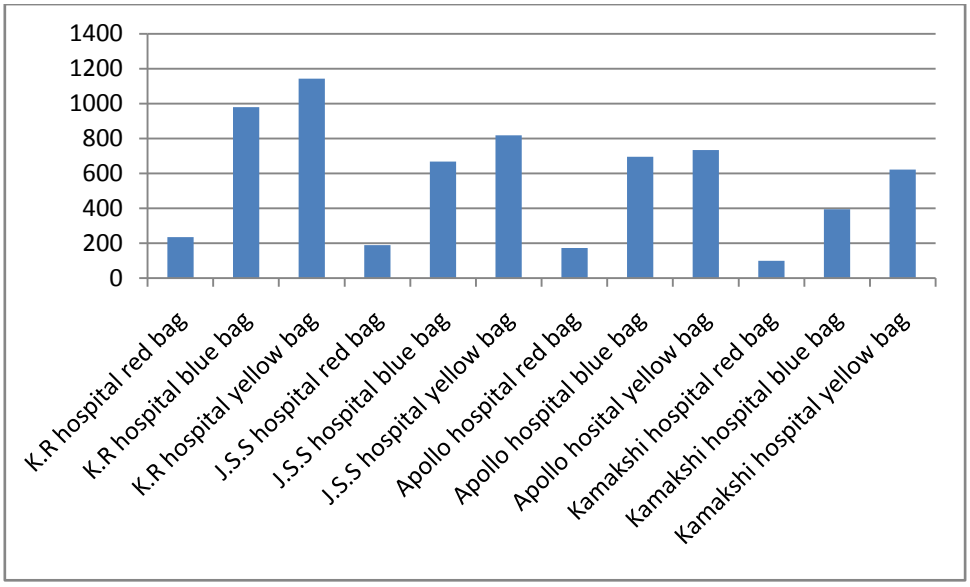

Figure 3. Total weight of individual waste bags generated from four major hospitals of Mysore city in the month of January-2013(kg/month).

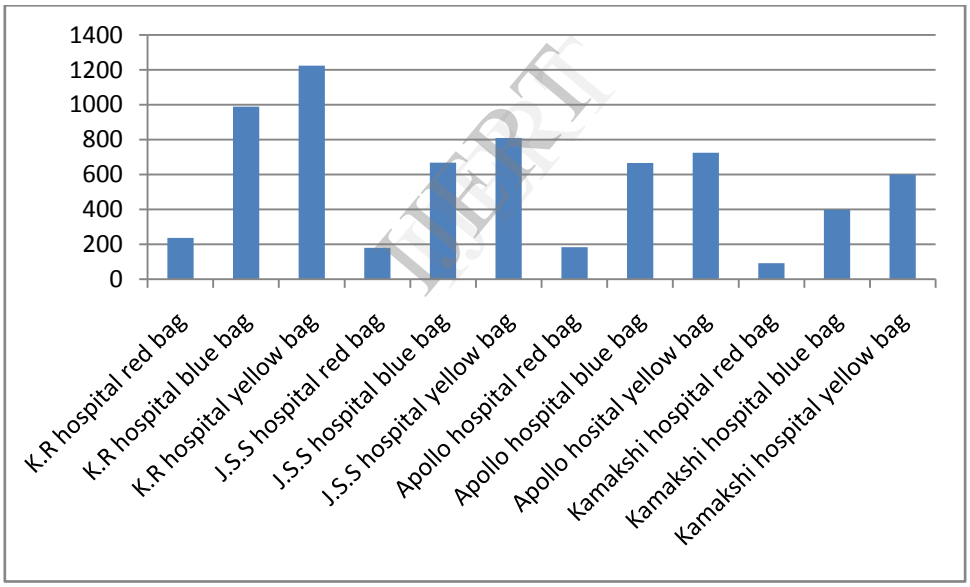

Figure 4. Total weight of individual waste bags generated from four major hospitals of Mysore city in the month of February-2013(kg/month).

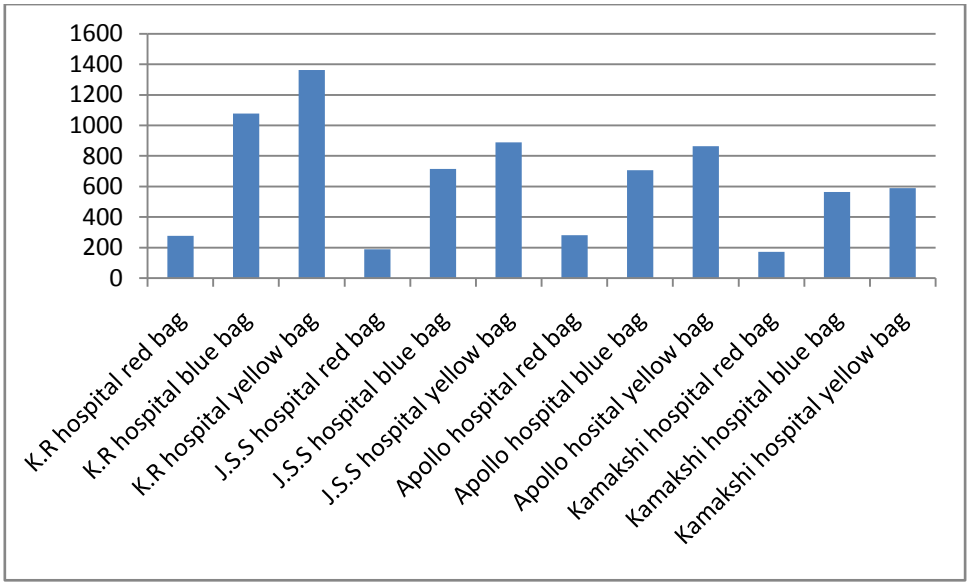

Figure 5 . Total weight of individual waste bags generated from four major hospitals of Mysore city in the month of March-2013(kg/month).

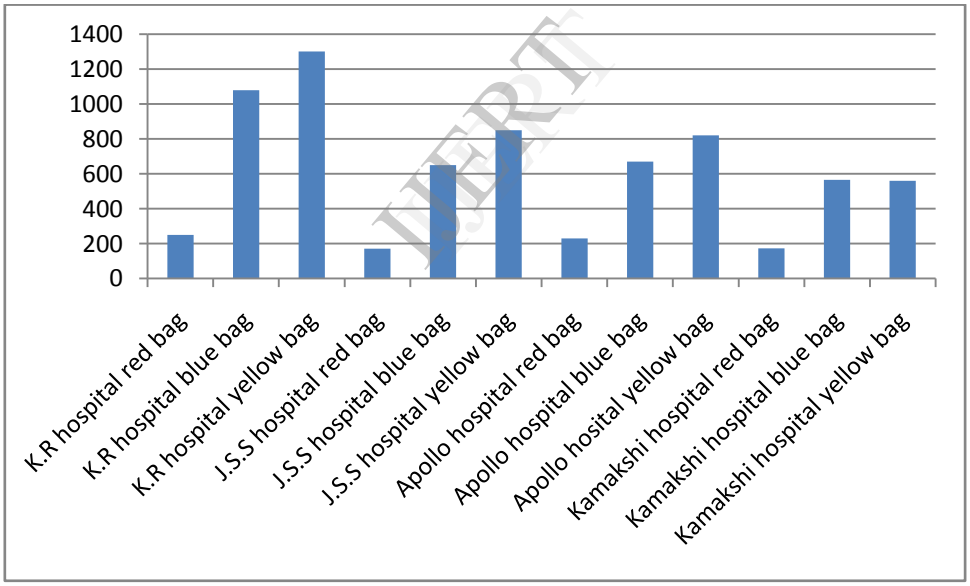

Figure 6. Total weight of individual waste bags generated from four major hospitals of Mysore city in the month of April-2013(kg/month).