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Research Paper

COMPARATIVE ANALYSIS OF HOSPITAL WASTE MANAGEMENT IN CALABAR METROPOLIS AND DEVELOPED COUNTRIES

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Healthcare Waste (HCW) constitutes a special category of waste because they contain potentially harmful materials. The problem of how to manage HCW has become one of critical concerns in developing countries. A cross sectional descriptive study of Medical Waste Management (MWM) practice and their implication to health and environment was carried out between August and September 2012 in Calabar metropolis, Cross River State, Nigeria with the aim of assessing the current practices and commitment to sustainable HCW management in three (1 tertiary, 1 General and 1 Private) hospitals ranging in capacity from 30 to 500 beds. The study approach involved the estimation of the quantity of HCW generated, evaluation of the waste segregation practices and determination of the knowledge of healthcare workers regarding HCW management. Daily waste inventory of each ward was carried out. An evaluation of the status of the waste management practice in the health facility was carried out using the following criteria: waste management (responsibility, segregation, storage and packaging); waste transport; waste recycling and reuse; waste treatment and final disposal. The result obtained from the study showed wastes generation at the rate of 1.31, 1.16 and 0.78 kg/day/patient for large, medium and small sized hospitals, respectively. Comparing the results gotten from the tertiary hospital and results gotten from developed countries, Analysis of Variance (ANOVA) was used which showed a less non-significant value. Out of the 189 people that participated in the survey of medical waste management, 19% of the people were highly concerned. 38% of the people were slightly concerned and 33% of them were neutral in their approach. The remaining people were not at all concerned with the MWM. Profession and age seemed to have an effect on the result.

Keywords: Healthcare waste, Microbial infections, Waste segregation

INTRODUCTION

The process of waste management in our environment calls for concern in recent years. Wastes are being disposed indiscriminately in our surroundings, on the streets and in the drains. The industries are discharging their

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wastes without pre-treatment into streams and farmlands and this affects the natural environment. Hospitals and other health-care facilities are not left out of this obnoxious act. Hospital or biomedical waste has distinct features apart from all other types of waste because of its infectious and hazardous properties. It has equally received very little attention in Nigeria in contrast to the management of other types of solid waste as hospital waste management was in a deplorable state with less or no provision for the health-care waste disposal (Coker *et al*., 1998).

Researches have been conducted all over the world, on HCWs and HCWM; Coker *et. al.* (1999), Wong and Ramarathnam (1994), all used quantification, physical observation and questionnaire administration as methodology for collating generated wastes data. Consultants and government agencies as well as institutions report hospital waste management in Florida; solid waste management in Florida (2000); working draft report HCWH (2002), Jorge *et al*. (2000), International meeting report on HCWM (2007), Alexander (2001), INTOSAI (2003), Shell medical waste EIA. (2002), etc., all discussed the various management intertwined activities necessary for proper HCWM. Some other researchers also dealt with data analysis tools needed for better predictions of the effect and impact of pollution as well as proper mitigations of HCWs. Longe and Williams (2006) presented a range of between 0.562 kd/bed/day and 0.670 kg/bed/day with between 26% and 37% infectious waste portion for Lagos state.

METHODOLOGY

The research design employed involved the use of surveys and also interviews with officers in charge MWM in each hospital. A simple and objective questionnaire based on the guidelines of the safe management of waste from health care facilities (WHO, 1999) was administered in each hospital. Health care managers, nurses, nursing assistants and waste handlers within and outside the hospitals were among those interviewed. The questionnaire contained information on waste generation and main aspects of segregation, collection, storage, transportation, treatment and final disposal of medical waste. Information gathered will be used to analyze profile of the management program adopted by the hospitals for their medical waste. Site visits was particularly helpful to obtain primary information data on common practices of MWM. Generation rate of medical waste in kg/bed/day in each hospital was evaluated. The study will be conducted in Calabar metropolis, Calabar, Cross River State; in the south-southern part of Nigeria using three hospitals.

DATA COLLECTION AND ANALYSIS

The data was collected between August through September 2012. Waste audit was carried out in line with the method used by Kazuhiro and Harumi (2001) to determine the quantities of the waste generated through the use of weighing instruments. The quantities of waste generated were physically weighed in each hospital. The method used by Monaham (1990) and Gonzalez-Torre *et al*. (2003) were employed in the design of the questionnaires by ensuring that the questionnaires were

administered to the selected hospitals to collect data on the management of waste generated. The questionnaires also addressed information on potential factors that can influence amount of waste generation and the type of management practice in place. The factors that influenced the choice of methods and facilities used in managing the waste were analyzed by the Relative Importance Index by using a scale of 1 to 5. The closer the relative importance index is to 5, the higher is the degree of importance of the factor.

MATHEMATICAL METHOD

The use of ANOVA as a statistical means of analysis will be adopted during the course of the research also A Multi Criteria Decision Analysis (MCDA) was used to determine the best treatment technology currently available (Dursun *et al.,* 2011).

MCDA is a structured approach used to determine overall preferences between different options, on the basis of various objectives which the decision making body has already identified. Measurable criteria were developed in order to assess the extent to which the objectives have been achieved. If it can either be proved, or reasonably assumed, that the criteria are preferentially independent of each other and if uncertainty is not formally built into the MCA model, then the simple linear additive evaluation model is applicable. (Dec *et al.,* 2007)

Three components of a typical MCDA Assessment are illustrated in the matrix shown in Table 1. It includes

1. The various available technologies (row 1).
2. The criteria's on which each alternative is measured (column 1).
3. The measured value (R11 to R84) for each criterion for each option (Rows 3 to 4 and columns 2 to 4).

The Various steps in the MCDA analysis are:

Selection of Alternative technologies

a. Incineration with energy recovery.
b. Autoclaving with shredding.
c. Chemical treatment.
d. Micro wave.

SELECTION OF THE EVALUATION CRITERIA, AND ANALYSIS OF POSSIBLE ACTIONS

The various technologies were evaluated by considering various health, environment and economic criteria. People doing research and working in the hospital waste management are consulted for the same. It is assumed that the criteria are preferentially independent of each other. One thing to be noted in the research is that this method aim to find out the best technology for the on-site medical waste treatment at the UCTH and not in general. Hence the criteria are selected accordingly and the criteria with which various technologies will be compared are (Batterman, 2004; Pruss 1999):

1. Capital Investment and Operational cost (C_1)
2. Types of Waste treated (C_2)
3. Volume and Mass reduction of medical waste (C_3)

4. Environmental Impacts of the proposed technology (C_4)
5. Public Acceptance (C_5)
6. Training and operational requirements (C_6)
7. Occupational Health and safety including needle stick prevention (C_7)

Determination of the Significant Coefficients (Ranking and Weighting)

Ranking

All the treatment technologies were assessed on each of the above mentioned criteria. A vast study on the available literature is done to obtain the data's required for the analysis. The capital investment is estimated from the literature review. The best technology is given a value score of 4 and the least viable technology is given a score of 1.

Weighting

A weighting was given to each criteria according to the importance and significance of each criteria.

Justification for Weighting: The hospital would highly benefit from avoiding unnecessary transport of waste if all the waste can be treated onsite and hence, a higher preference was given to technology which can treat all types of waste. Also, it should be able to effectively reduce the hazardous properties associated with medical waste.

Environmental impact, types of waste treated and volume and mass reduction was given higher weightage than the remaining criteria. Whatever be the technology, the impact on the environment is a significant factor and hence given a higher weightage. The public acceptance is really important because some of the technology like incineration has faced public opposition in the past. The criteria and weightage is shown in the figure below.

Analysis of the Results and Selection of Best Technology

The overall score for each alternative was found by multiplying the value score on each criterion by the weight of that criterion, and then

Table 1: MCDA matrix

Technology ì **Criteria** í	**Incineration**	**Autoclaving**	**Microwave**	**Chemical Treatment**
C_1	R_{11}	R_{12}	R_{13}	R_{14}
C_2	R_{21}	R_{22}	R_{23}	R_{24}
C_3	R_{31}	R_{32}	R_{33}	R_{34}
C_4	R_{41}	R_{42}	R_{43}	R_{44}
C_5	R_{51}	R_{52}	R_{53}	R_{54}
C_6	R_{61}	R_{62}	R_{63}	R_{64}
C_7	R_{71}	R_{72}	R_{73}	R_{74}

Table 2: Criteria's for the Selection of Best Treatment Technology

Criteria	Weight
Capital Investment and Operational cost (WC_1)	1
Types of Waste treated and disinfection efficiency (WC_2)	1.25
Volume and Mass reduction of medical waste (WC_3)	1.25
Environmental Impacts of the proposed technology (WC_4)	1.25
Public Acceptance (WC_5)	1.25
Training and operational requirements (WC_6)	1
Occupational Health and safety including needle stick prevention (WC_7)	1

adding all those weighted scores together.

$$\text{Overall score for incineration} = (R_{11} \times WC_1) + (R_{21} \times WC_2) + (R_{31} \times WC_3) + (R_{41} \times WC_4) + (R_{51} \times WC_5) + (R_{61} \times WC_6) + (R_{71} \times WC_7) \quad ...(1)$$

Similarly overall score for all the alternatives were found out and the alternative with the highest score was determined as the best technology available for an onsite treatment of medical waste for UCTH.

RESULTS AND DISCUSSION

The result obtained from the study showed that both hazardous and non-hazardous wastes are generated by the three categories namely; large, medium and small sized hospitals. The high proportion for combined wastes (that is, hazardous and non-hazardous) generated by small hospitals shows a low level of specialization in wastes handling in this category of hospital. It appears from the distribution that small hospitals generate more of combined wastes when compared to the distributions from the large and medium hospitals. Wastes generation at the rate of 1.31, 1.16 and 0.78 kg/day/patient for large, medium and small sized hospitals .

The probability of this result, assuming the null hypothesis, is 0.21.

Critical Value of F = 3.13, since calculated F < critical value of 3.13 there is no significant difference

The ANOVA analysis of the weight/day/ patient of UCTH, NNUH and ILLINOIS data indicates less non-significant, this collectively shows that though the analyzed data were generated within different sections, but the rate of generation was similar, this can be buttressed with the fact that most sections attends to the same number of patients daily, also the wards have similar total number of beds and the bed occupancy rates were also similar. The error exhibited on the analyzed data was however shown to be very big as indicated by the very largely values of the actual and the corrected values of the sum of squares. The ANOVA test was carried out at 0.05 or 95% confidence level. These errors may be as a result of waste management

Table 3: Waste Generated in UCTH, NNUH and Illionois

Sources	NNUH(kg/bed/patient)	UCTH(kg/bed/patient)	ILLINOIS(kg/bed/patient)
Medical	0.88	0.92	0.87
Surgical	1.22	0.97	0.99
Gynecology	0.86	1.00	0.71
Orthopedic	0.88	0.83	0.79
Cardiothoracic	0.93	1.04	0.96
Accident And Emergency	0.87	0.88	0.72
Observation	0.93	0.71	0.85
Eye Ward	1.15	1.07	1.18
ENT	0.90	1.60	1.23
Tetanus	0.61	1.18	1.13
CSSD	0.63	0.66	1.11
Hematology	0.33	0.4	0.34
Blood Bank	0.50	0.50	0.47
Anti-Natal Clinic	2.01	1.72	1.6
Pharmacy	0.78	0.63	0.6
Post-Natal	0.36	1.34	0.74
Radiology	0.41	1.61	0.94
Dental	0.55	0.83	0.63
Resuscitation	0.44	0.72	0.59
Recovery Room	1.00	0.74	0.63
Observation Room	1.04	2.37	1.65
DTU	0.89	0.96	0.77

Note: Source of Raw Waste Data of Illinois University (EPA, 2011)
Source of Raw waste Data of Norfolk and Norwich University Hospital NNUH (PUDUSSERY et al. 2011)

Source of Variation	Sum of Squares	Degree of Freedom	Mean sum of Squares	F
Between Groups	0.4882	2	0.2441	1.607
Within Groups	9.571	63	0.1519	
Total	10.06	65		

Note: The probability of this result, assuming the null hypothesis, is 0.21
Critical Value of F = 3.13, since calculated F < critical value of 3.13 there is no significant difference

structure developed by the three hospitals and other factors which are listed below;

MEDICAL WASTE MANAGEMENT COMPARISON BETWEEN UCTH AND NNUH

Collection

For the correct collection of wastes in Illinois the following criteria were the followed:

- Waste must be collected in specific days, or before the suggested days when ¾ full.
- DO NOT accumulate plastic bags with waste at the point of segregation? Collect to store room every time containers are ¾ full.
- The disposable sharp containers should be sealed by tape in the place of segregation.
- Sealed sharp containers should not be placed in plastic bags.
- Collect waste in the place of segregation (except general waste)? Take the store container into each room and then transport it again to the store room.
- Keep the same color-coding and labeling in between the segregation and storage room.
- Collect waste always avoiding spillage.
- Never mix infectious and non-infectious waste.
- Bags and containers should be equally and immediately replaced after collection.
- Containers should be collected carefully to avoid exposure and aerosol generation and disinfected after every cycle of waste collection (place new ones only after disinfection).
- Staff that handle wastes must wear protective clothing at all times, including face mask, industrial aprons, disposable or heavy duty gloves, and if available: leg protectors and industrial boots.

In UCTH, waste management is contracted to 3 waste managers with different responsibilities. The responsibility ranges from the collection of wastes from wards and impatient room and this is done by one of the waste managers. All waste collected were dumped in the trolley regardless of the category which is contrary to the regulations of Hospitals waste management.

Storage

Intermediate storage takes place on every floor in specially designed storage areas that full all of the requirements needed to store medical waste for up to 12 hours (ventilation, re protection, cleaning facilities, etc.). Storage before disposal takes place in the basement where infectious wastes are kept in a refrigerator at a temperature of 3^{o}C to 4^{o}C so as to avoid biodegradation, odors and the attraction of insects and rodents. Municipal wastes are stored in a different room at the same level, which also fulls the conditions of acceptable storage.

Problems were observed in the following areas:

- The inability to ensure that access to the storerooms is restricted to those people involved in the handling of medical waste.
- Storage of wastes for many hours – at times for more than 20 hours (especially in Labs and).
- Storage of municipal waste in contact with infectious waste.
- Failure to clean the storerooms after every transportation cycle. The stagnation of

liquids on doors was observed–in some cases it remained for more than 24 hours.

Segregation

Medical waste segregation is an important step in reducing the volume of hazardous waste as it offers the ability to make more accurate assessment about its composition with the use of labeled bags to separate infectious waste from domestic waste effectively. Segregation of hazardous/ infectious waste types is a key to achieving sound medical waste management therefore a right step to health risk reduction.

Results from investigation revealed that the three hospitals never gave high priority to segregation from source of infectious and two gave priority to sharp wastes by use of boxes. Segregation was done during the data collection from the three hospitals used for the survey through the aid of waste liners provided to the waste managers responsible for the collection and segregation. It was further observed that there is no uniformity in color coding of medical waste in all the hospitals. The existing National Guideline is also silent about this important aspect of the MWM. However, all the healthcare facilities collect and store their regulated waste in trolleys and buckets for eventual disposal.

Comparison of Different Medical Waste Treatment Technologies Using the Different Criteria Provided by MCDA

Capital Investment and Operational Cost (C_1): A detailed study was of the literature was done on the capital cost for various alternatives. The detail cost analysis is not carried out as the feasibility study of the selected alternative is done as a follow up study of this research. Program for Appropriate Technology in Health (PATH, 2005) conducted a detailed study on the cost of various technologies available. The cost estimated were:

The Ranking are as follows:

Types of Waste Treated (C_2): Not all the

Table 4: Treatment With Their Respective Capital and Operating Cost

Incinerator	Autoclave with Shredding	Microwave	Chemical Treatment
Capital cost: $ 1,600,000	Capital cost: $190,000-$375,000	Capital Cost: $500,000--$600,000	Capital Cost: $450,000
Operating cost: $ 0.04/kg	Operating cost: $0.04-$0.06/kg	Operating Cost: $0.03 – 0.05/kg	Operating Cost: $0.04/kg

Table 4.1: Ranking of Capital Investment and Operational cost

Treatment Technology	NNUH Ranking	UCTH Ranking
Modern Incinerator	1	1
Autoclaving and shredding	4	3
Microwaving	2	2
Chemical treatment	3	2

treatment technologies can treat all the waste classified as special waste. Incineration is the only option which is suitable to treat all the components of the regulated waste (Salkin, 2003; WHO, 2004). The chemical treatment and microwaving is not suitable for the pathological wastes. According to the guidance published by WHO (2004) on safe management of wastes from health-care activities autoclave, chemical and microwave treatment technologies cannot treat anatomical, cytotoxic and chemical wastes (Jang *et al*., 2006). Hence, in NNUH, incineration is the most preferred treatment technology and is given a rank 4.

In UCTH, survey showed that as at the time the research was conducted, the incinerator present in the facility was been faulty and the treatment options adopted within the facility are Autoclaving, Microwaving and Chemical Treatment (Done by the Central Sterilization Department) and this can be indicated with the table of ranking below.

Volume and Mass Reduction of Medical Waste (C_3):

Autoclave and Microwave After Shredding: The waste is reduced by 80% in volume and by 20-35% in weight.

Chemical Treatment: Shredding of waste before disinfection plus subsequent

Table 4.2: Ranking of Types of Waste Treated

Treatment Technology	NNUH Ranking	UCTH Ranking
Modern Incinerator	4	1
Autoclaving and shredding	1	2
Microwaving	1	1
Chemical treatment	1	2

Table 4.3: Ranking of Volume-Mass Reduction

Treatment Technology	NNUH Ranking	UCTH Ranking
Modern Incinerator	4	1
Autoclaving and shredding	2	1
Microwaving	2	1
Chemical treatment	3	2

Table 4.4: Ranking of Environmental Impacts of the Proposed Technology

Treatment Technology	NNUH Ranking	UCTH Ranking
Modern Incinerator	1	3
Autoclaving and shredding	2	2
Microwaving	2	2
Chemical treatment	3	3

compacting can reduce the original waste volume by 60-90% (WHO, 2004).

Incineration: The waste can be reduced up to 90-95% depending on the type of incinerator used. Ranking is shown in Table 4.3.

Environmental Impacts of the Proposed Technology (C4): The environmental impacts associated with the various alternatives are shown in the table: Ranking of the environmental impact is as follows-

- High environmental impact: Rank 1
- Medium environmental impact: Rank 2
- Low environmental impact: Rank 3
- The ranking shows that the respondents were not aware of the environmental impacts of the proposed technology with reason that the incinerator was not functioning as at the time and the chemical treatment was done in house the survey was carried out.

Public Acceptance (C_5): The survey public perception towards medical waste management shows that autoclaving and incineration are the most accepted treatment technologies. The ranking are as follows:

Training and Operational Requirements (C6): The non-combustible alternative treatment technologies need strict monitoring to ensure efficacy of the technology. Thus these technologies require more training and operating skills, whereas incineration requires limited operator skills. Ranking is given in table.

Occupational Health and Safety including

Table 4.5: Ranking of Public Acceptance

Treatment Technology	NNUH Ranking	UCTH Ranking
Modern Incinerator	3	4
Autoclaving and shredding	4	4
Microwaving	1	1
Chemical treatment	1	1

Table 4.6: Ranking of Training and Operational Requirements

Treatment Technology	NNUH Ranking	UCTH Ranking
Modern Incinerator	4	4
Autoclaving and shredding	3	2
Microwaving	3	2
Chemical treatment	1	1

Treatment Technology	NNUH Ranking	UCTH Ranking
Modern Incinerator	4	4
Autoclaving and shredding	3	2
Microwaving	3	1
Chemical treatment	3	1

Needle Stick Prevention (C_7): Due to the combustion of medical waste, disinfection efficiency, occupational health and safety including needle stick prevention is more for incineration than other alternatives.

Analysis of the Result

- The scores are entered in to the matrix table.
- The total score is calculated using Equation (1).
- Option with highest score will be the preferred alternative.

The result for NNUH is tabulated in the MCDA matrix table below

Final score using the equation (1) for NNUH

Incineration = 1*1 + 4*1.25 + 4*1.25 + 1*1.25 + 3*1 + 4*1 + 4*1 = 23.25

Autoclave = 4*1 + 1*1.25 + 2*1.25 + 2*1.25 + 4*1 + 3*1 + 3*1 = 20.25

Microwave = 2*1 + 1*1.25 + 2*1.25 + 2*1.25 + 1*1 + 3*1 + 3*1 = 15.25

Chemical treatment = 3*1 + 1*1.25 + 3*1.25 + 1*1.25 + 1*1 + 1*1 + 1*3 = 14.25.

The result for UCTH is tabulated in the MCDA matrix table below

Final score using the Equation (1) for UCTH

Incineration = 1*1 + 1*1.25 + 1*1.25 + 3*1.25 + 4*1 + 4*1 + 4*1 = 19.75

Autoclave = 3*1 + 2*1.25 + 1*1.25 + 2*1.25 + 4*1 + 2*1 + 2*1 = 17.25

Microwave = 2*1 + 1*1.25 + 1*1.25 + 2*1.25 + 1*1 + 2*1 + 1*1 = 11.00

Chemical treatment = 2*1 + 2*1.25 + 2*1.25 + 3*1.25 + 1*1 + 1*1 + 1*3 = 15.75

Table 5: MCDA Matrix Result for NNUH

Technology ì Criteria í	**Incineration**	**Autoclaving**	**Microwave**	**Chemical Treatment**
C_1 (1)	1	4	2	3
C_2 (1.25)	4	1	1	1
C_3 (1.25)	4	2	2	3
C_4 (1.25)	1	2	2	1
C_5 (1)	3	4	1	1
C_6 (1)	4	3	3	1
C_7 (1)	4	3	3	3

Table 6: MCDA Matrix Result for UCTH

Technology ì Criteria í	Incineration	Autoclaving	Microwave	Chemical Treatment
C_1 (1)	1	3	2	2
C_2 (1.25)	1	2	1	2
C_3 (1.25)	1	1	1	2
C_4 (1.25)	3	2	2	3
C_5 (1)	4	4	1	1
C_6 (1)	4	2	2	1
C_7 (1)	4	2	1	1

It can be clearly stated by the calculations using the MCDA matrix analysis that incineration is the most suitable treatment process, but it can be noted that more of Autoclaving is done in UCTH owing to the fact the incinerator is not functional at the time the survey was carried out. (Source of NNUH ranking: Pudussery *et al*.)

Transportation

Medical wastes are transported through pre-established routes, which include specific corridors and elevators on each door and are strictly used to transport wastes from the intermediate storerooms to the final storerooms in the basement of the hospital.

The problematic areas at this stage were:

- The transfer of infectious waste with improper means of transport. The trolleys used for transportation did not provide protection against leakage. In many cases, medical waste was transported by hand and made contact with the floor, thereby increasing the danger of the waste handler being injected or cut by contaminated sharps (such as needles or glass). Furthermore, on many occasions municipal waste was transported by the same vehicle that had been previously used to transport infectious waste, thereby increasing the possibility of contaminating the municipal waste with pathogenic microorganisms.
- Inappropriate cleaning of the trailers, which contributes to creating a focus of infection.
- Overloading of trailers.
- Unsuitable protective clothing. The wearing of thin gloves and fabric aprons were the only protective measures taken during the collection and transportation of medical waste. Waste handlers were at risk of contracting diseases such as hepatitis B and tetanus by possible injection from infectious needles.
- Elevators and staircase used for waste were often used by the medical staff, which contributed to the transfer of infectious agents to different hospital departments.

The demographic data of the people participated in the survey are shown in

Table 7: Demographic Data of Public Survey

Characteristics	Number of People	Percentage
Age		
16-20	1	Less than 1
20-30	23	14
30-45	36	23
45-60	47	27
60+	81	35.3
Gender		
Male	66	35
Female	123	65
Professionals		
Professional with Science Background	23	12
Skilled Worker	34	18
Unskilled Worker	70	37
Self-Employed	11	6
Unemployed	28	15
Others	23	12

Table 7 of the 250 surveys send only 189 was returned in a time period of 3 weeks.

Cost

The cost of waste management in NNHU ranges from $700,000 to $740,000 as capital cost and operational cost of $0.78/kg while the cost of waste management in UCTH ranges from $190,000 to $210,000 as capital cost and $0.58/kg operational cost. Waste management, if given the right funding and supervision can go a long way to be minimized.

RECOMMENDATIONS

1. Clearly define the problem.
2. Focus on segregation first.
3. Institute a sharps management system.
4. Keep focused on reduction.
5. Ensure worker safety through education, training and proper personal protective equipment.
6. Provide secure collection and transportation.
7. Require plans and policies.
8. Invest in training and equipment for reprocessing of supplies.
9. Invest in environmentally sound and cost effective medical waste treatment and disposal technologies.
10. Develop an infrastructure for the safe disposal and recycling for hazardous materials.

Developing a Waste Management Plan

In order to develop a waste management plan, the waste management team needs to make an assessment of all waste generated in the hospital. The Waste Management Officer should be responsible for coordinating such a survey and for analyzing the results.

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