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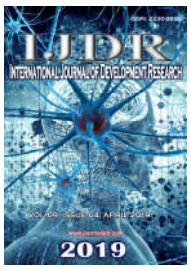

RESEARCH ARTICLE OPEN ACCESS

ETHICAL MEDICAL SERVICE THROUGH HEALTHCARE WASTE MANAGEMENT!! HOW IT IS FEASIBLE IN A TRANSITION COUNTRY?

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ABSTRACT

Health institutions have been producing undesirable waste when providing curative, preventive, rehabilitative and palliative health services irrespective of developed or developing countries. It is ethical if they are able to manage the health care wastes properly in addition to providing suitable health services. Hence this paper aims to assess the existing healthcare waste management practices in a town of Ethiopia so as to provide ethical health service. The study was conducted in 14 systematically selected sample health institutions which comprises of two hospitals (public & private), three health centers (governmental & NGO owned), two higher and seven medium clinics. Multi-stage sampling procedure was followed and sample size was determined by Yamane (1967) formula. Thus 196 paramedical and 78 cleaners were selected as sample. Structured questionnaire, interview schedule, observational checklist and waste measurement were used as tools for data collections. Healthcare waste generation was measured for the seven consecutive days (Monday – Sunday) from all the departments in sample hospitals and all health centers in Kg/Patient/Day. The collected data was coded, entered, edited and analyzed with the help of SPSS (version 21) using both descriptive and inferential statistics. The results showed that the healthcare waste generation rate in the study town hospitals and health centers ranges between 1.27 – 0.05 kg/patient/day. There was statistically significant difference in the healthcare waste generation rate between public and NGO owned health centers. The awareness level of above 50% of paramedical and cleaners is low and nearly two third of them have unsafe practice of healthcare waste management. There is no significant difference between healthcare waste management practice between hospitals, health centers and clinics. Allocating adequate resource, sustainable provision of personal protective equipment, a well coordinated healthcare waste management plan, functional healthcare waste management committee and staff training on safe handling of healthcare waste are the determinant factors on healthcare waste management practice in the selected health institutions. Established healthcare waste management system providing technical support and periodic supervision are the main recommendations for the town health offices. Providing training, appropriate resource budgeting, proper healthcare waste management planning, establishing committee, sustainable supply provision, awareness creation and guiding the healthcare waste management in line with the National Healthcare Waste Management Guideline are some of the recommendation for health institutions.

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INTRODUCTION

Health service provision is the basic service for all mankind. Health institutions have produce undesirable waste when providing curative, preventive, rehabilitative and palliative health services (Pruss *et al.,* 1999). Increasing population growth leads to increasing the foundation of health institution both in number and in size.

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Due to technological advancement, health institutions are using different disposable products during different investigations, diagnoses and treatment. Healthcare waste (HCW) generation differ based on the national income level. Developed countries generate on average up to 0.5 kg of hazardous health care waste per hospital bed per day; while low-income countries generate on average 0.2 kg of hazardous health care waste per hospital bed per day (WHO, 2011). Health care waste can cause serious harm if not managed properly. In recent years generated amount of waste increases

following the trends of population raise. This has the effect to the environment during transportation, treatment and disposal of waste. Among the total flow of waste, specific environmental loads are generated by the hazardous waste flow due to its properties: explosive, oxidizing, flammable, irritant, toxic and eco toxic, carcinogenic, corrosive, infectious, mutagenic, sensitizing, yielding another substance (USEPA, 2013). In a transition country like Ethiopia, health service is delivered through both public and private sectors. Public health institutions are hospitals, health centers and health posts and private health institutions working as different level of hospitals and clinics. There is different level of hospitals (Tertiary, referral, general, zonal, primary and district hospitals). And private clinics categorized as higher or specialty (provides one type of specialized service) and medium level clinics (provide general services). There is a referral linkages from health posts to health centers and finally different level of hospital based on national referral protocol. Based on Ministry of Health of Ethiopia, healthcare system organization in Ethiopia classify the hospitals and health centers by the number of people served: health center designed to serve 35,000 people; district hospitals designed to serve 250,000 people; zonal hospitals designed to serve 1 million people; referral hospitals designed to serve1.5 million people and Tertiary (Teaching) hospitals designed to serve 3.5 to 5 million people (Mulu, 2008). According to the United State Environmental Protection Agency (USEPA, 2013) medical waste contains all waste materials generated by healthcare facilities such as hospitals, clinics, physicians' offices, dental practices, blood banks, and veterinary hospitals and clinics as well as at medical research facilities and laboratories.

Because of inadequate research data on the existing situation of healthcare waste management in the country, the national guidelines have been developed by considering the general situation in developing countries and based on the biomedical and healthcare waste guideline prepared by the United Nations Environment Program (Kebede S. and Fantahun H. 2008). Many factors affect the rate of waste generation, including: level of activity (often measured in terms of the number of occupied beds, number of patients per day, and/or number of staff); type of department (e.g. general ward, surgical theatre, office);type or level of facility (e.g. clinic, provincial hospital);location (rural or urban); regulations or policies on waste classification; segregation practices; temporal variations (e.g. weekday versus weekend, seasonal); level of infrastructure development of the country. Dissimilarities among low, middle and high-income countries may be partly due to differences in resources; services provided available waste-management systems and the proportion of single-use disposable items (Pruss *et al*. 2013). In order to put appropriate waste management in place, understanding of the type and volume of waste generated and its characteristics in each health institutions is very essential. Hence this research aimed to represents town health institutions waste generation rate and waste management practice. The study categorized health institutions as referral (government) and general (private) hospitals, health centers and private owned clinics.

Statement of the Problem: The UN Basel Convention considers healthcare waste as the second most dangerous wastes after nuclear wastes. All individuals exposed to hazardous HCW are potentially at risk of being injured or infected (WHO, 2008). In developing countries, awareness regarding hospital waste management in terms of its segregation, collection, storage, transportation and disposal is lacking. Hospital waste is a special type of waste produced in small quantities carrying a high potential of infection and injury. Inadequate and improper handling may have serious public health consequences and a significant impact on the environment (Almuneef & Memish, 2003). Medical service provision stresses the environment by disposing healthcare waste (uncontrolled dumping, lack of appropriate treatment and disposal). The environment may make people ill and more ill people need more medical service (Mohammad, 2014). Uncontrolled combustion of medical waste accounted for 26% of the annual total dioxins/ furans release in 2003 in Ethiopia (USEPA, 2013). The nature and quantity of healthcare waste generated as well as institutional practices with regards to sustainable methods of healthcare waste management, including waste segregation and waste recycling are often poorly examined and documented in Ethiopia (Haylamicheal *et al*, 2011). In developing countries like Ethiopia, where many health concerns are competing for limited resources, it is not surprising that the management of healthcare wastes has received less attention and the priority it deserves. Unfortunately, relevant information on this important aspect of healthcare management is inadequate and research on the public health implications of inadequate management of healthcare wastes are few in number and limited in scope (Habtetsion *et al.,* 2009). Though healthcare waste management has double effect on health and environment, there is less attention given to the issue. There is no clear understanding among all health workers, health care administrators, waste handler and the general public. In a single healthcare institution there are different types of healthcare waste generated and these require different kind of treatment and disposal technologies. Among the total generated healthcare waste, hazardous waste contributes a minor proportion but it has a greater potential to contaminate a non hazardous waste if proper precaution is not taken. The hazardous healthcare waste can pose risk for the general public and the environment it requires special attention. In order to tackle the problem; a well defined policy and regulations, an investment for creating awareness, setting up treatment and disposal plants, continuous effort on supervision for the established system and the commitment of healthcare administrators, health workers and waste handlers all needed to provide ethical health service.

Specific objectives

- To assess the healthcare waste composition and generation rate in different health institutions
- To understand the knowledge of paramedical and cleaners on safe handling of healthcare waste
- To investigate the healthcare waste management practices in different health institutions
- To assess the factors determining the healthcare waste management practice in the sample health institutions

Methodology Adopted: The study was carryout in one of the town (Shashemene) of Ethiopia. The population of the town is rapidly increasing from time to time at average growth rate of 5.4% per annum because of favorable living situation and there is high immigration. The city is economically important and expanding quite rapidly compared to other towns. This is perhaps due to its location as a crossroad and a junction point for most towns located in the southern part of the country. It serves as an international highway route connecting Ethiopia

with Kenya. In order to address the objectives, primary data was collected from randomly selected paramedical staff and cleaners of sample health institutions by using interview schedule, observational checklist, structured questionnaire and waste inventory table which were adapted from "The Safe Management of Waste from Health Care Facilities" (Pruss *et al.,* 1999) and "The National Healthcare Waste Management Guideline 2008".

Multi-stage sampling procedure was employed to select the sample health institutions and the respondents. At the first stage, sample health institutions were selected by stratified random sampling (hospital, health center and clinics was consider as strata). In the second stage, one government referral hospital and one private hospital were selected purposively to explore the situation on government institution and private setting. In addition, two health centers were selected by simple random sampling and one NGO health center was selected purposively to explore the situation in different setting. In addition, out of 24 general/medium level clinics, seven were selected and out of seven specialties private clinics two were selected by simple random sampling technique. In the sample frame, all paramedical staff, management and cleaners in sample health institutions as a source population for the year 2017/18 were considered (P= 386 for paramedical staff and P=98 for the cleaners). Based on Yamane's sample size determination formula (1967) for the paramedical staff, the sample size is determined to be 196 with 95% confidence level. At the third step, based on the assumption that paramedical staff have different knowledge and experience due to their professional variation; they were stratified as Nurse, Midwifery, pharmacy technician, Laboratory technicians, x-ray technicians, health officers and management. By using proportionate random sampling 115 Nurse, 16 Midwifery, 16 Pharmacy Technicians, 26 Laboratory Technicians, 5 X-ray Technicians, 4 Health Officers and 14 managers from sample health institutions were included in the sample. In addition, 78 cleaners were selected as sample using stratified proportionate random sampling technique. The collected data was coded, entered, edited and analyzed with the help of SPSS (version 21). The analysis was performed using descriptive statistics such as frequency, percentage, mean and standard deviation to understand the knowledge of paramedical and supporting staff on safe handling of healthcare waste and to assess healthcare waste composition and generation rate. Wilcoxon Signed Ranks Test was used to see statistical significance difference on healthcare composition and generation rate between public and private hospital and public and NGO owned health centers. Furthermore, inferential statistic such as Kruskal-Wallis was used to compare the healthcare waste management practices. Moreover, *Chi*-square and ordered logistic regression analysis were carried out to identify the factors determining the healthcare waste management practice in the sample health institutions.

According to Greene (2008) and Liao (1994) the functional from of ordered logit model is specified as follows.

$$y* = \sum_{k=1}^{k} \beta_k X_k + \sum \quad \text{……(1)}$$

y* is unobserved and thus can be through of as the underlying tendency of an observed phenomenon.

∑= we assume it follows a certain symmetric distribution with zero mean such as normal or logistic distribution what we do observe is

$$\begin{aligned} &y = 1 \text{ if } y^* \leq \mu_1 \\ &y = 2 \text{ if } \mu_{1<} y^*_{\leq} \mu_2 \\ &y = 3 \text{ if } \mu_{2<} y^*_{\leq} \mu_3 \\ &y = j \text{ if } \mu_{j,<} y^* \end{aligned} \quad \text{……..(2)}$$

Where y is observed in j number of ordered categories μs are known threshold parameters separating the adjacent categories to be estimated with βs. The general form for the probability that the observed y falls in to category j and μs and the βs are to be estimated with an ordered logit models is:

$$\text{Prob } (\mu = j) = 1 - < [\mu_j - 1 - \sum^k k = 1 \beta_k X \, k] \quad \text{…….(3)}$$

Where (.) represents cumulative logistic distribution. The odds ratio on each healthcare waste management practice will be calculated by:

$$\left(\frac{\partial \, prob(y=j}{\partial XK}\right) = [f(\mu j - 1 - \sum_{k-1}^{k} \beta k \, X \, k) - f(\mu j - \sum_{k-1}^{k} \beta k \, X \, K)] \quad \text{……..(4)}$$

The dependent variable of the model is Healthcare waste management practice (Healthcare waste management practice is considers all of the waste segregation, collection, temporary storage, internal transportation, onsite treatment and disposal, external transportation and offsite treatment and disposal). The following nine variables were considered as explanatory variables in the model. The operational definitions of the selected independent variables are as follows.

Personal protective equipment: Personal protective equipments are gloves of different types and sizes, mask, apron, goggle and boot which are needed to prevent transmission of infections that health workers and sanitary workers use while handling different types of healthcare waste. Every health institution has to provide personal protective equipment to health workers and sanitary workers all the time. Availability of personal protective equipment ensures prevention of infection transmission. Hence sustainable supply of personal protective equipment positively affects healthcare waste management practice.

Knowledge of healthcare waste management: Health providers and sanitary workers have to be equipped with the basic knowledge on safe handling of healthcare waste. Health institutions have to provide the basic and refreshment trainings for all health workers and sanitary workers periodically. Knowledge of safe handling of healthcare waste is necessary to avoid infection transmissions and to protect the environment. Trained health workers and sanitary staff can implement healthcare waste management practice properly. Therefore, knowledge on safe handling of healthcare waste positively affects the healthcare waste management practice.

Healthcare waste management guideline: The national healthcare waste management guideline defines procedures that help to reduce or control possible health risks and hazards due to improper management of healthcare waste. Every health institution has to have the guideline which can govern the healthcare waste management in a proper way. The guideline

is also the base for the healthcare waste management plan. Having the guideline and planning in line with the guideline positively affects he healthcare waste management practice.

Healthcare waste management plan: Healthcare waste management plan is a plan which focuses how to handle healthcare waste safely from the point of generation up to the final disposal. It also allocates the resource needed and states assigning responsibilities, time frame for action, safety measures and how to report when injury happen. Every health institution has to have a plan for safe handling of healthcare waste especially for the hazardous one. If the health institution doesn't have the healthcare waste management plan, the healthcare waste management practice affects negatively.

Allocation of adequate resource: Allocation of adequate resources (material, financial and human) which needed for the effective implementation of healthcare waste management plan. Availability of adequate resources affects healthcare waste management practice positively.

Kind of service provision: Health institutions provide different types of health services. Hospitals, health centers and clinics provide different kinds of healthcare services and in the mean time they generate different types of healthcare waste. Hence, healthcare waste management of a given health institution has to consider the kind of service provision. Kind of service provision can affect the healthcare waste management practice.

Ownership of the health institution: Health institution can be owned by public, private or NGO owned. Every Health institution has to set up healthcare waste management plan which appropriate for the amount and type of waste generated. There is different healthcare waste management practices observed between public, private and NGO owned health institutions. Due to lack of commitment and minimal supervision, the management of health institutions fails to give appropriate attention to healthcare waste management practice. The different ownership can affects the healthcare waste management practice.

Healthcare waste management committee: Healthcare waste management committee establishes for a responsibility of handling proper healthcare waste management in a given health institution. The Health Care Waste Management committees comprise CEO/medical director or deputy, who shall be the chairperson, Head of administration and finance, Head of units/nurses, Metron, Environmental health officer/expert, Head of laboratory department, Head of operation and maintenance/head, cleaners and laundry staff and Head of pharmacy. A functional healthcare waste management committee can positively affect the healthcare management practice.

Hand washing facility: Hand washing practice is very crucial for infection prevention. Every health institution should have hand washing facility (water taps and detergents) in every waste generating point. Tap water has to be available in all the time. Availability of adequate hand washing facility can positively affects the healthcare waste management practice.

RESULTS AND DISCUSSION

Healthcare waste composition and generation rate: Understanding of the composition of healthcare waste and its generation rate is crucial and the first step in healthcare waste management. Different types of waste require different methods of handling, treatment and disposal. A health institution should know which types of waste generated, how much each healthcare waste constitutes and how much waste generated from each of healthcare waste type per day, per week, per year etc. And using this valuable information, health institutions can set up favorable healthcare waste management system.

Healthcare waste composition: The composition of HCW in the study hospitals and health centers categorized as hazardous and non hazardous. The hazardous waste further classified as infectious, pharmaceutical, sharps and pathological wastes. Infectious wastes included discarded materials or equipment from the diagnosis, treatment and prevention of disease which have been in contact with blood and its derivatives, tissues, tissue fluids or excreta, or wastes from infection isolation wards. Pharmaceutical waste included expired drugs, no longer needed; containers and/or packaging, items contaminated by or containing pharmaceuticals (bottles, boxes). Sharps waste included needles, syringes, scalpels, needles, hypodermic needles, blades, knives, infusion sets, broken glass, and nails and any other items that cut or puncture whether infected or not. Pathological waste included tissues, organs, body parts, fetuses, blood and body fluids. The non hazardous wastes, which are similar to general wastes, included food waste, papers and other office wastes.

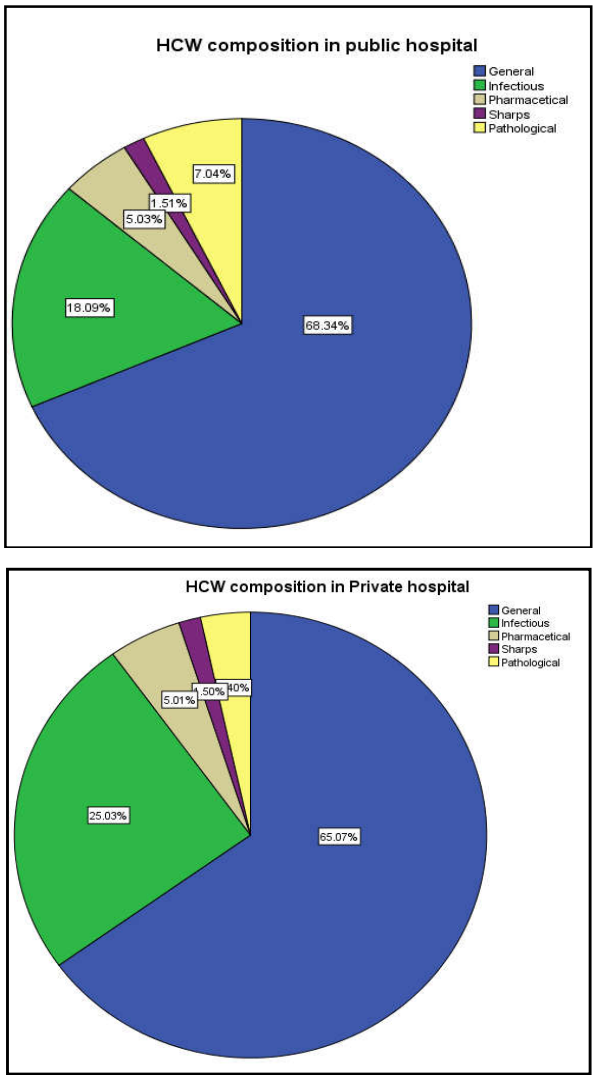

Figure 1. Composition of healthcare waste in the sample public and private hospitals

The study result depicted that in government hospital, 68% of the generated waste was non hazardous and the rest (32%) was hazardous and also the result found in private hospital almost similar (65% for non hazardous waste and 35% hazardous). The composition of healthcare waste in Public hospital was general (68%), infectious (18.7%), pharmaceutical (4%), sharps (1.4%), and pathological (8%) waste where as in private hospital general (65%), infectious (25%), Pharmaceutical (5%), sharps (1.5%), and pathological (3.4%) waste as indicated in Figure 1. There was mean difference in the composition of healthcare waste between public (264) and private hospitals (205) (table 1). Based on Wilcoxon Signed Ranks Test to see statistical significance difference on healthcare waste composition between public and private hospitals, since the p-value (0.138) is greater than 0.05, there is no significant difference of healthcare waste composition between public and private hospitals with 95% confidence level. The study result was higher than a study conducted in Addis Ababa selected hospitals which shows (general waste accounted for 79.76% and hazardous waste 20.24%) (Anteneh, 2008). In addition, the findings depicted that hazardous waste in public and private hospitals and health centers was higher than the threshold set by WHO (2000) (general waste of HCW must being the range of 85% and hazardous must be 15%). This variation was due to there was poor healthcare waste segregation practice. The higher proper healthcare waste segregation practice leads to the lower hazardous waste generation and the reverse is true.

Table 1. The mean value, Z-test and p-value of healthcare waste composition in sample hospitals and health centers

Variables	Mean value	Z-test	P-value
The HCW composition in public hospital	264	1.483[b]	0.138
The HCW composition in private hospital	205		
The composition of hazardous waste in public hospital	105	1.095[b]	0.273
The composition of hazardous waste in private hospital	89		
The HCW composition in government health center	12	1.483[b]	0.138
The HCW composition in NGO owned health center	10		
The composition of hazardous waste in government health centers	5.4	1.095[b]	0.273
The composition of hazardous waste in NGO owned health center	05		

From the total hazardous waste generated, in public hospital infectious (57.5%), pharmaceutical (16%), sharps (4.5%) and pathological (22%) where as infectious (72%), pharmaceutical (14%), sharps (4%) and pathological (10%) waste generated in private hospital. There was mean difference in the hazardous waste composition between public (105) and private hospitals (89). However, since the p-value (0.273) is greater than 0.05, there is no significant difference of hazardous healthcare waste composition between public and private hospitals with 95% confidence level. The healthcare waste composition in public health centers was general (62%), infectious (13%), pharmaceutical (11%), sharps (4%), and pathological waste (10%). While in the other NGO owned health center was general (61%), infectious (15.3%), Pharmaceutical (9%), sharps (6%), and pathological waste (9%). Also there was mean difference in healthcare waste composition between public (12) and NGO owned health centers (10). Since the p-value (0.138) is greater than 0.05, there is no significant difference between the mean healthcare waste composition between public and NGO owned health centers with 95% confidence level.

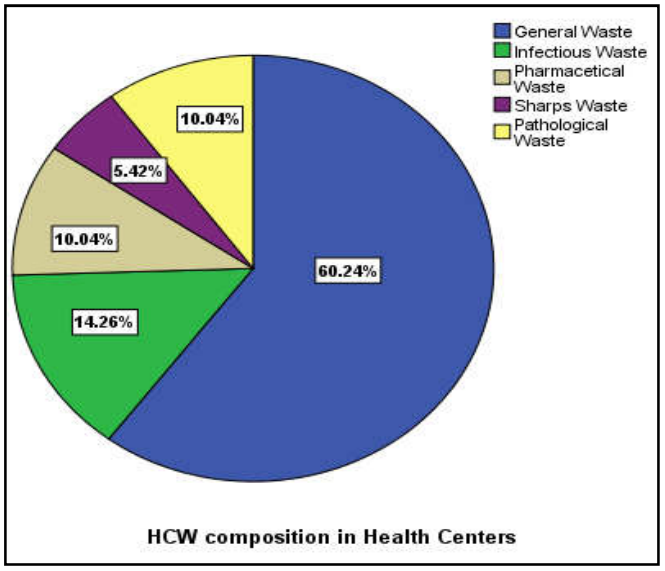

Figure 2. Composition of healthcare waste in the sample health centers

The result indicated that in town health centers, 60% of the generated waste was non hazardous and the rest 40% was hazardous. The composition of healthcare waste in health centers was general (60%), infectious (14%), pharmaceutical (10%), sharps (5.4%), and pathological waste (10%) (figure 2). There was slight mean difference in the hazardous waste composition between public (5.4) and NGO owned health centers (5). Since the p-value (0.273) is greater than 0.05, there is no significant difference between the mean healthcare waste composition between public and NGO owned health centers with 95% confidence level. The study indicated that health centers healthcare waste was highly constituted with the hazardous waste than both public and private hospitals. However, in all types of health centers there was lower hazardous waste than the study conducted in Adama public health centers (Chernet, 2016). The variation may be due to that there was better healthcare waste segregation practice in sample health centers than in Adama health centers relatively. Once the general waste put in infectious waste bin and it become contaminated and it considered as hazardous. As the study result showed in private and public hospitals and health centers infectious waste had a high frequency variation while other categories are evenly generated with less variation. This result give insight to health institutions administrators that, high attention is required to infectious waste as its generation is not predictable. Due to the fact that the cost of treatment and disposal of hazardous waste is higher than non hazardous waste; health institutions should lower hazardous waste proportion. Applying proper healthcare waste segregation practice enables health institutions to have cost effective healthcare waste management system beside other determinant factors.

Estimation of healthcare waste generation rate: In order to assess the impact of healthcare waste in the town, the initial work should be estimating the generation rate of solid healthcare waste in sample hospitals and health centers. The selected healthcare waste measuring procedures was that all types of wastes from each department measured at the point of waste generation for the seven consecutive days and the total healthcare waste divided by seven to get the mean daily waste generated.

Table 2. Summary of generated waste in the town hospitals

Measurement	General	Infectious	Pharmaceutical	Sharp	Pathological	Total HCW
Referral Hospital (Public)						
Total weight (kg/week)	900.7	241.9	66.6	19.3	92.6	1321.1
Mean kg/day	129	34	9.5	3	13.23	188.7
% by weight	68	18.7	4	1.4	8	100
SD	43.7	16.6	8.4	1.1	16.1	68.2
HCW generation rate	1.10 kg/patient/day					
Feya Hospital (Private)						
Total weight (kg/week)	667.7	256.5	51.3	15.39	34.88	1026
Mean kg/day	95.38	36.64	7.32	2.19	4.9	147
% by weight	65	25	5	1.5	3.4	100
SD	33.8	13.7	4.4	0.72	4.7	45.5
HCW generation rate	1.44 kg/patient/day					
Town hospitals						
HCW generation rate	1.27 kg/patient/day					

Table 3. Mean healthcare waste generation rate in the sample hospitals

Hospitals	Total HCW per week	Mean HCW Mean+SD	Mean of General Waste (%)	Mean of Hazardous Waste (%)
Referral Hospital	1321.1	77.71±68.23	52.98 (68)	24.73 (32)
Feya General Hospital	1026	60.32±42.65	39.2 (65)	21.1 (35)
Mean Kg/day	1135.3	66.77	46.12 (69)	20.65 (31)
SD	263	15.46	9.69 (63)	5.77 (37)

Table 4. The mean value of healthcare waste generation rate in hospitals and health centers

Variables	Mean value	Z- test	P-value
The healthcare waste generation rate in public hospital	77.7118	970b	0.332
The healthcare waste generation rate in private hospital	60.3235		
The healthcare waste generation rate in government health centers	12	2.366b	0.018
The healthcare waste generation rate in NGO owned health center	7		
The daily distribution of HCW generation in public hospital	188.7	1.859b	0.063
The daily distribution of HCW generation in private hospital	147		

Estimation of solid healthcare waste generation rate in hospitals: The healthcare waste generation rate in hospitals calculated as the mean healthcare waste generated per day divided by the mean patient flow per day. Patient flow per day for hospitals is the sum of Out Patient Department (OPD) patient flow and In Patient Department (IPD) patient flow. As hospitals registration book showed, the average patient flow per day for public and private hospitals was 171 and 102 respectively. And the mean patient flow per day for the hospitals was 137. The results showed that, 1,321.1kg and 188.7 kg waste generated in public hospital per week and per day respectively; whereas 1026 kg and 147 kg waste generated per week and per day in private hospital. The study indicated that the mean HCW generation rate of public hospital was 1.10 kg/patient/day while in private hospital was 1.44 kg/patient/day. The mean HCW generation rate for town hospitals was 1.27 kg/patient/day (table 2). Even if there was no statistically significance difference between public and private hospitals in healthcare waste generation rate, private hospital had higher healthcare waste generation rate in terms of waste generated verses patient treated. Since private hospital used many disposable items and different medical equipments which used for investigation and treatment. It implies that private hospital should consider waste minimization through waste avoidance, waste reduction and re-use. There was mean difference in healthcare waste generation rate between public (77.7) and private hospitals (60). Based on Wilcoxon Signed Ranks Test to see statistical significance difference on healthcare waste generation rate between public and private hospitals, the p-value (0.332) is greater than 0.05, there is no significant difference between the mean healthcare waste generation rate between public and private hospitals with 95% confidence level. The mean healthcare waste generation rate both in public and private hospitals was a bit higher than the study conducted in the selected three public hospitals in Addis Ababa (Azeb, 2016). Moreover, the average HCW generation rate was almost similar with the study conducted in Libya (Sawalem *et al.,* 2009) and the study showed in Calabra Metropolis and Developing Countries (Agunwamba, 2013). Regarding the rank of the highest generated departments in public hospital: Obstetric ward (18%), Operation Room, Surgical & Orthopedic ward (14%), and Emergency (10.2%) were ranked from 1 - 3. In private hospital, surgical ward and Operation Theater (16%), medical ward (12%), and pediatric ward (11%) were ranked from 1 – 3. The finding illustrated that the daily distribution of HCW generation in public hospital was peak in week days and less in weekend as shown in Figure 3. This variation may be happens due to the patient flow is high especially in Out Patient Department (OPD) in week days. In addition, governmental health institutions don't give service for OPD patient in weekend unless for emergency cases. The daily distribution of healthcare waste generation on Monday and Thursday was peak in relation to other week days in public hospital. This variation is due to on Monday, OPD patient flow was high since Saturday and Sunday there was no OPD service unless emergency cases and Thursday is the market day in the town especially the rural people have a trend of visiting health institutions when coming to market. Moreover, the generation rate on Wednesday was lower than all week days, in the past the rural people don't want to go to health institutions on Wednesday due to the perception that they believe there is no heal on Wednesday. Even though the government is struggling to create proper awareness through health extension packages,

still it persists. In contrast, the result found that in private hospital in daily distribution of healthcare waste generation was peak in weekend and less in week days as shown in Figure 4. This variation may be happens due to patient flow was high especially in OPD during weekends. The fact that in the weekend, many part time specialist doctors works in private hospital OPD in addition to other routine work.

The daily patient flow was ranges between 71 and 153. As the rank of the highest generated departments in public health centers: Delivery ward (22 – 34%), MCH and OPD (13% and 19%) and Injection and Dressing Room (12 – 14 %) were ranked from 1 – 3; where as in NGO owned health center delivery room (22%), OPD (19%) and Injection and Dressing Room (14%) were ranked from 1 – 3.

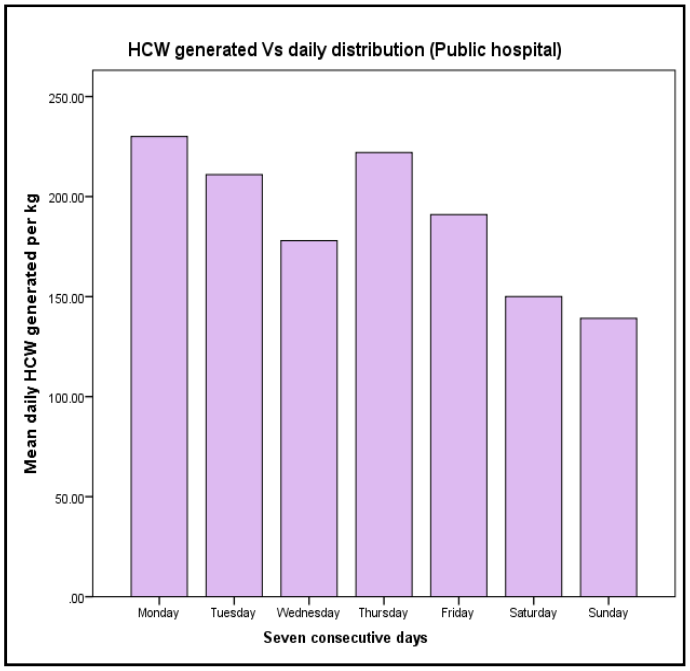

Figure 3. The average daily distribution of all types of healthcare waste generated in public hospital (kg/day)

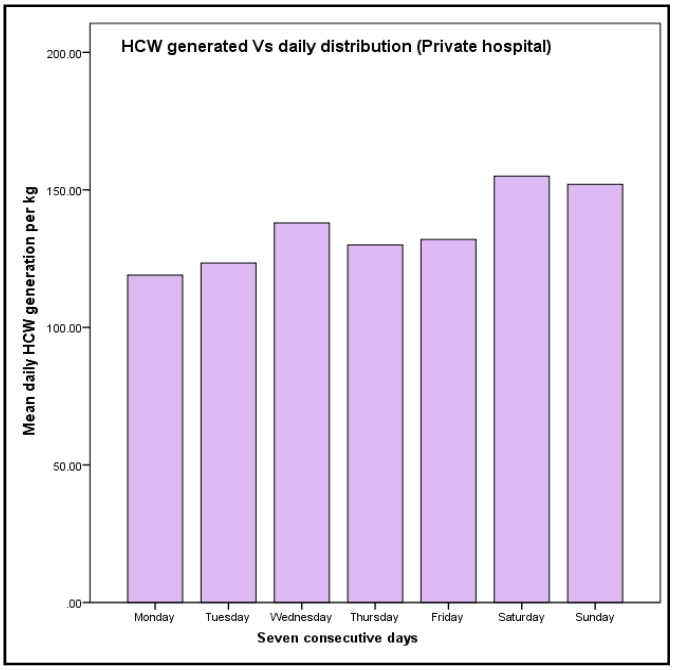

Figure 4. The average daily distribution of all types of healthcare waste generated in private hospital (kg/day)

Table 5. Summary of the generated waste in town health centers

Sample Health Centers	Total HCW per week	Mean HCW Mean+SD	Mean of General Waste (%)	Mean of Hazardous Waste (%)
Bulchana Health Center	32.8	4.68±1.46	3.04 (65)	1.64 (35)
Dida Boke Health Center	24.5	3.5±2.2	2.04 (58)	1.46 (42)
Catholic Mission Health Center	48	6.86±2.95	4.18 (61)	2.68 (39)
Mean Kg/day	35.1	5.01	3.08 (61)	1.93 (39)
SD	11.92	1.7	1.12 (66)	0.58 (34)
Public Health Centers				
HCW generation rate	0.06 kg/patient/day			
NGO owned Health Center				
HCW generation rate	0.04 kg/patient/day			
Town Health Centers				
HCW generation rate	0.05 kg/patient/day			

There was mean difference in the daily distribution of healthcare waste generation between public (188.7) and private hospital (147). Based on the rank test, the p-value (0.063) is greater than 0.05, there is no significant difference between the mean daily distribution of healthcare waste generation in public and private hospitals with 95% confidence level. This study is in line with the study conducted in Amhara regional state (Esubalew, 2015).

Estimation of healthcare waste generation rate in health centers: The healthcare waste generation rate in health centers is calculated to the total healthcare waste generated per day divided by the mean patient flow per day. Patient flow per day for health center is the sum of OPD patient flow and delivery service. There is no patient admission in health centers. As health centers registration record showed, the average patient flow per day for public and NGO owned health centers was 78 and 153 respectively. And the mean patient flow per day for the town health centers was 103.

The public health centers a range of 24.5 – 32.8 kg and 3.5 – 4.7 kg healthcare waste generated per week and per day respectively; whereas 48 kg and 6.86 kg waste per week and per day generated respectively in NGO owned health center (Table 5). It is found that the mean HCW generation rate of public health centers was 0.06 kg/patient/day while in NGO owned health center was 0.04 kg/patient/day. The mean HCW generation rate for town health centers was 0.05 kg/patient/day. There was mean difference in healthcare waste generation rate between public (12) and NGO owned health centers (7). Based on the rank test, the p-value (0.018) is less than 0.05, there is significant difference between the mean healthcare waste generation rate in public and NGO owned health center with 95% confidence level. As health centers provide preventive health services, the public health centers have obtained different support like medical supplies and other disposable items from different partners. This may be one of the reasons that public health centers had a higher waste generation rate than NGO owned health center.

Table 6. Knowledge on Healthcare Waste Management (HCWM) for Paramedical staff

Variables	Yes	No
Knowledge on the existence of HCWM guidelines	58 (31.8%)	124 (68.2%)
Knowledge on HCW segregation		
Different types of HCW	79 (43.4%)	103 (56.6%)
Specific color coding system used for waste containers	66 (36.2%)	116 (63.8%)
HCW Segregation at the point of generation	88 (48.3%)	94 (51.7%)
Knowledge of waste collection and temporary storage		
Infectious waste shouldn't be store for > 48 hours	42 (23%)	140 (77%)
Level of safety box should be filled before closing	112 (69.5%)	49 (30.5%)
Time table for waste collection	134 (73.6%)	48 (26.4%)
Knowledge on HCW Treatment & Disposal		
Different methods of HCW treatment	59 (32.4%)	123 (67.6%)
Different methods of HCW disposal	63 (35%)	119 (65%)
Waste reduction, recycling and reuse	13 (7.1%)	169 (92.9%)
Knowledge on HCW related Precaution		
International Biohazard Signs	3 (1.6%)	179 (98.4%)
Disease transmitted by improper HCW disposal	182 (100%)	
Post exposure measures after NSI	94 (58.3%)	67 (41.7%)
How to report after NSI	115 (63.1%)	67 (26.9%)
Receive HCWM training	76 (41.6)	106 (58.4%)

Table 7. Knowledge on Healthcare Waste Management for Cleaners

Variables	Yes	No
Knowledge on HCW segregation		
Different types of HCW	30 (38.2%)	48 (61.9%)
Specific color coding system used for waste containers	25 (32.1%)	53 (67.9%)
HCW Segregation at the point of generation	14 (18%)	64 (72%)
Knowledge of waste collection and temporary storage		
Infectious waste shouldn't be store for > 48 hours	24 (31%)	54 (69%)
Level of safety box should be filled before closing	32 (41%)	46 (59%)
Time table for waste collection	30 (38%)	48 (62%)
Knowledge on HCW Treatment & Disposal		
Different methods of HCW treatment	29 (37.4%)	49 (62.6%)
Different methods of HCW disposal	31 (40%)	47 (60%)
Knowledge on HCW related Precaution		
Knowledge of use of PPE to prevent infection	78 (100%)	
Post exposure measures after NSI	65(83.3%)	13 (16.7%)
How to report after NSI	65(83.3%)	13 (16.7%)
Receive HCWM training	27 (34.7%)	51 (65.3%)

However, NGO owned health center had a lower waste generation rate with a higher patient flow. The donated items in the public health centers increased the waste whereas in NGO owned health center waste minimization especially re-use was highly practiced. The finding was a bit higher than the study conducted in Adama (Chernet, 2016).

Knowledge on safe handling of healthcare waste: Knowledge of health workers and cleaners on safe handling of healthcare waste is the one of the determinant factors in healthcare waste management practice. In order to assess the existing healthcare waste management practice in the town health institutions, identifying the level of understanding of both health workers and cleaners is vital. Besides placing appropriate waste bins in waste generation points and other necessary healthcare waste treatment and disposal construction; equipping health workers and cleaners with the basic concepts of healthcare waste management practice is mandatory. In order to assess the knowledge of HCWM, one hundred eighty two questionnaires were distributed among paramedical staff to fill the questionnaires. In addition, seventy eight cleaners were interviewed with structured interview schedule. Paramedical staff included Nurses, Midwifery, Health Officers, Laboratory Technician, Pharmacy Technician, and X-ray Technicians. Different studies showed that there was low level of understanding of both paramedical staff and cleaners on the HCWM and also there was unsafe HCWM practice.

The study result showed that 43.4% of paramedical staff knew the different type of HCW but only 36.2% knew the specific color coding system used for waste bins. Concerning the Knowledge of HCW segregation at the point of generation, only 48.3% of the paramedical has the knowledge. Knowledge on International Biohazard Signs, only 1.6% of paramedical were knew. Only 7.1% of the paramedical knew waste reduction, recycling and reuse. Concerning infectious waste shouldn't be store for > 48 hours, only 23% of the paramedical had the knowledge and 58 % of paramedical staff had never received training on HCWM practice (Table 6). The finding depicted that 38.2% of cleaners knew the different type of HCW but only 32.1% of the cleaners had the knowledge of specific color coding system used for waste bins. Knowledge of HCW segregation at the point of generation, only of 18% of the cleaners had the knowledge. The knowledge on different methods of treatment and disposal, below 50% of cleaners responded correctly. Concerning infectious waste shouldn't be store for > 48 hours, only 31% of the cleaners had the knowledge and 65 % of cleaners had never received training on HCWM practice (Table 7). The present study indicated that the level of understanding of both paramedical staff and cleaners was very low. The study in line with the study conducted in Yemen (Al-Emad AA., 2011); the study conducted in eight teaching hospitals in Karachi (Shahida *et al*., 2007) and the study conducted in selected hospitals of Iran (Dehgahani *et al*., 2008).

Practice of healthcare waste management in different health institutions: The healthcare waste management practice of the sample health institutions were evaluated by structured observation. The observed healthcare waste management practice has different components. Healthcare waste segregation, collection and transportation, temporary storage, treatment and disposal were the observed components of healthcare waste management. The following sections described the observed healthcare waste management practice in the surveyed health institutions.

Healthcare waste segregation practice: In order to apply the proper healthcare waste segregation practice, different waste bins should be put at the service delivery points. Placing of the number of waste bins in a specific service delivery point depends on the number of different types of waste generated in that specific place. Based on the color coded system: black for general waste, yellow for infectious waste, red for highly infectious or pathological waste and safety box for sharps waste (Pruss *et al.,* 1999). Beside, placing appropriate waste bins in place, the paramedical staff and cleaners should be equipped with the knowledge on different types of wastes, which items included in specific waste category and the color coding system. In all studied hospitals, health centers and clinics segregation of general, infectious and sharp waste was segregated in unsatisfactory manner. In few places, standard color coded bins and in some places labeled ordinary plastic buckets were used in place of waste generation point. In some cases safety box for sharps and only one waste bin for infectious waste were placed and waste bin for general waste missed. As a result general and infectious wastes were mixed. In few cases the three bins were placed at the point of waste generation, but general waste items mixed with infectious waste also observed. Placenta and other pathological waste were separately stored in closed plastic containers considered as highly infectious waste in Maternity Ward and Operation Theater. In most sample health institutions, sharp waste was stored in standard sharp safety boxes where as in one NGO owned health center and half of the clinics, sharp waste was stored in sub standard storages such as ordinary carton boxes that can be easily damaged or torn out. Also general and infectious wastes were stored in open and substandard waste bin until collection. In case of infectious waste store in open bin, there is a possibility of invisible disease causing pathogens can escape from the bin and enter into the air. As a result, who inhale this contaminated air can be infected. HCW Segregation practice was observed that lack of consistency in practice even within the same health institution. As indicated in picture 1 showed that the standard foot press and covered waste bin in one of the surveyed health institutions; picture 2 showed that properly labeled but semi open ordinary buckets in one of the surveyed health institutions and picture 3 showed that improperly labeled color coded bins and improperly placed safety box in one of the surveyed health institutions.

Collection and transportation of healthcare waste: Health institutions should have the standard healthcare waste collection and transportation route. The different types of wastes have to be collected and transported separately. The national HCWM guideline says the waste bins and safety boxes should not be kept above 3/4th full. As it is observed, there was no structured collection and transportation route for general and infectious wastes. Waste collection was done early morning before 8:00 am and afternoon 5:00 pm as regular schedule in most of sample health institutions. It was observed that pathological waste was collected within 1 -2 hours after generation. Sharps and pathological wastes were collected and transported separately. Infectious waste was collected and transported in open containers and carton boxes. In some health institutions the standard transportation bins were available but they weren't functional due to the walk ways not paved and difficult to move the wheels. The sanitary workers carried the waste bins and dump at the backyard of the health institutions and they replaced the bins at the waste generation point. It was observed that the infectious waste bins were replaced without washing.

The HCWM guideline says that the collection of safety box has to be done the bins 3/4th full; but the actual collection done on time table not considering the level of filling. As indicated in picture 4 showed that safety box was filled more than full and it is difficult to close in one of the surveyed health institutions. This situation indicated that closing the box has a risk of facing needle stick injury and also transporting as it is also has a risk of dropping needle during transportation.

Temporary storage of healthcare waste: Health institutions should have a washable temporary storage especially for infectious waste. This storage should be adequate for the total infectious waste generated in the health institution. There is a possibility of infectious waste store the maximum of 48 hours. The temporary storage should protected by fence and the door has to be locked. Animals, insects and birds shouldn't have the access to the stored infectious waste. In all sample health institutions, there was lack of central and purpose-built waste storage area. Infectious waste was collected and dumped at open pit at the backyard of the health institutions until open burning done. It was observed that the waste stayed more than two days. When rain rains the waste become wet and it become difficult for burning so they wait additional days until dry. In some health institutions, the dumping area was fenced and protected from people and animal entrance but still flies, insects, rats and rodents had access of the stored infectious

waste. And these animals can transmit infections. In the some health institutions, the area was not fenced. In some cases it was fenced but the doors were not closed. The other cases there were no fence at all. The other observation was that the dumped waste had bad odor. As indicated in Picture 6 mixed waste was dumped in open pit for open burning but the waste become wet due to rain in one of the surveyed health institutions.

Picture 6

Healthcare waste treatment and disposal practice: Treatment and disposal of healthcare waste is the final step of healthcare waste management. Depending on their classification application of waste treatment varies. In order to ensure complete composition of the waste, the incinerator should be double chamber with sufficient air inlets. The incinerators should be protected with fence and the incinerator bottom ash should be buried in ash pit. The ash pit should be constructed based on landfill principles. Steam sterilization is used for the sterilizing contaminated medical equipments. Chemical disinfection is one of the waste treatment methods and it is applicable for laboratory test tubes, medical equipment and the socked lenin, blanket and patient gown. All sample health institutions followed almost similar trend for waste treatment and disposal.

The common treatment methods included steam sterilization, chemical disinfection brick incineration, open burning in metal barrel. And the common disposal methods were open pit and pit burial. Open pit burning and single chamber incineration were the most used treatment methods. It was observed that all incinerators were single chamber but to ensure complete combustion of the waste it requires double chamber incinerator. Less attention was given to bottom ash and it was observed that surveyed health institutions were lack of ash pit and the bottom ash was dumped on the soil as diffused pollutant. Different studies indicated that the bottom ash contains high level of heavy metals (Azeb, 2016 & Anteneh, 2008).

It was observed that 80% of Incinerators in the surveyed health institutions lack of sufficient air inlets on the side. And 60% of incinerators were not fenced. In addition 30% of incinerators were lack side doors. As indicated in picture 7, covered placenta pit in one of the surveyed health institutions; Picture 8 showed that open placenta pit in one of the surveyed health institutions; picture 9 showed that single chamber incinerator in one of the surveyed health institutions and picture 10 showed that partially burned mixed waste (General + Infectious + Pharmaceutical) in one of the surveyed health institutions.

Picture 7 Picture 8


Picture 9 picture 10

It was concluded that all public health institutions and private hospital used open hand dig pits located in their back yard as the final disposal of the untreated healthcare waste. The private clinics used the municipal dump site as final disposal for mixed and untreated healthcare waste.

Healthcare waste recycling and reuse practice: Recyclable healthcare waste can be recycled and used after getting proper treatment. In all surveyed health institutions, healthcare waste recycling practice was totally absent. In contrast, reusing was practiced in all health institutions. Reusable items like medical equipment, laboratory test tubes and other reusable items like linen, blanket, patient gown and draping towel which designed for reuse and resistant to the sterilization or disinfection process were undergone treatment. In studied hospitals, pressurized materials such as Oxygen gas cylinders were returned to the suppliers for refilling and reuse. The surveyed health institutions were used different size of autoclaves for sterilization of medical equipment. The size of autoclave depends on the amount of sterilized medical equipment needed. As indicated in picture 11 autoclave used for sterilizes contaminated medical equipment in one of the sample health institutions.

Picture 11. Autoclave used for sterilizes contaminated medical equipment in one of the surveyed health institutions

The study concluded that the practice of healthcare waste segregation was very poor in all hospitals, health centers and clinics. There was no structured collection and transportation, for general and hazardous waste in both private and public hospitals. Moreover, all public health institutions and private hospital used open hand dig pits located in their back yard as the final disposal of the untreated healthcare waste. The private clinics used the municipal dump site as final disposal for mixed and untreated healthcare waste. The finding depicts that

the healthcare waste management practice of town can cause risk for the public health and environmental pollution. It is similar to the study conducted in Amhara regional state (Esubalew T., 2015), in Adama (Chernet 2016) and in Addis Ababa (Azeb 2016). This indicated that the healthcare waste management practices also a challenge in other parts of Ethiopia. The reason may be healthcare workers; administrators and waste handlers weren't adequately perceived the health and environmental risks of handling healthcare waste and the healthcare waste management lack appropriate attention.

Factors determining the healthcare waste management practice: This section tried to examine the effect of selected independent variables on healthcare waste management practice. The selected independent variables were adequate resource, healthcare HCWM guideline, HCWM plan, HCWM committee, hand washing facility, training, provision of personal protective equipment (PPE), types of service provision, and ownership of health institutions. In order to examine the relative importance or net effect of each independent variable, ordered logistic regression analysis was carried out. Before using the model, multicollinearity problem among the independent variables was tested using Contingency Coefficient. According to White (1980), if the value of contingency coefficients is greater than 0.75, the variables are said to be collinear. Consequently, the contingency coefficient result indicated that all the selected independent variables except HCWM committee and types of service provision had no Multicollinearity problem. As a result, type of service provision as one of the independent variables was excluded in the model and HCWM committee was included in the model. The national HCWM guideline says that all types of health institutions have to be established HCWM committee. And the study was considered this as inclusion criteria for HCWM committee.

Table 7. Pearson Tests of Model Coefficients and Model Summary

Chi-square	Df	Sig.	Pseudo R Square
3187.2***	160	0.000	0. 737

The *Chi*-square result (x^2 =3187.2, df=160, p<0.001) from the model summary indicated that the overall model was significant when all independent variables (adequate budget, HCWM plan, HCWM guideline, HCWM committee, adequate hand washing facility, staff training, provision of PPE and ownership of health institutions) entered. The "pseudo" R^2 estimates indicated that approximately 73.7% of the variance in the HCWM practice was predicted by the above mentioned independent variables. The other (26.3%) of variation in HCWM practice was predicted by other independent variables, which weren't included in this model. In order to understand the determining factors on healthcare waste management practice, Ordinal Logistic Regression Model was used. The dependent variable for the model was healthcare waste management practice. The independent variables which included in the model were: ownership of health institutions, availability of adequate budget, healthcare waste management plan, healthcare waste management guideline, health care waste management committee, adequate hand washing facility, training and provision of personal protective equipment. Ordinal regression model selected the fact that the very nature of the dependent variable (healthcare waste management practice) is ordinal and categorical. The following table showed that significant and insignificant variables on the healthcare waste management practice. As presented table 8, eight variables were hypothesized that determine the health care waste management practice. The ordinal logistic regression output revealed that among eight variables five of them had shown significant effect on the healthcare waste management practice. They are availability of adequate resources, a well coordinated healthcare waste management plan, functional healthcare waste management committee, training and provision of personal protective equipments. The following few paragraphs described only significant variables.

Table 8. Results of Ordinal Logistic Regression Model

Variables	B	SE	Wald	P-value
Ownership	1.982	1.415	1.962	.161
Adequate resource	5.557**	2.061	7.269	.007
HCWM Plan	-6.640**	2.506	7.022	.008
HCWM guideline	1.254	2.352	.284	.594
HCWM Committee	7.807*	3.494	4.992	.025
Adequate hand washing facility	2.412	1.683	2.053	.152
Training	5.610*	2.303	5.933	.015
Provision of PPE	5.724*	2.261	6.407	.011

Note: β=Beta Coefficient, S.E=Standard Error & * and ** Significant at 1% and 0.05% level

Adequate resource: It refers the amount of resource allocated to manage healthcare waste management annually. The resources considered were financial, human and material. Regarding this variable, table 8 showed that the allocation of adequate of resource by health institutions had positive and significant effect on HCWM practice ($\beta = 5.557, p < 0.01$) . The result of the odds ratio indicated that a one unit increase in the availability of resource will be increased the level of HCWM practice by 5.557 units keeping other variables constant. This implies that the allocation of adequate resource enables health institutions to implement HCWM practice properly.

HCWM Plan: It refers a plan which sets to govern HCWM practice in accordance with the HCWM guideline in health institution. Regarding this variable, the results showed that having a HCWM plan had negative and significant effect on HCWM practice in health institutions ($\beta = -6.640, p < 0.01$) .The result of the odds ratio indicated that a one unit increase in the availability HCWM plan will be decreased the level of HCWM practice by -6.640 units keeping other variables constant. This implies that having unrealistic plan leads to poor performance in HCWM practice. The reason why achieving poor HCWM practice even for those who had HCWM plan: due to the plan wasn't set in line with the HCWM guideline, lack of commitment or inadequate resource.

HCWM Committee: It refers the committee which established primarily concerned for the safe handling of healthcare waste (HCW) in health institution. Regarding this variable, results showed that availability of functional HCWM committee had positive and significant effect on HCWM practice ($\beta = 7.807, p < 0.05$) .The result of the odds ratio indicated that a one unit increase in the availability functional HCWM committee will be increased the level of HCWM practice by 7.807 units keeping other variables constant. This implies that the presence of functional HCWM committee enables the health institution to implement HCWM practice in a safer way.

HCWM Training: It refers provision of healthcare waste management (HCWM) training for medical and cleaners in

order to equip with the basic knowledge and skill on safe handling of healthcare waste. Regarding this variable, table 8 results showed that provision of HCWM training for paramedical staff and cleaners had positive and significant effect on HCWM practice ($\beta = 5.610, p < 0.05$) The result of the odds ratio indicated that a one unit increase in the provision of training will be increased the level of HCWM practice by 5.610 units keeping other variables constant. This implies that the provision of HCWM training for paramedical staff and cleaners enables health institutions to implement HCWM practice to the standard.

Provision of sustainable Personal Protective Equipment (PPE)*:* It refers sustainable provision of personal protective equipment for medical staff and cleaners. Regarding this variable, model results showed that availability of PPE all the time had positive and significant effect on HCWM practice ($\beta = 5.724, p < 0.05$) .The result of the odds ratio indicated that a one unit increase in the availability of PPE all the time will be increased the level of HCWM practice by 5.724 units keeping other variables constant. This implies that the sustainable provision of PPE enables health institutions to implement HCWM practice in a safer way. Thus allocation of adequate resource, sustainable supply of PPE, functional HCWM committee and knowledge of safe handling of healthcare waste were positively and significantly affecting the HCWM practice and lack of a well coordinated HCWM plan was negatively and significantly affects the practice in the town. The study concluded that health institutions should consider the above mentioned determinant factors in setting healthcare waste management system.

Conclusion & Recommendations

Healthcare waste management requires special attention because the presence of hazardous substance in the waste can cause health and environmental risk. And also healthcare waste management practice affected by different factors. The research findings has indicated that the existing gaps regarding proper healthcare waste management in the selected health institutions. The proportion of hazardous waste generated from sample health institutions in was above the threshold set by the WHO. All healthcare wastes were mixed with the general waste that leads to both infectious and hazardous. Healthcare waste collection, transportation and temporary storage system was inefficient to protect the environment, health workers, waste handlers, patients and their relatives and the general public. The waste treatment and disposal methods also released huge amount of air pollutant and diffused pollutant to the soil which can cause health and environmental risk. Moreover, the low level awareness among health workers and cleaners highly contributed to the inappropriate healthcare waste management practice. There is an urgent need to set up the standard healthcare waste management at all health institutions. Then only ethical medical service can be affirmed to the society in the transition country like Ethiopia. The following recommendations are forwarded to ensure ethical medical service in the study area.

Program implementers (Town Administration Health Offices)

- The Health offices should provide technical support for each health institutions to plan and conduct HCWM training for medical staff and waste handlers. Also should provide technical support in designing and construction of HCW treatment and disposal plants.
- The offices should create awareness on environmental preferable purchasing policy.
- The office should conduct periodic supervision to ensure the health institutions moving in a right track in implementing HCWM plan.

Health Institutions

- All health institutions should have the copy of the National HCWM guideline (2008) and HCWM plan should be set in accordance with the HCWM guideline in addition adequately allocating resource for proper implementation of HCWM plan. All health institutions should have a functional and accountable HCWM committee which has a responsibility of tracking progress in terms of implementation of the HCWM plan.
- All health institutions should plan and conduct HCWM training and refreshment trainings for all medical staff and waste handlers along withinformed safety measures.
- To ensure waste minimization, health institutions should apply environmentally preferable purchasing policy. Waste segregation should be implemented with color coding system. Appropriate number of color coded bins should be placed and the number depends on the different types of waste generated in a particular waste generation point.
- Health institutions should set appropriate waste collection and transportation route which consider environmentally sound approaches for both general and hazardous wastes. Waste collection should be implemented with easy wash waste collection bins and the walk ways should be paved to allow easy movement.
- All health institutions should have closed easily cleanable waste container which appropriately designed and adequate as a temporary waste storage. And also it should be lockable and protected with fence.
- All health institutions should have incinerators which properly designed and constructed to burn waste completely. In addition, incinerator ash pit and placenta pit should be applied with proper landfill principles in order to dispose of the healthcare waste without affecting the public health and the environment. The incinerators and landfill areas should be fenced.
- All health institutions should ensure that HCWM practice documented properly and disseminate best practices among departments as lesson learnt.

Policy makers (Ministry of Health and Regional Health Bureau): The development and implementation of an information-based healthcare waste management strategic plan has significant benefits for health institutions. There is an urgent need for raising awareness on healthcare waste issues. This should be supported by a representative and fully functional healthcare waste management structure, which is able to monitor and control all healthcare waste management activities. Develop rules, regulations and revise the operational guideline for the management of healthcare waste in health facilities nationwide.

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