Health Care Waste Generation rate and its Management in Felege Hiwot Referral Hospital, Bahir Dar Town, northwest Ethiopia

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A research submitted to Jimma University College of Health Sciences, Department of Health Economics, Management, and Policy for the Partial Fulfillment for the Requirement for Master of Health Care and Hospital Administration (MHA)

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Abstract

Background: Hospitals provide patient care and prevent the public from health risk. On one hand they cure patients and on the other, have emerged as a source of diseases because of by the activities of health care service hazardous waste they produce. Until recent time, not enough attention has been given for the management of hospital waste. The amount and type of waste generated from the hospital is not well established in Ethiopia .The aim of this study, assessment of waste generation rate and its management system provide important information for future planning and appropriate waste management practice for Felege Hiwot Referral Hospital.

Objective: To assess health care waste generation rate and management system in Felege Hiwot Referral Hospital, 2014.

Methods: A facility based cross-sectional study using quantitative and qualitative was employed to determine waste generation rate and assess its management system in Felege Hiwot Referral Hospital from November 20- December 20/2014. Observation checklist and in-depth interview with 16 key informants of the hospital staffs were used to assess the health care waste management practice in terms of segregation, collection, transportation and disposal. Weighting scale was used to quantify the waste generation rate for seven consecutive days in each unit. For the average quantity, mean, standard deviation and Kurskal-Wallis test was computed for descriptive and statistical analysis. And results were presented using tables and figures as appropriate.

Result: -The total waste generated was 758.55kg/day. Among these, the 0.1kg/bed/day were pathological, 0.88 were infectious, 0.02 were harps and 1.69 were general wastes. The three largest proportion of wastes were generated from gynecology and maternity (31%), surgical (18.8%), and OPD (16.1%). The three units that smallest amount of wastes were generated from laboratory (4.4%), the offices (0.2%) and radiology (0.2%). The hospital has no waste segregation practice by type of waste. The waste disposal methods were open burning pit, incinerator and placenta pit.

Conclusion: The mean health care waste generated was high, which was 2.70 kg/bed/day, of which 1.69 kg/bed/day (62.59%) was general waste and 1.01 kg/bed/day (37.4%) was hazardous waste.

But such amount of wastes were managed and disposed in manner that causes health risks to healthcare workers, waste handlers and the surrounding community. In addition it contaminates the surrounding environment (air, soil and water). Segregation of wastes at point of generation and pretreatment should be carried out before disposing to the environment. Standard practices should be adopted in health care waste management. Besides, relevant training should be given to health workers and waste handlers.

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List of Acronyms

ART:	Anti-Retroviral Therapy
EPI :	Expanded Program of Immunization
HCW:	Health Care Waste
HCWM:	Health Care Waste Management
HCF:	Health Care Facility
MOH:	Ministry of Health
MCH:	Maternal and Child Health
OPD:	Outpatient Department
POPS:	Persistent Organic Pollutants
PTS:	Persistent Toxic Substances
PVC:	Poly Vinyl Chloride
TB:	Tuberculosis
WHO:	World Health Organization

Chapter 1: Introduction

1.1 Background

Health care waste (HCW) is defined as the total waste stream from a health care facility that includes both potential infectious waste and non-infectious waste materials. Infectious wastes include syringe or other needles, blades, bandages, swabs or items soaked with blood, infusion sets. Non-infectious wastes may include materials that have not been in contact with patients such as paper and plastic packaging, metal, glass or other wastes which are similar to household(1,2)

HCW includes all the wastes generated by health-care establishments, research facilities, and laboratories. In addition, it includes the wastes that are originated from minor or scattered sources such as that are produced in the course of health care undertaken in the home (insulin injections). Between 75% and 90% of the waste produced by health-care providers is non-risk or general health-care waste, comparable to domestic waste. It comes mostly from the administrative and housekeeping functions of health-care establishments and may also include waste generated during maintenance of health-care building (1, 2).

According to WHO the waste produced by health care facilities carries a higher potential for infection and injury than any other kind of waste. The negative health and environmental impacts of health care waste may include the transmission of disease, as well as contamination of underground water tables (3). Health-care activities are a means of protecting health, curing patients and saving and lives because of this activities generate hazardous and nonhazardous waste, 20 percent of which cause risks either of infection, of trauma or of chemical or radiation exposure (**4**). Exposure to infectious HCW can cause serious health problems particularly for waste collectors, hospital patients and healthcare workers (**5)**. In waste management; healthcare wastes need high priority due to their hazardous nature and some part of HCWs are considered most hazardous that can affect human health and pollute the environment badly (**6**).

Waste generation depends on numerous factors such as the number of hospital beds ,number of patients, types of health care services or medical activities provided, established waste management methods, hospital specializations and seasonal variation and available waste segregation options **(6,4**).

Health-care activities leads the production of waste and may cause adverse health effects. Some types of health-care waste represent a higher risk to health. These include infectious waste (15% to 25% of total health-care waste) among which are sharps waste (1%), body part waste (1%), chemical or pharmaceutical waste (3%), and radioactive and cytotoxic waste or broken thermometers (less than 1%).Sharps waste, although produced in small quantities, is highly infectious. (7).

According to Ethiopian MOH, proper management of HCW is a key issue to control and reduce infections inside a hospital, health centers, clinics, and health posts, and to ensure that the environment outside is well protected. HCWM should be part of the overall management system of a health care facility (HCF) and reflect the quality of the services provided by the facilities **(7**).

1.2 Statements of problem

The health-care activities are a means of protecting health, curing patients and saving lives. However, health care activities in the health institutions generate hazardous waste, 20 percent of which entail risks either of infection, of trauma or of chemical or radiation exposure. Especially in many developing countries, collection, transportation, treatment and disposal of waste are the major challenges for government and health institutions (8, **9**).

Environmental contaminants of global concern enter the environment in significant quantities as a result of the activities of health-care facilities and services such as, hospitals, health centers, clinics, health posts, immunization campaigns, etc. and the treatment and disposal of resulting wastes. As health systems are strengthened and health-care coverage expanded in developing countries through efforts to meet the Millennium Development Goals, the releases of persistent organic pollutants (POPs) and other persistent toxic substances (PTS) to the environment can increase largely(6).

In waste management; healthcare wastes hold high priority due to their hazardous nature. According to WHO some part of healthcare wastes are considered most hazardous that can affect human health and pollute the environment badly. Besides, exposure to infectious HCW can cause serious health problems particularly for waste collectors, hospital patients and healthcare workers (**10, 11)**. The waste generated in healthcare activities is classified in to two: general or non-hazardous and hazardous waste. General wastes are non-hazardous waste that

poses no risk of injury or infections. Hazardous waste that may cause or significantly contribute to mortality or serious illness, or pose a substantial hazard to human health and the environment if improperly managed or disposed of (**12**).

Wastes generated from health institutions are heterogeneous mixtures composed of general refuse, laboratory and pharmaceutical chemicals and their containers, and pathological waste. As a result, some infectious wastes do not separate from general waste. However, there are only a small percentage of the health care wastes. This may contain potentially infectious waste and cause the community's health problem (**13**). In recent years, health care waste management has become a growing issue of concern with the increasing evidence suggesting health hazards related to HCW cause the health risk to service providers, patients and the community as a whole (**14,5**)

According to WHO (2000), high-income countries generate up to 6 kg of hazardous waste per person per year and in the majority of low-income countries, the total healthcare waste is from 0.5 to 3 kg per person per year (15). Another study also estimated that the daily production of solid waste by rural hospitals in Sub-Saharan Africa ranges between 0.3 and 1.5 kg per bed, of which 2-10% is estimated to be hazardous and this figure for industrialized countries is 3-6 kg and 5-20%, respectively (16).

According to the 2000 WHO estimate, injections with contaminated syringes had resulted: 21 million hepatitis B virus (HBV) infections; 2 million hepatitis C virus (HCV) infections; 260 000 HIV infections. Besides, epidemiological studies indicate that a person who experiences one needle-stick injury from a needle used on an infected source patient has risks of 30%, 1.8%, and 0.3% respectively to become infected with HBV, HCV and HIV. (7). A significant portion of the infections arising from blood borne pathogens may be due to needle-stick injuries that result from improperly managed HCWs. At the facility level, nurses and supporting staffs are generally at the greatest risk. As health-care wastes leave the facility, waste transporters and landfill workers, waste pickers, scavengers, recyclers, children and the community as a whole are also at risk(6).

In the developing countries some urban and many rural hospitals, health centers, clinics and health posts simply disposed their medical waste in a manner that pose a risk of diseases among populations. In 2002, the results of a WHO assessment conducted in 22 developing countries

showed that the proportion of health-care facilities that do not use proper waste disposal methods ranges from 18% to 64 %(6, 7).

A study done by MOH in Ethiopia in 1985 in 46 hospitals and 76 health centers the total amount of waste generated was 80,741 kg per day. Another study in 1989 in 16 health centers and 48 clinics showed that most of them have no proper liquid and solid waste disposal facilities (7). Healthcare services providing facilities in Ethiopia have been increasing for the past few years even though the healthcare system is underdeveloped and only able to provide basic services to about 72% of the population (17).

Accordingly a study conducted in six hospitals of Addis Ababa among health institutions revealed that the median waste generation rate was found to be varied from 0.361- 0.669 kg/patient/day, which composed of 58.69% non-hazardous and the rest 41.31% hazardous wastes, this study further explored that the amount of waste generated was increased as the number of patients flow increased. Almost all of the hospitals reported that there was no segregation of waste into infectious, pathological and pharmaceutical, and had no separate bins for the collection of infectious waste. (18)

According to a study done in west Gojjam zone of Amhara region it was found out that the daily mean healthcare waste-generation rate was 1.79 ± 0.54 kg, which was equivalent to 0.035 ± 0.05 kg/outpatient/day. Out of the total health care waste generated (52.0%) was general and the remaining (48.0%) was hazardous waste. However, it was indicated that segregation of wastes and pretreatment of infectious wastes were not properly practiced by any of the health centers under study. Besides, only 40% of the health centers used local type of incinerators, while others used open burning for the final handling of healthcare wastes (**1**).

Unlike in developed and few developing countries, research on healthcare waste management in Ethiopia has not been well explored particularly in the study area. It is not very clear the amount of waste generated within a health care facilities with many health care providing services. This study was carried out waste generation rate and its management practice in Felege Hiwot referral hospital. And also for better understanding of the contribution of health care waste in Felege Hiwot referral hospital. Hence the aim of this study is to assess health care waste generation rate and its management system provides information about waste generation rate by type and how health care wastes handled from the time of generation to ultimate disposal

1.3 Significance of the study

The results of this study could possible show the waste generation rate and its management practice in the hospital. And also base line information for managers for planning, implementing and evaluation on health care waste management practice in the hospital.

Therefore, studying waste generation rate and its management in Felege Hiwot Referral Hospital was necessary to help for intervention and focus of handling health care waste in the hospital. Besides, this study can be used as input for the proper health care waste management and further serves as baseline information for anyone interested to study on health care waste generation and management.

Chapter 2: Literature review

2.1 Generation rate

Health care waste includes all the wastes generated by health-care establishments, research facilities, and laboratories. In addition, it includes the waste originating from minor or scattered sources such as that produced in the course of health care undertaken in the home (insulin injections). Between 75% and 90% of the waste produced by health-care providers is non-risk or general health-care waste, comparable to domestic waste. It comes mostly from the administrative and housekeeping functions of health-care establishments and may also include waste generated during maintenance of health-care building (1, 2,).

In a study conducted by the WHO, the distribution of hospital wastes in developing countries are 80% general health care wastes, 15% pathological and infectious waste, 1% sharp waste, and 3% chemical or pharmaceutical wastes. Geotaxis waste, radioactive matter, and wastes with heavy metal content represent about 1% (**6**).

There are various estimates regarding to hazardous and non-hazardous constituents of healthcare waste. According to a report made by a study, around 85% of hospital wastes are non-hazardous, 10% are infectious (hence, biological hazardous), and the remaining 5% are toxic chemicals, pharmaceutical and radioactive wastes (**12**).

High-income countries generate on average up to 0.5 kg of hazardous waste per bed per day; while low-income countries generate on average 0.2 kg of hazardous waste per hospital bed per day. However, health-care waste is often not separated into hazardous or non-hazardous wastes in low-income countries making the real quantity of hazardous waste much higher. Every year an estimated 16 000 million injections are administered worldwide, but not all of the needles and syringes are properly disposed of afterwards. (19)

Variations in waste generation according to the type or level of health-care facility, or between rural and urban health-care facilities, may reflect differences in services provided level, organizational complexity, availability of resources and the number of medical and other staff, regulations or policies on waste classification as well as segregation practices affect the breakdown of waste-generation rates(20).

Between 75% and 90% of the waste produced by health-care providers is comparable to domestic waste and usually called “non-hazardous” or “general health-care waste”. It comes mostly from the administrative, kitchen and housekeeping functions at health-care facilities and may also include packaging waste and waste generated during maintenance of health-care buildings. The remaining 10–25% of health-care waste is regarded as “hazardous” and may cause a variety of environmental and health risks (20).

A study conducted in Nigeria indicated that average waste types generated in the three categories of hospitals for both hazardous and non-hazardous wastes were in the order of 17.66, 7.89 and 2.36 kg/day for large, medium and small hospitals respectively. The percentage waste generation for the large hospitals show that 41% of the waste type are hazardous, 33% are non-hazardous while in the medium size hospitals, 35% of the waste generated are hazardous and non-hazardous had 35% and the small scale hospitals had combined waste types as the dominant waste type with 51% followed by non-hazardous with 31% and hazardous had the least with 18% of waste types (**17**).

According to a study done in Muhimbili National Hospital and Mwananymala hospital in Tanzania showed that the waste generation per hospital section psychology 13%, pediatric 13%, orthopedic 16%, Gynecology 18%, surgical 25%, and medical 15%. The average healthcare waste generation rates were in the range of 1.053kg/bed/day to 2.290kg/bed/day in Abuja. Similar ranges have been reported for Dhaka City (0.8kg/bed/day to 1.67 kg/bed/day), Amsterdam (2.7kg/bed/day) and Paris (2.5kg/bed/day. However higher 1.0kg/bed/day to 4.5kg/bed/day ranges were documented for New York City, Chile, Brazil, Argentina, and Venezuela and in Ibadan in Nigeria (1.0kg/bed/day to 1.50kg/bed/day) (**20)**

Different studies reported that there is difference in the magnitude of waste generation rate depending on several contributing factors. A study done in Ghana among health centers to determine the amount of health care waste generated revealed that about 1.2kg/bed/day was generated (**21**).

A study conducted in Addis Ababa among health institutions revealed that the median waste generation rate was found to be varied from 0.361- 0.669 kg/patient/day, which composed of 58.69% non-hazardous and the rest 41.31% hazardous wastes, this study further explored that the amount of waste generated was increased as the number of patients flow increased, health institutions generated high proportion of total health care wastes (59.22%) in comparison with

private health institutions (40.48%). The median waste generation rate was significantly vary between health care institutions and the amount of waste generated was correlated with the number of patients. (18)

A study conducted in west Gojjam zone of Amhara region it was found out that the daily mean healthcare waste-generation rate was 1.79 ± 0.54 kg, which was equivalent to 0.035 ± 0.05 kg/outpatient/day. Out of the total health care waste generated (52.0%) was general and the remaining (48.0%) was hazardous waste. The study further indicated that the mean healthcare waste generation rate among health centers did not significantly vary. (1)

2.2 Health risks from HCW

Health-care waste contains potentially harmful microorganisms which can infect hospital patients, health-care workers and the general public. The greatest risk is from the infectious and sharp component of the waste because people generated by health care activities includes a broad range of materials, from used needles and syringes to soiled dressings, body parts, diagnostic samples, blood, chemicals, pharmaceuticals, medical devices and radioactive materials.(19).

A study have indicated that the inappropriate handling and disposal of healthcare waste cause health risks to health workers who may be directly exposed and to people near health facilities, particularly children and scavengers who may become exposed to infectious wastes and a higher risk for diseases. World Health Organization estimates that each year there are about 8 to 16 million new cases of Hepatitis B virus (HBV), 2.3 to 4.7 million cases of Hepatitis C virus (HCV) and 80,000 to 160,000 cases of human immune deficiency virus (HIV) due to unsafe injections and mostly due to very poor waste management systems (23).

2.3 Health care waste handling

Infectious waste must be collected in leak-proof containers carefully sealed and transported to a central storage facility /delivery point in a way that stop direct contact. They must either be incinerated or be disinfected prior to final disposal using a recognized method, preferably treatment with saturated steam (autoclaving). Disinfected waste may be disposed of in the same ways as domestic waste. While waste with high contents of heavy metals should normally be treated in specific recycling /treatment facilities (14).

Alternatively, as for chemical waste, it may be encapsulated. Waste with high contents of heavy metals, in particular mercury or cadmium should never be incinerated. Radioactive waste should be placed in large containers or drums and labeled with the radiation symbol showing the radionuclide activity on a given data and the period of storage required. Containers or tanks with radioactive waste that has not yet decayed to back ground level should be stored in a specifically marked room with thick concrete walls (minimum 25cm) (**14**).

Poor management of health care waste potentially exposes health care workers, waste handlers, patients and the community at large to infection, toxic effects and injuries, and risks polluting the environment. It is essential that all medical waste materials are segregated at the point of generation, appropriately treated and disposed of safely (19).

Medical staff should be encouraged to think of waste disposal as part of a patient's treatment, so all aspects of the care process are completed at the bedside or treatment room. If intervention at the bedside is required, a waste container should be taken to the bed. Sharps container is also sometimes taken to a patient for drug administration or blood sampling. A mobile trolley with infectious waste and sharps containers may be more adaptable and should be given serious consideration. The alternative is establishing a limited number of locations in a medical area where general waste (black bags) and infectious health-care waste (yellow bags and sharps containers) are placed. The locations should be away from patients; typical sites are the sluice (utility) room, treatment room and nurses' station (20).

Major sources of health care waste include hospital wards/ toilets, blood banks, laboratories, nursing homes, mortuaries, autopsy centers, laundries, hospital kitchen and cafeteria as well as institutions of disabled persons (22). A study conducted in Addis Ababa among health institutions almost all of the hospitals reported that there was no segregation of waste into infectious, pathological and pharmaceutical, and had no separate bins for the collection of infectious waste. (18)

A study conducted in west Gojjam zone of Amhara region it was indicated that segregation of wastes and pretreatment of infectious wastes were not properly practiced by any of the health centers under study. Besides, only 40% of the health centers used local type of incinerators, while others used open burning for the final handling of healthcare wastes (**1**).

Conceptual frame work

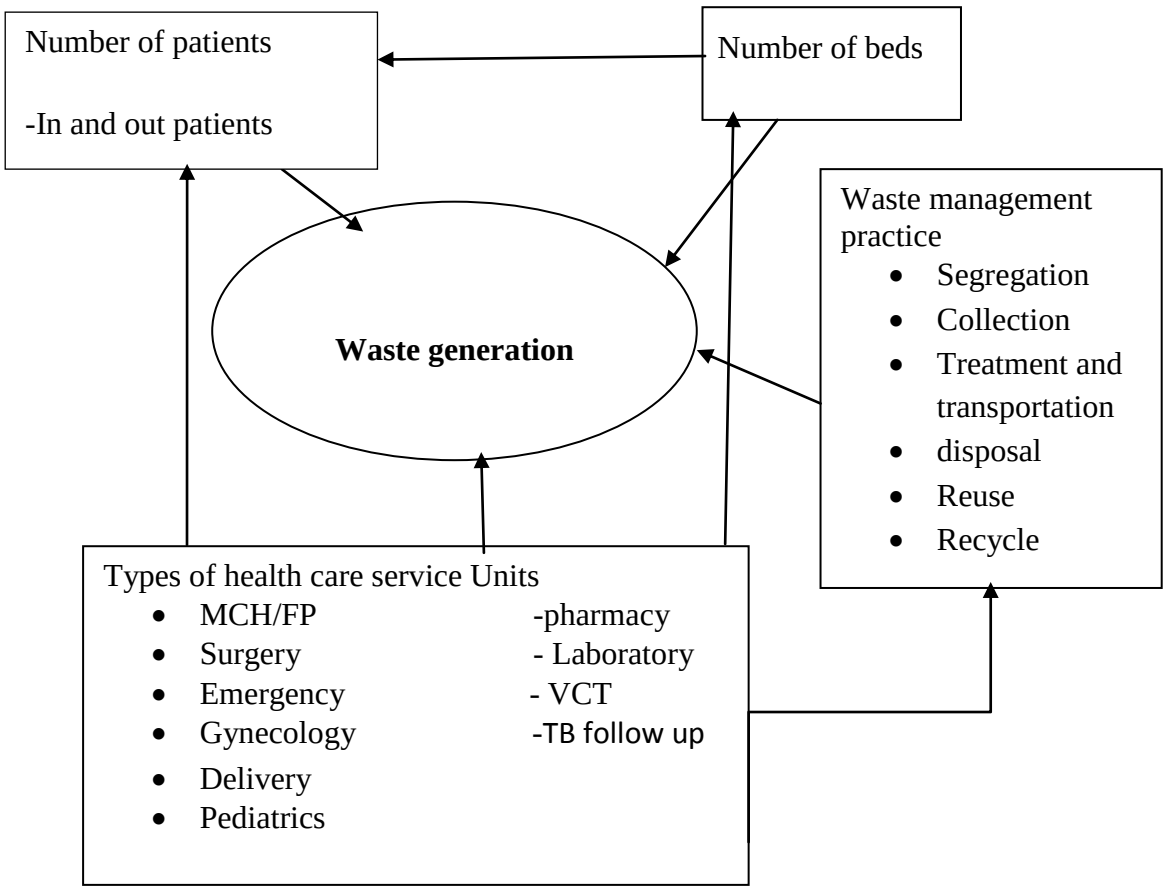

Fig. 1 Factors that determine type and generation rate of health care waste in Felege Hiwot Referral Hospital from November 20 -December 20, 2014 and adopted from the studies done six hospitals in Addis Ababa and ten health centers in west Gojjam (1, 18)

Chapter 3: Objectives of the study

3.1 General objective

To assess health care waste generation rate and its management system in Felege Hiwot Referral Hospital, 2014

3.2 Specific objectives

1. To determine the waste generation rate in Felege Hiwot Referral Hospital.
2. To identify the type of wastes generated in Felege Hiwot Referral Hospital.
3. To assess waste management practice in the Hospital (segregation, collection, transportation, storage, treatment and disposal) in Felege Hiwot Referral Hospital.

Chapter 4: Methods and materials

4.1 Study area and period

The study was conducted in Felege Hiwot Referral Hospital from November 20 to December 20, 2014. Felege Hiwot Hospital is one of referral and teaching hospitals in Amhara Region. It is located in Bahir Dar town, north west part of Ethiopia at a distance of 565kms from Addis Ababa, the capital city of the country. The total catchment area population of Felege Hiwot referral hospital is 5.5 million. Felege Hiwot referral hospital has 400 beds, 391 technical staffs and 258 supportive staffs. On average, the hospital served for 484, 1767, 1,692 and 14,523 people in a month in delivery service, emergency service, inpatient and outpatient visit of the hospital respectively. The hospital gives different health care services during the study period such as inpatient service, OPD service, labor and delivery service, emergency service, operation service, pharmacy service, Laboratory service, x-ray service, physiotherapy service and administrative service were given.

4.2 Study design

A facility based cross-sectional study using quantitative and qualitative was conducted to quantify waste generation rate and assess its management system.

4.3 Population

4.3.1 Source population

All hospital units and all staff in Felege Hiwot Referral Hospital were the source population.

4.3.2 Study population

All hospital units and selected key informants.

4.4 Sample size and sampling procedure

All Hospital units such as OPD rooms (adult general OPD, pediatric, ART clinic, MCH, eye clinic, dental clinic ,psychiatry clinic), inpatient rooms (medical ward, surgical ward, gynecological ward, pediatric ward, eye ward, psychiatry ward, labor and delivery ward, neonatal intensive care unit (NICU)), emergency room, operation room (minor and major operation room), pharmacy room (in patient pharmacy, outpatient pharmacy, ART pharmacy, emergency pharmacy, drug store), laboratory room (emergency laboratory ,OPD laboratory, ART laboratory) x-ray room, pathology room, physiotherapy room, dialysis room, blood bank**,** Kitchen, administrative room and card room were selected for quantitative study to quantify the amount of waste in the hospital and key informant interview respondents were selected by using non probability purposive sampling technique and a total of 16 respondents such as

CEO, medical director, pharmacy head, laboratory head, infection prevention and control officer, nurse coordinator, outpatient coordinator, inpatient coordinator, emergency coordinator, labor and delivery coordinator, operation room coordinator, surgical ward coordinator, radiology coordinator, medical ward head nurse, janitors coordinator, gynecological ward head nurse.

4.5 Data collection procedures

Observation checklist and in-depth interview guide were used to assess the waste management practice of the hospital and weighting scale was used to quantify the amount of waste generation rate in each units of the hospital. Observation and in-depth interviews were conducted by a supervisor and weighing of hospital waste was done by data collectors.

Wastes of each units of the hospital were collected and measured daily for seven consecutive days to estimate the amount of waste generated. Plastic buckets of different colors were distributed to collect different type of wastes generated by various units of the hospital. such as: OPD room (adult general OPD, pediatric, ART clinic, MCH, eye clinic, dental clinic, psychiatry clinic), inpatient room (medical ward, surgical ward, gynecological ward, pediatric ward, eye ward, psychiatry ward, labor and delivery ward, neonatal intensive care unit (NICU)), emergency room, operation room (minor and major operation room), pharmacy room (in patient pharmacy, outpatient pharmacy, ART pharmacy, emergency pharmacy, drug store), laboratory room (emergency laboratory ,OPD laboratory, ART laboratory) x-ray room, pathology room, physiotherapy room, dialysis room, blood bank, kitchen, administrative room and card room. Accordingly, black color bucket was used for general wastes, yellow color used for infectious wastes, red color used for pharmaceutical wastes, sharps and pathological wastes.

Plastic bags with different colors (black for general waste, yellow for infectious waste and red for pharmaceutical waste, sharps and pathological waste) were kept inside in the buckets. The buckets and plastic bags was labeled to indicate the different categories of hospital wastes, the place of generation, date of collection and sample number.

A plastic bag was removed every morning and its weight was measured every day at 8 AM using weighing scale. As much as possible care was taken to collect different categories of waste, i.e. general, pathological, infectious, pharmaceutical, and sharps wastes. For the purpose of data collection five enumerators who were diploma holder nurses and one

supervisor, who has a first degree in environmental health and currently working in Bahir Dar special zone was recruited. Waste weighing and recording station was arranged in convenient site in the hospital.

Hand protecting plastic gloves, plastic buckets, and plastic bags and waste weight measuring scale were used to collect and measure health care wastes. Digital camera was used to take photos during the observation and was operated by the investigator.

4.6 Study variables

List of study variables:

The amount of waste generated

Materials used for waste collection and transportation

Presence or absence of waste management policy

Segregation at the source

Number of patients

Number of beds

Management practice of reuse and recycle

4.7 Operational definitions

Hazardous wastes: This has multiple sources in a facility and includes biologically and chemically hazardous materials and radioactive materials.

General wastes: They don't cause risk or infections under conditions they are generated.

Health care wastes: All wastes generated by medical activities from a facility including offices.

Infectious wastes: materials contaminated with blood or other body fluids, laboratory cultures and stocks of infectious agents from laboratory work, waste from infected patients in isolation wards, dressings, bandages, and others contaminated with blood or other body fluids.

Health care waste generation: all health care wastes that are generated in all units of the hospital by giving health care activities.

Sharps wastes: needles, in fusion sets, scalpels, knives, blades, broken glasses.

Pharmaceutical wastes: includes expired, unused, dropped, and contaminated pharmaceutical products, drugs, vaccines, and pharmaceuticals that are expired or no longer needed that are no longer required and need to be disposed of appropriately. The category also includes discarded

items used in the handling of pharmaceuticals, such as bottles or boxes with residues, and drug vials.

Pathological waste: consists of tissues, organs, body parts, placenta, dead & aborted human fetuses, blood and body fluids and un used blood products.

Segregation of waste: to separate the waste by type (sharps waste, non-sharp infectious waste, pathological waste, pharmaceutical waste and general waste) and to identify the type of waste, immediately putting all the waste with in different color coded containers and safety box.

Health care waste management: includes all activities involved in waste generation, segregation, transportation, storage, treatment, and final disposal of all types of waste generated in the health care facility.

One day: A 24 hours from 8:30 AM until it reaches the starting time.

Patient: a person who gets any healthcare service within the hospital.

Annual health care waste generation rate: is mean of health care waste in kg/day*365 days.

Waste generation: measured by weighing scale using a known standard of 100g, 500g and 1000g.

4.8 Data Analysis Procedures

The collected data were entered and analyzed using SPSS version 16 software package to enable the estimation of waste generation rate in each health service units of the hospital. Data cleaning was performed by running each variable to check the accuracy, consistency, and missed value. The average quantity of health care wastes in the hospital was computed. Mean, standard deviation and Kurskal-Wallis test was computed for descriptive and statistical analysis was used to describe waste generation rate and to analyze the significance difference of health care waste generation rate in each units of the hospital. The result was presented using tables and graphs.

4.9 Data quality management

Training was given for the data collectors and supervisors. A pre-test was conducted in Finot Selam hospital prior to the actual data collection time to assure accuracy and validity of the pretest in-depth interview guide and weighting scale. Weighing scale was calibrated using a known standard of 100g, 500g and 1000g weighting objects every morning before the actual measurement started during data collection days. Calibration was made periodically. Besides,

on-site supervision was made by the investigator during the actual measurements. Daily meeting was conducted to improve data quality.

4.10 Ethical Consideration

Ethical clearance was obtained from institutional review board of Jimma University College of Health Sciences and permission letter was taken from Amhara Regional State Health Bureau. Further, written consent was obtained from Felege Hiwot Referral Hospital and the coordinators of each unit preceding to data collection.

4.11 Dissemination of the Results

The result of the study was submitted to Jimma University College of Health sciences, Department of Health Economics, Management and policy. Then findings of the study will be publicly defended at Jimma University and copies of the study findings will be provided to relevant stakeholders like Amhara Regional Health Bureau and Felege Hiwot Referral Hospital. In addition, the findings of the research will be presented on professional association meetings. Finally, efforts will be applied to publish on reputable scientific journals.

Chapter 5 Results

5.1 Health care waste generation rate

In Felege Hiwot Referral hospital waste generation rate was 2.70kg/bed/day, of which 1.69kg /bed/ day (62.7%) was general waste and 1.01kg/bed/day (37.3%) was hazardous waste. The waste generation rate per patient per day was 2.06 kg. General waste generated in large amount in the hospital which was 1.29kg/patient/day as compared with hazardous waste which was 0.77kg/patient/day (i.e. sharp waste was 0.02kg/patient/day, Pharmaceutical waste was 0.001kg/patient/day, Pathological waste was 0.08 kg/patient/day and infections waste was 0.67kg/patient/day). (Table 1)

Table1. Types of waste generated per day in Felege Hiwot Referral Hospital, November 20-December 20, 2014

Types of wastes	Waste kg/day	median	Mean Weight	Standard deviation	Kg/bed/day	Kg/patient/day	%by weight
General wastes	475.9	41.29	47.6	41.7	1.69	1.29	62.7
Sharp wastes	6	0.39	0.6	0.6	0.02	0.02	0.8
Pharmaceutical wastes	1.3	0.09	0.1	0.2	0.00	0.001	0.2
Pathological wastes	28.9	0.00	2.9	8.9	0.10	0.08	3.8
Infections wastes	246.5	18.29	24.7	26.7	0.88	0.67	32.5
Total	**758.6**	**50.25**	**75.9**	**72.5**	**2.70**	**2.06**	**100.0**

Table 2. Type of waste generated for 7 days in kg from each section in Felege Hiwot Referral Hospital, November 20 -December 20, 2014

Types of wastes in kg	OPD	Medical Ward	Pediatric Ward	Maternity Gynecology Ward	Surgical Ward	Laboratory Ward	Kitchen	Office	Radiology	Emergency Services	Total (kg)
General waste	646.6	441	228	867	558	110.6	350	11	3.85	115	**3331.05**
Sharp wastes	9	8.2	1.5	9.1	8.5	3	-	-	-	2.5	**41.8**
Pharmaceutical waste	0.91	1.4	1	4.6	0.3	0.08	-	-	-	1	**9.29**
pathological waste	-	-	-	198	0.5	0	-	-	-	3.5	**202**
Infectious waste	196	133	123	565	429.4	120.4	-	-	5.88	153	**1725.68**
Total weight	852.51	583.60	353.50	1643.70	996.70	234.08	350.00	11.00	9.73	275.00	**5309.82**
Average weight kg/day	121.79	83.37	50.50	234.81	142.39	33.44	50.00	1.57	1.39	39.29	**758.55**
Kg/person/day	0.008	0.088	0.168	0.152	0.175	0.004	0.019	0.001	0.0011	0.015	

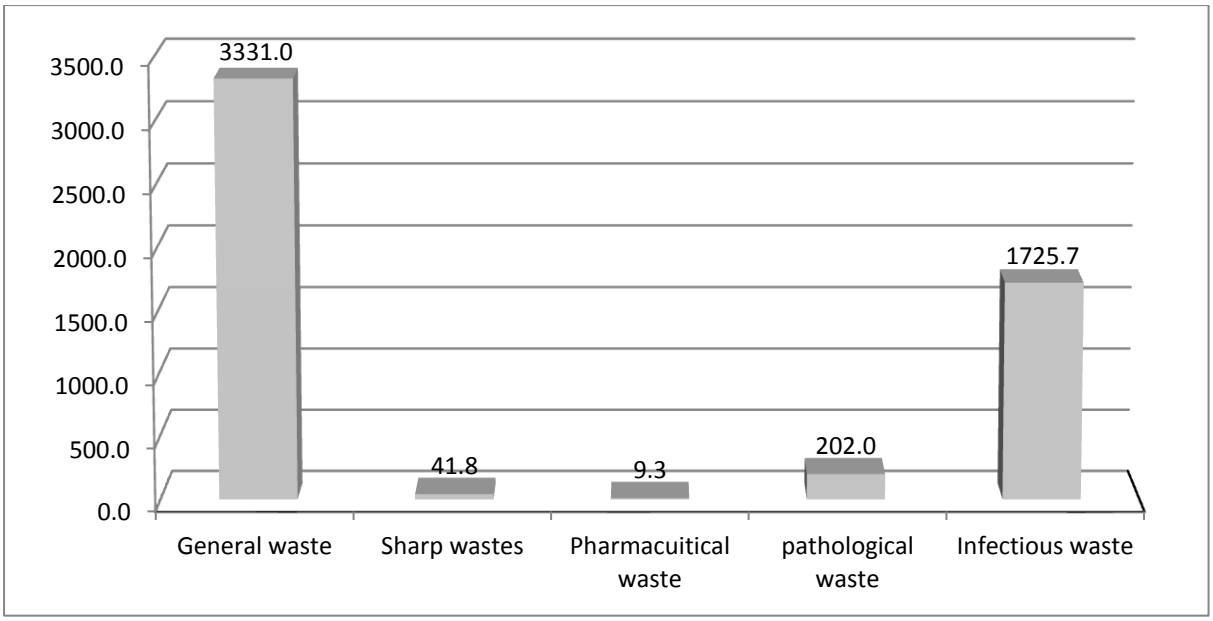

Fig.2. Types of healthcare Waste Generation for the study period of seven days (in Kg) in Felege Hiwot Referral Hospital, November 20-December 20, 2014

The contribution of total health care waste from each section was 758.55kg/day. Out of which high amount of waste was generated in gynecological and maternity ward which accounted for 234.81 kg/day (30.96%) while the lowest proportion was generated in radiological department which accounted for 1.39kg/day (0.18%).(Table 2) The amount of wastes were different from unit to unit such as OPD (16.1%), medical (11%), pediatric (6.7%), maternity and gynecology (31%), surgical (18.8%), laboratory (4.4%), kitchen (6.6%), office (0.2%), radiology (0.2%) and emergency (5.2%) (Table 2). High amount of waste generated in kg/patient/day in surgical ward (0.175kg/patient/day) while lowest amount of waste was generated in office (0.001kg/patient/day) (Table2).

Using parametric Kurskal-Wallis test, total health care waste, general and hazardous health care waste was compared among different sections within the hospital. There was no statistically significance difference of total health care waste (X^2=86, p-value 0.23), general health care waste (X^2=90, p-vale <0.23) and hazardous health care waste (X^2=88, p-value<0.23) among different sections.

Table 3:- Parametric Kurskal-Wallis test for health care waste generated in different sections of Felege Hiwot Referral Hospital, November 20-December 20, 2014

No.	Units of the hospital	Mean rank health care waste	Mean rank general health care waste	Mean rank hazardous health care waste
1	OPD	121.79	92.37	29.41
2	Medical Ward	83.37	63	20.37
3	Pediatric Ward	50.50	32.57	17.92
4	Maternity Gynecology Ward	234.81	123.83	110.95
5	Surgical Ward	142.39	79.71	62.67
6	Laboratory Ward	33.44	15.8	33.44
7	Kitchen	50.00	50	0.00
8	Office	1.57	1.57	0.00
9	Radiology	1.39	0.55	0.84
10	Emergency Services	39.29	16.43	22.86
		X^2=86	X^2=90	X^2= 88
		p-0.23	p-0.23	p-0.23

The annual health care waste generation rate can be estimated by using the mean health care waste generation rate in kg per day multiplied by 365 days (by assuming the mean of health care waste generation rate within seven consecutive days may represent the whole year). The estimated annual waste generation rate of Felege Hiwot Referral Hospital was 27,703.5Kg/year or 985.5 kg/bed/year. The annual health care waste generation by type of waste was estimated to be 36.5kg/bed/year for pathological, 321.2 kg/bed/year for infectious, 7.3kg/bed/year for sharps, and 616.85 kg/bed/year for general waste.

5.2 Health care waste handling practice

All of the units used plastic buckets for collection and transportation of hospital waste. Safety boxes were used for collection of sharp wastes (syringes, needles & lancet).during observation in this hospital, black and yellow plastic buckets were available but used inappropriately. Red plastic buckets were not available in most units to collect hazardous wastes. But red plastic bags were available in surgical, maternity and gynecology wards.

The hospital did not segregate infectious waste from general waste at the source of generation, and plastic buckets were not appropriately sealed. Open and closed plastic buckets were used for manual transportation of health care waste to the disposal site. Used needles, syringes, scissors and surgical blades were found in the surrounding of the hospital especially around disposal sites. Besides, most of the safety boxes were overfilled.

A total of 84 contract waste handlers were assigned in the hospital. Among this, 1.2% waste handlers use personal protective equipment and 98.8% waste handlers do not use heavy duty

gloves, aprons and boots when handling and transporting medical waste. They used apron but it was short and their body was not fully protect. They only used medical gloves during waste collection and transportation of health care waste.

Figure.3 Health care wastes not segregate at the source in Felege Hiwot referral hospital, November 20-December 20, 2014

Figure 4. Over filled Safety boxes in Felege Hiwot referral hospital, November 20-December 20, 2014

Table 4. Type and number of color coded containers used for waste collection and transportation during the study period and recommended by WHO depending on the type of generation unit in Felege Hiwot referral hospital, November 20-December 20, 2014

S.N	Types of units	No, of classes	Number & type of containers presented during study period			Number & type of containers Recommended by WHO (20)			Deference /additional needed/		
			black	yellow	red	black	yellow	red	black	yellow	red
1	OPD	44	59	2	-	88	88	-	29	86	-
2	Inpatient	80	87	37	-	160	160	240	73	123	240
3	Operation room	5	21	1	-	10	10	20	-	9	20
4	Maternity & gynecology	20	41	7		40	40	80	-	33	80
5	Pharmacy	8	6	2	-	16	-	16	10	-	16
6	Laboratory	3	19	-	-	6	6	6	-	6	6
7	X-ray	2	2	-	-	4	-	4	2	-	4
8	Ultrasound	2	1	-	-	2	-	-	1	-	-
9	Pathology	1	1	-	-	2	2	-	1	2	-
10	Physiotherapy	1	1	-	-	1	-	-	-	-	-
11	Dialysis	1	1	1	-	2	2	2	1	1	2
12	Blood bank	1	1	-	-	2	2	-	1	2	-
13	Administrative	24	24	-	-	24	-	-	-	-	-
14	kitchen	1	1	-	-	2	-	-	1	-	-
15	Corridors, patient waiting areas &streets	-	23	-	15	44	-	-	44	-	-
	Total	**193**	**288**	**50**	**15**	**403**	**310**	**388**	**163**	**262**	**368**

In the area of hospital wards, operations rooms, laboratories, Maternity & gynecology that produces hazardous waste, and three color coded containers and safety box will be needed. Safety boxes were available in all relevant units of this hospital but the main problem was being over filled. There was no clean and disinfected reserve plastic container. Because of the absence of clean and disinfected plastic containers, it was difficult to replace the filled containers immediately. Instead of this, the hospital used the former unclean plastic containers returned from the final disposal sites. Based on the WHO recommendation, there is shortage of the required containers in the hospital, such as 163 black, 262 yellow, and 368 red color coded plastic containers (Table 4).

This was support by in depth interview: One of the member of infection prevention committee said, "Three color coded plastic buckets were not available at each relevant places and units. In addition to this, regular health education was not given for patients, care takers, and new contract waste handlers they put wastes in to three color coded containers like black

bins for general waste such as leftover food, banana & orange covers, paper, etc. yellow bins for infectious waste like used glove, cotton, used plasters, broken bottles, and glass etc. red bins for hazardous waste like body fluids, body parts, aborted fetus, placenta, etc. and safety box for syringes and needles and surgical blade."

A 31 years old female nurse said, "All staffs might not take responsibility; especially the physicians their attention focus on give medication for their patients and saving life. Most of the staffs think waste segregation is the responsibility of environmental health professionals and cleaners and not practiced accordingly. And also most of the medical practitioner students mix medical wastes with general wastes."

A 35 years old female doctor said, "It was difficult to manage care takers and patients because most of the people came from rural areas. They do not have knowledge about the risk of medical wastes. They think medical wastes may not cause risk for themselves, the community, and the environment. And they also put left over foods, fruit covers collect and mix with medical wastes."

5.3 Health care waste collection and transportation

Medical wastes generated in Felege Hiwot Referral Hospital were collected and transported to the final disposal site by hospital waste handlers within the hospital manually by plastic containers. In this hospital, plastic containers were used for on-site transportation of wastes from the sites of production in different sections to the final disposal area.

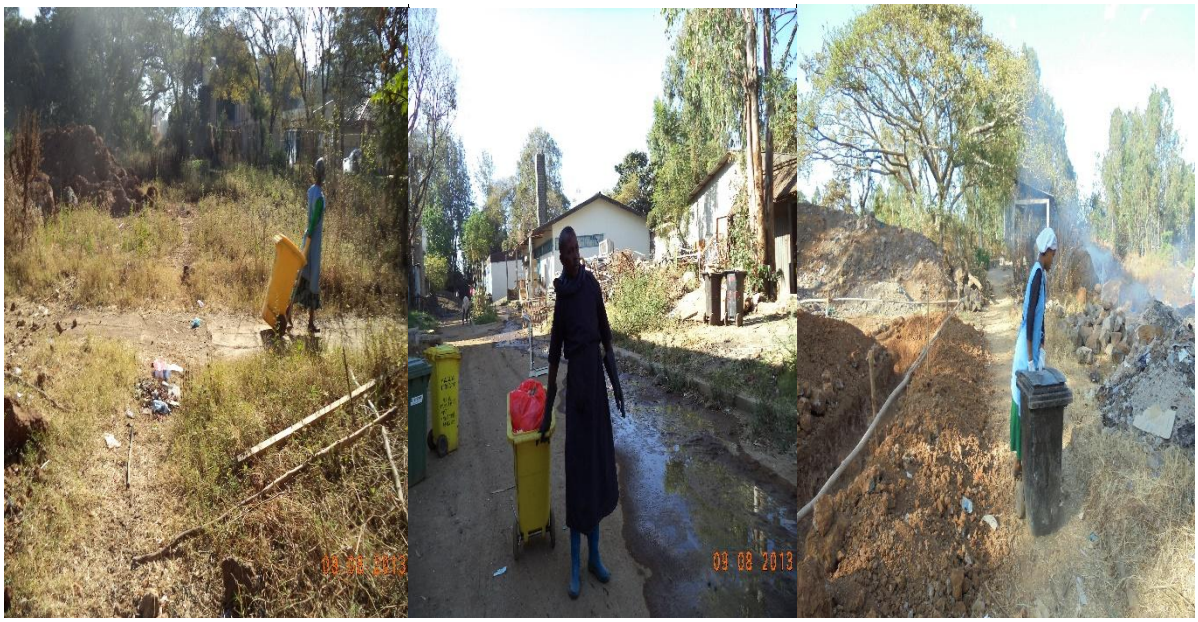

Figure 5. Medical wastes transported by waste handlers to final disposal sites in Felege Hiwot referral hospital, November 20-December 20, 2014

Health care wastes were collected within 24 hours in all administrative rooms, but wastes from kitchen, OPD units, laboratory units and pharmacy units were collected in 12 hours interval. Also, medical ward, surgical ward, labor and delivery ward, gynecology ward, ART service, pediatric ward, emergency service wastes were collected in 6 hours interval. Further, there was no temporary waste storage area in the hospital.

This was supported by in depth interview: A 34 years old laboratory technologist said, "Waste bins collected during morning, mid-day and after noon were transported manually by waste handlers; there was no other option to transport the wastes because the infrastructure of the hospital was not comfortable to transport by another means like carts. The hospital used only onsite disposal methods."

5.4 Health care waste treatment and disposal methods

The onsite waste disposal methods employed by Felege Hiwot referral hospital were incinerator, open burning pit and placenta pit. However, there were no offsite disposal methods outside the hospital. Incinerator was used for disposing sharps such as syringes and needles while placenta pit was used for the disposal of dead and aborted fetus, body parts and placenta. However, it had no concrete slab cover and it was simply covered by plastic sheet. Open pit was used for the disposal of other health care wastes including used batteries, broken thermometers, IV-bags, gloves, gauzes and other infectious wastes, needles and syringes mixed with other wastes. In addition, open burning pit was very shallow and too wide. The health care wastes were scattered around the open burning pit.

The incinerator was fenced by wire but the door of the fence was not always closed. The incinerator has no air inlet and complete combustion did not take place. The incinerator has no ash removal pit but the ash was disposed in placenta pit. The fence of the hospital was broken near to the open burning pit and small children scavenge the waste for playing. General wastes that generated from kitchen were recycled. It was seen during observation that pretreatment of infectious wastes and plastic buckets were not disinfected by sodium hypochlorite (Barakina) after the wastes had been disposed.

This was supported by in depth interview: One of the hospital management body said, "Lack of advanced incinerator that works under high temperature and pressure, inadequate knowledge of the outsourced waste handler staffs for proper handling of medical wastes. And also the company that contract cleaners do not provide personal protective equipment for cleaners."

A 28 year old male pharmacist said, “The hospital management bodies were not give attention for waste management from segregation up to final disposal like other major activities, and did not allocate enough budget to construct a separate temporary storage area, pretreatment of infectious wastes, and to construct better incinerator.”

Final disposal sites in Felege Hiwot Referral hospital**,** November 20-December 20, 2014

Figure 6. Incinerator and placenta pit in Felege Hiwot Referral hospital, November 20-December 20, 2014

Figure 7. Open burning pit in Felege Hiwot Referral hospital, November 20-December 20, 2014

5.5 Health care waste management

The waste collection and disposal system in the hospital was manually-operated based on two shifts. A total of 84 contract waste handlers were assigned to work in the hospital. They did not receive any formal training regarding medical waste management, so they were unaware of the environmental health impacts of medical waste. What is worse is that only one female waste handler, not trained at all was responsible for burning of all hospital wastes, and the disposal sites were full of burned and unburned needles.

Figure 8. Wastes disposed at the final disposal site, November 20-December 20, 2014

Figure 9. The way of burning health care waste in Felege Hiwot referral hospital, November 20-December 20, 2014

The hospital has health care waste infection prevention committee but not functional. The process of collection, segregation, transportation and disposal of hospital waste are not performed according to the recommended standards (color coded plastic containers and bio-hazard symbols). Hence, patients, visitors, people from the nearby community members were exposed to the dangers of such wastes.

This was supported by in depth interview: A 23 years old female janitor said, "I didn`t know the risk of health care waste to me and to others. When I employed in this hospital by the company in the position of waste handler any formal training and personal protective equipment was not given except medical gloves that was used for during medical waste transportation."

Chapter 6. Discussions

This study aimed to assess health care waste generation rate and management practice in Felege Hiwot referral hospital. The finding showed that waste segregated, collected, transported and disposed inappropriate way and also there was no temporary storage area. But this finding is poor as compared to the study conducted in the hospitals of India, Costa Rica and Thailand which showed excellent examples of waste segregation practice (11). The possible reasons for this variation may be lack of training for health care workers, waste handlers, unavailability of three color coded plastic buckets, lack of attention by staffs and managerial bodies ,lack of operational standards for healthcare waste management at each units and absence of regular supervision by responsible bodies of Regional Health Bureau.

The study revealed that the waste disposal methods employed were incinerator, open burning pit and placenta pit. Syringes and needles were disposed in the incinerator. The incinerator has no air inlet and incomplete combustion takes place. Mixed disposal of other a health care wastes including used batteries, syringes & needles, scissors ,broken thermometers, IV-bags, and other packing materials disposed in open pit. But, this finding is very poor as compared to the Study conducted in Nigeria burning of pharmaceuticals and cytotoxic drugs in well-constructed incinerators at recommended temperatures (>1200°C) with facilities to control emissions (40). And also Study conducted in India showed that only pathological wastes like body parts bandages and soiled cottons incinerated and plastics or metal wastes shredded and disinfected by an autoclave and buried in a pit (29). The possible reason for poor performance of the current study Hospital may be due to less attention given by the management bodies as other important duties and, lack of adequate budget allocation for waste management.

The proportion of general and hazardous health care waste of Felege Hiwot referral hospital was 62.7% and 37.3% respectively. This was different from the study conducted by WHO the proportion of hospital wastes in developing countries are 80% general and 20% hazardous (6). The possible explanation might be lack of waste management practice of the hospital that is reuse, recycle, and pretreatment of infectious wastes.

The current study revealed that the average waste generation rate of the hospital was 2.7 kg/ bed/ day, which is similar with the study done in Amsterdam (2.7kg/bed/day) (35). However, the finding is different from the study conducted in Nigeria Garki General Hospital whose

average waste generation was (0.08kg/bed/ day) (19). Moreover, a study done in some African hospitals showed that the range of total waste generation in sub-Saharan Region was 0.3kg/bed/day -1.5 kg/bed/day (17*)*. The reason for high proportion of the study hospital may be a higher proportion of patients treated on a day, number of care takers and there was no reuse item from health care wastes, and newly emerging chronic diseases, the hospital give permission for care takers to bring food items and fruits for their patients and relatives and leftover foods, plastics etc. remains there.

In the current study, the mean health care waste generation rate for general waste was 1.69kg/bed/day and for hazardous waste (sharps, pathological, infectious, pharmaceutical waste) was 1.01kg/bed/day. The result was different from a study done in Narasuan Hospital in Phitsanulok where on average the daily waste generation rate for general waste was 0.922 kg/bed/day and for hazardous waste (sharps, pathological, infectious, pharmaceutical waste) was 0.004 kg /bed/day (5). The possible reasons for high proportion of the study hospital may be most of the customers are chronic patients do not take their medication by orally, and also they may need different medications, number of medical practitioner students (use more glove for one patient because of each of them wants to know the cases), treatment of infectious wastes, lack of waste minimization by purchasing and stock control strategies.

The current study also revealed that the weight of health care wastes generated in kg/patient/day was 2.06. This finding was different from study done in six hospitals of Addis Ababa where the generation rate was ranged from 0.361- 0.669 kg/patient/day (18). The result of this hospital waste generation kg/patient/day is 2.06kg/patient/day. The possible reasons of the current study hospital may be number of delivery & safe abortion attendants, number of patients and care takers, most of the customers are chronic patients they may need different medications.

Limitation of the study

Seasonal variation may affect the mean healthcare waste generation rate and that requires assessments at different season.

Chapter 7: Conclusion and recommendations

7.1 Conclusion

- Segregation of health care wastes was not practiced. As a result of the absence of waste segregation practice, the health care waste leaving from the hospital was potentially infectious and hazardous.
- The health care waste collection, storage, transportation and disposal practices is poor.
- The amount of health care wastes generated in the hospital is high.
- Waste handlers did not use personal protective equipment.
- Standardized color coded plastic buckets were not found and not cleaned/disinfect/ regularly.
- Medical wastes are transported manually by waste handlers.
- The incinerator has not air inlet and complete combustion does not take place.
- Used needles, syringes, scissors, surgical blade and other sharps in the surrounding of the hospital were scattered on the pathways and surroundings of the hospital especially near to disposal sites.
- General, sharps, pharmaceutical, pathological and, infectious wastes were generated.

7.2 Recommendation

- The hospital staffs should segregate wastes at point of generation.
- The hospital management body shall provide enough bio hazard plastic bags and recommended color coded plastic containers according to the types of wastes that are generated in that room.
- The hospital infection prevention committee should give trainings on healthcare waste management for hospital staffs, waste handlers and the nearby community members who are directly or indirectly affected by the generated waste.
- The hospital management bodies should modify the incinerator according to the amount of waste generated.
- The hospital infection prevention committee should burry hazardous health care waste such as chemical and radioactive waste should be in a water tight disposal pit.
- The hospital management body should establish all disposal sites far from the human settlements and fenced.
- The hospital management body should provide continuous supply of personal protective equipment.

- Amhara Regional Heath Bureau and the hospital governing body should develop continuous supervision and monitoring mechanisms for effective implementation of HCWM in the hospital.
- The hospital infection prevention committee should establish an efficient sharps management system and avoid safety box and plastic containers over fill at all generating units.
- The hospital should transport medical wastes in suitable wheeled and leak proof containers.
- The hospital should do further studies on waste generation rate to check the seasonal variation.

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Annexes

Annex I

Consent form

This is a study to assess health care waste generation and management system in Felege Hiwot Referral Hospital. In order to attain effective goal, I ask your honest and genuine answer. There is no need to put your name. No individual response will be reported. This is to keep absolute confidentiality. It is your full right to participate or refuse in the study. Your correct and genuine answer to the questions can make the study achieve its goals. Therefore, you are kindly requested to respond voluntarily with patience.

Are you willing to participate in the interview?

If Yes! Go to the next page.

If No! Thank them and interrupt the interview.

Result of the interview

1. Completed ☐
2. Partially completed ☐
3. The interviewee refused ☐
4. Others----------

Name of interviewer----------

Sign----------

Annex II

Data collection tools

Jimma University Department of Health Services Management, College of Public Health and Medical Science

Part I

Health Care Waste-management Observation Checklist

Name of the Hospital ----------

S.No	**Question**	Response	Skip to
1	**Handling of Health care waste**		
1.1	Does the facility have separate containers for general and hazardous waste (general, infectious, pathological, pharmaceutical, and sharps)?	1 Yes 2 No	
1.2	Does all three types of containers are clearly marked or labeled?(red, yellow and black)	1 Yes 2 No	
1.3	Are all types of containers located in every area where they might be needed?	1 Yes 2 No	
1.4	Are containers made from washable, leak-proof material (preferably plastic or galvanized metal) for disposal of HCW?	1 Yes 2 No	
1.5	Are sharp containers made of a puncture-resistant material (cardboard, plastic, or metal)?	1 Yes 2 No	
1.6	Does the facility segregate wastes at the source in different color coded containers such as red, yellow and black?	1 Yes 2 No	
1.7	Are needles and syringes collected in safety box?	1 Yes 2 No	
1.8	Is there any waste collection containers over fill (above ¾) in the facility?	1 Yes 2 No	
1.9	How was the condition of the safety box or sharp containers in the health facility?	1 over filled 2 torn and needles seen the hole 3 sharps mixed with other waste	

1.10	What goes in to the safety box?	1 Disposable syringe with needles 2 Lancets 3 Empty vials 4 Cotton pad 5 Dressing material 6 Latex glove	
1.11	Are the contaminated needles, syringes or other sharps in the surrounding of the health facility?	1 yes 2 No	
1.12	Do all waste handlers wear heavy duty gloves, apron and boots when handling medical waste?	1 Yes 2 No	
1.13	Does the facility generate any waste of special concern: Cytotoxic? Pathological waste? Reagent? Outdated pharmaceuticals? Radioactive waste?	 1 yes 2 No 1 yes 2 No 1 yes 2 No 1 yes 2 No 1 yes 2 No	
1.14	A, Does the temporary storage bin have a cover? B, Is the temporary storage bin easily cleanable?	1 yes 2 No 1 yes 2 No	
2.	**For waste collection and transportation**		
2.1	Is the waste collection done with time table of the frequency of collection?	1 yes 2 No	
2.2	Do the cleaners wear duty glove, boots and apron?	1 yes 2 No	
2.3	Are the hazardous/infectious health care waste and non-infectious health care wastes collected in separate trolleys?	1 yes 2 No	
2.4	Are the waste containers appropriately sealed?	1 yes 2 No	
2.5	Are wastes removed and replaced immediately when they are no more than three quarters full?	1 yes 2 No	
2.6	What are the containers used for transporting HCW	1 Cart 2 Open plastic bucket 3 Closed plastic bucket 3 Others	
3	**Temporary Storage**		

3.1	Does the facility have temporary separate storage area for HCW?	1 Yes 2 No	
3.2	Is the storage areas easily to clean, have good lighting and ventilation?	1 yes 2 No	
3.3	Do all temporary storage containers have lids?	1 Yes 2 No	
3.4	Is there any possibility for animals /insects to have access to hazardous / infectious waste storage?	1 Yes 2 No	
3.5	Is the health care waste stored for more than 24 hours before being treated / disposed?	1 Yes 2 No	
4	**Treatment and disposal of health care waste**		
4.1	What treatments (if any) are done to the waste before disposal?	1 incinerator 2 autoclave 3disinfectionby chlorine	
4.2	Are waste treatment residuals handled appropriately?	1 yes 2 No	
4.3	How is health care waste disposed?	1. On-site? 2. Off- site?	
4.4	What are the on-site practices for HCW treatment?	1.Crushing of sharps 2.Sterilization 3.Chemical disinfection 4 Destruction through burning	
4.5	What are the practices for on-site disposal?	1 Dumping 2 Open burning 3 Incineration 4 other specify	
4.6	How are syringes and needles and sharps disposed in the health facility?	1 Open incineration 2 Protected, incineration 3 Open dumping 4 Burial in the pit 5 Dumping 6 Others	
4.7	How are tissues (placenta, removed body parts) disposed in the hospital?	1 Open dumping 2 Burial in the pit 3 Dumping	

		4 Other specify	
4.8	Are there tissues (placenta, removed body parts) disposed in the immediate surroundings of the hospital?	1Yes 2 No	
4.9	Is the incinerator functional?	1yes 2 No	
4.10	Is the incinerator located at the wind side of the hospital?	1 Yes 2 No	
4.11	Does the incinerator have sufficient air inlets on the side?	1 Yes 2 No	
4.12	What type of HCW is burned in the incinerator?	1 Infectious 2 Syringes 3 plastics 4 All type	
4.13	Does the hospital have ash pit?	1 Yes 2 No	
4.14	Is the ash pit 1-2 meters wide and 2-5 meters deep? Is the bottom of the pit is at least 1.8 meters above the water table?	1 Yes 2 No	
4.15	Is the incinerator surrounded by a fence?	1 Yes 2 No	
4.16	Is the burial site away from any water source at least 50 meters?	1 Yes 2 No	
4.17	Is there any of the waste taken off-site?	1 Yes 2 No	
4.18	Is there any waste recycle in the hospital?	1 Yes 2 No	
5	**Management issues**		
5.1	Is there any national, regional, and local guideline for HCW management in unit level?	1 Yes 2 No	
5.2	Is there any health care waste management committee?	1 Yes 2 No	
5.3	If yes, does the committee conduct meetings on the issue of waste management in one month?	1 Yes 2 No	

Part II

In-depth interview guide

1. How are the health care wastes segregated at the source in the hospital?
2. How are health care wastes transported, on- site and off-site?
3. What are the healthcare waste treatment practices in the hospital?
4. What are the challenges of HCWM in the hospital?

Part III

Recording data sheet for health care waste generation rate.

Name of the hospital…….

Name of units……..

Sample number……..

Estimation of the total quantity of hospital waste generated (kg/day)

Name of data collector----------Sign----------date-----/-------2014

Name of supervisor----------sign----------date-----/-------2014

1. **----------OPD room**

Date	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
No. of patients						
Type of waste						
General waste						
Sharps						
Pharmaceutical						
Pathological						
Infectious						

2. ----------in patient room

Date	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
No. of patients						
Type of waste						
General waste						
Sharps						
Pharmaceutical						
Pathological						
Infectious						

3. ----------pharmacy room

Date	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
No. of patients						
Type of waste						
General waste						
Sharps						
Pharmaceutical						
Pathological						
Infectious						

4. ----------laboratory room

Date	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
No. of patients						
Type of waste						
General waste						
Sharps						
Pharmaceutical						
Pathological						
Infectious						

5. ----------operation room

Date	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
No. of patients						
Type of waste						
General waste						
Sharps						
Pharmaceutical						
Pathological						
Infectious						

6. ----------emergency room

Date	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
No. of patients						
Type of waste						
General waste						
Sharps						
Pharmaceutical						
Pathological						
Infectious						

7. ----------x-ray room

Date	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
No. of patients						
Type of waste						
General waste						
Sharps						
Pharmaceutical						
Pathological						
Infectious						

8. ----------pathology room

Date	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
No. of patients						
Type of waste						
General waste						
Sharps						
Pharmaceutical						
Pathological						
Infectious						

9. ----------physiotherapy room

Date	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
No. of patients						
Type of waste						
General waste						
Sharps						
Pharmaceutical						
Pathological						
Infectious						

10----------card room

Date	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
No. of patients						
Type of waste						
General waste						
Sharps						
Pharmaceutical						
Pathological						
Infectious						

10.----------Administrative room

Date	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
No. of patients						
Type of waste						
General waste						
Sharps						
Pharmaceutical						
Pathological						
Infectious						

Part IV

1**. General facility information**

S. No.	**Questions**	**Response**
1	How many outpatients visit the hospital each day?	
2	How many patients visited the hospital last year?	
3	What is the bed occupancy rate in the hospital?	
4	How many beds are there?	
4	How many employees are there?	
5	Has the hospital perform a waste audit in the last 3 years	
6	Are visual aids or instructions present near the waste receptacles to help in Proper segregation?	
7	Does your hospital provide waste management education or training for staffs?	
8	Do you communicate your environmental successes with the community?	
9	Do you have environmental preferable purchasing policy to encourage waste reduction?	