Addis Ababa University
School of Graduate Studies

Assessment of healthcare waste generation rate and its management system in health centers of West Gojjam zone, Amhara Region.

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A thesis submitted to School of Graduate Studies, Addis Ababa University, Faculty of Medicine, Department of Community Health in partial fulfillment of the requirements for the Degrees of Master of public health.

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March, 2007
Addis Ababa, Ethiopia.

Declaration

I, the undersigned declared that this my original work, has not been presented for degree in this or other university and that all source of materials used for this thesis has been fully acknowledged.

Name_____

Signature _____

Place: Addis Ababa University

Date of submission_____

This thesis has been submitted for examination with my approval as university advisor.

Name_____

Signature _____

Acknowledgment

First I would like to express my deepest gratitude to my Advisor to Dr. Abera Kumie for his unreserved support through out the study period.

I would like to extend my thanks to Addis Ababa University, Faculty of Medicine, Department of Community Health for financial support to carry out this research paper.

I sincerely thank Amhara Regional Health Bureau, West Gojjam Zone Health Bureau and their Worda Health Bureau, head of the study health centers for their unreserved cooperation during data collection time.

My deepest gratitude also goes to all data collectors and supervisor for their commitment during data collection.

I would like to thank my parents and my friend Atakilt Melkamu who encouraged me through out this study.

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List of acronyms

AAU = Addis Ababa University
EPA = Environmental Protection Agency of USA
EPI = Expanded Program Immunization
FP = Family planning
HCW = Healthcare waste
MCH = Mother and child health
MOH = Ministry of health
OPD = Out patient department
QSAE= Quality and Standard Authority of Ethiopia

Abstract

Background: The aim of healthcare services is to reduce health problems and to prevent potential health risks. On the other hand health facilities generate hazardous and non hazardous waste that is potentially harmful to public health and the environment if not segregated and dispose properly.

Objective: To assess the waste generation rate and its management system in health centers of West Gojjam zone. .

Methods: Cross-sectional study was employed to estimate waste generation rate and evaluate their management system in health centers from March 2007 to April 2007. Ten health centers were included in the study. Observational checklist, key informant interview and weighting scale were used to assess the management and to quantify the generation rate. Weighing of healthcare waste was done for eight days in each health center. Data collectors and supervisor were recruited and trained. Training of data collectors and calibration of weighing scale with standard weights were done during data collection to assure data quality. Data were compiled and analyzed with EPi Info version 6.04d & SPSS version 13.0.

Results: The mean (±SD) healthcare waste generation rate was 1.79 ±0.57 kg/day or 0.035kg/patient/day±0.07, of which (52.0%) 0.93±0.3 kg/day was general or non-hazardous waste and (48.0%) 0.86 ± 0.33 kg/day was hazardous. The mean healthcare waste generation rate between health centers did not significantly vary with Kurskal-Wallis test (x^2=8.105, p-value=0.524). Only six health centers used safety boxes for collection of sharp wastes and all health centers used plastic buckets with out lid for collection of healthcare waste. Segregation of wastes and pre treatment of infectious wastes were not employed by any of the health centers. Only four out of ten health centers used incinerators and the rest six health centers used open burning for disposal of healthcare wastes. All study health centers had placenta pit for disposal of pathological waste however only three pits had proper covering material. Training about healthcare waste management was not given for waste handlers and healthcare workers. Operational standards and healthcare waste management committee were not found in any of the study health centers.

Conclusion and Recommendation: The mean healthcare waste was 0.035 kg/patient/day or 1.79 kg/day per health center of HCW was generated. It is managed and disposed in manner that pose health risk to healthcare workers, waste handlers and the

community in addition to contaminate the surrounding environment (air, soil and water). Segregation of wastes at point of generation with appropriate collected material and pre treatment of infectious waste before disposal should be practiced. Training of healthcare workers and waste handlers should be given. Incinerators must be constructed in a manner that facilitates complete combustion and the lining of placenta pit should be constructed in watertight material.

1. INTRODUCTION

1.1. Back ground and statement of the problem

Healthcare institutions provide medical care comprising of observational, diagnostic, research and therapeutic and rehabilitative services in an attempt to reduce health problems and protect the public from health risks. However, they generate waste that is potentially harmful to public health and the environment (1, 2).

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. There are different estimates regarding to hazardous and non-hazardous constituents of healthcare waste. According to a WHO report, around 85% of hospital wastes are actually non-hazardous, 10% are infectious (hence, hazardous), and the remaining 5% are non-infectious but hazardous (toxic chemicals, pharmaceutical and radioactive) (2, 3, 4, 5, 6).

Waste generation depends on numerous factors such as established waste management methods, type of health-care establishment, hospital specializations, proportion of reusable items employed in health care, seasonal variation and proportion of patients treated on a day-care basis. In middle and low-income countries, health-care waste generation is usually lower than in high-income countries (2, 4, 7).

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 (4). Halbwaches 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 (3).

In the developing countries some urban and many rural hospitals and clinics 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 %(8).

A study done by Ministry of Health 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 (9).

Mixed disposal of special healthcare wastes contaminate water, air and soil. In addition to that from such practices health care workers, patients, waste handlers, waste pickers, and the public are exposed to health risks from infectious waste (particularly sharps), chemicals, and other special health care waste (6, 7). In our country there is no data a bout the impact of healthcare wastes on environment and the public. As the healthcare services become increasing contamination of water, air and soil, health risks from infectious wastes to healthcare workers, waste handlers, patients and community might be more likely to be occurred if the wastes are improperly handled and disposed.

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 (10). The amount and types of waste generated from healthcare facilities in the country is not well established at macro and micro level. Therefore, assessment of 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.

2. Literature review

2.1. Generation rate

Health-care wastes are the waste generated by health-care establishments like hospitals, health centers, laboratories, medical research centers, pharmaceutical manufacturing plants, pharmacies, blood banks, veterinary healthcare centers and home healthcare activities are some of the generators of healthcare waste (1, 7). Health care waste is the second most hazardous waste after radioactive waste (2).

Although there is a difference in denominator to express mean of healthcare waste in hospitals and in health centers, the generation rate of healthcare waste in different countries in hospital setting were varied. This difference may be due to geographical location, living habits and standards, availability of different treatment facilities and the ways in which solid waste are categorized (11,12).

The proportion of general and hazardous waste were also varied in similar setting. In the US for example, about 15% of hospital waste are regulated as infectious. In India, this range from 15-35% depending on the total amount of waste generated. In Pakistan a bout 20% of hospital waste is potentially infectious or hazardous (2). Seventy six to ninety percent of the total HCW in Dhaka city was general, 5-16% was infectious, 2-6% was sharps and 1-3 % was pathological (12)

The study done in Phitsanulok Thailand, the average daily waste generation of general, infectious and hazardous from all clinics was 0.323, 0.041 and 0.02 kg/patient, respectively (13).

A study done in Saudi Arabia on medical waste in 16 primary health centers and clinics indicated that the mean primary healthcare centers and clinics healthcare waste rate of generation was 0.08+/-0.08 kg/visitor/day. The estimated mean amount of all healthcare waste generated in Saudi Arabia is 25,207 tons/year (14).

Another study done in Sylhet city, Bangladesh in diagnosis centers and higher clinics, the mean healthcare waste generation rate was 0.041 kg/patient/day, of which 63.97% was general and 36.03% was hazardous (15)

A study done on Health-care waste generation in government Health facilities of Dar es Salaam (United Republic of Tanzania) in 1995/1996 showed that 0.14 kg/day per patient and 0.02 kg/day per patient of healthcare waste were generated at district hospital (in- and outpatients) and urban health centers(16).

Another study done to estimate health-care waste generation rate in Botswana in 1996 in urban clinics and rural clinics indicated that 15 kg/day from urban clinics and 7 kg/day from rural clinics was generated. The rate varied greatly not only from country to country but also among facilities within any given country. This variation may be due to different hospital specializations, waste management practices, use of reusable items, etc (16)

2.2. Health risks from healthcare waste

Improper disposal of wastes in hospitals places direct and indirect health risks on those working in hospitals and the surrounding communities, and on the environment (1, 2). Such practices contribute to the spread of disease, as well as pollution of the air, soil and water. Runoff from untreated infectious wastes or human excrement dumped on the land can contaminate surface and ground water supplies, exposing the population to the risk of diseases and parasites (1, 2, 3, 18).

In addition to the community and environmental hazards unsafe health care waste practices and improper disposal of wastes in the health care industries expose health care professionals remain under a constant risk. Unsafe sharps waste collection also causes 5% to 28% of needle stick injuries. e.g. the annual injury rates in health care personnel in developed countries vary from 10 to 20 per 1000 workers (19). WHO estimated that, in 2000, worldwide, injections with contaminated syringes caused an estimated 21 million infections of Hepatitis B, 2 million of Hepatitis C and 260,000 HIV (4).

Incineration remains an important technological tool in health care waste management due to its ability to completely destroy infectious or contaminated materials (such as used syringes) (20). However, Uncontrolled burning of medical waste pollutes the air with acid gases, dioxins, furans and heavy metals (18). According to the EPA, of the top 20 pollutants through the toxic release inventory in 1997, nearly three-quarters are known or suspected neuro toxicants. Medical waste incinerations contribute to this list of environmental neuron toxicants (13).

Currently, health care waste incinerations are ranked among the top four sources for dioxin and anthropogenic mercury emissions in the United States (20). Dioxin can cause cancer, birth defects, decreased psychomotor ability, hearing defects, cognitive defects and behavioral alternations in infants. Mercury is also bio-accumulative and is toxic to the kidneys and nervous system and interferes with normal brain development (19).

2.3. Healthcare waste handling

WHO report showed that only a very small amount of health care wastes couldn't be recycled or sent to a municipal landfill if properly segregated from hazardous waste, while the management of hazardous waste required special arrangement depending on the type of the hazardous waste (1, 2, 4, 5).

In Pennsylvania, the Environmental Protection Agency (EPA) reported that approximately 3.2 million tons of medical wastes from hospitals were generated each year. Almost 90% of infectious and chemotherapeutic waste was generated by hospitals the rests are generated from other health care institutions. Forty-eight percent of hospitals used on-site incineration to dispose of infectious and chemotherapeutic waste and almost half of the hospital incinerators were operating at less than full capacity (21).

The amount of health-care waste produced in the Istanbul Metropolitan City in Turkey is 30 ton day^{-1} in total healthcare institutions. The method used for the final disposal of most of the health-care waste of Istanbul was incineration. However, a great portion of the infectious waste is disposed of with the domestic waste into the sanitary landfill because of improper segregation practices applied in the health-care institutions (22)

A study done on medical waste in national Hospital, the largest and a five star hospital in Abuja Nigeria showed that the average waste generation rate per bed/day was found to be 2.78 kg of solid waste, 26.5% of the total waste was hazardous in nature. Waste segregation was found not to be practiced by any of the hospitals surveyed, 18.3% of the hospitals incinerated waste in a locally built brick incinerator; 9.1% bury; 36.3% burn waste in open pits while 36.3% dispose of a waste into municipal dumpsites (23).

A survey conducted by Dr.Salim R. etal on medical waste disposal in Dhaka city revealed that governmental hospitals placed all wastes in open dustbins (i.e. open waste containers that are accessible to the general public) and the wastes were left in the open for one to two days. There was no clear guidance to segregate wastes and ensure their proper disposal. Waste was primarily carried by open bucket as respondent mentioned (44.38%) and plastic bowl (23.86%). The researcher concluded that there was a lack of knowledge and interest in safe waste disposal

by most health workers and an absence of adequate funding to effectively implement safe waste disposal (2).

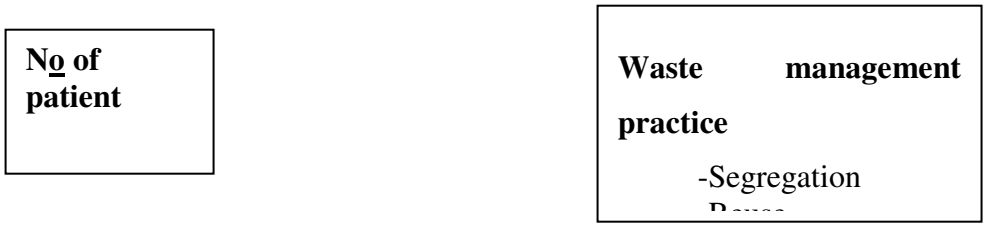
Another study in South Africa in the Kwazulu-Nata province showed that 45% of health care waste is illegally dumped, buried or burnt somewhere (24). In Swaziland, healthcare facilities have no common standards for source separation, collection equipment for disposal of medical waste. Medical waste is generally disposed of by the use of incinerators or it is simply dumped together with other waste types at landfill sites (24).

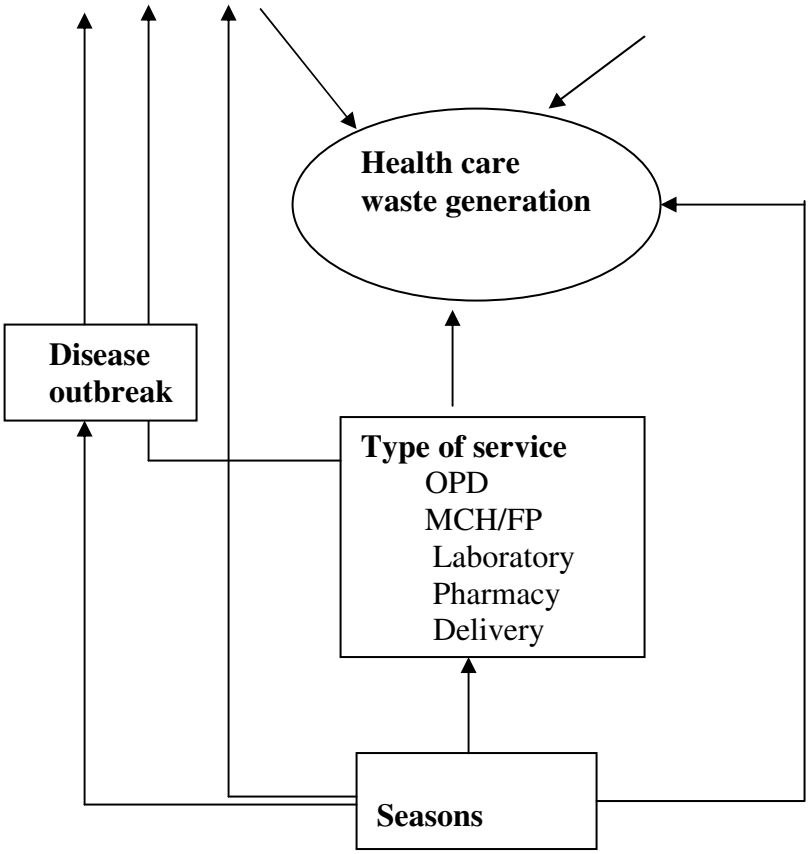
A study done by Yoseph W. in Sidama zone showed that 42.5% of health institutes use protected incinerators to dispose syringes, needles and other sharp objects and in 35% of these institutes used syringes, needles or sharps were observed to be disposed of in a manner that exposes workers and the rest of the community to health hazards (25).

In Ethiopia, there are 131 hospitals, 600 health centers, 1662 health stations, 4211 health posts and 1578 private clinics, but there is inadequate data a bout medical waste, generation rate, management and disposal system at regional and nationally level (10). Only providing basic health service is questionable without proper disposal of the wastes because the waste produced by the medical care centers if disposed off improperly, can pose an even greater threat than the original diseases themselves. Therefore, assessment of waste generation and its management systems is a prerequisite in order to offer proper disposal methods.

2.4. **Conceptual framework.**

Factors that determine healthcare waste type and generation in health center.




Health care
waste generation
Disease
outbreak
Type of service
OPD
MCH/FP
Laboratory
Pharmacy
Delivery
Seasons

3. OBJECTIVES

3.1 General objective

To assess the waste generation rate and its management system in health centers.

3.2 Specific objectives

- To determine the waste generation rate in health centers.
- To identify the type of wastes generated.
- To estimate the annual generation rate
- To evaluate healthcare waste management system.

4. MATERIALS AND METHODS

4.1 Study design

Cross-sectional study was conducted to quantify waste generation rate and evaluate its management system from March 2007 to April 2007.

4.2 Study area

West Gojjam zone is found in Amhara region, which is bounded by Bahir Dar town in Northern part, East Gojjam zone in the Southern part. The total population of the zone is 2,610,861 of which 2,411,558 (92.4 %) are found in rural and 199,303(17.6 %) are found in urban. There are governmental and private health facilities, which provide basic health service. Among governmental facilities, there are one hospital, 10 health centers, and 187 clinics.

4.3 Study population

All health centers, which are found in the zone, were the study population i.e. Adet, Merawi, Durbetie, Sekela, Shindi, Bure, Dangila, Injibara, Gimjabet and Chagini health center.

4.4 Variables

Independent variables

Materials used for waste collection and transportation.

Presence or absence of waste management policy

Segregation at the source

Number of out patients

Dependant variables

The amount of waste generated.

The type of waste

Waste management practice.

4.5 Data collection

Observational checklist, key in format interview and weighting scale were used to assess the health care waste management system and its generation rate in each health center. Observational checklist was used to assess the management system in terms of segregation, collection, transportation, and treatment of health care wastes and key informant interview was used to assess how healthcare workers and waste handlers handled healthcare waste in each health centers. Weighting scale was used to quantify the generation rate of healthcare waste in health centers.

Data collection procedures

First health centers were grouped in to three according to the geographical location in order to easily manage data collection. Walk through inspection of the health center were done by investigator in order to identify what type of waste generated in relation to the working section of the health center.

Waste was collected and measured daily for eight consecutively days to estimate the amount of waste generated. Plastic buckets of different colors such as blue color for general waste, green color for pharmaceutical waste and red color used for infectious waste and pathological waste were distributed according to the type of waste generated in different section of the health center such as OPD, Pharmacy, Injection and dressing room, MCH/FP and EPI, Laboratory and VCT room, TB unit, Ward and delivery room. Plastic bags with different colors (blue strip plastic bags for general waste and red strip plastic bags for infectious waste and pathological waste) were kept inside in the buckets. The buckets and plastic bags were labeled to indicate the different categories of healthcare waste, the place of generation, date of collection and sample number. Plastic bags were removed every morning and its weight was measured every day at 8:A.M using weighing scale. As much as possible care was taken to collect different categories of waste, i.e. general, pathological waste, infectious waste, pharmaceutical waste and sharps waste. For the purpose of data collection 20 enumerators and 5 supervisors who have completed secondary school were recruited and a one day training was given on the types of waste of concern, how to collect waste in different containers and in the use of weighing scale. Guideline was prepared by the investigator to facilitate the training. The training was followed

by pre-test so that training was given good opportunity to the enumerators and supervisors to practice the work. Measured data of different types of waste were recorded daily with recorded data format sheet.

4.6 Operational definitions

General waste: Domestic type of waste, packing material, wastewater from laundries etc.

Pathological waste: consists of tissues, organs, body parts, human fetuses, blood and body fluids.

Infectious waste: includes cultures and stocks of infectious agents from laboratories, waste from survey and autopsy on patients in isolation wards and dialysis from infected patients.

Sharps: includes items like needles, blades, broken glass etc i.e. any item that can cause a cut or puncture.

Pharmaceutical wastes: consists of pharmaceutical products, drug and chemicals those have been returned from the wards.

Segregation: keeping noninfectious waste out of the infectious waste stream (14).

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

Patient: a person who gets any healthcare service with in the health center

4.7 Data quality management

Pre-test was conducted prior to the actual data collection time to assure accuracy of the observational checklist and weighing scale. Weighing scale (Baby scale, capacity range 15kg & model 4 capacity range 20 kg) was calibrated using a known standard of 100g, 500g and 1000g weighting objects every morning before the actual measurement started. Training was given to data collectors and supervisors.

4.8 Data analysis

The raw data collected from the field were entered and compiled using EPI info version 6.04d and SPSS version 13.0 to enable the estimation of waste generation rate in each health center. Data cleaning were performed by running each variable to check for accuracy, inconsistencies, and missed value. The average quantity of health care wastes in the health centers was computed. Mean, standard deviation and Kurskal-Wallis test were computed for statistical analysis. Kurskal-Wallis test was used as result of non normal distribution of the data. The result was presented using tables and graphs.

4.9 Ethical consideration

Ethical clearance was obtained from the Department of Community Health, Faculty of Medicine, and Addis Ababa University. Consent was taken from Amhara regional Health Bureau, West Gojjam zone and Woreda Health Bureau. Verbal and written consent from the head of each health center were also taken before proceeding data collection.

4.10 Dissemination of the result

The result of the study was submitted to the Department of Community Health, Faculty of Medicine, Addis Ababa University. In addition, the paper will be disseminated to the concerned body such as Amhara regional health bureau, and Environmental Protection Authority and also the paper will be presented to the reviewed publication committee.

5. Results

5.1. Service, section and patient loads in study health centers.

A total of ten health centers were included in the study to quantify healthcare waste generation rate and to evaluate its management system. Different health service such as diagnosis at OPD (out patient department), laboratory examination (HIV test, blood, stool, urine and sputum examination), mother and child health service (immunization, family planning and delivery service) were the type of service that had been considered in each health centre during study period.

Different sections such as OPD (out patient department), Pharmacy, Injection and dressing, MCH (mother and child health), FP (family planning) and EPI (expanded program immunization) room, TB room (tuberculosis follow up unit), Wards (for emergency case) and delivery room were found with in each health center that generate different healthcare wastes.

A total of 14,866 patients visited in all section, of which 4,167 (28.0%) patients visited OPDs in all health centers with in eight days. The mean ±SD (standard deviation) patient flow per day in all section and at OPD in each health center was 185.8±30.3 and 51.7±11.6, respectively (Table 1).

Table 1: Number of patient visited in different section and at out patient department in each health center, West Gojjam, Amhara Region, March 2007.

Name of health Center	Patient flow per day in all sections	Patient flow per day at OPD
Adet	185.2	45.8
Merawi	198.0	72.5
Durbete	196.5	55.6
Sekela	172.8	39.5
Shindi	137.0	45.6
Bure	163.5	35.8
Dangila	233.9	61.0
Injbara	191.0	58.1
Gimjabet	156.1	47.1
Chagini	224.0	59.9
Mean	185.8	51.7
SD	29.8	11.6

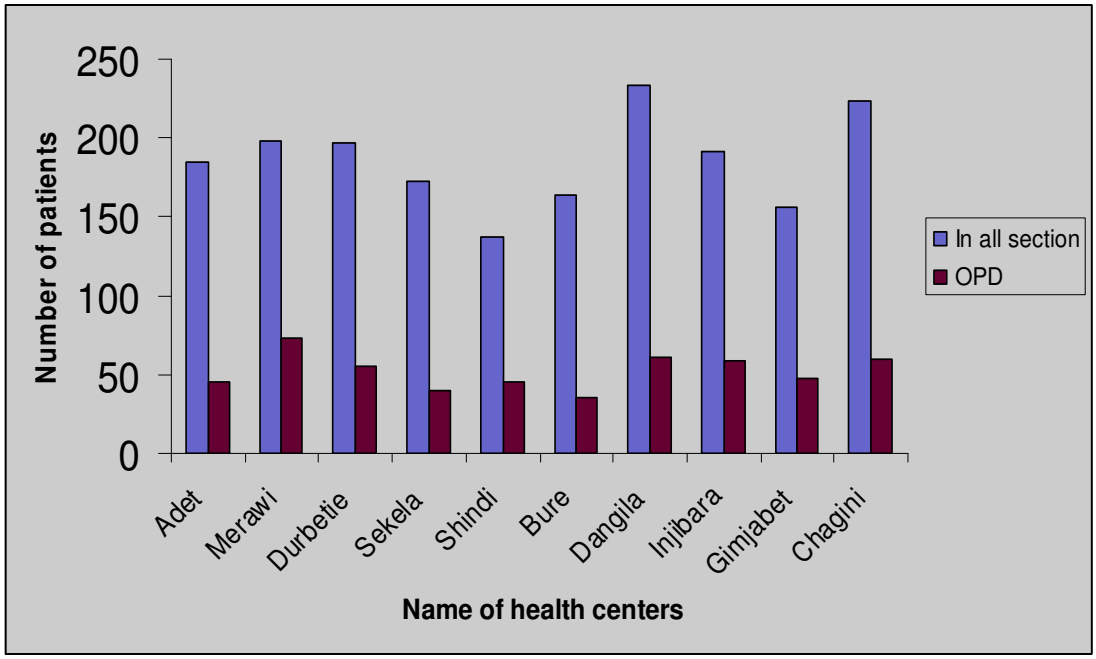


Fig 1: The distribution of patient flow in all section and at OPD among the study health centers, West Gojjam, Amhara Region, March 2007.

5.2. Generation rate

5.2.1 Daily HCW generations in health centers

The mean (±SD) healthcare waste generation rate per health center was 1.79 ±0.57 kg/day, of which (52.0%) 0.93±0.3kg/day was general or non-hazardous waste and (48.0%) 0.86 ± 0.33 kg/day was hazardous. High amount of healthcare waste per day was generated at Dangila (2.82±2.27 kg/day) and Chagini (2.6±2.4 kg/day) health centers while small amount of healthcare waste was recorded at Gimjabet (1.12±0.50 kg/day) and Shindi (1.16±0.87 kg/day) health centers (Table 2).

Table 2: A mount of daily HCW generation rate by type in each health centers, West Gojjam, Amhara Region, March 2007

Name of Health centers	Daily HCW in kg/day			
	Total HCW in eight days	Mean.of HCW Mean ±SD	Mean of General Waste (%)	Mean of Hazardous Waste (%)
Adet	11.52	1.44±0.81	0.68(47.2)	0.77(52.8)
Merawi	16.56	2.07±1.39	1.31(63.3)	0.76(36.7)
Durbete	14.00	1.75±0.69	0.75(42.9)	1.00(57.1)
Sekela	12.48	1.56±0.79	0.98(62.8)	0.58(37.2)
Shindi	9.28	1.16±0.87	0.55(47.4)	0.61(52.6)
Bure	12.40	1.55±1.28	0.81(52.3)	0.74(47.7)
Dangila	22.56	2.82±2.27	1.46(51.8)	1.36(48.2)
Injbara	14.88	1.86±1.24	0.98(52.7)	0.88(47.3)
Gimjabet	8.96	1.12±0.50	0.65(58.0)	0.47(42.0)
Chagini	20.8	2.60±2.16	1.11(42.7)	1.49(53.7)
Mean	14.34	1.79	0.93(52.0)	0.86(48.0)
SD	4.53	0.57	0.30	0.33

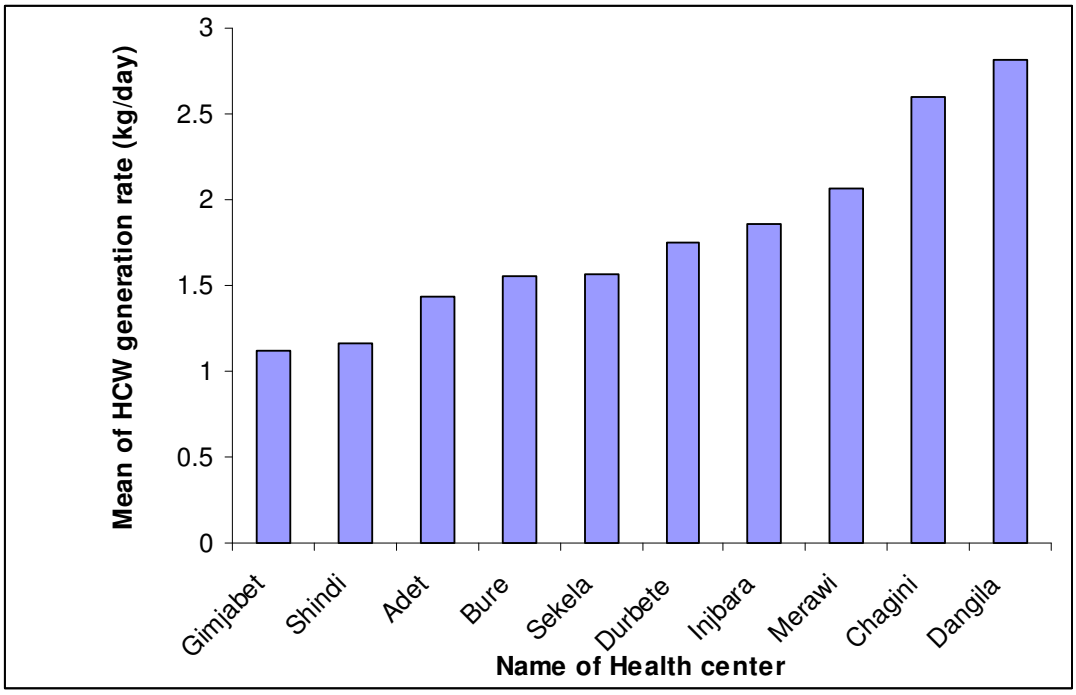


Fig 2: The distribution of mean HCW generation rate per day (kg/day) among the Study health centers, West Gojjam, Amhara Region, March 2007.

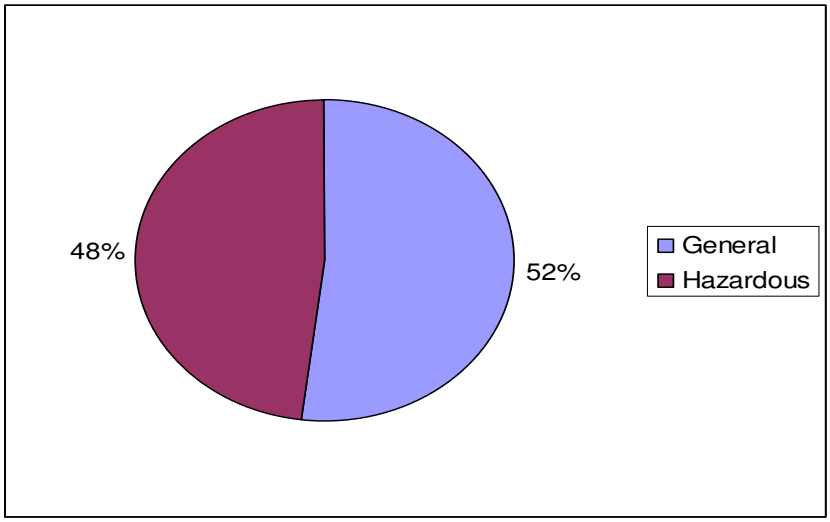


Fig 3: The percentage of types of HCW (general and Hazardous waste) in all Study health centers, West Gojjam, Amhara Region, March 2007.

The types of hazardous waste generated from study health centers were sharps, infectious pathological and pharmaceutical waste. Radioactive waste was not generated in any of health centers. The mean±SD generation rate of sharps, infectious, pathological and pharmaceutical waste in each health center was 0.34±0.1 (19%), 0.17±0.04 (9.5%), 0.34±0.25 (19%) and 0.017±0.01 (0.95%) kg/day, respectively (Table 3).

Table 3: A mount daily hazardous waste generation rate by type from each health centers, West Gojjam, Amhara Region, March 2007.

Name of health centers	Sharps*	Infectious	Pathological	Pharmaceutical	Total Hazardous waste
	Kg/day(% of total HCW)	Kg/day(% of total HCW)	kg/day(% of total HCW)	kg/day(% of total HCW)	Kg/day (% of the total HCW)
Adet	0.32(22.2)	0.16(11.1)	0.28(19.4)	0.01(0.6)	0.77(52.8)
Merawi	0.47(22.7)	0.13(6.3)	0.13(6.3)	0.026(1.4)	0.76(36.7)
Durebet	0.39(22.3)	0.19(10.9)	0.40(22.9)	0.019(1.1)	1.00(57.1)
Sekela	0.20(12.8)	0.20(12.8)	0.16(10.3)	0.016(1.3)	0.58(37.2)
Shindi	0.17(14.7)	0.15(13)	0.29(25)	0.003(0.26)	0.61(52.6)
Bure	0.24(15.5)	0.17(11)	0.32(20.6)	0.010(0.6)	0.74(47.7)
Dangila	0.46(16.3)	0.25(8.7)	0.63(22.3)	0.023(0.7)	1.36(48.2)
Injbara	0.39(21)	0.16(8.6)	0.31(16.7)	0.018(1.1)	0.88(47.3)
Gimjabet	0.32(28.6)	0.13(11.6)	0.00(0)	0.020(1.8)	0.47(42.0)
Chagini	0.39(15)	0.20(7.7)	0.87(33.5)	0.026(1.2)	1.49(53.7)
Average	0.34(19)	0.17(9.5)	0.34(19)	0.017(0.95)	0.86(48.0)

SD	0.01	0.04	0.25	0.01	0.33

- Sharps* includes needles, blade, lancet needles, syringes, scalpel blades.

5.2.2 Daily HCW generation in different section.

In different sections the amount of healthcare waste generation rate was different. The mean (±SD) healthcare waste generation rate in each section was 0.224±0.22 kg/day. A bout 33% of healthcare waste was generated at injection and dressing room where as less amount (0.39%) of healthcare waste was generated at TB follow up unit. There was statistically significance difference mean of HCW generation rate in different sections in study health centers (X^2= 229.196, p-value<0.001) (Table 4).

Table 4: A mount of daily HCW generation rate in different departments in all health centers, West Gojjam, Amhara Region, March 2007

Departments	HCW (kg/day) Mean ± SD	Percent	Mean rank*
OPD	0.053 ±0.012	3.0	304.66
Pharmacy	0.436 ±0.209	24.3	357.89
Injection & Dressing	0.597 ±0.135	33.3	545.20
MCH, FP &EPI	0.208 ±0.099	11.6	370.89
Laboratory & VCT	0.091 ±0.050	5.0	310.68
TB follow up Unit	0.007 ±0.007	0.39	170.51
Ward	0.052 ±0.073	2.9	207.17
Delivery	0.350 ±0.259	19.5	297.01
Mean	0.224		
SD	0.22		

* **X^2= 229.196, p-value<0.001** *** Degree of freedom=9**

5.2.3 Annual HCW generation rate estimation.

The estimation of healthcare waste generation rate per year can be calculated in two ways. The first way can be calculated by using annual flow of patients and mean healthcare waste generation rate per patient per day (the assumption was each patient who visited the health center may generate the same amount of HCW through out the year).

Total HCW generation per year = Mean HCW generation in Kg per patient per day * No of patients flows in a year

The second way can be calculated by using healthcare waste generation rate per day (kg/day) and number of days in year (the assumption was the mean of HCW per day may represent through out 365days).

Total HCW generation per year =

Mean HCW generation in Kg per day * 365

The mean (±SD) patient flow per day per health center was 71.5 ±12.4. The mean (±SD) healthcare waste generation rate in was 34.76±7.718 gram per patient per day or 1.79 kg/day. The annual mean (±SD) of healthcare waste generation rate per health center was 908.0± 268.6 kg/year by using the first method and 654.0±206.5 kg/year in the second assumption. There was a variation of annual HCW generation rate in both assumptions (Table 5).

Table 5: A mount of HCW generation rate estimation per year in health centers, West Gojjam, Amhara Region, March 2007

Name of Health center	Patient flow in 1998	Patient flow/day in 1998	Mean HCW (kg/day)	Mean HCW (g/pat/ day)	**Total HCW (kg/year)	* Total HCW(kg/ year)
Adet	24,382	66.8	1.44	31.40	525.6	765.6
Merawi	27,325	74.9	2.07	28.58	755.6	780.9
Durebet	31,863	87.3	1.75	31.54	638.8	1005.0
Sekela	19,964	54.7	1.56	39.33	569.4	785.2
Shindi	23,983	65.7	1.16	27.98	423.4	671.0
Bure	21,451	58.8	1.55	43.44	565.8	931.9
Dangila	33,125	90.8	2.82	46.22	1029.3	1531.0
Injbara	21,460	58.8	1.86	32.04	678.9	687.6
Gimjabt	28,512	78.7	1.12	23.73	408.8	676.6
Chagini	28,732	78.7	2.60	43.34	949.0	1245.2
Mean	26069.7	71.5	1.79	34.76	654.0	908.0
SD	4534.2	12.4	0.57	7.718	206.5	268.6

**** Total HCW generation rate in kg per year =HCW generation rate in kg per day * 365**

*** Total HCW generation rate in kg per year = (HCW generation rate in g per patient per day * No of annual patient flow)/1000**

Patient flow, healthcare waste generation rate and its types such as general and hazardous waste (sharps, infectious, pathological and pharmaceutical waste) among different health centers were compared using Kruskal-Wallis test to check for the presence of significant difference among their values.

There was no statistically significant difference for patient flow (x^2=12.156, p-value=0.205), mean of healthcare waste (x^2=8.105, p-value=0.524), general (x^2=8.077, p-value=0.526) and hazardous waste(x^2=16.700, p-value=0.054) among study health centers.

Table 6: Comparison of visitors, healthcare wastes generation rate and its type among study health centers, West Gojjam, Amhara Region, March 2007.

Name of health center	Mean rank			
	Patient flow	**Total HCW**	**General Waste**	**hazardous waste**
Adet	41.81	38.13	27.06	39.31
Merawi	45.75	44.88	48.50	41.69
Durebet	44.78	46.63	44.38	48.19
Sekela	37.25	40.44	43.63	33.06
Shindi	23.06	27.25	34.35	24.63
Bure	34.00	35.63	32.38	37.63
Dangila	54.69	51.5	53.88	52.06
Injbara	43.19	43.50	42.56	43.31
Gimjabet	30.06	29.94	40.38	25.25
Chagini	50.44	47.13	28.00	59.88
Chi-Square	12.156	8.105	8.077	16.700
Asymp. Sig.	0.205	0.524	0.526	0.054

* Degree of freedom=9

The extent or strength of linear relation ship between numbers of patients and amount of healthcare waste generation rate were checked using Spearman's rank correlation coefficient (r_s) in all health centers. Spearman's rank correlation coefficient showed that there was a positive linear relation ship as number of patients increased healthcare wastes also increased in all study health centers. A strong linear relation ship was observed at Shindi and Bure health centers, the spearman's correlation coefficient was 0.928 and 0.810, respectively which is a bit far from a perfect linear relation ship at spearman's correlation coefficient value (r_s=1) but it was not a strong linear relation ship at Adet, Merawi,

and Durebet health centers which is far from a perfect linear relation ship at Spearman's correlation coefficient value (r_s=1) (Table 7).

Table 7: Relation of visitors and a mount of healthcare waste in study health centers, West Gojjam, Amhara Region, March 2007.

Name of Health center	Spearman's rank correlation coefficient
Adet	0.452
Merawi	0.452
Durebet	0.690
Sekela	0.333
Shindi	0.928
Bure	0.810
Dangila	0.690
Injbara	0.738
Gimjabet	0.714
Chagini	0.571
Total	0.703

5.3. Waste management

The observational checklist about healthcare waste management system in the health centers revealed that all of them used plastic buckets with out lid for collection of healthcare waste. Some health centers (six out of ten) safety boxes were used for collection of sharp wastes (syringes, needles & lancet). Plastic buckets had a size of 10-14 liters and the colors of plastic buckets were not differing according to types of healthcare waste. Those containers (plastic buckets) were not coded or labeled during collection of different types of healthcare wastes.

Waste minimization (reuse and recycling) and segregation of wastes were not employed by any of the health institution. Open plastic buckets and safety boxes were used for transportation of healthcare waste and transported manually to the disposal site in all study health institutions.

Results indicated that waste pre treatment with sodium hypochlorite (Barakina) for special waste like infectious waste was not practiced in any of the study health centers and plastic buckets were not disinfected after the wastes had been disposed. Incinerators, burial in the health center premises (placenta pit), and burning in open pits were the techniques employed for waste disposal means in study health institutions.

Only four health centers had incinerator among the study health institutions. The incinerators were built from local bricks and have no adequate air inlets for facilitating combustion of wastes. Three of the health centers used their incinerators to burn safety boxes and papers while one health center used the incinerator to burn all types healthcare waste except pathological waste and the ash remains at the bottom of the incinerators. The rest health institution (six out of ten) simply burned their healthcare wastes in open pits.

Fig 4 .HCW burning with incinerator in Durebetie health center

Fig 5. Newly constructed incinerator for HCW disposal in Dangila health center

Fig 6. Mixed disposal of HCW with open pit in Dangila health center

Fig 7.HCW burning with open pit in Durbetie health center

All of them used placenta pits for disposing pathological waste, of which four out of ten made their slabs from mud while the rest made from concrete; however only three placenta pits from the total had proper covering material and the lining of the pits were not water tight or impermeable. Liquid waste from wards, laboratory and delivery room was simply disposed into sewer lines with out any treatment in the premises of the health centers.

Fig 8.Placenta pit (slab made from mud) in Injibara health center

Fig 9.Placenta pit (slab made from concrete) in Dangila health center

The responsibility of healthcare wastes management was considered only for the waste handlers and sanitarians by all staffs of health centers. A total of 30 waste handlers were assigned in the health centers and the mean of waste handlers experience was six years and training a bout healthcare waste management for waste handlers was not given and 4 out of 30 had stick injuries in the past 12 months during collection and disposing of sharp wastes. Only gloves (heavy duty glove) were used by waste handlers during collection of wastes. Operational standards as well as any applicable local or regional policy for healthcare waste management and waste management committee were not found in the study health institutions.

5.4. Healthcare workers related to sharp waste management

A total of 40 healthcare workers were interviewed on issue of sharp wastes, of which ten out of them were injection provider, ten were worked at OPD and the rest were assigned at EPI, FP and MCH room. Five out of forty healthcare workers had an injury by needles and other

sharps. All of them have knowledge that dirty or used needles and sharps can transmit disease, but they didn't know the types of healthcare waste. From the total healthcare workers 25 of them feel that injection was over prescribed. Injection has fast action than other treatments, client request and knowledge deficit by prescriber on the risk of injection were most common reasons of healthcare workers for over prescription of injection. Almost all healthcare workers (36 out of 40) were not taking any training about healthcare waste management.

6. Discussion

The mean healthcare waste generation rate per health centers was 1.79 ± 0.57 kg/day, of which (52.0%) 0.93±0.3kg/day was general or non-hazardous waste and (48.0%) 0.86 ± 0.33 kg/day

was hazardous. There was not statistically significant difference in generation rate between health centers. This may be due to the similarity of the kinds of health service had been given among study health centers, resource allocation and patient flow (there was no statistically significance difference (x^2=12.156, p-value=0.205) between study health centers.

The amount of healthcare waste generation rate in different section varied. High quantity of HCW was recorded at injection and dressing room which accounted 34.4% and fewer amounts was recorded at TB unit which accounted 0.4%. There was statistically significant difference of healthcare waste generation rate in different section of the health center (X^2= 229.196, p-value<0.001). This variation may be due to the difference of number of attendance, the kinds of healthcare service, the type and the nature of waste generated at each department,

The annual mean (±SD) healthcare waste generation rate per health center was 908.0± 268.6 kg/year or 654.0±206.5 kg/year. The estimation of annual mean healthcare waste generation rate was varied in both assumptions. This may be due to the variation of annual patient flow and seasonal variation. However, the first assumption was the preferable method to estimate annual health care waste generation rate because the mean of annual healthcare waste was determined by annual patient flow with in the health center.

The mean healthcare waste generation rate in kg per patient per day per health center in this study was 0.035, of which 52% was general waste and 48% was hazardous waste. It was lower than the study done in Saudi Arabia in health centers and higher clinics, it was reported that the mean healthcare waste generation rate was 0.08 kg/patient/day (14). It was also different from another study done in Sylhet city; Bangladesh in diagnosis center and higher clinics, the mean healthcare waste generation rate was 0.041 kg/patient/day (15). The mean of healthcare waste in this study was higher than a study done in Tanzania in urban health centers; it showed that the mean healthcare waste generation rate was 0.02 kg/patient/day. This variation may be due to geographical location, season of the year, availability of different facilities, social status of the patients (i.e. income, living standard, awareness about disease), healthcare waste management and legislation of system of the country.

The proportion of general (52%) and hazardous (48%) of healthcare wastes in this study was different in WHO report in hospital setting, general was 85% while hazardous was 15% (2, 3). It was also different with the study done in Sylhet city, Bangladesh in diagnosis center and higher clinics general waste accounted 64% and hazardous waste accounted 36% (15). However the percentage of general (50%) and hazardous (50%) were similar with the study done in Tanzania in urban health centers (16). The difference could be due to seasonal variation, availability of different facilities, resource allocation and the variation of denominators between hospitals and health centers.

The finding of healthcare waste management system in this study showed that all health centers used plastic buckets with out lid for collection of healthcare wastes and six out of ten health centers used safety boxes for collection of sharp wastes. It was better than the study done by Yeman & Millogo(2000), on injection safety in Ethiopia, safety box was observed only in 2(4%) of the 52 health facilities assessed (26). This variation may be due to the risk of used needles and sharps related with improper collection might be given better attention by governmental health system and other NGOs to reduce the transmission of HIV and other related disease.

Waste segregation and treatment are the most important option in the management of hazardous wastes. Waste management system in this study revealed that segregation of waste at source was not practiced by any of health centers. This finding was consistent with the survey conducted on four federal hospitals by MOH (2004ub), out of the hospital surveyed; all but one hospital was segregate infectious waste at source (26). This was similar with other study conducted on four hospitals in Nigeria segregation of waste was not practice by any of the study health institutions (23).

In most African countries, waste disposal was reported to be problematic. Different studies done in Cameroon (1998), Chad (1997), Cotedivoire (1997), Guinea-Bissau (1997), and Uganda (1998) showed that no health centers had the facilities for safe disposal of used needles and other sharps (27). In Ethiopia (1997-98), like Kenya, Rwanda and Zambia, incineration of used syringes and needles was reported to the common practice (27). Another study conducted

by Yoseph in similar setting revealed that 42.5 %(17 out of 40) of the health institutions incinerators were used for disposing used needles and other sharps and the rest 57.5% of the institution used open burning and other methods to dispose used needles and other sharps (25). This finding was similar to the above mentioned study in that four out of ten health centers used incinerators and the rest six health centers used open burning for disposal of healthcare wastes.

The study showed that all studied health centers used placenta pits for disposing pathological waste even though only three placenta pits from the total had proper covering material. Liquid waste from wards, laboratory and delivery room was simply dispose into sewer lines with out any treatment in the premises of the health centers. This was similar with the study done by ministry of health (MOH) in Ethiopia in 1989 in 16 health centers and 48 clinics. It was reported that most of them had no proper liquid waste and solid waste disposal facilities (9).

Sharps and needle stick injuries are the commonest form of HIV, HBV and HCV exposure in health institutions. In developing countries the data available are very few and are mere gross under estimation of the real risks (4). In this study, 4 out of 30 of waste handlers and 5 out of 40 of healthcare workers had injuries by contaminated needle or sharp objects. This needle stick injury may be related with improper handling of healthcare wastes particularly sharps because unsafe sharps waste collection causes 5% to 28% of needle stick injuries on healthcare workers and waste handlers (19).

The result of this study revealed that all healthcare workers aware of the transmissibility of disease through dirty needles and other sharps. It was similar with the study done by Yoseph, on Safety of Injections and Related Medical Practices in Health Institutions in Ethiopia, it was reported that all healthcare workers aware of the transmissibility of disease through used needles and other sharps (25).

Quality and Standard Authority of Ethiopia (QSAE) has prepared a standard on handling and disposal of waste materials within healthcare facilities in 2004. In 1997, Ministry of Health has also prepared on healthcare waste handling and disposal for the promotion of occupational

health, the protection of the environment from healthcare waste and the promotion of the safe handling and disposal of healthcare waste (26). But in the studied health centers, operational standards as well as any applicable local or regional guide line a bout healthcare waste management were not found. It was similar with a review done by Solomon on healthcare waste management in Ethiopia, it was reported that there was no guide line specifically deals with hazardous waste and waste from healthcare activities at micro level even though there is at federal level prepared by the Environmental policy of Ethiopia, the Public Health Proclamation No.200/2000 (FDRE, 2000) and the Environmental Pollution Proclamation No.300/2002 (26). This gap may be due to less attention is given on healthcare waste management by responsible authority, lack of supervision with the responsible body and lack of healthcare management committee at Federal as well as Regional Health Bureau.

Strength of the study

Data were collected with measurement (weighing scale) and observational check list which made the collected data more reliable than other methods.

There is inadequate data in waste generation rate in our set up specifically in health centers so that it can be used as base line data for planning and implemented activities.

Limitation of the study

Seasonal variation may affect the mean healthcare waste generation rate per health centers.

Conclusion

- The mean of healthcare waste generated in all health centers was small in amount when compare it from other countries in similar setting.

- Sharps, infectious waste, pharmaceutical and pathological wastes were the types of healthcare waste generated in all health centers.

- Healthcare waste management system had been given very little attention in all health centers. Segregation and treatment of HCW were not practiced this exposes healthcare workers, waste handlers and the public to health risk and in addition to contaminate the surrounding environment.

- Four out of ten and the rest six health centers were used poorly constructed incinerators and open burning, respectively. Complete combustion may not take place in poorly constructed small scale incinerators. In such practice the release of pollutants in the atmosphere is more likely. Mixed disposal of wastes can lead to unhealthy and hazardous environment i.e. Soil and water contamination is more likely occurred.

- In all health centers placenta pit were used but most of them had no cover which creates offensive odor and accessible for vector breeding and the lining of the pits were not watertight or impermeable this practice also contaminate the ground water.

- Training was not given for healthcare workers and waste handlers a bout healthcare waste management and also operational standards, healthcare waste management committee was not found in any of the study health centers. Such things also expose waste handlers and healthcare workers expose them selves to health risks.

Recommendations

- For improving on healthcare waste management system the following activities should be practiced in each health center

  - Segregation should be done at point of generation with colored and/or marked containers. Sharps must be collected in safety boxes or puncture proof containers with a lid that can be closed in order to minimize the risks.

  - Pre treatment of infectious waste and liquid waste must be practiced before disposing to the environment

  - Incinerators must be constructed in manner that facilitates complete combustion or meets WHO standard and the residual ash should be buried in pit which has made low permeable material.

  - The lining of Placenta pits must be constructed in water tight and covered with covering material.

  - Training of waste handlers and healthcare workers on safe handling of healthcare waste should be given.

  - Healthcare waste management committee must be established at micro level and operational standards must be found at all levels of healthcare facilities.

- Further research on healthcare waste generation rate at different seasons is strongly recommended

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Annex I

consent form

A Questionnaire prepared to collect data on health care waste generation rate and management system in different health centers in West Gojjam zone.

Hallo! Good morning?

My name is Ato----------I am here today to collect data on health care waste generation rate and waste management system in one of the health center in West Gojjam zone. The objective of this questionnaire is to assess healthcare waste generation rate and their waste management system at ---------health center. 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. The interview may take 20 min. we assure you that this study is surely confidential, thus writing your name is not needed. Are you willing to participate in the interview?

Yes! Go to the next page.

No! Thank them and interrupt the interview.

Sign of the consenting interviewer ----------

Result of the interview 1. Completed

2. Partially completed

3. The interviewee refused

4. Others----------

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

Annex II

Data collection tools

Addis Ababa University

Department of community health

Faculty of medicine

Questionnaire I

Health Care Waste-management Checklist

1. **General facility information**

   Name health center----------

   What are the facilities medical specialties and departments?

   What none-medical departments are there?

   How many beds does the facility have?

   How many out patient come each day in the health center?

   How many out patients visited the health center in last year?

Ser. No	Question	Response	Skip to
2.	**Handling of Health care waste**		
2.1	Does the facility have separate storage area for HCW?	1 Yes 2 No	
2.2	Does the facility have separate containers for general and hazardous waste (infectious, pathological, pharmaceutical, and sharp?	1 Yes 2 No	
2.3	Does all three types of containers are clearly	1 Yes	

	marked or labeled?	2 No	
2.4	Are all types of containers are located in every area where they might be needed	1 Yes 2 No	
2.5	Are containers made from washable, leak-proof material (preferably plastic or galvanized metal) for disposal of HCW?	1 Yes 2 No	
2.6	Are these containers washed with a disinfectant cleaning solution daily?	1 Yes 2 No	
2.7	Are Sharps containers made of a puncture-resistant material (cardboard, plastic, or metal)?	1 Yes 2 No	
2.8	Are HCW containers emptied daily or whenever they are 3/4 full?	1 Yes 2 No	
2.9	Are sharps containers closed securely and disposed of whenever they are 3/4 full?	1 Yes 2 No	
2.10	Does any formal or informal separation of waste take place? Are plastics I.V sets kept separately for recycling?	 1 Yes 2 No 1 Yes 2 No	
2.11	Do all waste handlers wear heavy utility gloves and sturdy shoes when handling medical waste?	1 Yes 2 No	
2.12	Do staffs wash both their gloves and their hands after handling HCW?	1 Yes 2 No	
2.13	What are the containers used for transporting HCW?	Cart---- Open bucket— Other----	
2.14	Does the establishment generate any waste of special concern: cytotoxics? Pathological waste? Reagent?	 1 Yes 2 No 1 Yes 2 No 1 Yes 2 No	

	Outdated pharmaceuticals? Radioactive waste? If yes, how is their disposal handled?	1 Yes 2 No 1 Yes 2 No	
2.15	How is liquid waste handled? Specify for cytotoxics, reagents, and X-ray film processing liquids		
3	**Interim Storage**		
3.1	Do all interim storage sites and medical waste-disposal sites are located in areas that are minimally accessible to staff, clients, and visitors?	1 Yes 2 No	
3.2	Do all interim storage containers have lids?	1 Yes 2 No	
3.3	Is Waste stored on site for more than a few days before final disposal?	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? If yes, how the residuals handled?		
4.2	Is the health care waste disposed of at On- site? Off- site?		
4.3	What are the on-site practices for HCW treatment?	1 Crushing of sharps 2 Sterilization 3 Chemical disinfect ion 4 Destruction through burning	
4.4	What are the practices for on-site disposal?	1 Dumping 2 Open burning	

		3 Incineration	
4.5	Is the incinerator located downwind from the Clinic?	----Yes/ No----	
4.6	Does the incinerator have sufficient air inlets on the side?	1 Yes 2 No	
4.7	What type of HCW is burned in the incinerator?	1 Infectious 2 Syringes 3 plastics 4 All type	
4.8	Where the ash from the incinerator is disposed of?		
4.9	Is the incinerator surrounded by a fence or wall to limit access?	1 Yes 2 No	
4.10	Does the burial site away from any water source at least 50 meters?	1 Yes 2 No	
4.11	Does the pit have 1-2 meters wide and 2-5 meters deep? Does the bottom of the pit is at least 1.8 meters above the water table?	1 Yes 2 No	
4.12	Is there any of the waste taken off-site, how is the waste transported out side the premises of the health care facility?	1 Yes 2 No	
5	**Management issues**		
5.1	Who is responsible for healthcare waste management at the healthcare facility?		
5.2	Is there any current operational standard for HCW management?	1 Yes 2 No	
5.3	Is there any applicable national, regional, and local guide line for HCW management?	1 Yes 2 No	

5.6	Is there any healthcare waste management committee?	1 Yes 2 No	
6	**Risks of the current waste management system**		
6.1	Does the management of the healthcare facility have concerns about the facility's current HCW practices? If so, what problems identify?	1 Yes 2 No	
6.2	Does the waste pose any risk to waste collectors? If yes, what kind	1 Yes 2 No	
6.3	How many waste handlers are working in the health centre?	One Two Three Four Five	
6.4	Have you had any injury by needle since the past 12 months?	Yes No	
6.5	Types of injury sustained	1 deep injury 2 slight skin penetration 3 superficial 4 others,(specify)-----	

Questionnaire II.

Checklist for health care workers related to sharps.

	Question	**Response**	**Skip to**
1	Year of service		
	Responsibility (place of work) in the health center in this week	1 proscribing 2 deliver room 3 injection 4 laboratory 5 others, (specify)----	
2	Have you had any injury by needle since the past year	1 yes 2 no ---------- 3 I don't remember	If no 6
3	How much injury by needle have you sustained?		
4	Type of injury sustained	1 deep 2 slight skin penetration 3 superficial 4 others	
5	How did you sustain the injury?	1 during recapping 2 by a sudden movement of a patient	

		3 during sharp collection 4 others (specify)--------	
6	Have you had any injury by sharps (scissors, blade etc.) since past year?	1 yes 2 no---------- 3 I don't remember	
7	Types of injury sustained	1 deep injury 2 slight skin penetration 3 superficial 4 others,(specify)-----	
8	Can diseases be transmitted through dirty needles and sharps?	1 yes 2 no 3 I don't know 4 I have no idea	
9	Do you have sufficient quantities of sharps boxes to dispose of sharps safely?	1 yes 2 no 3 I don't know	
10	Do you feel that you over prescribed injection in your facility?	1 yes 2 no 3 I don't know	
11	What are the reasons for the over prescription of injection?	1 knowledge deficit on the risk of injection 2 clients/ Patient request 3 because injection are more effective than other forms of drugs 4 in availability of alternative drugs 5 others (specify)	
12	Are needles, syringes, and sharps immediately discarded after use in sharp containers?	1 yes 2 no 3 I don't know	

		4 others (specify)	
13	Are syringes and needles appropriately disposed of in your health center?	1 yes 2 no 3 I don't know 4 others (specify)	
14	Do you have any treatment before disposed of used syringes and sharps?		
15	Did you take any training about any healthcare waste management in the health center in the past years?	1 yes 2 no 3 I don't remember	
16	Have you got any client injured by sharps that are used by any healthcare institution?	1 yes 2 no 3 I don't remember	If yes
17	How many clients did you treat?		

II. Recording data sheet for healthcare waste generation rate.

Name of health center…….
From -----to ------in 1999E.C

1 OPD

Date								
No visitors								
Types of waste General waste								

2. PHARMACY

Date								
No visitors								
Types of waste General waste								

3. Injection and dressing room

Date								

No visitors								
Types of waste General waste Sharps Pharmaceutical pathological								

4 .MCH/FP AND EPI room

Date								
No visitors								
Types of waste General waste Sharps Pharmaceutical pathological								

5 LABORATORIES and VCT room

Date								
No visitors								
Types of waste General waste Sharps								

Pharmaceutical Infectious								

6 TB ROOM

Date								
No visitors								
Types of waste General waste Sharps Pharmaceutical								

7 .WARDS

Date								
No visitors								
Types of waste General waste Sharps Pharmaceutical pathological								

8 DELIVERY room

Date								
No visitors								
Types of waste General waste Sharps Pharmaceutical pathological								

Annex III

Photos during data collection

Fig. Plastic bags used for data collection

Fig. Weighing healthcare waste

Fig. Plastic buckets used for data collection

Fig. Data collection materials

Fig . weighing scales used for data collection

Fig. Weighing scale used for data collection