ADDIS ABABA UNIVERSITY

COLLEGE OF HEALTH SCIENCES

SCHOOL OF NURSING AND MIDWIFERY

DEPARTMENT OF NURSING

POSTGRADUATE PROGRAM

KNOWLEDGE AND PRACTICE TOWARDS MEDICAL WASTE MANAGEMENT AND ITS ASSOCIATED FACTORS AMONG HEALTH CARE WORKERS AT PUBLIC HOSPITALS ADDIS ABABA, ETHIOPIA

BY: HABTEMARIAM MULAT (BSC)

A THESIS TO BE SUBMITTED TO ADDIS ABABA UNIVERSITY COLLEGE OF HEALTH SCIENCES SCHOOL OF NURSING AND MIDWIFERY FOR PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR MASTER OF SCIENCE IN PERIOPERATIVE NURSING

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This is to certify that the thesis prepared by **Habtemariam Mulat**, entitled: **Knowledge and Practice towards Medical Waste Management and Its Associated Factors among Health Care Workers at Public Hospitals Addis Ababa, Ethiopia** and submitted in fulfillment of the requirements for the Degree in Master of Science in perioperative Nursing complies with the regulations of the University and meets the accepted standards with respect to originality and quality.

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LIST OF ACRONYMS ABBREVIATIONS

ALERT	All African Leprosy Tuberculosis Rehabilitation and Training Center
AOR	Adjusted Odds Ratio
CI	Confidence Interval
ETB	Ethiopian Birr
FEPA	Federal Environmental Protection Authority
FMHACA	Food, Medicine and Healthcare Administration and Control Authority
FMOH	Federal Ministry of Health
HBV	Hepatitis B virus
HCF	Health Care Facilities
HCPs	Health Care Professionals
HCV	Hepatitis C virus
HCWs	Health Care Workers
HIV	Human Immunodeficiency Virus
MTs	Medical Laboratory Technologist
MW	Medical Waste
MWM	Medical Waste Management
MSC	Master of Science
OPD	Outpatient Department
PPE	Personal Protective Equipment
PPS	Probability Proportional to Size
St.Peter	Saint Peter Hospital
SPSS	Statistics Package for Social Science
SPHMMC	Saint Paul Hospital Millennium Medical College
TASH	Tikur Anbessa Specialized Hospital
ZMH	Zewditu Memorial Hospital

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ABSTRACT

In Ethiopia, medical waste management has become a problem due to an ever-increasing number of hospitals, clinics, diagnostic laboratories and other health care services. Although health care workers are one key personnel for the proper management of medical wastes at any health facilities, their level of performance depends on their level of knowledge, practice and some related factors regarding medical waste management. A Quantitative institutional based cross sectional study and a qualitative observational study was conducted and a total of 627 health care workers from 4 public hospitals at Addis Ababa, Ethiopia, were included. Study participants were allocated proportionally based on the number of healthcare workers from each hospital and profession. Data were collected using pre-tested self-administered structured questionnaires and observational checklists. The collected data was analyzed using SPSS version25.0. Multivariable logistic regression model was used to identify factors associated with knowledge and practice of healthcare workers. Out of the total respondents, 52.7% and 51.5% of health care workers had adequate knowledge and adequate practice towards medical waste management, respectively. Hospital working hours of 8 per day [AOR=1.5, 95% CI (1.09, 2.18)], Getting MWM information from guidelines [AOR=1.54, 95% CI (1.087, 2.189)] and adequate practice score [AOR = 2.14, 95% CI (1.50, 3.02)] were significantly associated with the knowledge level of health care workers. On the other hand, HCWs working at Saint peter hospital [AOR=4.1, 95%CI (2.78-7.75)], professional categories, Doctors[(AOR=3.8,95%CI(1.2-12.70],Nurse[(AOR=4.4(1.38-13.8)]MTs [(AOR=9, 95%CI(2.3-44.9)], getting medical waste management information from training [AOR=2.1,95%CI(1.58-3.50), getting medical waste management information from others[(AOR=0.49,95%CI(0.25,0.95)], presence of MWM guidelines in hospital[(AOR=1.73, 95%CI(1.04,2.88)] and adequate knowledge score [(AOR=2.10,95%CI(1.45-3.048)] were significantly associated with practice level of health care workers. In this study, both knowledge and practice level of health care workers towards medical waste management were not satisfactory. To improve better, proper and intensive job training is recommended.

Key words: knowledge, practice, medical waste, waste management, health care worker

CHAPTER ONE

1. INTRODUCTION

1.1. Background

Although health care services engage in life saving activities, they generate waste which has to be managed and disposed in a safe way to avoid or minimize the risks it poses to the health of the healthcare providers, clients and to the community [1].

During the healthcare delivery process at any health care facilities, where diagnosis and treatment are conducted, there are medical wastes (MW) and management of these wastes is a challenge of great concern due to possible public health risks associated[2].

At the course of the healthcare delivery process, there are medical wastes which are generated from the healthcare facilities (HCFs) [3]. It includes human or animal tissue, blood or other body fluids, excretions, drugs or pharmaceutical products, swabs or dressings, syringes, and needles or other sharp instruments [4]. Medical waste, biomedical waste, hospital waste, and health care waste are used frequently in different articles [5]. For this study, we used “medical waste” to represent the entire waste generated from hospitals.

Since medical waste can harbor potentially harmful microorganisms and carries the risk of transmission of infections from healthcare facilities to healthcare workers, patients, and the general public, it can be considered as being of the greatest environmental concern and can cause ill health to individuals who are exposed to it [5]. Many studies indicate that inappropriate handling and inappropriate disposal of medical waste poses health risks to health care workers who may be directly exposed to infectious wastes and a higher risk of diseases. Medical wastes are responsible for the transmission of more than 30 dangerous blood borne pathogens including hepatitis and HIV/AIDS [5, 6]. In order to prevent those harmful consequences to the human health, the community, and the environment, safe and effective medical waste management (MWM) is needed including having careful planning, proper guidelines and full participation of health care workers (HCWs) [4,7].

In developing countries especially in Africa, medical waste has not received the adequate attention that it deserves [8] .This is because of the inadequate resources in these countries

resulting in low priority for MWM. Segregation of hazardous and medical wastes, collection of waste using recommended color coding containers, storage of waste in isolated areas were not satisfactory in many countries, including Ethiopia and usually mixed with non-infectious waste [7,9] . Health care workers' inadequate knowledge and inadequate practices are major challenges in the management of medical wastes [10]. Previous research indicates that MWM may be affected by lack of regular training, lack of knowledge on medical waste management and limited interest from hospital administration [2, 7, 11, and 12].

1.2. Statement of the Problem

Nowadays, generation and disposal of medical wastes has become an emerging problem worldwide [13]. And it causes major concern for the environment and the health care facilities [14]. A World health organization (WHO) report indicated that, from the total amount of MWs generated through health-care activities, approximately 10-25% of it holds hazardous waste [6,14]. However, this proportion varied from country to country which ranged from 16 to 75% including Ethiopia [6]. Health care workers' inadequate knowledge and inappropriate practice to the placing of medical waste contributes serious consequences of health problems and a significant impact on the whole health care delivery system, environment and community [15, 16].

Researches indicated that in the past, healthcare waste has done much damage to the environment and to public health. One estimate shows that 5.2 million people (including 4 million children) die each year from waste-related diseases and the situation is likely to get worse if proper action is not taken to restrain further damage [17].

The rising amounts of medical waste cause's significant public health and environmental problems worldwide. This situation is worsened by improper medical waste disposal methods, insufficient physical resources and lack of research done on medical waste management [18]. The World Health Organization (WHO) estimates that per year about 8 to 16 million new cases were diagnosed for Hepatitis B virus (HBV), 2.3 to 4.7 million cases diagnosed for Hepatitis C virus(HCV) and 80, 000 to 160, 000 diagnosed for Human Immunodeficiency Virus (HIV) due to very poor waste management systems, like unsafe injections disposals [10]. MWs can transmit more than 30 dangerous blood borne pathogens [6].

Lack of awareness, lack of trained clinical staffs', absence of medical waste management guideline, legislation and unavailability of suitable treatment and disposal option obstructs waste management efforts and leads to expose all individuals, particularly healthcare professionals (HCPs), who are on the first line of contact [14]. Also, studies indicated that staff resistance, managerial poor commitment, lack of adequate resources, negligence, and unfavorable attitude of the healthcare staff were the main identified challenges in the study [6].

Even though, there were no separate/independent/ rules and regulation specific for the health care facilities to enforce them for the proper management of the medical wastes, in Ethiopia there were three MWM guidelines prepared by the Federal Ministry of Health (FMoH), Food, Medicine and Healthcare Administration and Control Authority (FMHACA), and Federal Environmental Protection Authority (FEPA) .Those guidelines were not updated and it lacks proper compliance on their implementation [6].

CHAPTER TWO

2. LITERATURE REVIEW

Literature related to Knowledge and practice of health care workers towards medical waste management and its associated factors both at global and local levels were reviewed and discussed with Ethiopian contexts as follows.

2.1. Knowledge and Practices towards Medical Waste Management

A cross sectional study was conducted in 2016 among public health-care staff in Karnataka, India. A total of 273 participants were included in the study and it showed that awareness is very poor among lower age groups, male participants, lab-technicians and pharmacists. Doctors were better at theoretical knowledge such as rules, legislation and public-health importance of MW management than the practical aspects such as categorization and color-coding [19].

Another cross-sectional study was conducted on Knowledge and practice of medical waste management among health care workers in India, 2016. A total of 305 participants were included in the study. About 96% of doctors, 91% of nurses, and 80 % of lab technicians knew about the primary source of MW generation. Knowledge regarding different MW categories was good among doctors (91.6%) but only 72.7% of nurses, and 66.6% of lab technicians knew about it. Knowledge about MW rules and regulations was least among lab technicians (40%) followed by nurses (45.4%), and doctors (70.8%). Fifty four percent (54.2%) of doctors, 36.4% of nurses, and 33.3% of lab technicians knew that MW cannot be stored beyond 48 hours. Eighty seven (87.5%) of doctors correctly identified the biohazard symbol while 52.7% of nurses, and 66.6% of lab technicians identified it. About 93% of doctors, 86% of nurses and 80% of lab technicians knew about color coding of containers [20].

A cross-sectional study conducted at Kolkata India in 2014 and the result revealed that the knowledge level of Doctors about the existence of MW management rules was 90.47%, awareness about spread of diseases by improper MW management was 100%, but the knowledge about the storage and disposal time of MW was poor (47.65%). Awareness regarding MW segregation was 71.42%. The overall practice of Doctors on MWM was 77.8%. The overall knowledge and practice among nursing staff regarding the MWM was 98.1% and 97.32% respectively. The least knowledge (85.71%) was regarding the MW storage time. The overall

response regarding knowledge and practice of MWM among medical laboratory technologists (MTs) was 56.26% and 53.73% respectively .The awareness about the MW rules was 62.5%, and that of MW storage period was only 37.57% [21].

Further cross-sectional study was conducted on knowledge and practice towards medical waste management among health care workers at India in 2015. Among the respondents about 31.4 % of doctors, 70.9% of nurses and 33.3% of MTs had correct knowledge on disposal of infectious wastes in yellow colored bins. Regarding internationally accepted biohazard symbols, about 85.5% of HCW were identified. About 95% of healthcare workers used PPE while handling and disposal of MW. And about 65.5% of HCWs had appropriate practice on segregation at source. [22].

Jahan et al conducted a cross-sectional study on medical waste management among healthcare personnel in Dhaka, Bangladesh during 2018. The data showed that knowledge regarding waste disposal in yellow containers of human anatomical parts and infected materials were 97% doctors, 73% nurses, and 57% medical technologists. Knowledge on general waste disposal in black containers like pieces of paper, boxes, food wastes were 98% doctors, 79% nurses, and 68% medical technologists. For Sharp waste, all participating doctors and nurses, and 97% of medical technologists answered as red color containers. Regarding practices, 84% of doctors, 92% of nurses, 84% of medical technologists were aware about discarding used needles by hub cutters. All participants including doctors, nurses, and medical technologists were wearing gloves during handling of hospital waste. The result showed that among the participants of the study, 94% of Doctors, 59% of Nurses, and 73% of Medical Technologists attend training on MW management [23].

Another cross-sectional study was conducted on medical waste management at Cairo Egypt. In this study 350 participants were included. Among the total participants 68.3% of physicians and 60.9% of nurses had satisfactory knowledge scores. On the other hand, nurses had (84.0%) more level of practice scores than physicians (67.3%) [25].

A further cross-sectional study was conducted on medical waste management and associated factors among health care workers at Uganda, Kampala, in 2017. A total of 200 healthcare workers participated in the survey; their Knowledge of MWM was high 143 (71.5%). Among the

participants about 160 (80.0%) wear appropriate PPE when handling MWs. Overall, 148 (74.0%) of the participants had satisfactory MWM practices [26].

A cross-sectional study was employed at Gondar, Northern Ethiopia among health care workers in 2013. Two hundred sixty (260) HCWs participated in the study. Of the total respondents, 252(96.9%) of the HCWs did not access any guideline/operational documents in their workplace. Regarding previous training about 47.9% of HCWs were trained about MW management. The prevalence rates of needle stick and sharps injury in the previous 12 months were 65 (25%). Regarding the presence of safety instructions in their work environment, about 51.9% of HCWs reported that they had safety instructions. Among the participants, 82 (31.5 %) of HCWs had appropriate medical waste management practice. Two hundred forty two (93%) of the respondents used gloves during handling of healthcare wastes. Of the total respondents, merely 83 (31.9%) of respondents segregate medical wastes at sources [7].

Further cross-sectional study was conducted by Tewabe et al at Gondar, Northwest Ethiopia in 2018 and a total of 420 participants were involved in the study. The overall adequate knowledge and appropriate practice of HCWs towards medical waste segregation were 39% and 42.6% respectively [16].

Deress et al conducted cross-sectional studies at Debre Markos, Northern Ethiopia in 2017, a total of 296 health care workers were studied. Merely 188(54%) study participants identified the internationally accepted biohazard symbols. HCWs were aware that general 255 (73%), infectious 275(78%) and sharp wastes 303(86%) should be placed in a black, yellow and safety box, respectively. About 291(83%) were aware that a safety box should be filled a maximum of 3/4th. Of the total respondents, about 236 (67%) of HCWs knew 72 hours as a maximum time delay to start HIV post exposure prophylaxis. Only 36(10%) of study participants knew the maximum storage time limit of infectious wastes before disposal was 48 hours. The study revealed that 174(58.8%) of health care workers used visual aid at their health care service delivery section. About 275(92.9%) of HCWs practiced segregation of MWs at the source. And 261(88.2%) of them followed color coding segregation. Of these, general (77%), infectious (66.9%) and sharp wastes 247(83.4%) into black bin, yellow bin and safety box respectively. The overall adequate knowledge and adequate practice score were 55% and 78.9% respectively [14].

Dolyo et al conducted a cross-sectional study at Jijiga, Eastern Ethiopia. A total of 400 health care workers were included. Of the total HCWs, 188 (47%) had good knowledge and the rest 212 (53%) had poor knowledge on medical waste management. Accordingly, 169 (42.3%) and 231 (57.7%) of the respondents had good and poor practice on medical waste management respectively [5].

2.2. Factors Associated With Medical Waste Management

2.2.1. Demographic Factors towards Medical Waste Management

Cross-sectional study conducted among 273 health-care workers in selected public health-care institutes of Karnataka, India and results revealed that age and years of experiences are showing positive association, as years of experience increases the awareness of healthcare staff also increases. Only 15% of the respondents who have less than one year experience are aware compared to 47% who have five to nine years of experience [19].

The study conducted among 241 health care staffs at a district hospital in south Africa, had showed that there is associations between participants' categories and knowledge, as well as practice and knowledge, indicates a significant ($p < 0.05$) and also it revealed that nurses demonstrated a better level of knowledge compared with other professional healthcare workers having the lowest knowledge score [24].

Further study was conducted in Kampala ,Uganda and revealed that Health care workers with a diploma, compared to health care workers with higher secondary education, were 1.49 times more likely to have satisfactory waste management practices (AOR: 1.49, 95%CI (1.13–1.96)), p-value = 0.005). The odds of satisfactory waste management practices were 1.1 times higher among health workers in the teenage corner as compared to those working in the outpatient clinic [26].

Another study conducted at University of Gondar, Northwest Ethiopia, revealed that male HCWs have 1.57 times more knowledge than females(AOR: 1.57, 95% CI: 0.99, 2.45). On the other hand, females segregate waste at sources 1.28 times more than males (AOR: 1.28, 95% CI: 0.81, 2.03) [16].

A Cross-sectional study conducted at Jijiga, eastern Ethiopia, the study revealed that age group [35–44 years [AOR: 6.83, 95% CI (1.30, 15.78)]] was found to be significantly associated with knowledge of medical waste management. Normally as age increases, health workers will get

more experiences and enhance their knowledge in their professional career. In this study, the Professional category had a statistical significance. Accordingly, nurses [AOR: 3.42, 95% CI (1.33, 13.86)], midwifes [AOR: 1.53, 95% CI (1.07, 12.18)], medical laboratory professionals [AOR: 7.58, 95% CI (1.55, 19.54)], and anesthetists [AOR: 4.52, 95% CI (2.49, 7.80)] had good knowledge towards medical waste management compared to medical doctors. In the study, health workers with educational status of diploma [AOR: 2.78, 95% CI (1.02, 7.59)] and first-degree level [AOR: 2.55, 95% CI (1.01, 6.50)] had good practice on medical waste management compared to those with second-degree. Similarly, level of education was found statistically significant with the practices with p-value < 0.05[5].

2.2.2. Health Care Facility Related Factors towards Medical Waste Management

Kallihal conducted among 273 HCWs, majority (54%) of them have not received any training pertaining to MW. Only 43% of the participants correctly knew the categorization of MW and its disposal in proper color-coded bins/bags [19].

A cross-sectional study was done at Natal, South African, in 2018. A total of 329 personnel participated. Among the total participants, about 48.3% reported that they have never received any formal training in MW management. However, of the 50.7%, who reported in-service training in MW management, 38.7% were nurses [24].

Another cross-sectional study conducted by Wafula et al towards medical waste management among health workers and associated factors and revealed that Participants who had been trained on HCW management were 1.19 times more practices (AOR: 1.19, 95%CI (1.01–1.42) compared to not trained. And those who thought MWM was important were 2.81 times more (AOR: 2.81, 95%CI (1.22–6.47)) compared to those who thought otherwise [26].

Muluken et al conducted cross-sectional study towards MWM practices among HCWs, and it showed that, healthcare institutions' type, training on medical waste, knowledge had a significantly associated with medical waste management practice. Healthcare workers who worked at health centers and clinics were 3.10 and 4.95 times more appropriate than who worked at hospitals, respectively. A study also revealed that training is significantly associated with medical waste management [AOR= 2.29, 95% CI: (1.24, 4.24)] [7].

Another cross-sectional study conducted by Tewabe et al at Gondar, Northwest Ethiopia during 2018 and results showed that training and reward were significantly associated with the knowledge. And training, personal needs to use PPE for health care waste handling were significantly associated with the practice of medical waste segregation [16].

Further cross-sectional study conducted among HCWs towards medical waste management and the result showed that Presence of MWM committee, previous training, presence of MWM guideline, use of visual aid, working in another department and presence of color-coded bins in the work section had significant association for both knowledge and practice level of HCWs towards medical waste management[14].

In general, different studies have been done worldwide on Knowledge, practice and factors associated with MWM and were reviewed from global to local. Overall, poor to good levels of knowledge and practice of HCWs were found in these studies. And factors such as work experience, educational level, Presence of MWM committee, previous training, presence of MWM guideline, presence of color-coded bins in the department, availability of PPE and rewards were factors that found to be associated with knowledge and practice level of HCWs along with some other factors; but there is no study conducted at the current study site Addis Ababa, Ethiopia. Therefore, this study was aimed at assessing knowledge, practice and its associated factors towards medical waste management among health care workers at public hospitals Addis Ababa, Ethiopia.

2.3. Conceptual Framework

After reviewing different literature [5, 7, 14, and 16] about knowledge and practice of MW management among health care workers, the following conceptual framework is adapted.

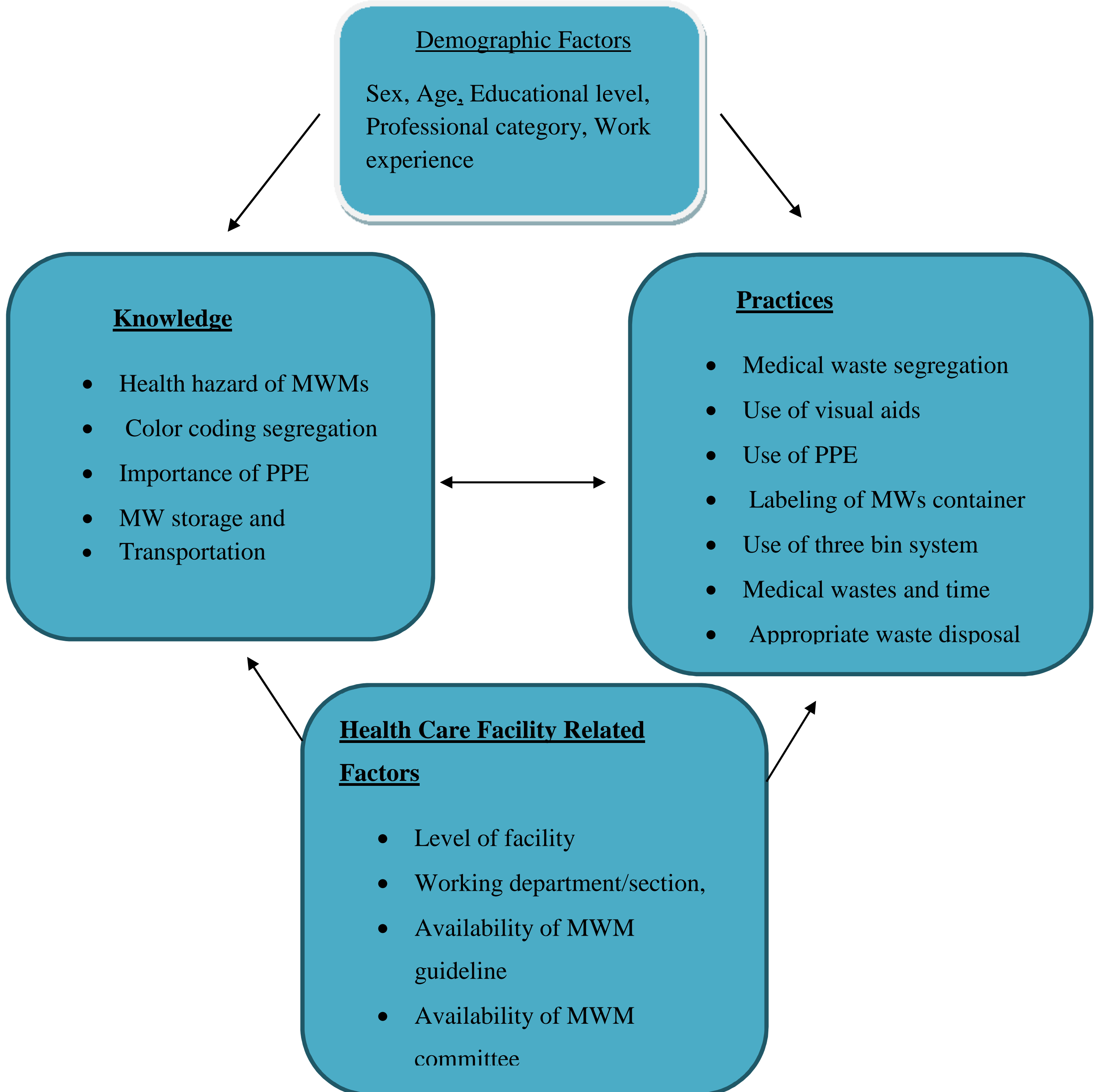


Figure 1: Conceptual framework for knowledge and practices towards medical waste management and its associated factors among health workers at public hospitals Addis Ababa, Ethiopia, 2021

2.4. Justification of the Study

A lot of literature stated that management of medical waste is becoming a global concern and it needs adequate knowledge, proper techniques and safety practice. Healthcare personnel play a significant role for its proper management. From the empirical observation, health care providers often practice inappropriately and they are victims of occupational health hazards due to improper waste management practice.

In Ethiopia, MWM is given less attention than the other healthcare issues. As a result, the knowledge and practice of health workers about medical waste management didn't get sufficient attention. Since MWM didn't get sufficient attention, there was no adequate recorded information and this hindered better management of it. Although, the success of the medical waste management rests on the knowledge and practice of health care workers, there was no adequate study conducted on knowledge and practice of health workers towards medical waste management in the current study site Addis Ababa, Ethiopia.

2.5. Significance of the Study

This study was proposed to assess knowledge and practices towards medical waste management and its associated factors among health workers at public hospitals Addis Ababa, Ethiopia. The results from this study may help the patient, visitors, health care provider, and medical waste handlers to be safe from all possible hazardous and injuries which may come from poor medical waste management in the clinical area. It will provide information for HCFs to identify the level of knowledge and practices of health care workers and factors contributing to inappropriate practice of medical waste management. This study will provide information for policy makers and stakeholders to use as input about existing situations of MWM. Additionally, this study may provide further information to other researchers about the knowledge and practice level of health care providers towards medical waste management.

CHAPTER THREE

3. OBJECTIVES

3.1. General Objective

- Knowledge and practice towards medical waste management and its associated factors among health care workers at public Hospitals Addis Ababa, Ethiopia ,2021

3.2. Specific Objective

- To assess level of knowledge towards medical waste management among health care Workers at public Hospitals Addis Ababa, Ethiopia,2021

- To assess level of practice towards medical waste management among health care workers at public Hospitals Addis Ababa, Ethiopia,2021

- To identify associated factors with knowledge and practice towards medical waste management among health care workers at public Hospitals Addis Ababa, Ethiopia,2021

CHAPTER FOUR

4. METHODS AND MATERIALS

4.1. Study Area and Period

This study was conducted in Addis Ababa, the capital city of Ethiopia and where the African union is headquartered. Addis Ababa is a home to almost all ethnic groups in Ethiopia. According to the 2007 census report, Approximately Addis Ababa has 3.14 million inhabitants. But, by 2020 it is estimated as more than 5 million [33]. Addis Ababa has an average temperature of 22.8C° and average rainfall of 1,180.4mm. Its estimated area was 530Km2 with altitudes ranging from 2200 to 3000m above sea level [27, 28]. The city has more than 52 hospitals of which 12 are public [29]. Public hospitals in Addis Ababa are; TASH, SPHMMC, Zewditu Memorial Hospital, ALERT Hospital, Yekatit12 Hospital, Ras Desta Damtew Memorial Hospital, St. Peters Hospital, MenilikII Hospital, Tirunesh Beijing Hospital, Federal Police hospital, Amanuel Hospital and Gandhi Hospital. The study was conducted among health care workers in four randomly selected governmental hospitals namely TASH, MenilikII hospital, Zewditu memorial hospital (ZMH) and Saint Peter Hospitals. According to the human resource management report of the four hospitals, in TASH there are Medical Laboratory Technologist (55), Midwifery (69), Anesthesia (39), Medical doctor (478), and 825Nurses. In ZMH there are medical doctors(70),Nurse(400),Midwifery(44),Anesthetists(21),Medical Laboratory Technologist(44).In MenilikII hospital there are Medical Doctors(90),Anesthesia(22),Midwifery(46),Nurse(350) and Medical Laboratory Technologist(40).In Saint Peter Hospital there are(200)Medical Doctors, Medical Laboratory Technologist(45),Anesthesia(35),Midwifery(50) and Nurse(500).

This study were carried out in public hospitals Addis Ababa, Ethiopia from March to April**,** 2021

4.2. Study Design

Both a quantitative institution- based cross-sectional study and qualitative observational study was conducted.

4.3. Populations

4.3.1. Source Population

All health care workers who were working in public hospitals of Addis Ababa

4.3.2. Study Population

All health care workers who were working in selected public hospitals of Addis Ababa

4.3.3. Sampling Population

Health care workers (nurses, doctors, midwife, medical laboratory technicians and anesthetists) who were working in selected public hospitals and fulfill the inclusion criteria

4.4.4. Sampling Unit

Each selected health care workers participated in this study

4.4. Eligibility Criteria

4.4.1. Inclusion Criteria

All Healthcare workers with work experience of at least 6 months in public hospitals, Addis Ababa, and who have direct involvement in the generation and management of medical wastes were included.

4.4.2. Exclusion Criteria

Healthcare workers who are on annual leave, maternity leave, and ill at the time of data collection period and those who have no willingness to participate in the study were excluded.

4.5. Sample Size Determination and Procedure

4.5.1. Sample Size Determination

Sample size was determined by using a single population proportion formula. By considering 5% margin of error, 95% confidence interval (CI), proportion was 45%, by taking mean value of good knowledge and good practice, from recent studies conducted in jijiga, eastern Ethiopia 2018 [5], design effect 1.5 and 10% non-response rate. Actual sample size of study participants were calculated as:

$$ni = \frac{(Z@/2)^2 p(1-p)}{d^2}$$

Where ni = the minimum sample size required

$Z\alpha/2$ = standard normal deviation, set at 1.96, to correspond to the 95% confidence interval

P = 45% =0.45

d = margin of error =5%=0.05

Design effect=1.5

$$n_i = \frac{(1.96)^2 (0.45)(1-0.45)}{(0.05)^2} = 380$$

The calculated sample size was 380, by considering the design effect (1.5) and non-response rate (10%), the final sample size was 627 HCWs.

4.5.2. Sampling Technique and Procedures

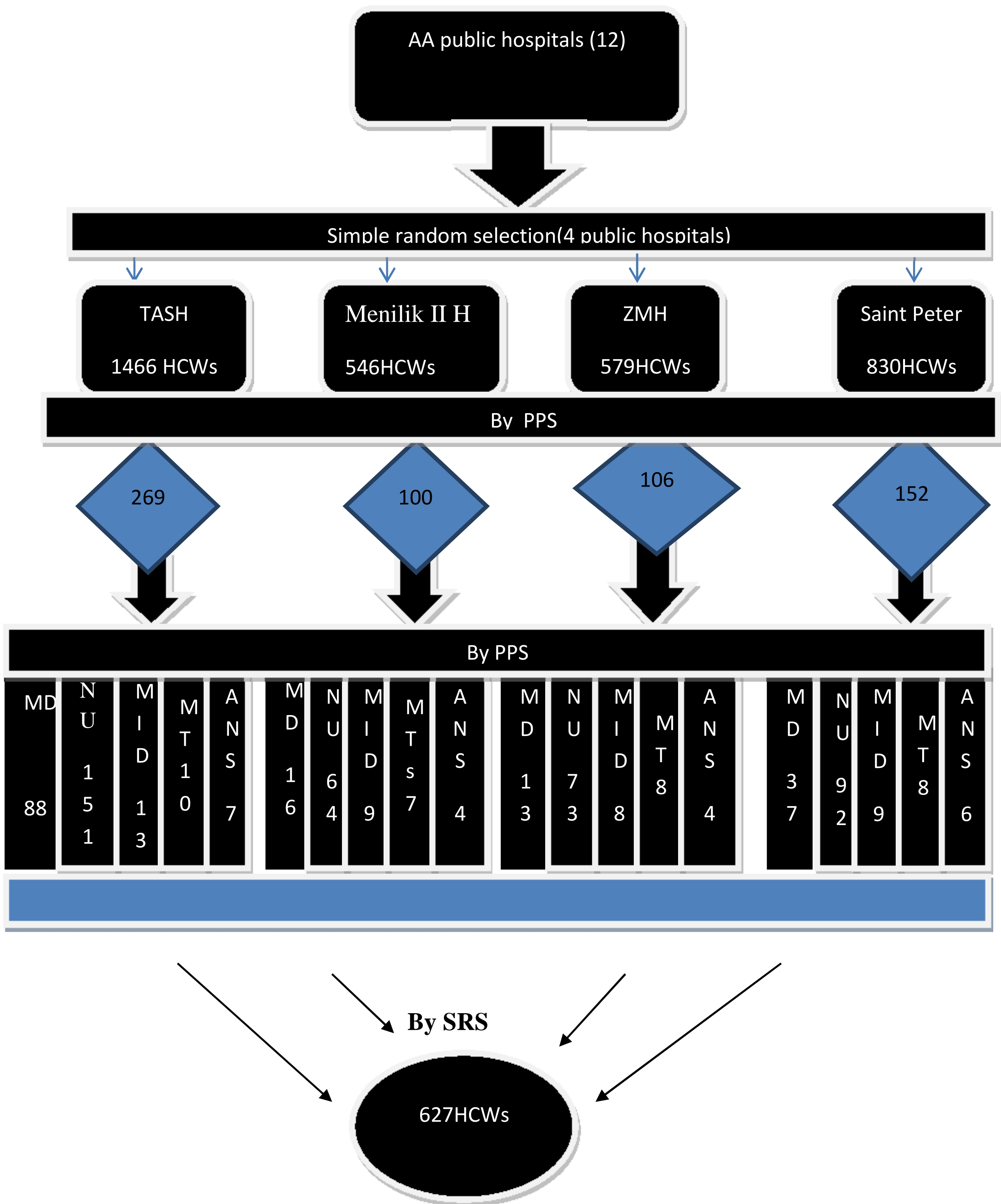
Multi-stage sampling technique was employed. First, 4 public hospitals were selected among 12 public hospitals by a simple random sampling method. Second, eligible HCWs enumerate along with each hospital and each profession. And then, sample size was allocated to each profession by probability proportion to size (PPS) of the profession.

$$(n_i = n \times N_i/N)$$

Final required numbers of individuals were enrolled to the study using simple random sampling.

Table 1: Proportional Allocation of HCWs towards Medical Waste Management at Public Hospitals Addis Ababa, Ethiopia 2021

Name of selected hospital	Total HCW in selected Hospitals	Total No. of participants in each Hospitals	Proportional allocation of each participants in each profession by the formula ; ni= (n * Ni)/ N
TASH	1466	(627*1466)/3421 =269	Medical Doctor=269*478/1466=88
			Nurse= 269*825/1466=151
			Midwifery= 269*69/1466=13
			MTs = 269*55/1466=10
			Anesthesia= 269*39/1466=7
MenilikII Hospital	546	627*546/3421 =100	Medical Doctor= 100*90/546=16
			Nurse= 100*350/546=64
			Midwifery= 100*46/546=9
			MTs= 100*40/546=7
			Anesthesia= 100*22/546=4
Zewditu Memorial Hospital(ZMH)	579	627*579/3421 =106	Medical Doctor= 106*70/579=13
			Nurse= 106*400/579=73
			Midwifery= 106*44/579=8
			MTs= 106*44/579=8
			Anesthesia= 106*21/579=4
Saint Peter Hospital	830	627*830/3421 =152	Medical Doctor = 152*200/830=37
			Nurse= 152*500/830=92
			Midwifery= 152*50/830=9
			MTs= 152*45/830=8
			Anesthesia= 152*35/830=6
Total	3421	627	627 participants



Key: MD=medical doctor, NU=nurse, MID=Midwifery, MTs= Medical Laboratory technologist, Ans=anesthesia

Figure 2: **schematic presentation of sampling procedure used to select study participants from public hospitals in Addis Ababa, Ethiopia, 2021**

4.6. Study Participants

In this study, medical doctors, nurses, Medical Laboratory Technologists (MTs), midwives and anesthetists were incorporated. These departments /professional categories/ were picked up due to they are enormous in number per their work classification or either they are large in number per their job category or mostly they are involved in MW generation/segregation. Also, these category/departments/ had more contact with medical wastes than other staff. A total of 627 HCWs were incorporated from the selected public hospitals.

4.7. Study Variables

4.7.1. Dependent Variables

- ✓ Knowledge
- ✓ Practice

4.7.2 Independent Variables:

Demographic factors

- ✓ Age
- ✓ Sex
- ✓ Educational level
- ✓ Professional category
- ✓ Work experience

Health care facility related factors

- ✓ level of facility
- ✓ Assigned working department/ section
- ✓ MWM guideline/ operational document
- ✓ Designated individual/MWM committee
- ✓ Previous training access on MWM
- ✓ Personal protective equipment
- ✓ Rewards

4.8. Operational Definition

Knowledge: Capacity of study participants to respond to knowledge related questions and it is measured in terms of knowledge scores. Knowledge scores below mean and above or equal to

mean score were categorized as having ‘Inadequate’ and ‘Adequate’ knowledge, respectively [14].

Practice: Practice level of HCWs was bifurcated into two categories. Practice score below mean or more or equivalent to mean was categorized as ‘Inadequate’ and ‘Adequate’, respectively [14].

Health care workers: Health care workers are people whose job is to protect and improve the health of their communities. In this study, nurses, medical doctors, anesthetists, midwives, and medical laboratory technicians were considered as HCWs.

4.9. Conceptual Definitions

Medical waste: All the wastes generated by medical activities. It includes non-hazardous, hazardous and sharps [30].

Medical waste management: The management of waste produced by HCFs using techniques and that will check the spread of diseases through HCFs [32]

Waste segregation: Systematic separation of wastes generated from the HCFs according to their type (non-infectious, infectious and sharps) using color-coded containers [6].

4.10. Data Collection Procedure

Before distributing questionnaires to the participants, data collectors exchanged greetings and had got Verbal consent. Then, the structured and pretested self-administered questionnaires were distributed to the participants as hard copies. After collecting the distributed questionnaire, data was checked for its completeness.

At the same time, data collectors had observed the study participants and filled observational checklists while they provided services. But the study unit didn’t know what the data collector was doing. And then, self-administered questionnaires and observation checklists were labeled and attached with similar individual and HCFs identification codes. One supervisor (MSc) and four BSc nurses were used as data collectors.

4.11. Data Collection Tools

The tool was adapted from recent published articles [14, 16] and it has 4 parts. The first part contains 13 questions requesting demographic and HCF related data. The second part contains 20 questions to assess HCWs knowledge towards medical waste management and the third part

contains 12 questions constructed to assess HCWs practice towards medical waste management. The last part was HCWs individual observation checklists, since observational measurement is better to address this issue, and it contains 12 questions. English version questionnaires were used. All the four part contains a closed ended multiple questions

4.12. Data Quality Control

Questionnaires and observational checklists were pretested by 10% of the similar study participants at ALERT hospital one week before the actual data collection. After the pretest, contents of questionnaires were modified and suggestions from different individuals were included in the final questionnaire before actual data collections, like modifying vague statements with clear and understandable one, and reordering questions. Also training was given for data collectors; continuous supervision and daily checkup for content completeness and accurateness of the collected data was done. The respondents were informed as ethical clearance has gotten to conduct the study and they also assured confidentiality of the information they provide. Current internal reliability test (cronbach's alpha coefficient) was 0.7 for knowledge and 0.72 for practices.

4.13. Data Processing and Analysis

The collected data was coded, cleaned and entered into Epiinfo7.0 statistical software and then exported to SPSS version 25 for analysis. Descriptive statistics were computed through cross tabulation and summary tables were generated. Bivariate and multivariable logistic regression analyses were computed to identify independent variables having significant association with the dependent variables. Odds ratios with 95% confidence intervals were used to determine the strength of association between independent and dependent variables. For this study, all variables having p- value ≤ 0.25 were entered into the multi variable logistic regression model to adjust possible confounders and then their strength of association was measured with odds ratio (OR). Variables having p-value of < 0.05 in the final analysis (multivariable logistic regression model) were considered presence of association. In addition, qualitative findings from HCWs individual observation checklists were recorded and paraphrased.

4.14. Ethical Consideration

Ethical clearance was obtained from hospital administrative offices (from TASH and Saint Peter) and Addis Ababa public health research and emergency management directorate (for Minilik II

and Zewditu Memorial hospitals). Before the beginning of data collection, a permission letter was provided to the hospital's administrative body for data collection. Participation was volunteered and information was collected anonymously after obtaining oral informed consent from each respondent by assuring confidentiality throughout the data collection period. Participants were told the objective of the study and their right to refuse to answer the questionnaires and were given the right to stop or withdraw at any time of data collection. Also they had told that the information obtained from them be treated with complete confidentiality and do not cause any harm to them. Confidentiality was maintained by omitting their name and personal identification.

4.15. Dissemination of the Results

This result will be submitted to Addis Ababa University, Health Sciences College, and department of nursing. Also, it will be disseminated to Addis Ababa Public Health Research and Emergency Management Directorate. To publish it in different journals, present it in workshops and conferences, further effort will be made.

CHAPTER FIVE

5. RESULTS

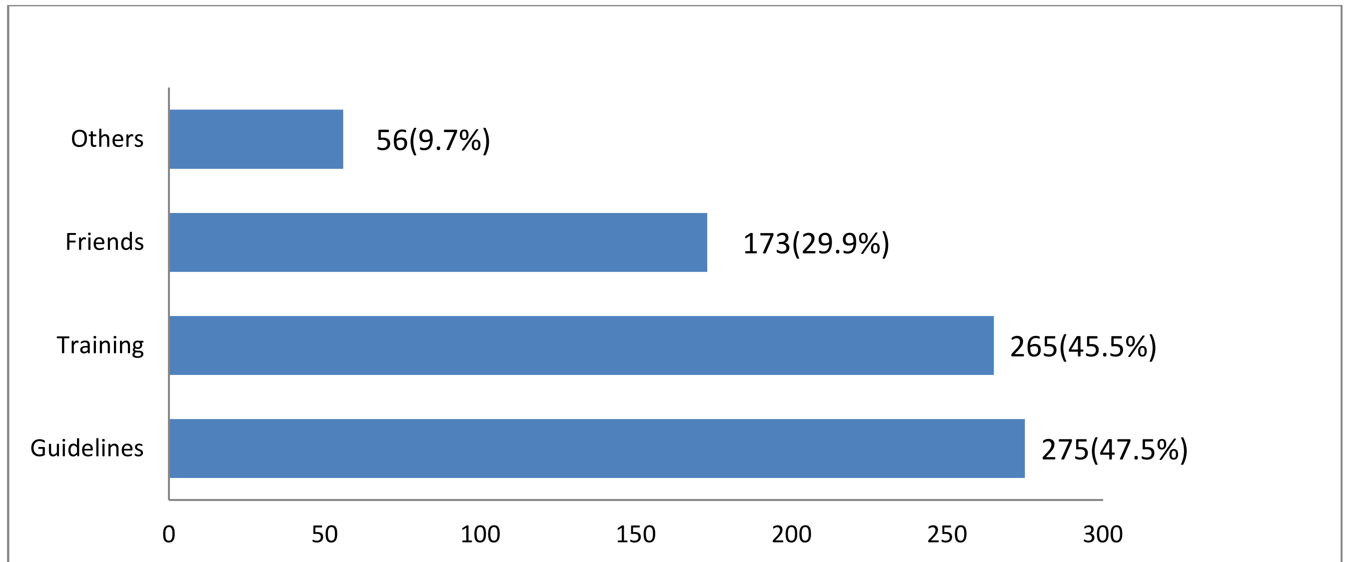
5.1 Demographic Descriptive Statistics of Health Care Workers

A total of 627 study participants were invited to participate in the study and five hundred seventy nine study participants (responded with 92.3%) with the mean age of 28.2±4.0 were included from 4 public Hospitals. Most of participants, 337 (58.2%) were in the age group of 26–30 years old, and 85 (14.7%) and 487 (84.1%) were found to have second degree (above) and first degree, respectively. Regarding the professional category of the respondents, almost two-third of them, 377 (65.1%) were nurses and the majority, 178 (30.7%), reported they were working in the ward followed by emergency rooms 149(25.7%) and operation rooms 92(15.9%). Three hundred sixty six (63.3%) of them had work experience of 1–5 years. Regarding previous training access, only 229(39.6%) of study participants were trained about medical waste management (**Table2**).

Regarding their source of information about MWMs, nearly half of HCWs responded to guideline (47.5%) as their source of information followed by training (45.8%) and their friends (29.9%) (**Figure3**).

Table2.Demographic and HCF-related factors Towards MWM at public hospitals Addis Ababa, Ethiopia, 2021 (n=579).

Demographic and HCF related variables	Variable category	Study participant n (%)
Sex	Male	309(53.4%)
	Female	270(46.6%)
Age of respondents	≤ 25 years	131(22.6%)
	26-30 years	337(58.2%)
	31-35 years	73(12.6%)
	>35 years	38(6.6%)
Educational level	Second degree and above	85(14.7%)
	First degree	487(84.1%)
	Diploma	7(1.2%)
Professional category	Medical Doctor	113(19.5%)
	Nurse	377(65.1%)
	MTs	30(5.2%)
	Midwifery	37(6.4%)
	Anesthetist	22(3.8%)
Present working department/section of the respondent	OPD	54(9.3%)
	Ward	178(30.7%)
	Lab room	28(4.8%)
	Emergency	149(25.7%)
	OR	92(15.9%)
	Others	78(13.5%)
Work experience	1-5 years	366(63.3%)
	6-10 years	167(28.8%)
	>10 years	46(7.9%)
Working hours per day	less than 8 hours	10(1.7%)
	8hours	265(45.8%)
	greater than 8 hours	304(52.5%)
Take previous training about MWM	Yes	229(39.6%)
	No	350(60.4%)
Presence of MWM guidelines in the facility	Yes	255(44.0%)
	No	218(37.7%)
	Not sure	106(18.3%)
Presence of MWM committee in the facility	Yes	211(36.4%)
	No	163(28.2%)
	Not sure	205(35.4%)
Presence of rewards in the facility	Yes	133(23.0%)
	No	276(47.7%)
	Not sure	170(29.3%)



Others=internet, and other social medias

Figure 3.Health care workers' source of information towards medical waste management, at public hospitals Addis Ababa Ethiopia 2021(n=579).

5.2 Knowledge of Health Care Workers

5.2.1 Knowledge of Health Care Workers towards Medical Waste Management

From the total participants, 382(66.0%), 407(70.3%) and 510(88.1%) of them were aware that infectious, general and sharp wastes should be placed in yellow, black and safety boxes respectively. About 358(61.8%) health care workers identified the internationally accepted biohazard symbol. In addition, 435(75.1%) were aware that safety boxes should be filled a maximum of 3/4th. Four hundred twenty five (73.4%) of HCWs were aware that 72 hours was a maximum time delay to start HIV post exposure prophylaxis and merely 41(7.1%) of them knew the maximum storage time limit of infectious wastes before treatment was 48hrs (**Table3**).

Table3: **Health care workers response among each knowledge-related item question at public hospitals, Addis Ababa Ethiopia, 2021 (n=579)**

Questions	Response	Frequency	Percentage
Do you know your facility generates medical wastes?(n=579)	Yes	457	78.9%
	No	54	9.3%
	Not sure	68	11.7%
Do you know medical waste management?(n=579)	Yes	481	83.1%
	No	61	10.5%
	Not sure	37	6.4%
Is there any health hazards associated with medical wastes?(n=579)	Yes	495	85.5%
	No	43	7.4%
	Not sure	41	7.1%
Is needle stick/sharp injury a concern?(n=579)	Yes	543	93.8
	No	34	5.9%
	Not sure	2	10.3%
Does wearing PPE reduce risk of infection? (n=579)	Yes	550	95.0%
	No	25	4.3%
	Not sure	4	0.7%
Are all medical wastes are biologically hazardous(infectious)?(n=579)	Yes	329	56.8%
	No	205	35.4%
	Not sure	45	7.8%
Are items contaminated with body fluids are considered as MW ?(n=579)	Yes	494	85.3%
	No	64	11.1%
	Not sure	21	3.6%
Do you know about color coding segregation?(n=579)	Yes	445	76.9%
	No	102	17.6%
	Not sure	32	5.5%
Should infectious waste container should be labeled with biohazard symbol?(n=579)	Yes	461	79.6%
	No	92	15.9%
	Not sure	26	4.5%
Dose disinfection of infectious medical waste decreases infection transmission?(n=579)	Yes	526	90.8%
	No	34	5.9%
	Not sure	19	3.3%
Medical waste containers should be filled closed while transport ?(n=579)	Yes	478	82.6%
	No	56	9.7%
	Not sure	45	7.7%

Table 3 Health care workers response among each knowledge-related item question at public hospitals, Addis Ababa Ethiopia, 2021 (n=579)…continued

Medical wastes waiting for treatment and disposal should be secured? (n=579)	Yes	465	80.3%
	No	55	9.5%
	Not sure	59	10.2%
Do you know about medical waste disposal methods ?(n=579)	Yes	441	76.2%
	No	80	13.8%
	Not sure	58	10.0%
Infectious medical wastes can be stored before treatment or disposal with the maximum time of ?(n=579)	24 hours	238	41.1%
	48 hours	41	7.1%
	72 hours	57	9.8%
	Don't know	243	42.0%
A type of wastes which should disposed in a yellow disposal bin?(n=579)	General waste	128	22.1%
	Infectious waste	382	66.0%
	Don't know	69	11.9%
He /she knew internationally accepted symbol of bio hazardous(n=579)	Yes	358	61.8%
	No	221	38.2%
A type of wastes which should disposed in a black disposal bin?(n=579)	General waste	407	70.3%
	Infectious waste	108	18.7%
	Don't know	64	11.0%
Medical supplies capable of causing puncture or cut should disposed in?(n=579)	Black bin	19	3.3%
	Yellow bin	30	5.2%
	Safety box	510	88.1%
	Don't know	20	3.5%
Safety box containing sharp medical supplies should filled with maximum of ?(n=579)	½ full	45	7.8%
	¾ full	435	75.1%
	Full	46	7.9%
	Don't know	53	9.2%
Maximum delay to start HIV Post exposure prophylaxis, WHO Guideline,?(n=579)	24 hours	85	14.7%
	48 hours	41	7.1%
	72 hours	425	73.4%
	Don't know	28	4.8%

5.2.2 Knowledge score

By using statistical software, the level of knowledge was first computed from 20 knowledge related questions and a score was generated for each respondent. After computing the score for each respondent from the questions, the mean score (15.1) of 20 knowledge related questions was used as a cutoff point to say inadequate or adequate knowledge. Of the total respondents 579, 304(52.7%) had adequate knowledge and the rest 275 (47.3%) had inadequate knowledge on medical waste management (**Table4**)

Table 4.**Knowledge of each professional category/departments/ based on their knowledge-related question score towards MWM at public hospitals, Addis Ababa, Ethiopia, 2021 (n=579).**

	Profession category n (%)					
Level of knowledge	**Doctor (n=113)**	**Nurse (n=376)**	**MTs (n=30)**	**Midwifery (n=37)**	**Anesthetists(n=22)**	**Total (n=579)**
Inadequate	51(45.1%)	180(47.9%)	13(43.3%)	17(45.9%)	13(59.1%)	275(47.5%)
Adequate	62(54.9%)	196(52.1%)	17(56.7%)	20(54.1%)	9(40.9%)	304(52.5%)

5.3 Practice of Health Care Workers

5.3.1 Practice of Health Care Workers regarding to Medical Waste Management

This study revealed that about 463(80.0%) HCWs worked without labels/indicators at their health care delivery sections. Regarding use of PPE, 377(65.1%) and 423(73.1%) HCWs always used gloves and gowns while handling or working with MWs. On the other hand, 142(24.5%) HCWs has injured with sharp/needle stick injury in the last 12 months

From the total respondents, about 407(70.3%) of them practiced segregation of wastes at their source. Three hundred seventy five (92.0%) of them followed color coding segregation. Of these, general (77.4%), infectious (73.5%) and sharp wastes (92.4%) were put into black bin, yellow bin and safety boxes respectively (**Table5**).

Table 5.**Health care workers response among each practice-related item question at public hospitals Addis Ababa, Ethiopia, 2021 (n=579)**

Questions	Response	Frequency	Percentage
Is there any sharp/needle injury in the last 12 months(n=579)	Yes	142	24.5%
	No	437	75.5%
There were labels/indicators near the waste disposal bins (n=579)	Yes	116	20.0%
	No	463	80.0%
There were gloves in sufficient quantity in the facility(n=579)	Yes	205	35.4%
	No	374	64.6%
Uses gloves while handling of medical wastes(n=579)	Always	376	64.9%
	Sometimes	190	32.9%
	Never	13	2.2%
Wear gown while working/handling of medical wastes(n=579)	Always	423	73.1%
	Sometimes	130	22.5%
	Never	26	4.5%
He/she labels medical waste containers(n=579)	Yes	194	33.5%
	No	385	66.5%
All three bins are available at their work section/department(n=579)	Yes	283	48.9%
	No	296	51.1%
Segregate medical wastes at the point of generation/source(n=579)	Yes	407	70.3%
	No	172	29.7%
He/she follows color coding segregation'(n=407)	Yes	375	92.0%
	No	32	8.8%
Non-infectious wastes like paper, plastic and others' should put(n=407)	Black waste bin	315	77.4%
	Yellow waste bin	92	23.6%
Infectious wastes like cotton, gauze and others' contaminated with blood should put(n=407)	Black waste bin	108	26.5%
	Yellow waste bin	299	73.5%
Sharp wastes which may cause cut or puncture should put in (n=407)	Safety box	376	92.4%
	Black waste bin	2	0.5%
	Yellow waste bin	29	7.1%

5.3.2 Practice score

By using statistical software, the level of practice was first computed from 12 practice related questions and a score was generated for each respondent. After computing the score for each respondent from the questions, the mean score (6.36) of 12 practice related questions was used as a cutoff point to say inadequate or adequate practice. Of the total respondents 579, 298(51.5%) had adequate practice and the rest 281(48.5%) had inadequate practice towards medical waste management.

Table 6.Practice of each professional category/department/ based on their practice-related question score about medical waste management at public hospitals Addis Ababa, Ethiopia, 2021 (n=579).

	Profession category n (%)					
Level of practice	**doctor (n=113)**	**Nurse (n=376)**	**MTs (n=30)**	**Midwifery (n=37)**	**Anesthetists (n=22)**	**Total (n=579)**
Inadequate	60(53.1%)	172(45.7%)	9(30.0%)	23(62.2%)	17(77.3%)	281(48.5%)
Adequate	53(46.9%)	204(54.3%)	21(70.0%)	14(37.8%)	5(22.7%)	298(51.5%)

5.4 Observational result

5.4.1 Individual practice observational result

However, 191(32.8%) participants were segregating medical wastes at their source, about 419(72.4%) used internationally accepted biohazard labeled safety boxes for sharp waste. Of the participants, about 382(66.0%) and 197(34.0%) were using yellow and black bins containing mixed wastes, respectively. About 456(78.8%) participants were working with unlabeled MW containers and 159(27.5%) participants were observed using more than 3/4th filled infectious waste containers. Observational results and study participants' self-report were not congruent with presence of labels/safety instructions/ 117(20.2%), wearing gown 568(98.1%), and glove uses 550(95.0%).

5.5. Factors associated with Knowledge and Practice of Health Care workers towards medical waste management

5.5.1 Factors Associated with Knowledge of Health Care Workers towards MWM

In multivariable logistic regression analysis for which the respondent had been taken from the bivariate analysis with $p \leq 0.25$, getting MWM information's from guidelines, hospital working hours of 8 and adequate practice score had remained significantly associated with knowledge of health care workers towards medical waste management.

Accordingly, this study claimed that HCWs who had hospital working hours of 8 were 1.5 times more knowledgeable towards MWMs [AOR=1.5, 95% CI (1.09, 2.18)] compared to those who had working hours of >8. Getting MWM information from guidelines was 1.54 times [AOR=1.54, 95% CI (1.087, 2.189)] more adequate knowledge towards medical waste management compared to those who didn't get from it. On the other hand, HCWs who had adequate practice scores [AOR = 2.14, 95% CI (1.50, 3.02)] had adequate knowledge compared to those who had inadequate knowledge (**Table7**).

Table7.Bivariate and Multivariate Logistic Regression of Factors Associated with Knowledge of Health Care Workers at Public Hospitals Addis Ababa, Ethiopia, 2021(N=579)

			Knowledge				
Variables	**Variable category**		**Inadequate**	**Adequate**	**COR(95%CI)**	**AOR (95%CI)**	**P value**
Working hours	**8hours**		96(37.9%)	157(62.1%)	**1.6(1.2,2.3)*** **	**1.5(1.09,2.18)***	**0.014**
	>8hours		156(52.5%)	141(47.5%)	1.00	1.00	
Get Information about MWMs from	**Guidelines**	**No**	158(52.0%)	146(48.0%)	1.00	1.00	
		Yes	116(42.2%)	159(57.8%)	**1.46(1.05,2.03)**	**1.54(1.09,2.189)***	**0.015**
	Training	**No**	163(51.9%)	151(48.1%)	1.00	1.00	
		Yes	111(41.9%)	154(58.1%)	1.52(1.09,2.10)	1.39(0.92,2.09)	0.118
	Others	**No**	184(45.3%)	222(54.7%)	1.00	1.00	
		Yes	90(52.0%)	83(48.0%)	0.58(0.33,1.01)	0.9(0.59,1.40)	0.14
Previous training	**No**		180(51.2%)	169(48.4%)	1.00	1.00	
	Yes		94(41.0%)	135(59.0%)	1.49(1.07,2.09)	1.28(0.85,1.92)	0.24
Practice score	**Inadequate**		164(59.6%)	117(38.5%)	1.00	1.00	
	Adequate		117(40.4%)	187(61.5%)	**2.36(1.7,3.3)*** **	**2.14(1.5,3.02)*** **	**0.000**

CI= confidence interval, COR =crude odds ratio, AOR =adjusted odds ratio

*p-value<0.05, **p-value<0.01, ***p-value<0.0001

5.5.2 Factors Associated with practice towards medical Waste Management

On multivariable analysis, variables like HCWs working at Saint Peter hospital, professional categories (Medical Doctor, Nurse, and MTs), getting MWMs information from training, presence of MWM guidelines at hospitals, and adequate practice score had remained significantly associated with practice of health workers regarding to medical waste management.

Accordingly, the study indicated that HCWs working at Saint Peter hospital had adequate practices almost 4 times [(AOR=4.1, 95%CI (2.78-7.75)] than those who are working at TASH. Professional categories; including Medical Doctor[(AOR=3.8,95%CI(1.20-12.7)], Nurse[(AOR=4.40,95%CI(1.38-13.8)], and MTs[(AOR=9.0,95%CI(2.30-44.9)] had more adequate practice towards medical waste management compared to Anesthetists. Also, this study claimed that the presence of MWM guidelines [(AOR=1.73, 95%CI (1.04, 2.88)] compared to the respective references (**Table8**).

Table 8.Bivariate and multivariate logistic regression of factors associated with practice of health care workers at public hospitals Addis Ababa, Ethiopia, 2021(n=579)

Variables	Variable category		Practice Inadequate	Adequate	COR(95%CI)	AOR(95%CI	P – value
Level of education	MSc+		51(18.1%)	34(11.4%)	1.00	1.00	
	First degree		226(80.4%)	261(87.6%)	1.73(1.08-2.77)	1.4(0.81-2.42)	0.234
Working hospitals	TASH		161(57.3%)	108(36.2%)	1.00	1.00	
	Saint Peter		41(27.2%)	110(72.8%)	**4(2.59-6.17)*** **	**4.1(2.49,6.7)*** **	**0.000**
Profession	MD		60(21.4%)	53(17.8%)	**3(1.04-8.70)***	**3.8(1.2-12.7)***	**0.028**
	Nurse		172(61.2%)	204(68.5%)	**4(1.46-11.20)** **	**4.4(1.38-13.8)***	**0.012**
	MTs		90(32.0%)	21(7.0%)	**7.9(2.24-28.2)** **	**9.0(2.3-44.9)** **	**0.002**
	Anesthetist		17(6.0%)	5(1.7%)	1.00	1.00	
Information source about MWM from	training	No	174(61.9%)	140(47.0%)	1.00	1.00	
		Yes	107(38.1%)	158(53.0%)	**1.8(1.32,2.56)*** **	**2.1(1.59,3.5)*** **	**0.001**
	others	No	241(85.8%)	281(94.3%)	1.00	1.00	
		Yes	39(13.9%)	17(5.7%)	**0.37(0.2,0.7)** **	**0.49(0.25,0.95)***	**0.034**
Previous training	No		184(52.6%)	166(47.4%)	1.00	1.00	
	Yes		97(42.4%)	132(57.6%)	1.5(1.08,2.1)*	1.1(0.68,1,67)	0.79
Presence of guidelines	No		58(54.7%)	48(45.3%)	1.00	1.00	
	Yes		92(36.1%)	163(63.9%)	**2.14(1.35,3.39)** **	**1.73(1.04,2.88)***	**0.035**
Knowledge score	Inadequate		164(58.4%)	111(37.2%)	1.00	1.00	
	Adequate		117(39.3%)	187(62.8%)	**2.36(1.69,3.3)*** **	**2.14(1.5,3.1)*** **	**0.000**

CI= confidence interval, COR =crude odds ratio, AOR =adjusted odds ratio

*p-value<0.05, **p-value<0.01, ***p-value<0.0001

MSC+=master degree and above

CHAPTER SIX

6. DISCUSSION

6.1. Knowledge of study participants towards medical waste management

Of the total respondents, 52.7% of the study participants had adequate knowledge. With an adequate knowledge score of participants' analyses in terms of profession, highest knowledge was scored among MTs (56.7%), followed by medical doctors (54.9%), midwives (54.1%) and nurses (52.1%). Anesthetists had (40.9%) adequate knowledge, which is last compared to other HCWs. This result was better than a study conducted in Jijiga eastern Ethiopia, only 39% study participants had adequate knowledge, reciprocally highest knowledge were scored among anesthetists(71.4%) followed by medical laboratories(57.0%), nurses(50.7%), midwifes(48.3%) and medical doctors(10.0%)[16]. This might be due to the difference in availability of training for different departments towards MWM. However, it was less comparable with 55.0% adequate knowledge in a study conducted at Debre-Markos [14]. This difference might be due to difference in availability and strength of the MWM/infection prevention/ committee. On the other hand, the study was not congruent with a study conducted in India where highest good knowledge was scored among nurses (98.1%), followed by medical laboratory technologists (56.26%) [21]. Better results were found in Bangladesh, about 68.3% and 60.9% of physicians and nurses had satisfactory knowledge scores, respectively [23]. Also, in Egypt doctors (68.3%) and nurses (60.9%) had scored satisfactory knowledge [25]. In addition, a study conducted in Kampala, Uganda indicated that the overall knowledge of participants towards MWM was high 71.5% [26]. These differences might be due to differences in training access, academic knowledge or national health sector strategy differences. More specifically, in this study about 85.8%doctors, 75.8%nurses, 90.0%MTs, 81.1%midwife and 90.7%Anesthetists had answered correctly regarding their HCF generate wastes, which is congruent with the study conducted in India where about 96% of doctors, 91% of nurses, and 80 % of lab technicians knew HCF were a primary source of MW generation [20].This might be due to similarity in academic level of health care workers towards MWM or similarity in availability of training to those study areas towards medical waste management.

In this study, only 70.2% of the study participants had knowledge of color coding segregation which is lower than 81.9% reported from Nigeria [10]. Specifically, 70.3%, 66.1% and 88.3%

study participants were able to identify that general, infectious and sharp wastes should be placed into the black, yellow and safety box respectively. This does not fulfill minimum national guideline requirements (there should be three types of waste containers; black, yellow and safety box for general, hazardous and sharp wastes respectively) [6]. This difference might be a difference in national strategy towards HCFs waste management. A study is consistent with studies conducted at Debre-Markos, which is 77%, 66.9% and 83.4% HCWs put general, infectious and sharp wastes into black bin, yellow bin and safety box respectively [14].These similarity might be happen due to similar in availability of color coding bins and waste management equipment, medical waste management strategy of HCFs, study setting and availability in training.

In this study 65.5% of doctors, 62.0% of nurses, 80.0% of MTs, 51.4% of midwives and 45.5%of anesthetists knew about the biohazards symbols, which is better than studies conducted in Cairo Egypt, 47.3% of doctors, 52.7% of nurses, and 66.6% of lab technicians identifies it [25, 20]. Also this study is better than studies conducted in Debre-Markos, only 54% of participants knew biohazard symbols [14].This might be difference in academic level of HCWs and time difference.

This study indicated that, 436(75.3%) of participants answered correctly safety boxes should be filled a maximum of $3/4^{th}$. About 417 (72%) knew 72 hours is the maximum time delay to start HIV post exposure prophylaxis and only 50(8.6%) of study participants knew the maximum storage time limit of infectious wastes before disposal was 48 hours. This study is consistent with studies conducted at Debre-Markos, 83%, 67% and only 10% knew about maximum filling of safety boxes, maximum storage limit time of infectious wastes before disposal, and maximum time delay to start HIV post exposure prophylaxis respectively [14].

6.2. Practice of study participants towards medical waste management

The overall practice of healthcare waste management in this study, (51.5%), was found to be higher than a study conducted in Gondar northern Ethiopia, and Jijiga eastern Ethiopia, which were 31.5% and 42.3% respectively [7, 5]. But it was relatively lower than the study conducted in Debre-Markos health care facilities 78.9% [14] and Kampala 74.0% [26]. This difference might be due to the difference in level of facilities, availability of bins, presence or absence of focal persons, lack of coordination, lack of awareness and training towards medical waste management, and institutional financial issues

More specifically, medical laboratory technologists (70%) had the highest practice score, followed by nurses (54.3%), medical doctors (46.9%) and midwives (37.8%). Also the least practice score was scored by anesthetists (22.7%). This study is lower than studies conducted at Kolkata India, 77.8% of doctors and 97.32% of Nurses had satisfactory practice scores [21], but better than studies, 42.6% of participants had appropriate practice towards medical waste management at Gondar Ethiopia [16]. This difference in level of practice might be due to their poor knowledge about medical waste management, because the level of knowledge was one of the factors that affect medical waste management. Also this might be due to difference in study period, which might be related to the increased attention given for infection prevention.

Waste segregation at the source based on the recommended color coded waste bins is a critical step. However, in this study only 64.8% of HCWs followed color coding segregation which is better than 31.5% studies conducted at Gondar, But lower than 92.9%, studies conducted at Debre-Markos health facilities [14].The difference might be difference in availability of color coded bins in the facility, lack of motivation, lack of follow-up, workload, lack of work experience, low in individual commitment for waste management and low awareness about hazards of medical wastes.

In order to protect them from exposure to blood and other potentially infectious materials, HCWs should wear gloves and other available PPEs while they are doing any procedures. In this study 64.9% of HCWs always used gloves while handling MWs. This is less than studies conducted in Bangladesh; all participants were wearing gloves during handling of hospital waste [23]. This might be due to insufficient glove access in their HCFs or it might be due to ignorance or negligence of its hazardous associated with mismanagement of wastes

6.3 Factors Associated with knowledge and Practice of Health Care Workers towards Medical Waste Management

This study showed that 8 hours working per day was 1.5 times more for adequate knowledge compared to those who were working greater than 8 hours per day. This indicated that individuals who had more free time will read different guidelines and will upgrade their knowledge towards medical waste management. Similarly the study claimed that HCWs who were getting MWM information from guidelines were 1.54 times more adequate knowledge compared to those who didn’t get from guidelines. This might be due to guidelines being clear and concise, which enables

any one to read, understand easily and increase their awareness. Another reason might be that mostly guidelines are prepared by experienced persons; they are a better source of trusted information than others.

As the institutional level/hospital level increases, HCWs will have less practice [7]. Health care workers working at Saint Peter hospital were 4.1 times more appropriate practices than TASH. Probably this difference might be due to differences in institutional level; lack of training access, unavailability of waste bins, it might be due to workload, low work experience, and individual commitment for waste management, enforcement from concerned bodies or ignorance of HCWs towards MWM.

According to this study, HCWs level of practice was significantly associated with the professional category. Accordingly, nurses [AOR: 4.4, 95% CI (1.38-13.8)], medical laboratory technologists [AOR: 9.0, 95% CI (2.3, 44.9)] and medical doctors [AOR: 3.8, 95% CI (1.2, 12.7)] had more adequate practice towards medical waste management compared to Anesthetists. These gaps might be due to differences in training access, or academic knowledge differences. Also this study showed that health care workers who had gotten MWMs information from training had 2.1 times more practice than those who didn't get MWM information from training. This indicates that training helps to achieve specific objectives than the other sources. Another possible explanation may be because they are able to put into practice what they have trained in or it might be due to individuals may gain appropriate information from training

Presence of guidelines in the hospital remained significantly associated with healthcare waste management practice after adjusting in multivariate analysis. Respondents who have MWM guidelines in their hospital were 1.7 times more compared to respondents who did not have guidelines. This implies that guidelines /visual aids/ in the workplace are important in order to improve waste management practice. Also this study claimed that those participants who had got medical waste management information from others were 51% less practice than those who didn't get from it. This might be due to the information that are gotten from others were less accurate and reliable.

CHAPTER SEVEN

7. STRENGTH AND LIMITATION OF THE STUDY

7.1. Strength of the study

Used multiple data collection methods (observation checklists and questionnaires), which enables to see the actual practice of HCWs. This study incorporates a large sample size, which increases representativeness and provides a more accurate mean value, and will be more precious than similar studies during making an inference to the target population. The hospitals were selected randomly so that generalization can be made to all public hospitals. Also, the tool used to collect data was pretested for clarity and reliability

7.2. Limitation of the study

In this study, only public hospitals were included with a view that most of the people are utilizing such facilities. This might however reduce the maximum credibility of the research, especially while generalizing the findings to the whole health workers in the study area. And this study used a cross-sectional study design; it is weak in identifying which variable causes a change to the other in the exposure-outcome relationship. In addition, there might be information bias, due to the nature of the study design which may create different findings between the questionnaire and observation checklist. The other limitation of this study is that many of the hospitals are not volunteered to being included in the study (specifically Saint Paul's and ALERT).

CHAPTER EIGHT

8. CONCLUSION AND RECOMMENDATION

8.1. Conclusion

The overall knowledge and practice score of HCWs towards MWM were not satisfactory. Almost two third of the participants didn't access any previous training towards MWM. Similarly above three fourth of them did not have any visual aids /labels near to their work places. Working hours, source of information and practice scores were significantly associated with knowledge. Also, working hospital, professional category, source of information, presence of MWM guidelines and knowledge score were significantly associated with practices of health care workers towards medical waste management.

8.2. Recommendation

The following recommendations are made to the concerned ones based on knowledge and practice score of HCWs towards medical waste management.

To FMOH

Despite of currently there are three MWM guidelines prepared by the Federal Ministry of Health (FMoH), Food, Medicine and Healthcare Administration and Control Authority (FMHACA), and Federal Environmental Protection Authority (FEPA) independently, there was no separate rules and regulations specific for the health care facilities to enforce them for the proper management of the medical wastes. So there should be separate rules and regulations specific to the health care facilities towards medical waste management. Since providing training and retraining for HCWs helps to improve their knowledge and practice on MWM, FMOH should provide proper and intensive training programs for all health-care staff, with continuous monitoring at regular intervals. FMOH should also ensure proper supply of personal protective equipment and other preventive mechanisms in collaboration with hospitals and NGOs.

To hospital managers

Hospital managers should ensure continuous supply and proper distribution of personal protective equipment. They should provide training and re-training HCWs to improve their knowledge and practice level regarding proper medical waste management. Awareness should be created on HCWs about MW hazards. Responsible individuals should supply PPE and color coded bins in

the HCFs. Medical waste management guidelines /operational documents/visual aids/instructions should be put in the workplace. And also there should be provision of MWM guidelines for each unit for readers. In general the health facilities should encourage the MWM Committees to increase its education and awareness programs and adherence to MWMs knowledge and practices.

TO HCWs

HCWs should consider all wastes as potentially infectious. And they should segregate medical waste at sources according to recommended bins. Also HCWs should upgrade their knowledge by reading medical waste management guidelines and the staff should be committed towards waste management.

To Researchers

Conducting further observational study, by using WHO checklists, which is more accurate than using questionnaires is recommended to find out the other factors associated with HCWs knowledge and practice towards medical waste management.

Since medical waste is a public concern further studies should be undertaken to establish the health worker perceptions and their associated factors towards adherence to the recommended MWM practices in health facilities and also investigate the factors influencing adherence to proper MWM practices among health workers in public, private health care facilities both in urban and rural settings.

CHAPTER NINE

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CHAPTER TEN
10. ANNEXES

Annex A: Information Sheet

My name is **__________________________**. I am working as a data collector in the research conducted by Habtemariam Mulat, who is conducting this research for the partial fulfillment of his Master degree in Perioperative nursing specialty track in Addis Ababa University. We are trying to assess Knowledge, practice and associated factors among health care workers towards medical waste management. We would like your honest opinion concerning the questions.

Title: Assessment of Knowledge, practice and associated factors towards medical waste management among health care workers in Addis Ababa public hospitals, Ethiopia, 2021

Purpose: The aim of the study will be to assess level of Knowledge, practice and associated factors towards medical waste management among health care workers nurses in Addis Ababa public hospitals, Ethiopia, 2021

Duration: The question that is going to be asked will take about 20 minutes.

Benefit of the study: There is no direct benefit to you now. However, the result of the study will be helpful for all populations in the future by assessing health care workers' Knowledge, Practice and associated factors towards medical waste management.

Risk of the study: Participating in this study will not have any risk or harm associated with data collection.

Rights of the participant: participating and not participating is the full right and participants can stop from participation in the study at any time. Participants can ask any questions which are not clear for understanding.

Confidentiality: Any information forwarded will be kept private and his/her name will not be specified

Address of the principal investigator:

Name: Habtemariam Mulat (BSc, MSC student)

Tel: +251-904583479

E-mail: habtemulat0@gmail.com

Annex B: Consent Form

By reading the above information, I consent voluntarily to participate in the study and understand that he/she has the right to withdraw from the study at any time.

If you are willing to participate in this study, proceed to the questionnaires on the next page.

Signature---------------------------- date---------------------------

Thank You for your willingness to participate!!

ANNEX C: QUESTIONNAIRES

ENGLISH VERSION QUESTIONER
ADDIS ABABA UNIVERSITY

COLLEGE OF HEALTH SCIENCES

SCHOOL OF NURSING DEPARTMENT OF NURSING AND MIDWIFERY

This is the questionnaire designed to assess Knowledge, practice and associated factors towards medical waste management among health care workers in Addis Ababa public hospitals, Ethiopia. Please read carefully and provide your response to each item. Thank you for your cooperation!!

Part 1: Demographic and health facility related factors

Instruction: Please encircle your choice code among the given alternatives.

No.	Demographic Variables	Answer
101	Sex?	1.Male 2.Female
102	Age in full years?	--------------Years
103	What is your level of education?	1.Second degree and above 2. First Degree 3. Diploma
104	In which hospital are you working now?	1.TASH 2.MinilikII Hospital 3.Zewditu Hospital 4.St.peter Hospital

105	What is your profession?	1.Medical doctor 2. Nurse 3.Medical laboratory Technologist 4.Midwife 5.Anesthetics
106	In which department/ section are you working now? (More than one answers are possible)	1. OPD 2. Ward 3. Laboratory room 4. Emergency room 5. OR 6. Others (specify) _____
107	How much is your work experience as a healthcare professional?	----------years
108	How much are your working hours per day in your profession?	------------hours/day
109	Where do you get information about medical waste management? (More than one answers are possible)	1. Guideline 2. Training 3. Friends 4. Others (specify)_____
110	Have you ever taken training on medical waste management or related issues?	1. Yes 2. No
111	Are there any guidelines /operational documents for medical waste management or infection prevention in your	1. Yes 2. No 3. Not sure

	department/ section?	
112	Are there designated individual/medical waste management committees in the facility?	1. Yes 2. No 3. Not sure
113	Are there rewards in your health care facility to individuals/staff that practices proper medical waste management?	1.Yes 2.No 3.Not sure

Part 2: Questions to assess knowledge of health care professionals towards medical waste management and associated factors at Addis Ababa public hospitals.

Instruction: Please encircle your choice among the possible alternatives for the questions given below.

No.	Questions to assess health care professionals' knowledge	Answers
201	Does your facility generate medical wastes?	1.Yes 2.No 3.Not sure
202	Do you know about medical waste management?	1.Yes 2.No 3.Not sure
203	Is there any health hazard associated with medical wastes?	1.Yes 2.No 3.Not sure
204	Is needle-stick or sharp injury a concern?	1.Yes 2.No

		3.Not sure
205	Does wearing personal protective equipment reduce risk of infection?	1.Yes 2.No 3.Not sure
206	Are all medical wastes biologically hazardous (infectious)?	1.Yes 2.No 3.Not sure
207	Are items contaminated with body fluids considered as medical wastes?	1.Yes 2.No 3.Not sure
208	Do you know about color coding segregation of medical wastes?	1.Yes 2.No 3.Not sure
209	Should infectious waste containers be labeled with a biohazard symbol?	1.Yes 2.No 3.Not sure
210	Does disinfection of infectious medical wastes decrease infection transmission?	1.Yes 2.No 3.Not sure
211	Do we need to close medical waste containers while transporting?	1.Yes 2.No 3.Not sure
212	Do we need to secure stored medical wastes waiting for treatment and disposal?	1.Yes 2.No 3.Not sure

213	Do you know about medical waste disposal methods?	1.Yes 2.No 3.Not sure

214. What is the maximum time infectious medical wastes can be stored before treatment or disposal?

1. 24 hours
2. 48 hours
3. 72 hours
4. I don’t know

215 .What type of biomedical waste should be disposed of in a yellow medical waste disposal bin?

1. General waste
2. Infectious waste
3. I don’t know

216. Which of the following is an internationally accepted symbol for biohazard?

1.
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2.
3.
4. Do not know

217. What type of biomedical waste should be disposed of in a black medical waste disposal bin?

1. General waste
2. Infectious waste
3. I don’t know

218. Where should medical supplies capable of causing puncture or cut be disposed of?

1. Black bin
2. Yellow bin
3. Safety box
4. I don’t know

219. How full should the safety box containing sharp medical supplies be, maximum?

1. ½ full
2. 3/4 full
3. Full
4. I don’t know

220. What is the maximum delay to start HIV post exposure prophylaxis, WHO guidelines?

1. 24 hours
2. 48 hours
3. 72 hours
4. I don’t know

Part 3: Questions to assess practices of health care professionals about MW management at Addis Ababa public hospitals.

Please encircle your choice among the possible alternatives given the table below. Please use the following description for the terms given in the question.

Keys: For question 303 sufficient means availability of enough glove for 1-day consumption and for question 304 and 305 always means use of the indicated personal protective equipment continuously while it is necessary, sometimes means when you use occasionally while it is necessary and never means when you don't use the indicated personal protective equipment at all times while it is necessary.

No.	Variables	Answers
301	Have you ever encountered any sharp /needle stick injury in the last 12 months?	1.Yes 2.No
3o2	Are there visual aid/ instructions present near the waste receptacles?	1.Yes 2.No
303	Are gloves available in sufficient quantities in your facility?	1.Yes 2.No
304	How often do you use gloves while you are working with/handling medical wastes?	1. Always 2. Sometimes 3. Never
305	How often do you wear a gown while you are working with/handling medical wastes?	1. Always 2. Sometimes 3. Never

306	Do you label medical waste containers?	1.Yes 2.No
307	Are all 3 bins (black bin, yellow bin and safety box) available in your department/ section?	1.Yes 2.No
308	Do you segregate medical wastes according to their type at the point of generation?	1.Yes 2,No
309	If yes on question 308, do you follow color coding segregation?	1.Yes 2.No (If No stop)

310. Where do you put non-infectious wastes like paper, plastic and other supplies?

1. Black waste bin
2. Yellow waste bin
3. Other (specify)______

311. Where do you put infectious wastes like cotton, gauze and other items contaminated with blood and body fluids?

1. Black waste bin
2. Yellow waste bin
3. Other (specify)______

312. Where do you put sharp waste medical supplies which may cause punctures or cuts?

1. Safety box
2. Black plastic bin
3. Yellow plastic bin
4. Other (specify) ___

Dear Participant, Thank You for Your Cooperation!!

Hospital Identification Code ____

Study Participant Identification Code ______

Section 4: Health care professionals' practice observation checklist

Data collector should observe actual practices of health care professionals and tick the appropriate alternatives in the table given below

No	Activities to be observed	Answers
401	Are there visual aid/ instructions present near the waste receptacles?	1.yes 2.No
402	Are gloves available in sufficient quantities?	1Yes 2.No
403	Does he/she use gloves while handling/ working with medical wastes?	1.Yes 2.No
404	Does he/she wear a gown while handling/ working with medical wastes?	1.Yes 2.No
405	Is there a yellow bio-hazardous waste disposal bin in the section?	1.Yes 2.No(If no go to 408)
406	If yes, does it contain only infectious waste?	1.Yes 2.No
407	Is there black medical waste disposal bin in the section?	1.Yes 2.No(If no go to 410)
408	If yes, does it contain only non-infectious waste?	1.Yes 2.No

409	Is there a biohazard symbol labeled safety box in the section?	1.Yes 2.No
410	Does he/she segregate medical wastes according to their category?	1.Yes 2.No
411	Are all available bins clearly labeled?	1.Yes 2.No
412	Is there an infectious waste container more than 3/4 full?	1.Yes 2.No