



Infectious Waste Management in the Face of COVID-19 in a Rural Health Facility in Eastern Uganda

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Authors' contributions

This work was carried out in collaboration among all authors. All authors designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors OD and IJS managed the analyses of the study. Author OD managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

Aim: This study aimed to assess Infectious Waste Management in face of COVID-19, among Health care workers in Rural Health Facilities in Amuria district, Eastern Uganda. Little evidence exists of the challenges that occur while implementing Infectious waste management in the face of COVID-19 in resource-limited settings in Eastern Uganda. Our findings will close this apparent research gap and inform current district and national policies in Infectious Waste Management.
Materials and Methods: We conducted cross-sectional survey in five health facilities in Amuria district, using modified CDC Infection Control Assessment Tool for health facility, and a validated structured questionnaire to assess the knowledge of health care workers present on Infectious waste management in the face of COVID-19. Observation and in-depth interviews were also conducted in addition to assess the practice and attitude of staff towards infectious waste management.

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Results: The five (100%) of the Health Facilities assessed in Amuria district lacked written infection prevention policies and procedures that are current, and are based on evidence-based guidelines. The facilities also had no competency-based training program that provides job-specific training on infection prevention policies and procedures to health care personnel. In terms of knowledge, Waste handlers had poor knowledge in infection control only 8.3% of the medical waste handlers could identify biohazard symbols and knew how infectious waste is segregated into the different categories at the point of generation. All (100%) of the health care workers were knowledgeable about the COVID-19 standard operating procedures.

Conclusion: The doctors, nurses, clinical officers, and laboratory personnel had good knowledge of infectious waste Management and were up to date with COVID-19 standard operating procedures. The Medical Waste handlers had poor knowledge of Infectious Waste Management and COVID-19 standard operating procedures. Medical Waste handlers also had a poor attitude, towards the use of personal protective gear while on duty. All the Medical Waste handlers were willing to be trained in Infectious Waste Management. The facilities assessed had no enabling environment for infection control (no policies and in-service training in infection control for staff). We recommend Medical Waste Handlers to be trained in infection control and prevention before and after they are employed.

Keywords: Infectious waste; medical waste handlers; COVID-19; Eastern Uganda.

1. INTRODUCTION

The World Health Organization estimates that out of every one hundred hospitalized patients at a given time, seven in developed countries and ten in developing countries will acquire at least one health care infection [1]. The World Health Organization also notes that at any given time the prevalence of hospital-acquired infections varies from 5.7% and 19.1% in low and middle-income countries respectively [1]. A recent analysis by the World Health Organization has indicated that healthcare-associated infections are more frequent in resource-limited settings as compared to developed countries [1].

The World Health Organization defines Infectious waste as body fluids or secretions, contaminated sharp objects, biological laboratory waste, and pathological specimens [2]. Studies have shown the presence of specific pathogenic organisms in clinical solid and general waste including opportunistic bacterial agents, viruses, and other communicable disease agents [2]. A study conducted in Penang Island Malaysia [3], confirmed the presence of pathogenic bacteria in various types of clinical solid waste, general waste, and clinical sharp waste. The harm caused by improper management of wastes includes infections through contaminated syringes (Hepatitis B, Hepatitis C, and HIV), [3].

Corona Virus disease 2019 (COVID-19) is a respiratory illness that can spread from person to person, it is caused by a novel virus that was first identified during an investigation into an outbreak

in Wuhan, China [4]. The virus is thought to spread when people are in close contact (within 6 feet) through respiratory droplets produced when an infected person coughs or sneezes. It's also spread when you touch a surface or an object that has a virus on it, and then immediately touch your nose, mouth, or eyes [4]. From the time of declaration of the outbreak of COVID-19, the government of Uganda immediately moved to put in place proactive infection preventive measures at the airport and other entry points [5]. (On 18-3-2020 H.E the president of Uganda declared a COVID-19 national emergency and has since issued guidelines on preventive measures to suppress the spread of COVID-19 in Uganda. Uganda registered her first case of COVID-19 on 21-3-2020, the confirmed case was a 36-year-old Ugandan male who arrived from Dubai on 21-3-2020 [5].

In Africa, most hospitals have no effective infection control programs and there is a lack of both awareness of the problem and personnel trained in infection control practices [6]. In sub-Saharan Africa, sometimes infectious waste may be handled and disposed off using bare hands together with domestic waste, this creates a health risk to health workers, the general public, and the environment. It's important to note that the infectious waste segregation rate normally depends on the size of the hospital, number of patients coming to that particular facility, number of beds available, segregation steps, and the kind of care provided to patients [1]. As a result, proper segregation of infectious waste is not only

a matter of hospital and environmental concern but also a matter of economic importance because of the costs the country incurs in the management of patients with nosocomial infections as a result of poor infectious waste management [7] concluded that nosocomial infections are associated with a substantial increase in the costs of inpatient care, even when estimates are corrected for potential confounding. According to the World Health Organization, low-income countries (Uganda inclusive), generate only 0.2kg per hospital per bed per day, however, health care waste is not often separated into infectious and non-infectious waste, this makes the real quantity of infectious waste potentially higher than 0.2 kg [2]. Besides, studies done in developing countries reveal that the collection and segregation of infectious waste using recommended color-coded containers is not done in most health facilities, and storage of infectious waste in isolated areas is not specific, this is based on report by making medical injections safer project in Uganda. In 2015, a joint WHO/UNICEF assessment found that just half (58%) of sampled facilities from twenty-four countries had adequate systems in place for the safe disposal of health care waste [8].

In Uganda, infectious waste management remains a big challenge for hospital management and the situation is getting worse because of rapid population growth and heavy patient loads MOH. Several studies conducted amongst doctors and nurses in Thailand [9], India [10], Pakistan [11], Ethiopia Ramesh, Kumar and Uganda [12], concluded that the knowledge, understanding, and interpretation of infection control measures are not adequate. This in turn adversely affects the implementation of infection control measures in health facilities [12]. A study done in Pakistan [11] concluded that poor resources and lack of health care worker Infectious waste management training results in poor waste management. As infectious wastes are produced from the hospitals during the diagnosis, immunization, surgical procedures, and treatment of patients, some nurses do not discard these wastes well due to heavy patient load and hence force the attendants to discard the wastes, this increases the risk of transmission of Nosocomial infections [13]. Another study conducted in Pakistan revealed that; sharps and white safety box for injection safety were not properly labeled by Nurses and the wastes were mixed up indicating poor practices [11]. In India, it was found out that knowledge regarding color coding and risks of

handling biomedical waste was not adequate among the participants, variations were observed between the nurses and the doctors [14]. A study in Thailand [9], indicated that the quality of Nosocomial Infection control in the country had yet to be improved regarding structure and process. To achieve these improvements there was the need for better co-operation between the nosocomial infection control team and Health facility personnel. Ministry of Health Uganda considers five basic standard precaution measures that enhance infection control within health facilities. These are hand hygiene, proper sterilization, safe waste management, proper sharps disposal, and adequate protective gear [15].

Although previous studies have pointed out the main challenges associated with poor infectious waste management, little evidence exists of the challenges that exist while implementing Infectious waste management in the face of COVID-19 in resource-limited settings in Eastern Uganda. There are virtually no studies (Infectious waste management in face of COVID-19) that have been conducted in Eastern Uganda. The Amuria District supervision reports and medical students reports revealed some gaps in Infectious Waste Management. These reports recommended that a study be conducted to assess Infectious Waste Management in face of COVID-19, among Health Workers in Amuria District. These reports are also in line with [16] where they found a high level of bacterial and fungal colonization on hospital surfaces and theatre environments with a correspondingly high level of resistance to antimicrobial agents in Ngora Fred Car Hospital. Amuria Hospital and Ngora Hospital have similar contexts.

Current evidence suggests that COVID-19 spreads between people through direct, indirect (through contaminated objects or surfaces) or close contact with infected people via the mouth and nose secretions [17]. Based on how COVID-19 is spread, improper management of infectious waste is likely to increase the incidence of COVID-19 in the affected communities To address the apparent research gap, we conducted a study to assess Knowledge, attitude, the practice of infectious waste management among Health care workers in face of COVID-19, in Amuria District. We also assessed the health facilities (Amuria Hospital and four health center threes(Asamuk, Abarirela, Wera, and Kaju), for the availability of an enabling environment(necessary

infection control programs, COVID-19 Standard operating procedures, and infrastructure that is, the presence of hand washing facilities, protective equipment, Policies, etc).

2. METHODOLOGY

2.1 Study Site and Design

We conducted a health facility-based cross-sectional study in Amuria District Uganda 2020. Amuria District is located in the North-Eastern part of Uganda between latitudes 10° North and 20° South and longitudes 330° East and 340° West and covers an estimated area of 2,613 km² (MPED, 1997). It borders Katakwi district to the East, Soroti to the South, Kaberamaido to the West, and Napak and Alebtongto to the North. Its headquarters are in Amuria Town Council 40 Km to the North East of Soroti town along the Soroti-Abim road. Amuria district is mainly inhabited by the Iteso (97.6%), the Langi (1.6%), and the Karamajong (0.1%). It has a population of 270,928 people according to 2014 Census data, of which 138,407 (51.1%) are females and 132,521 (48.9%) are males. The district has 40 Health Facilities in total both government and Private not for profit (PNFP). These health facilities include; one Hospital (Amuria HCIV which was upgraded to Hospital), one Health Centre four (HC1V), Seven Health Centre threes (HC111), and Twenty-one Health Centre twos (HC11) that are owned by the government of Uganda. The remaining ten health facilities out of forty are owned by PNFP. According to the Ministry of Health Uganda, Health Centre two is managed by a nurse, serves a catchment population of 5,000 people, and provides only outpatient services. The health center three serves a catchment population of 10,000, and is run by a clinical officer and provides inpatient services in addition to what the health center two provides. In connection with the above, health center four is managed by a medical doctor and provides surgical services in addition to what health center three provides (MOH Health Strategic plan 2000). Amuria Hospital currently has an in-patient capacity of 69 beds and is in a position to handle several cases. Amuria Hospital currently holds the Health Sub-District (HSD) headquarters and serves 8 sub-counties (Wera, Abarilela, Asamuk, Kuju, Apeduru, Wila, Akoromit, and Amuria town council) with a catchment population of 24,379 people of whom 4,924 are women of childbearing age.

2.2 Study Population and Sampling Procedure

All the health care workers in Amuria Hospital and selected health center-three (Asamuk, Abarilela, Wera, and Kuju) present at the time of study that provided written informed consent were eligible. Any health worker that was absent during data collection was excluded.

Amuria Hospital was purposely selected because it's a district referral hospital and the four health center-threes were randomly selected using simple random sampling. All the health center threes were listed in alphabetical order and assigned a number, after which the numbers were selected at random.

2.3 Data Collection and Management

We assessed the health facilities using a modified CDC infection control tool. The tool had three sections namely: facility demographic, infection control program and infrastructure, and last section which involved direct observation of facility practices. We reviewed the available documents to support each response that was given by facility staff to ensure that the correct response was given. For example, if we asked for the existence of an infection control policy and the respondent said yes, we would ask him/her to present it and we have look at it.

We also interviewed health workers using a structured questionnaire to assess their knowledge in Infectious Waste Management. The interviews were conducted by experts in qualitative research from the Faculty of Health Science Busitema University. The interviews lasted on average twenty minutes per participant. The structured questionnaire was first pretested in a non-participating government health facility with a similar context. After pre-testing, the questionnaire was then administered to health workers to obtain information about their knowledge and practice on Infectious Waste Management and their responses were filled in by research assistants. We also did in-depth interviews till the point of saturation; the principal investigator conducted these interviews himself with the assistance of a qualitative expert. An invitation to participate in the in-depth interviews was sent to the prospective participants by email and these included the district Health officer, medical superintendent of Amuria Hospital, focal person infection control Amuria Hospital, senior

nursing officer Amuria Hospital, and the ward and Health Centre three in-charges. Verbatim notes were taken and interviews recorded, with permission from respective participants.

The interviews took place at the respective offices of the healthcare professionals according to the convenience of the participant. The interviews followed a semi-structured interview script exploring the implementation of infectious waste management. There was a reflection on the interview questions with the principal investigator. The interviews were audiotaped and later subjected to careful verbatim transcription. Data was checked for completeness by faculty supervisors before the Research Assistants left the health Facility. To ensure data quality, Research assistants were trained on how to conduct an interview and how to do observations. The data collectors were supervised by members of faculty who are experts in data collection.

2.4 Data Analysis

Quantitative data underwent descriptive analysis (health care workers were grouped into different groups, that is doctors, nurses, clinical officers, laboratory technicians, and Medical waste handlers. The percentage of each group that was knowledgeable for each question asked was calculated. Qualitative data collected was transcribed and thematic content analysis was done. Specific nodes were developed for the questions, and significant findings and responses were aggregated as subnodes, which were later developed into themes. Information from the

responses was then triangulated in the discussion section.

3. RESULTS

3.1 Participants Socio-demographic Characteristics

Of the eighty participants interviewed 47.5% were females and 52.5 % were males. The oldest respondent was 60 years old and the youngest was 21 years old (range = 39years). In terms of participant qualification, we interviewed two doctors, 41 nurses, 16 lab technicians, nine clinical officers, and 12 Medical waste handlers.

3.2 Knowledge of infection Control among Health Care Workers in Amuria

Bar Graph below shows the percentage of different health workers who could correctly identify the biohazard symbols (percentage of health workers in Y axis and Cadre of health workers in X axis) in face of Covid-19 in Amuria District.

Bar graph below shows percentage of health workers who knew that inappropriate disposal of biomedical waste results in environmental degradation in the face of Covid-19 in Amuria district.

The Pie chart below shows the percentage of health workers that were aware of existence of biohazard management rules in the context of Covid-19 in Amuria district

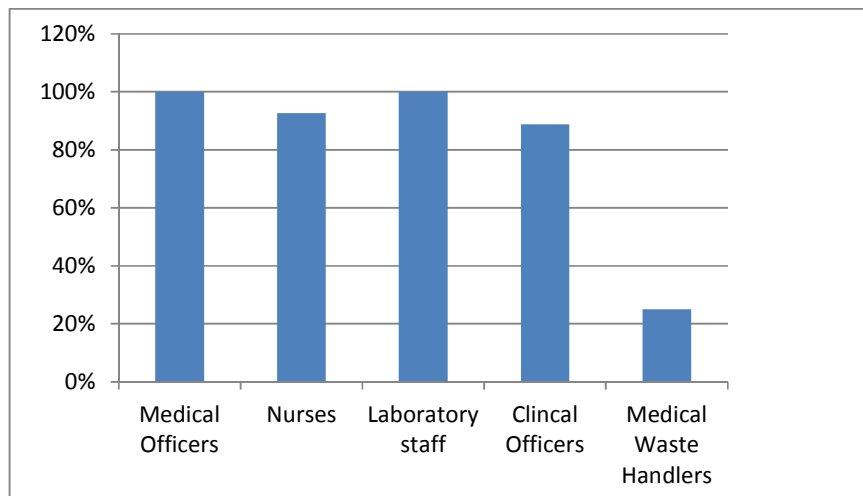


Fig. 1. Infection control among health care workers in Amuria

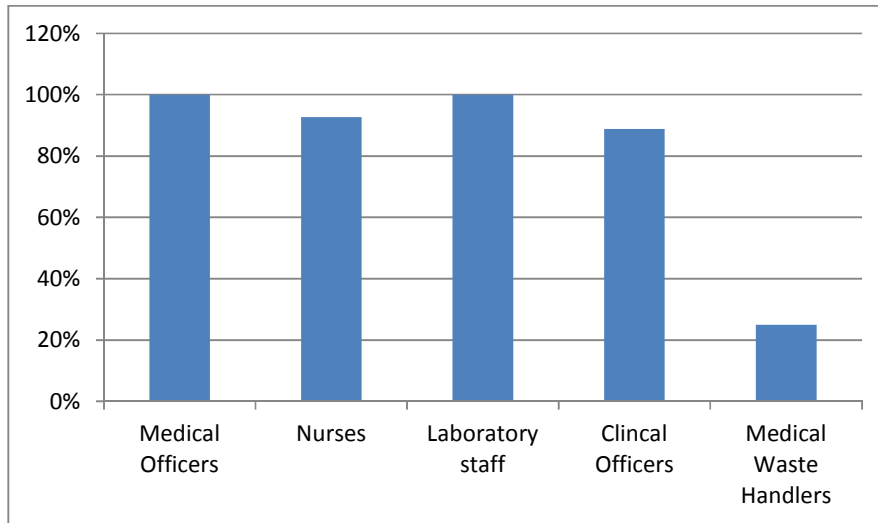


Fig. 2. Bar graph shows percentage of health workers who knew that inappropriate disposal of biomedical waste

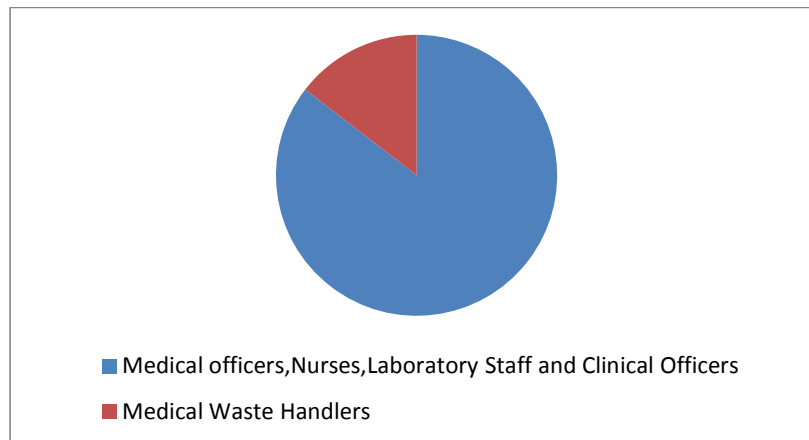


Fig. 3. Pie chart shows the percentage of health workers that were aware of existence of biohazard management rules

The Medical Waste handlers had poor knowledge in infection control only 8.3% could identify biohazard symbols and knew how infectious waste is segregated into the different categories at the point of generation. Also, 16.6% of medical waste handlers knew biohazard waste management rules existed and 75% did not know that inappropriate disposal of biomedical waste results in environmental degradation. Only 33.3% of the Medical Waste handlers knew that health care waste should be disinfected before disposal. The doctors, nurses, lab technicians, and clinical officers, had a good level of knowledge, over 80% of these workers could identify biohazard symbols, knew how infectious waste is segregated into different categories at point of

generation, they also knew that inappropriate disposal of biomedical waste results into environmental degradation and 100% knew about the transmission of diseases through poor medical waste handling. The results are summarized in bar graph and pie chart above And Table 1 below.

3.3 The Attitude of Health Care Workers Regarding Medical Waste Management in Face of COVID-19

Doctors, nurses, and clinical officers had a good attitude regarding waste management, they felt safe management of health care waste was the responsibility of all health care workers; it was

not an extra burden and were willing to undergo training in infectious waste Management. The Medical waste handlers had a poor attitude, though they were willing to be trained. Table 2 below summarizes the findings.

3.4 The Practice of Health Care Workers Towards Infectious Waste Management in Face of COVID-19

We observed how the health care workers practiced a range of infectious waste management activities ranging from safe disposal of waste, hand hygiene, injection safety to respiratory hygiene. We also reviewed the existing documents to verify if they had current existing policies, guidelines, training, and materials to be used in infectious waste management in the face of COVID-19. The findings are summarized below Fig 4.

In Figs 4-6 we see improper disposal of infectious waste, health workers though knowledgeable do not practice or follow guidelines on safe disposal of infectious waste. Facility Infection Control and Infrastructure, Written infection prevention policies and procedures that are current, and are based on evidence-based guidelines were not available in all (100%, 5/5) facilities assessed. The COVID-19 standard operating procedures charts were not pinned on notice boards and wards. There was no individual specifically trained in infection prevention and employed to manage the facility's infection control program. No staff was trained in the Prevention and Control of COVID-19 in 100% of facilities (they read about COVID-19 in published articles) All the facilities assessed had

a system for early detection and management of potentially infectious persons at initial points of the patient encounter.

Infection Control Training and Competency, all (100%) of the facilities assessed had no competency-based training program that provides job-specific training on infection prevention policies and procedures to health care personnel. The facilities had no documented exposure control plan that is tailored to specific requirements of the facility. All (100%) health care workers employed did not receive baseline tuberculosis screening before placement.

Personal Safety, all (100%) of the facilities had no well-defined policies concerning contact of personnel with patients when personnel have the potentially transmissible condition. These policies usually include; Work –exclusion policies that encourage reporting of illnesses and education of personnel on prompt reporting of illnesses to supervisor.

Surveillance and Disease Reporting, all (100% 5/5) facilities assessed had an updated list of diseases (COVID-19, Ebola, Cholera, etc) that are reportable to the Public health authority and were readily available to all personnel. The facilities also demonstrate knowledge and compliance with mandatory reporting requirements for Notifiable diseases and healthcare-associated infections. Patients who undergo procedures at the facilities were educated on the signs and symptoms of infection that may be associated with the procedure (for example wound care after cesarean section delivery).



Fig. 4. Infectious medical waste dumped outside the incinerator site in amuria hospital by medical waste handlers in amuria hospital

Table 1. Questions asked about infectious waste management in face of COVID-19 and percentage of health workers with correct responses

Questions asked	Percentage of different health workers with correct responses					
	MON=2	NN=41	LSN=16	CON=9	WHN=12	TotalN=80
Awareness regarding the existence of waste management committee in the institution	2 (100%)	41 (100%)	16(100%)	9 (100%)	2 (16.6%)	70 (87.5%)
Knows the existence of color coding for medical waste segregation	2 (100%)	39 (95.1%)	16(100%)	9 (100%)	3 (25%)	69 (86.3%)
Knows how waste is segregated into categories at the point of generation	2 (100%)	19 (46.3%)	13(81.2%)	2 (22.2%)	1 (8.3%)	37 (46.3%)
Knows that health care waste is disinfected before disposal	1 (50%)	39 (95.1%)	14(87.5%)	8 (88.8%)	4 (33.3%)	66 (82.5%)
Knows the about transmission of diseases through poor medical waste handling	2 (100%)	36 (87.8%)	16(100%)	9 (100%)	10 (83.3%)	73 (91.3%)

MO= medical officer (doctor), N=Nurse, LS=Laboratory staff (lab assistants and lab technicians), CO= Clinical officer, WH=Medical Waste handler

Table 2. Questions asked and percentage of different health care workers who disagreed

	Percentage of different categories of health care workers who disagreed					
	MON=2	NN=41	LSN=16	CON=9	WHN=12	TotalN=80
Feels that safe management of medical waste is not an issue at all	Disagreed 2 (100%)	Disagreed 35 (85.4%)	Disagreed 13(81.2%)	Disagreed 8(88.8%)	Disagreed 3 (25%)	Disagreed 61 (76.3%)
Feels that safe management of health care waste is the responsibility of all health workers	Agreed 2 (100%)	Agreed 36 (87.8%)	Agreed 13 (81.2%)	Agreed 9 (100%)	Agreed 7 (58.3%)	Agreed 67 (82.7%)
Feels that the safe management of Health Care waste is an extra burden on work.	Disagreed 2 (100%)	Disagreed 37(90.2%)	Disagreed 10 (62.5%)	Disagreed 9 (100%)	Disagreed 8 (66.6%)	Disagreed 66 (82.5%)
Likes to undergo a training program on medical waste management	Agreed 2 (100%)	Agreed 37 (90.2%)	Agreed 16 (100%)	Agreed 9 (100%)	Agreed 12 (100%)	Agreed 76 (95%)

MO= medical officer (doctor), N=Nurse, LS=Laboratory Staff (Laboratory assistants and Laboratory technician), CO= Clinical officer, WH=Medical Waste handler



Fig. 5. The used vaginal speculum is seen on the washing tray



Fig. 6. One color of bin liners used for all color cords of the dust bins and infectious waste was disposed of in a bin lined with a non-infectious waste bin liner

Hand Hygiene, all health care workers are not educated regarding appropriate indications for hand hygiene in the face of COVID-19 upon hire, the facilities do not routinely audit adherence to hand hygiene and there are no policies to promote the preferential use of alcohol-based hand rub over soap and water in most clinical situations.

Personal Protective equipment, all the health care workers who used personal protective equipment (PPE) did not receive training on proper selection and use of PPE upon hire. The facilities do not routinely audit adherence to proper PPE selection and use.

Injection Safety, all the health care workers who prepare and administer parenteral medications had received training on safe injection practices upon hire, annually, and when new equipment is introduced. Health care workers also demonstrated competency with safe injection practices. The facilities do not routinely audit

adherence to safe injection practices and do not have policies and procedures to track Health Care worker (HCW) access to controlled substances to prevent narcotic theft/diversion.

Respiratory Hygiene, the facilities assessed had policies and procedures to contain respiratory secretions in persons who have signs and symptoms of respiratory infections (COVID-19, Tuberculosis, etc), beginning at the point of entry to the facilities and continuing through the duration of the visit. The policies observed included the offering of masks to coughing patients, providing space in waiting rooms, and encouraging persons with symptoms of respiratory infections to sit as far away from others as possible. The facilities also educated HCW on the importance of infection prevention measures to contain respiratory secretions to prevent the spread of respiratory pathogens. All clients in the facilities were encouraged to follow COVID-19 standard operating procedures (wear masks, wash hands, avoid crowded spots, etc).

Point of Care Testing, Poor infection control practices were observed among the laboratory staff. There were no standard operating procedures for infection control for example; one staff would handle the microscope with gloved hands and another would do the same with bare hands. A similar practice was observed with the door handles. There were few infection control signs in the laboratory and the emergency shower was external to the laboratory building, under lock and key. Continuous medical education (CMEs) were rarely conducted on waste management even with the imminent threat of COVID-19.

Code	Age	Cadre	Gender	Years of experience and health facility
NRAMR1	23	Nurse	Male	6 months, Amuria Hospital
DOCAMR1	41	Medical Doctor	Male	9 years, Amuria Hospital
HAAMR1	28	Health assistant	Female	3 years, Amuria Hospital
NURAMR3	38	Senior Nursing officer	Female	6 years, Amuria Hospital
WICW		Nurse	Female	Amuria Hospital
WICM		Midwife	Female	Amuria Hospital
LIC		Laboratory technician	Male	Amuria Hospital
ICHC3		Clinical officers	Male	Asamuk, Abarirela, Wera, and Kuju Health Centre 111 respectively
NHC3		Enrolled Nurses	Female	Asamuk, Abarirela, Wera, and Kuju Health Centre 111 respectively
LTHC3		Lab assistants	Male	Asamuk, Abarirela, Wera, and Kuju Health Centre 111 respectively

HAAMR=Health Assistant at Amuria District Hospital (Acting in charge infection control), NURAMR1=Senior Nursing officer at Amuria District Hospital, DOCAMR1=Doctor at Amuria General Hospital (Acting Medical Superintendent), WICW=Ward incharge of children's ward, WICM=Ward incharge Maternity, LIC=Laboratory in charge Amuria Hospital, ICHC3=In charge health center three, NHC3=Enrolled nurse in Health Centre three, LTHC3=Laboratory assistants in Health Centre three

Theme 1: Capacity of health workers to implement infection control measures

The health care professionals acknowledge that there was a limited staff and those available were not trained in infection control. There is no training on infection control but instead, get knowledge during continuous medical education (CMEs) which were rarely carried out once a month.

"No actually that's another issue, no one has been trained thoroughly on infection control but we just have short sessions during CMEs(NURAMR3, Female, 38 years)".

"Lack of adequate training on infection control, most staff have received theoretical training in infection control but have no practical skills in infection control (NRAMR1. Male, 23 years)".

There is limited staffing and the only person trained in infectious waste management was transferred (DOCAMR1, male, 41 years)".

Theme 2: Availability of necessary supplies to implement Infectious Waste Management

Health care professionals at Amuria district hospital acknowledge that there is a limited

supply of equipment for infection control. While a national medical store (NMS) endeavors to supply some equipment like waste bins, they don't supply enough bin liners and the supplied waste bins are few. This has made most health care professionals mix infectious waste with one which is highly infectious and less infectious waste.

"We have several challenges in waste segregation, I have tried to educate the health workers but since we don't have enough supplies (waste bins, bin liners, gloves) it's hard to implement what I have taught. NMS which comes to pick up the waste don't take waste without bin liners, (HAAMR1, female, 28 years)".

"No, we just dispose of all (mixed up) because we have support staff (Medical Waste Handlers) who dispose it or empty the bins but they cannot segregate it due to lack of bin liners (HAAMR1, female, 28 years)".

"The challenges are with corded bins and bin liners, what is supplied by government are not enough for one quarter. Secondly, the incinerator is not functional, it produces excess heat, we are forced to dispose of waste outside the incinerator. (NURAMR3, Female, 38 years)".

“Sometimes we lack all the necessary infectious waste supplies and sometimes we have the bins but no liners. Maternity has the corded bins, children’s ward, and the private wing have bins but they lack liners (DOCAMR1, male, 41 years)”.

Theme 3: Capacity of Health Facilities to monitor Hospital-acquired infections

There is no functional infection control committee in the health facilities; however, the top management of the health facility encourages staff to use personal protective gear.

“We do have facility infection control committee (she goes silent) however, we have not had regular infection control committee meetings she stammers.HAAMR1, female, 28 years)”. We even don’t have infection control guidelines in place (NRAMR1. Male, 23 years)”.

4. DISCUSSION

In this study, we found out that, Knowledge of infectious waste Management as seen in the Table 1 among Health Care Workers in Amuria was fairly good except for Medical Waste Handlers who had poor knowledge. All (100%) of Medical doctors, laboratory technicians, and clinical officers were knowledgeable about diseases that can be transmitted as a result of poor infectious waste management. They were also knowledgeable about color codes used in medical waste segregation; they could identify biohazard symbols and knew that health care Waste is disinfected before disposal. Medical Waste handlers had poor knowledge in Infectious Waste Management; only 8.3% of the Medical Waste Handlers knew how medical waste is segregated at the point of collection and only 16.6% knew Medical Waste Management guidelines existed. This is because the rest of the Health Care Workers had acquired training in infection control while in medical, nursing, and allied health Institutions. The Medical waste handlers had no prior or in-service training in infectious Waste Management. These findings are in agreement with a study in Soroti Regional Referral Hospital (Muhwezi 2014) where they found medical waste handlers with little knowledge in handling medical waste because their education level was low. The health workers though fairly knowledgeable in infectious waste Management, were not up to date with current policies, guidelines in Infectious Waste Management. This is because they lacked in-service training and necessary supplies. These

findings are consistent with several studies conducted in Ethiopia, Kenya, Nigeria, and in West Nile Region in Uganda. A study conducted in Ethiopia [18] assessed knowledge, practice, and associated factors of infection prevention control among health care workers and revealed good knowledge of Infection Prevention among the majority of participants with a relatively minimal practice rate. Another study was done in Kenya that looked at Adherence to Infection Control Measures in level four district hospital found out that Health Care Workers had good knowledge of infection prevention and practice [19]. Another study conducted in Nigeria [20] found out that the majority of respondents were aware of biomedical waste management 94.7% and its health hazards at 86.9%.In Uganda, our findings are also consistent with the study conducted by Wasswa and the team where they found out that health care workers were fairly knowledgeable about most infection control measures. In the context of COVID-19, the Infection prevention goal is to support the maintenance of essential health care services by containing and preventing COVID-19 transmission within health care facilities to keep patients and health care workers safe and Healthy. For this goal to be achieved the health workers need to have a good level of knowledge in infectious Waste Management.

The Health care workers in Amuria had a positive attitude towards the improvement of their knowledge and skills of infectious Waste Management as seen in the Table 2, 95% of the Health workers would like to undergo in-service training in Infectious Waste Management. The majority of health workers (82.7%) felt that safe management of Health Care Waste was the responsibility of all the staff and 17.5% felt the management of Health Care Waste was an extra burden. Our findings are in agreement with the study by [21] where they found a favorable attitude of health workers towards biomedical waste management. The positive attitude towards the improvement of knowledge and skills of Infectious Waste Management in the context of COVID-19 Pandemic provides an opportunity to strengthen crucial aspects of the health care system that have been previously overlooked. These improvements will prove to be valuable not only during the COVID-19 pandemic but also in the fight against other infectious diseases and antimicrobial resistance [22].

In terms of practice, the laboratory technicians, medical waste handlers, and midwives did not

practice or follow safe Infectious Waste Management disposal guidelines. In Fig. 6 we see one color of bin liners used for all the dust bins and infectious waste was disposed off in a bin lined with a non-infectious waste bin liner, in Fig. 4 we see infectious waste dumped outside the incinerator by Medical Waste Handlers and in Fig. 5 used vaginal speculum is seen on washing tray in the maternity ward. In the context of COVID-19 practices seen in Figs 4, 5, and 6 are not acceptable because COVID-19 can easily thrive in such conditions. These findings are in agreement with a study done by(11)that revealed serious gaps and deficiencies related to segregation, collection, storage, and disposal of hospital wastes hence proving to be hazardous to patients as well as visitors.

We also found out that written infection prevention policies and procedures that are current and are based on evidence-based guidelines were not available in all (100%, 5/5) facilities assessed. The COVID-19 standard operating procedures charts were not pinned in notice boards and wards. There was no individual specifically trained in infection prevention and employed to manage the facility's infection control program. No staffs were trained in Prevention and Control of COVID-19 in 100% of facilities (they read about COVID-19 in published articles) All the facilities assessed had a system for early detection and management of potentially infectious persons at initial points of the patient encounter, this was positive finding in the face of COVID-19. Infection Control Training and Competency, all (100%) of the facilities assessed had no competency-based training program that provides job-specific training on infection prevention policies and procedures to health care personnel, this is a negative finding [20] noted that lack of adequate training on health care waste management may be responsible for improper waste management practices observed in health facilities hence on job training program and monitoring was necessary. The facilities had no documented exposure control plan that is tailored to specific requirements of the facility. On a positive note, in terms of surveillance and Disease Reporting, all (100% 5/5) facilities assessed had an updated list of diseases (COVID-19, Ebola, Cholera, etc) that are reportable to the Public health authority and were readily available to all personnel. The facilities also demonstrated knowledge and compliance with mandatory reporting requirements for Notifiable diseases and healthcare-associated infections. Patients who

undergo procedures at the facilities were educated on the signs and symptoms of infection that may be associated with the procedure (for example wound care after cesarean section delivery). On a sad note, for Hand Hygiene and use of personal protective gear, all health care workers are not educated regarding appropriate indications for hand hygiene in the face of COVID-19 upon hire, the facilities do not routinely audit adherence to hand hygiene and there are no policies to promote the preferential use of alcohol-based hand rub over soap and water in most clinical situations. For personal protective equipment, all the health care workers who used personal protective equipment (PPE) did not receive training on proper selection and use of PPE upon hire. The facilities do not routinely audit adherence to proper PPE selection and use. Injection Safety, Health care workers also demonstrated competency with safe injection practices possibly because of past training in health institutions. Respiratory Hygiene, the findings were very good probably because of COVID-19 pandemic; facilities assessed had policies and procedures to contain respiratory secretions in persons who have signs and symptoms of respiratory infections (COVID-19, Tuberculosis, etc), beginning at the point of entry to the facilities and continuing through the duration of the visit. The policies observed included offering masks to coughing patients, providing space in waiting rooms, and encouraging persons with symptoms of respiratory infections to sit as far away from others as possible. The facilities also educated HCW on the importance of infection prevention measures to contain respiratory secretions to prevent the spread of respiratory pathogens. All clients in the facilities were encouraged to follow COVID-19 standard operating procedures (wear masks, wash hands, avoid crowded spots, etc). Point of Care Testing, Poor infection control practices were observed among the laboratory staff. There were no standard operating procedures for infection control for example; one staff would handle the microscope with gloved hands and another would do the same with bare hands. A similar practice was observed with the door handles. There were few infection control signs in the laboratory and the emergency shower was external to the laboratory building, under.

lock and key. Continuous medical education (CMEs) were rarely conducted on waste management even with the imminent threat of COVID-19. The barriers and challenges noted in

the daily practice of Infectious waste management in Amuria District included; Lack of written Infection control policies and Procedures, Absence of in-service training in infection control, and lack of well-defined policies concerning contact of personnel with patients when personnel have the potentially transmissible condition. The other barriers noted included frequent stock-outs of waste bins and bin liners, the Absence of functional infection control committees, and limited human resources.

Our findings above are consistent with several studies that have demonstrated that most hospitals in developing countries have no effective infection control program due to lack of awareness of the problem, lack of personnel, poor water supply, and non-adherence to safe practices for health workers [6] and [20] found out that real practice of medical waste management was poor among the majority of respondents and the majority of them had not received training on infectious waste management subjects. In Uganda study conducted in Arua found out that most facilities (93.8%,30/32) in Arua district West Nile lacked infection control committees and adequate supplies or equipment for infection control. Besides they also noted that isolation, housekeeping, needle recapping, and use of personal protective gear were inadequately implemented. In Kenya the barriers noted in a study where they looked at health care worker adherence to Infection practices and Control included; frequent shortage of water, inadequate updates of infection control guidelines through continuous professional education, and ineffective infection control committees [19]. Another study in Nigeria [23] found out that selected health facilities in Nigeria were lacking in the adoption of sound waste management practices, this is in line with what we found in Amuria district.

5. LIMITATION OF THE STUDY

We had some limitations and first was recall bias and information bias (some respondents would give you the responses that are meant to please the interviewer). For example, Health Facility in charge can respond and say they have adequate personal protective gear, in face of COVID-19 just to impress the interviewer. The second limitation was the absence of some key staff during data collection. It was not possible to observe all the infection control activities in the health center 111 due to time constraints.

6. CONCLUSION

Health Care Workers in the Amuria district have fairly good knowledge of Infectious Waste Management in face of COVID-19 except for Medical Waste Handlers. Only 8.3% could identify biohazard symbols and knew how infectious waste is segregated into the different categories at the point of generation. Also, 16.6% of medical waste handlers knew biohazard waste management rules existed and 75% did not know that inappropriate disposal of biomedical waste results in environmental degradation. Only 33.3% of the Medical Waste handlers knew that health care waste should be disinfected before disposal. The medical waste handlers had poor knowledge because they did not have formal training in Infection control before and after they were employed. Health workers have a good attitude towards infectious Waste Management (they are willing to be trained) however they don't have an enabling environment to practice. The facilities in Amuria District lack current written policies, guidelines, materials that can be used for safe disposal of waste, and in-service training on infectious waste management. In addition the facilities lack functional infection control committees and have frequent stock outs of infection control supplies.

7. RECOMMENDATIONS

Medical Waste Handlers should be trained before and after they are employed. They should be given adequate protective gear and necessary waste bins. The incinerator should be rehabilitated and fenced off from the Public. The rest of the health care workers should receive continuous in-service training and necessary infection control policies, guidelines should be provided. The Ministry of Health Uganda should provide the necessary supplies and adequately monitor the implementation of Infection control measures in Health Facilities in the face of Covid-19.

CONSENT AND ETHICAL APPROVAL

Ethical approval was got from the institutional review board of Mbale hospital through Busitema University COBERS program. Permission to conduct the study in Amuria was also got from the district health officer and head of the facility. Written informed consent was obtained from all the respondents, after explaining the objectives of the study. Confidentiality was observed and

participants were free to withdraw from the study if they wished. Data collected was kept under lock and key by the principal investigator.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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