# Assessment of Health Care Workers' Knowledge Attitudes and Practices of Effective Management of Biomedical Waste in Dodoma City Tanzania

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*Abstract:* **Background: Biomedical waste mismanagement has been and continues to be a hazardous health risk to health personnel and the general public. This study endeavoured to identify and asses' knowledge, attitudes and practices effect biomedical waste management with particular focus on those handling biomedical wastes.**

*Methods:* **The study used cross-sectional research design. The study was conducted in hospitals, health centres and dispensaries in Dodoma City, Tanzania. The population of the study consisted of all health staff of health facilities in Dodoma City, Tanzania. A total of 142 health care workers participated in the study. Structured questionnaire was used to collect Quantitative data and analysed using descriptive statistical techniques guided by the Statistical Package for Social Sciences (SPSS) version 20 (IBM Corp., Armonk,NY).**

*Results:* **The findings indicated that 96.5% of health care workers were aware that improper management of biomedical wastes lead to various health hazards. 97.9% of the participants indicated that mismanagement of biomedical wastes resulted in environmental problems. 73.2% of the participants stated that dumping of biomedical waste directly into garbage bins for removal and direct incineration were mostly used as methods of biomedical wastes disposal. The result revealed that a significant proportion of staff (80.3%) had not received adequate training related to biomedical waste management.**

*Conclusion*: **Health care workers in Dodoma city demonstrated good knowledge of the impact of improper management of health care waste had positive attitude and mindsets towards effective management of health care waste and had poor practice of biomedical waste in Dodoma City in Tanzania.**

*Recommendation*: **In Tanzania there is a need to build a comprehensive system that addresses and defines clearly the responsibilities, and resource allocation criteria for handling and disposing Biomedical wastes.**

*Keywords*: **Assessment, health care workers, knowledge, attitude, practice, effective management, Biomedical waste**

## I. INTRODUCTION

### A. *Background to the Study*

Medical waste management has become one of the major problems facing health care facilities worldwide. The problem is aggravated by the lack of or inadequate knowledge, staff attitudes, practices and regulated waste management services. Health care workers, particularly the waste handlers are mostly involved in waste management services need mitigation against potential risks (Deress *et al.*, 2019).

Manzoor and Sharma (2019) report that inadequate, unscientific and unregulated management of biomedical waste is linked to risks impacting people who are directly and indirectly associated with biomedical wastes. Biomedical waste does cause challenges such as threatening the quality of water, air, and soil. Several studies have reported that the proportions of different constituents of wastes, their handling, treatment, and disposal methods have been found to be inadequate in most of the studies (Manzoor and Sharma 2019). Also Manzoor and Sharma (2019) added that the hazard associated with poor biomedical waste management and pertinent shortfalls in the existing systems have been identified by various researchers as the main concerns for the people's health and living conditions.

Gap in knowledge and practice in medical waste management are high among health care workers (Mugabi *et al.*, 2018). The negative attitude of health care providers about the need to adhere to set regulations in waste management has been reported in previous studies to be responsible for health conditions caused by mismanagement of biomedical waste (Mugabi *et al.*, 2018), outcomes do affect the smooth provision of essential hospital services. The studies have also reported increasing home deliveries in African countries due to poor attitudes of health care providers on the need for expedient removal and management of wastes especially the biomedical wastes (Oyefabi and Yahuza, 2016). The key factors contributing to the poor management of biomedical wastes include the knowledge base, attitudes and behaviors of health care workers in different health care settings (Mohamed *et al.*, 2019). They further explained that health care staff must have an appropriate level of befitting knowledge, positive attitudes towards the need for clean environments and practices or timely actions appropriate for handling medical wastes in manners that positively impact the people's lives, the general community and the general environment. Health workers in Uganda who had received training in HCW management were more likely to demonstrate good practices in ensuring the people's health (Wafula *et al.*, 2019). They further opined that similar findings from a study in Ethiopia revealed that health workers

trained in waste management were more likely to exhibit satisfactory practices and behaviours relating to HCW management. They also recommended that training should therefore be recognized and intensified if the practices and attitude of health care workers are to effectively support and ensure the people's healthy living. Most results from literature reported inadequate health workers' knowledge, inappropriate attitude and inadequately responsible practices in involvement with biomedical wastes despite of many recommendations for corrective actions by different researchers, a high gap still exists in the implementation of the recommendations. It was established that there was not much improvement in practice following recommendations by different researchers. The current study provides yet other recommendations that are hopefully.

The aim of this study was to assess the current knowledge, attitude and practices of biomedical waste management among the health care workers in Dodoma city in comparison with international best practices in consonance with approved standards at national and regional levels. Appropriate management of health care waste through efficient and effective waste managemeñt is therefore a crucial component of environmental health protection and should be recognized as an integral feature of health care services worldwide.

B.  Statement of the Research Problem:

In the city of Dodoma, clinical waste has been observed in dumpsites alongside other domestic, business, industrial and environmental waste without any control measures as special waste that is bound to threaten and put at risk human health and contaminate the environment. The use of incineration to dispose medical waste is the common practice in the city health facilities. However, the release of matching air pollutants still constitutes an environmental health threat to humans and domesticated animals.

According to Zilihona*et al.* (2013), the major effects of uncollected or poorly managed waste are rampant in Dodoma city lead to epidemics (87.0%), air pollution (34.5%), environmental dirt (27.5%). These problems are due to poor waste collection and disposal technologies and infrastructures such as sanitary land filling, compositing, incineration.

Inadequate research, lack of appropriate modern technologies, limited capacity among health stakeholders and poor information flow among concerned stakeholders of the health sector stand as bottlenecks to intended strategies to curb the waste management problem. Dodoma City should scale up its effort to better manage wastes from all sources and so guarantee good human, animal and environmental health for the city dwellers. Tanzania does not have standard procedures for the segregation of waste produced in medical establishments. As a result, mistakes are bound to be committed in classifying wastes leading to the risk of a person accidentally coming into contact with hazardous waste. Improper management of wastes can result in the spread of infectious diseases such as HIV/AIDS, Hepatitis A, B and C,

Tuberculosis, pneumonia, diarrheal diseases, tetanus, and whoopingcough.

Currently there are no specific studies done on knowledge bases, attitudinal expositions and practice relating to Biomedical Wastes management in the city of Dodoma. Given this gap, this study aimed to assess the knowledge bases, attitudes and practice of health care staff in respect of biomedical waste management in Dodoma health facilities.

The researcher hopes that this study will add new and relevant knowledge to the available collection of literature on safe management of biomedical waste. It will also improve the behavioural and attitudinal outlooks and modes of actions of health care staff in the management of biomedical waste.

C.  General Research Objective

The main objective of the study was to assess the knowledge, attitudes and practices of health care workers in biomedical waste management with particular focus on the city of Dodoma.

D.  Specific Research Objectives

   i.  To assess the level of health care workers' knowledge of effective management of biomedical waste
  ii.  To determine the attitude of health care workers' towards effective management of biomedical waste
 iii.  To determine the health care workers' practice of effective management of biomedical waste

*Hypothesis.*

E.  Significance of the Research

The study adds new and relevant knowledge to the available collection of literature on safe handling and general management of biomedical waste. It will contribute towards improved attitude and behaviour and practices of health care workers in the management of biomedical waste in consonance with the current and emerging global trends in improvement of living and working environment. The study will provide valuable information for health policy makers, waste management regulatory authorities, health service providers, development support groups and all other health stakeholders.

II.  MATERIALS AND METHODS

A.  Study Area

The study was conducted at Hospitals, health centers and dispensaries in Dodoma City which are located in Dodoma urban which is among the seven districts in Dodoma region, the other districts include Bahi District, Chamwino District, Chemba District, Kondoa, Kongwa and Mpwapwa.

Dodoma District is Located at 6°10′23″S 35°44′31″E, in the centre of Tanzania, the district has an area of 2,576 km$^2$ of the region which is about 41,310 km$^2$ and 410,956 of population out of 2,083,588 population of the whole region according to

the 2012 national census.

Health services in Dodoma city are provided by the Government, NGO's and a growing number of Health Centres, private dispensaries and pharmacies. The city has mobile clinics which normally operate during local and national vaccination campaigns to reduce maternal mortality and infant mortality rates and manage the spread of HIV-AIDS Infection. According to the 2012 national census the city has 4 hospitals, 6 health centers 51 dispensaries, 4 special clinics and 56 outreach and mobile clinics owned by the government, parastatal and private organizations. Dodoma city is one of the newly established and growing cities in Tanzania. Dodoma city had a total population of 410,956 people per the 2012 census(Nyampundu*et al.*, 2020).

*B.      Study Design*

The study used a cross-sectional design method that applied quantitative research strategy. The study was conducted from August 2019.

*C.      Study Population*

According to Saunders *et al.* (2009), a population is the full set of cases from which a representative sample is taken for detailed study. The targeted population for this study ware staff of the health facilities in Dodoma city including doctors, nurses, pharmacists, laboratory personnel, and other health support staff.

*D.      Sampling Procedure and Sample Size*

The study employed multi-stage sampling procedure. Stage 1.selection of 12 health facilities using simple random sampling technique without replacement. Stage 2.selection of 146 health care workers using simple random sampling technique without replacement.

*E.      Type of Data*

In this study primary data was collected from the sample using structured questionnaires. The study applied primary data collection method, to obtain data directly from the selected institutions.

*F.      Ethical Clearance*

An approval to conduct this study was sought from the Open University of Tanzania (OUT) prior to going for field data collection. Due permission was also obtained from the relevant authorities at District level from the District Medical Officer (DMO) and at facilities level where the study was scheduled to be conducted. Request for consent to participate in the study was also sought from the potential participants. Confidentiality was assured to the respondents of the questionnaires that the data collected was for academic purposes only. The investigator was not directly involved nor in contact with the biomedical waste and hence safety in contact with the respondents was further enhanced.

*G.      Data Collection Methods*

Pre-Testing of the Questionnaire: Prior to data collection, a pre-test of the data collection tool was done on Health care workers in the same study population in order to see how the target population understood the questions in the data collection tool. The pre-testing enabled the refinement of the questionnaire.

*H.  Data Analysis*

In this study, all collected data was coded, categorized and ordered according to the emergent categories of the responses. The collected data was processed with the help of the computer SPSS software statistical package version 20 (IBM Corp., Armonk, NY) and analyzed statistically using descriptive statistical techniques giving frequencies and percentages and compare significant relationship between different variables by using p-values of Chi-square inferential statisticaltest.

## III. RESULTS

*A.      Response Rate:*

Of the expected 150 health care workers lined up in the research proposal to participate in the study, being 50 in hospitals, 50 in health centers and 50 in dispensaries only 142 (94.7%) made themselves available as follows: 40 from hospitals, 62 from health centers and 40 from the dispensaries.

*B.      Demographic Characteristics of the Respondents:*

The results in Table 1 below show that, data was collected from health centers which represented 62 (43.7%) of all the health facilities involved, hospitals 40 (28.2%) and dispensaries 40 (28.2%). The work experience of the majority of the respondents was lessthan1year, that is 45(31.7%), 1-5 years were 43(30.3%), 6-10 years 25(17.6%), above 20 years 17(12.0%), and 11-20 years 12 (8.5%).

The gender analysis of the respondents indicated that female employees were the majority, that is 88 (62.0%) and males were 54 (38.0%). The age group analysis showed that the 19 or below year olds were 1 (0.7%), 20-29 years' group were77 (54.2%), 30-39 were 32(22.5%), 40-49were17(12.0%),50 years and above were 15 (10.6%)

The distribution of the respondents by field profession was nurses 52 (36.6%), pharmaceutical personnel 40 (28.2%), clinicians (MD, AMO, CO) 32 (22.5%), laboratory personnel 16 (11.3%) and cleaners 2 (1.4%). By the level of education, the respondents were postgraduate qualification holders, 1 (0.7%); diploma holders, 69(48.6%), graduates  34 (23.9%), certificate holders  28(19.7%), secondary education 6 (4.2%), and primary education 4(2.8%).

Table 1. Demographic Characteristics of the Study Population

| Demographic characteristics | Valid | Frequency | Percent | Valid percent | Cumulative percent |
|---|---|---|---|---|---|
| Category of health facility | Hospital | 40 | 28.2 | 28.2 | 28.2 |
| | Health center | 62 | 43.7 | 43.7 | 71.8 |
| | Dispensary | 40 | 28.2 | 28.2 | 100.0 |
| | Total | 142 | 100.0 | 100.0 | |
| Gender of HCW | Male | 54 | 38.0 | 38.0 | 38.0 |
| | Female | 88 | 62.0 | 62.0 | 100.0 |
| | Total | 142 | 100.0 | 100.0 | |
| Age group of HCW | 19 or below | 1 | 0.7 | 0.7 | 0.7 |
| | 20-29 | 77 | 54.2 | 54.2 | 54.9 |
| | 30-39 | 32 | 22.5 | 22.5 | 77.5 |
| | 40-49 | 17 | 12.0 | 12.0 | 89.4 |
| | 50 or above | 15 | 10.6 | 10.6 | 100.0 |
| | Total | 142 | 100.0 | 100.0 | |
| Field profession of HCW | Clinicians (MD,AMO,CO) | 32 | 22.5 | 22.5 | 22.5 |
| | Nurses | 52 | 36.6 | 36.6 | 59.2 |
| | Pharmaceutical personnel | 40 | 28.2 | 28.2 | 87.3 |
| | Laboratory personnel | 16 | 11.3 | 11.3 | 98.6 |
| | Cleaners | 2 | 1.4 | 1.4 | 100.0 |
| | Total | 142 | 100.0 | 100.0 | |
| Highest level of education to HCW | Primary school | 4 | 2.8 | 2.8 | 2.8 |
| | Secondary school | 6 | 4.2 | 4.2 | 7.0 |
| | Certificate | 28 | 19.7 | 19.7 | 26.8 |
| | Diploma | 69 | 48.6 | 48.6 | 75.4 |
| | Graduate | 34 | 23.9 | 23.9 | 99.3 |
| | Postgraduate | 1 | 0.7 | 0.7 | 100.0 |
| | Total | 142 | 100.0 | 100.0 | |
| Working experience of HCW in years | Less than 1 year | 45 | 31.7 | 31.7 | 31.7 |
| | 1-5 years | 43 | 30.3 | 30.3 | 62.0 |
| | 6-10 years | 25 | 17.6 | 17.6 | 79.6 |
| | 11-20 years | 12 | 8.5 | 8.5 | 88.0 |
| | Above 20 years | 17 | 12.0 | 12.0 | 100.0 |
| | Total | 142 | 100.0 | 100.0 | |

*C.* *Assessment of Knowledge Level of the Respondents:*

The results in Table 2 below show that, 137 (96.5%) of health care workers were aware that improper waste management causes various health hazards, 3 (2.1%) said No and 2 (1.4%) did not know improper waste management causes health hazards or not.

A total of 101 (71.1%) respondents said that the government of Tanzania provided guidelines for biomedical waste management, 11 (7.7%) respondents said No to this item and the other 30 (21.1%) respondents they did notknow.

A total of 55 (38.7%) of the respondents informed that Biomedical wastes were disposed by dumping directly into garbage bins, 49 (34.5%), respondents said this was done by incineration, 24 (16.9%) said it was done by handing it over togarbage collectors and 14 (9.9%) opined that the waste was disposed by handing it over to a biomedical waste management (BMWM) agency. Ninety-two (92) respondents (64.8%) observed that maintaining records of biomedical waste (BMW) was mandatory in their health facilities, 28 (19.7%) did not know and 22 (15.5%) said no records of WM werekept.

A total of 139 (97.9%) of the respondents said they were aware that improper waste management causes environmental problems and only 3 (2.1%) respondents saidno.

Table 2. Summary of the Knowledge Base of Health Care Workers

| Knowledge assessment | Valid | Frequency | Percent | Valid percent | Cumulative percent |
|---|---|---|---|---|---|
| Can improper waste management cause health hazards? | Yes | 137 | 96.5 | 96.5 | 96.5 |
| | No | 3 | 2.1 | 2.1 | 98.6 |
| | Don't know | 2 | 1.4 | 1.4 | 100.0 |
| | Total | 142 | 100.0 | 100.0 | |
| Are guidelines for BMWM provided by government of Tanzania? | Yes | 101 | 71.1 | 71.1 | 71.1 |
| | No | 11 | 7.7 | 7.7 | 78.9 |
| | Don't know | 30 | 21.1 | 21.1 | 100.0 |
| | Total | 142 | 100.0 | 100.0 | |
| How is BMW Disposed in your health facility? | Dump directly into garbage bins | 55 | 38.7 | 38.7 | 38.7 |
| | Handing it over to garbage collectors | 24 | 16.9 | 16.9 | 55.6 |
| | Handing it over to BMWM agency | 14 | 9.9 | 9.9 | 65.5 |
| | Incineration | 49 | 34.5 | 34.5 | 100.0 |
| | Total | 142 | 100.0 | 100.0 | |
| Is maintaining BMW records mandatory in your health facility? | Yes | 92 | 64.8 | 64.8 | 64.8 |
| | No | 22 | 15.5 | 15.5 | 80.3 |
| | Don't know | 28 | 19.7 | 19.7 | 100.0 |
| | Total | 142 | 100.0 | 100.0 | |
| Does improper waste management cause Environmental problems? | Yes | 139 | 97.9 | 97.9 | 97.9 |
| | No | 3 | 2.1 | 2.1 | 100.0 |
| | Total | 142 | 100.0 | 100.0 | |

*D.        Health Care Workers' Attitude Assessment:* The results in Table 3 below show that, 129 (90.8%) of the respondents had positive attitude towards safe management of biomedical waste while 13 (9.2%) negative attitude. A total of 116 (81.7%) of the respondents said safe management of health care waste is the responsibility of government and 26 (18.3%) said that is not for the government to manage waste. A total of 113 (79.6%) of the respondents agreed that waste management is a matter of team work while 29 (20.4%) said no. A total of 54 (38.0%) of the respondents said safe management efforts by hospitals increases financial burden on managements and 88 (62.0%) said no to this question, that is it does not increase financial burden on management. 121 (85.2%) respondents said safe management of health care waste is not an extra burden on their work and 21 (14.8%) said that is an extra burden on work.

Table 3. Summary of Health Care Workers' Attitude Assessment

| Attitude assessment | Valid | Frequency | Percent | Valid percent | Cumulative percent |
|---|---|---|---|---|---|
| Safe management of health care waste is not an issue at all? | Yes | 13 | 9.2 | 9.2 | 9.2 |
| | No | 129 | 90.8 | 90.8 | 100.0 |
| | Total | 142 | 100.0 | 100.0 | |
| Safe management of health care waste is the responsibility of government? | Yes | 26 | 18.3 | 18.3 | 18.3 |
| | No | 116 | 81.7 | 81.7 | 100.0 |
| | Total | 142 | 100.0 | 100.0 | |
| Waste management is team work/no single class of people is responsible for safe management? | Yes | 113 | 79.6 | 79.6 | 79.6 |
| | No | 29 | 20.4 | 20.4 | 100.0 |
| | Total | 142 | 100.0 | 100.0 | |
| Safe management efforts by hospital increases financial burden on management? | Yes | 54 | 38.0 | 38.0 | 38.0 |
| | No | 88 | 62.0 | 62.0 | 100.0 |
| | Total | 142 | 100.0 | 100.0 | |
| Safe management of Health Care waste is an extra burden on work? | Yes | 21 | 14.8 | 14.8 | 14.8 |
| | No | 121 | 85.2 | 85.2 | 100.0 |
| | Total | 142 | 100.0 | 100.0 | |

*E.  Assessment of the General Conduct or Practice of Health Care Workers:*

The results in Table 4 below show that, a total of 133 (93.7%) respondents said different coloured bags were used to dispose different types of waste, 5 (3.5%) respondents said No to this item and 4 (2.8%) said they did not know. A total of 43 (30.3%) respondents said used disposable plastic items were disposed of in Yellow bags, 50 (35.2%) in Red bags, 15 (10.6%) in Black bags and 34 (23.9%) said they did not know.

While 15 (10.6%) of the respondents said soiled dressings and impression materials were disposed of in Blue/White bags, 63(44.4%) said this was done in Red bags, 30 (21.1%) in Black bags and 34 (23.9%) did not know.A total of 103 (72.5%) of the respondents said used sharps and needles were disposed of in Safety boxes, 19 (13.4%) in Red boxes, 9 (6.3%) in Yellow bags, and 11 (7.7%) said they did not know. A total of 97 (68.3%) of the respondents said extracted teeth and human tissue were disposed of in Red bags, 9 (6.3%) in Yellow bags, 5 (3.5%) in Black bags, and 31 (21.8%) they did not know.A total of 55 (38.7%) of the respondents said plaster of Paris (POP) was disposed of in Yellow bags, 30 (21.1%) in Black, 2(14.1%) in Red and 37 (26.1%) did not know.

Table 4. Assessment of Practice Roles of Health Care Workers

| Practice assessment | Valid | Frequency | Percent | Valid percent | Cumulative percent |
|---|---|---|---|---|---|
| Amount of waste generated per day? | 0-2Kg | 12 | 8.5 | 8.5 | 8.5 |
| | 2-4Kg | 57 | 40.1 | 40.1 | 48.6 |
| | Above 4kg | 73 | 51.4 | 51.4 | 100.0 |
| | Total | 142 | 100.0 | 100.0 | |
| Whether there is waste segregation before disposal? | Yes | 124 | 87.3 | 87.3 | 87.3 |
| | No | 18 | 12.7 | 12.7 | 100.0 |
| | Total | 142 | 100.0 | 100.0 | |
| Whether different coloured bags are used to dispose different types of waste? | Yes | 133 | 93.7 | 93.7 | 93.7 |
| | No | 5 | 3.5 | 3.5 | 97.2 |
| | Don't know | 4 | 2.8 | 2.8 | 100.0 |
| | Total | 142 | 100.0 | 100.0 | |
| Colour of bags in which plastic items (e.g., catheter) are disposed of in? | Yellow bags | 43 | 30.3 | 30.3 | 30.3 |
| | Red bags | 50 | 35.2 | 35.2 | 65.5 |
| | Black bags | 15 | 10.6 | 10.6 | 76.1 |
| | Don't know | 34 | 23.9 | 23.9 | 100.0 |
| | Total | 142 | 100.0 | 100.0 | |
| Colour of bags in which Soiled dressings and used impression materials are disposed of in? | Blue/white bags | 15 | 10.6 | 10.6 | 10.6 |
| | Red bags | 63 | 44.4 | 44.4 | 54.9 |
| | Black bags | 30 | 21.1 | 21.1 | 76.1 |
| | Don't know | 34 | 23.9 | 23.9 | 100.0 |
| | Total | 142 | 100.0 | 100.0 | |
| Colour of bags in which sharps and needles are disposed of in? | Yellow bags | 9 | 6.3 | 6.3 | 6.3 |
| | Satety box | 103 | 72.5 | 72.5 | 78.9 |
| | Red bags | 19 | 13.4 | 13.4 | 92.3 |
| | Don't know | 11 | 7.7 | 7.7 | 100.0 |
| | Total | 142 | 100.0 | 100.0 | |

| Colour of bags in which Extracted teeth and human tissue are disposed of in? | Yellow bags | 9 | 6.3 | 6.3 | 6.3 |
|---|---|---|---|---|---|
| | Red bags | 97 | 68.3 | 68.3 | 74.6 |
| | Black bags | 5 | 3.5 | 3.5 | 78.2 |
| | Don't know | 31 | 21.8 | 21.8 | 100.0 |
| | Total | 142 | 100.0 | 100.0 | |
| Colour of bags in which Plaster of Paris is | Yellow bags | 55 | 38.7 | 38.7 | 38.7 |
| | Red bags | 20 | 14.1 | 14.1 | 52.8 |
| | Black bags | 30 | 21.1 | 21.1 | 73.9 |

| disposed of in? | Don't know | 37 | 26.1 | 26.1 | 100.0 |
|---|---|---|---|---|---|
| | Total | 142 | 100.0 | 100.0 | |

*F. Assessment of Knowledge base and Working Experience of Health Care Workers:*

The results in Table 5 below show that, there is a significant relationship (p < 0.05) between improper waste management to and various health hazards for staff with working experience.

The remaining indicators of knowledge status are not significant to working experience (p>0.05).

Table 5. Summary of Chi-square Analysis Testing the Null Hypothesis of no Significant Difference in the Experience Knowledge Base Assessment.

| Experience Knowledge base assessment | | Working experience of HCW in years | Yes | No | Don't know | Total | Chi-square | Df | P value | Decision |
|---|---|---|---|---|---|---|---|---|---|---|
| Can improper waste | waste | Less than 1 | 44 | 0 | 1 | 45 | | | | |
| management cause health | health | 1-5 years | 42 | 1 | 0 | 43 | | | | |
| hazards? | | 6-10 years | 25 | 0 | 0 | 25 | | | | |
| | | 11-20 years | 9 | 2 | 1 | 12 | | | | |
| | | Above 20 years | 17 | 0 | 0 | 17 | | | | |
| | | Total | 137 | 3 | 2 | 142 | 2.015 | 8 | 0.010 | Accept |
| Are guidelines for BMWM | | Less than 1 | 31 | 2 | 12 | 45 | | | | |
| provided by the government? | | 1-5 years | 27 | 5 | 11 | 43 | | | | |
| | | 6-10 years | 20 | 0 | 5 | 25 | | | | |
| | | 11-20 years | 9 | 2 | 1 | 12 | | | | |
| | | Above 20 years | 14 | 2 | 1 | 17 | | | | |
| Total | | | 101 | 11 | 30 | 142 | 9.921 | 8 | 0.271 | Reject |
| Is maintainingBMWrecords | | Less than1 | 27 | 5 | 13 | 45 | | | | |
| mandatory in your health | | 1-5 years | 24 | 8 | 11 | 43 | | | | |
| facility? | | 6-10 years | 17 | 7 | 1 | 25 | | | | |
| 11-20 years | | | 9 | 1 | 2 | 12 | | | | |
| | | Above 20 years | 15 | 1 | 1 | 17 | | | | |
| | | Total | 92 | 22 | 28 | 142 | 14.639 | 8 | 0.067 | Reject |
| Does improper waste | | Less than 1 | 43 | 2 | 0 | 45 | | | | |
| management cause | | 1-5 years | 42 | 1 | 0 | 43 | | | | |
| Environmental problems? | | 6-10 years | 25 | 0 | 0 | 25 | | | | |
| | | 11-20 years | 12 | 0 | 0 | 12 | | | | |
| | | Above 20 years | 17 | 0 | 0 | 17 | | | | |
| | | Total | 139 | 3 | 0 | 142 | 2.358 | 4 | 0.067 | Reject |

*G. Attitude Assessment of Health Care Workers Based on their Level of Education:*

All indicators of attitude assessment shown in table 6 below are not significant in relation to level of education in biomedical waste management (p > 0.05).

Table 6.Summary of Chi-Square Analysis Testing the Null Hypothesis of no Significant Difference in the Attitude ff Health Care Workers' Base on Educational Attainment

| Attitude assessment | | Highest level of education to HCWs | | | | | | Total | Chi-square | Df | P value | Decision |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Pri edu | Sec edu | Cert | Dip | Gra | Posgra | | | | | |
| Safe management of health care waste is not an issue at all | Yes | 1 | 2 | 3 | 6 | 1 | 0 | 13 | 7.204 | 5 | 0.206 | |
| | No | 3 | 4 | 25 | 63 | 33 | 1 | 129 | | | | Rejected |
| | Total | 4 | 6 | 28 | 69 | 34 | 1 | 142 | | | | |
| Safe management of health care waste is the responsibility of government | Yes | 1 | 2 | 8 | 10 | 5 | 0 | 26 | | | | |
| | No | 3 | 4 | 20 | 59 | 29 | 1 | 116 | | | | |
| | Total | 4 | 6 | 28 | 69 | 34 | 1 | 142 | 4.188 | 5 | 0.523 | Rejected |
| Waste management is team work/no single group is responsible for such safety | Yes | 2 | 4 | 22 | 57 | 27 | 1 | 113 | | | | |
| | No | 2 | 2 | 6 | 12 | 7 | 0 | 29 | 3.433 | 5 | 0.633 | |
| | Total | 4 | 6 | 28 | 69 | 34 | 1 | 142 | | | | Rejected |
| Safe management efforts by hospital increases financial burden on management | Yes | 1 | 3 | 7 | 31 | 11 | 1 | 54 | | | | |
| | No | 3 | 3 | 21 | 38 | 23 | 0 | 88 | 6.158 | 5 | 0.291 | |
| | Total | 4 | 6 | 28 | 69 | 34 | 1 | 142 | | | | Rejected |
| Safe management of Health Care waste is an extra burden at work | Yes | 1 | 0 | 5 | 10 | 4 | 1 | 21 | | | | |
| | No | 3 | 6 | 23 | 59 | 30 | 0 | 121 | 7.595 | 5 | 0.180 | Rejected |
| | Total | 4 | 6 | 28 | 69 | 34 | 1 | 142 | | | | |

## IV. DISCUSSION

Assessment of Knowledge base of Health Care Workers: The findings of the present study conducted in Dodoma, Tanzania indicated that most health care workers had adequate knowledge about the hazards of improper biomedical waste management to communities and the environment. They demonstrated adequate knowledge of management of biomedical waste which can reduce direct health impact on the community, the health care workers and the environment. These findings are similar to the findings of a study conducted in Brazil by Da Silva *et al.* (2020) which revealed that risks to health and environment can be caused by improper management and disposal of waste.

This finding is supported by the findings of a study conducted in Uganda by Wafula*et al.* (2019) which reported that, the risk of hazards such as injuries, infections (HIV/AIDS, Hepatitis B and C), and environmental pollution were caused by improper health care waste management. Another study conducted in India by Patil (2015) reveals that more than 50,000 people die every day from infectious diseases, and one of major causes is the increase in infectious diseases due to improper waste management.

The findings of the present study, was more surprising that two disposal methods, namely dumping directly into garbage bins and incineration were associated with the greatest health risk were used in many health facilities. This is in agreement with the finding of a study in Ethiopia by Yazie*et al.* (2019)

which revealed that incineration is the most widely used waste treatment method to treat hazardous HCW before their final disposal.

In Nigeria a study found a lot of open dumping of potentially infectious materials and general absence of incinerators to treat waste materials (Anozie*et al.,* 2017). The present study also revealed similar findings with those of Hossain (2018) in Dhaka city Bangladesh who found that, open dumping is very basic in developing nations because of low financial bases. Nonetheless, in this study a good number of health care workers also agreed that maintaining records of biomedical waste (BMW) was mandatory in their health facilities.

The findings of this study indicated that most health workers in Dodoma demonstrated positive attitudes towards safe management of biomedical waste. This was similar to the findings in a study conducted in Ethiopia by Abdela*et al.* (2016) who revealed that, in the overall, attitudes towards Hepatitis B Virus (HBV) prevention among the participants was favourable when prevention was connected with biomedical waste management. However, a study in Nigeria by Anozie*et al.* (2017) showed that, all the healthcare managers admitted that their activities with respect to healthcare waste management and occupational safety procedures had never been subjected to scrutiny by relevant government agencies. All the respondents in this study showed willingness to improve their current practices in the interest of the health of staff, patients and the community.

Another similar study in Oman byAl-balushi and Muqeet (2018) reported that biomedical waste management should be a team work responsibility which concurs to the findings of this study and the majority of them followed universal precautions while handling biomedical waste. But the findings of the present study disagree with those in a study conducted in Ethiopia byDeress*et al.* (2019) who reported that the level of attitude score for health care staff attitudes towards BMWM was unsatisfactory and their use of appropriate personal protective devices and waste management utilities were limited. Furthermore, a study conducted in Botswana by Mugabi*et al.* (2018) showed that, in terms of attitude, most respondents agreed that medical waste should be segregated at the point where it is generated. A study in Uganda conducted by Sani (2016) revealed that, in terms of attitudes towards BMW, the majority of multipurpose staff felt that the segregation of BMW is not an issue at all and it is purely the responsibility of the concerned institution and not individual responsibility, also they felt that the safe segregation of BMW is an extra burden at their work, and all doctors felt that Safe segregation of Health Care waste is an extra burden to their work, this can cause health risk to health care workers and the public in general. In the present study it was observed that, waste produced in the course of health care activities carries a higher potential for infection and injury than any other type of waste. Again, inadequate and inappropriate attitude in handling health care waste may have serious health consequences and a significant impact on the environment as well. Da Silva *et al.* (2020) reports similar findings in Brazil. Therefore, Tanzania generally needs to promote positive attitudes, commitment and team work in overcoming consequences related to ill-effects of health care wastes. The results show that a high number of health facilities do produce more wastes than low level health facilities.

A study conducted by Kuchibanda *et al.* (2015) in Shinyanga municipality, Tanzania showed that, the increase of healthcare facilities has resulted in an increase in healthcare wastes, which poses serious threats to the environment, the health status of workers, and the general environment.

In the present study, segregation of biomedical waste was mostly conducted in many health facilities but proper segregation practice was not observed in most of health facilities. General waste and sharps waste were observed mixed in common waste collection vessels. The results concur withAnozie*et al.* (2017) in Nigeria who reported that hazardous waste were not properly collected, segregated and disposed in an appropriate manner and that there was a lot of open dumping of potentially infectious materials and general absence of incinerators to treat waste materials. The finding is in agreement with Kuchibanda*et al.* (2015) in Shinyanga municipality who found that awareness about practical actions on waste colour coding is still poor leading to high health risks for the general public. Another study conducted in Ethiopia by Deress*et al.* (2019) reported that health care practice scores were unsatisfactory despite their use of appropriate personal protective gear and waste management precautions. Also a study in Botswana conducted byMugabi*et al.* (2018) pertaining to the practical handling of biomedical waste agreed with this study particularly in that there was a colour-coding system in the hospitals studied. These findings are similar to study from South-Eastern Nigeria, where Anozie*et al.* (2017) reported that 98.1% of hospitals in the region practiced indiscriminate disposal of biomedical waste. It is therefore recommended that proper segregation of healthcare waste must follow standardized procedures, according to national and international guidelines. In addition, Section 92(a) of the Tanzania Public Health Act emphasizes that, the concerned authority shall, in collaboration with the Ministers responsible for health, environmental management agencies and local government, ensure that health care wastes are sorted and stored in prescribed coded containers and transported in waste trucks designed and registered for the purpose. Strong enforcement of this law is needed in order to maintain good practices of biomedical waste management and so avoid hazards associated with improper disposal of biomedical waste. Generally, most health care workers in Dodoma city do not demonstrate safe management of health care waste for most of them do not observe the prescribed use of coloured bags. The results of the present study failed to show good correlation between health workers' knowledge levels, attitudes and practices relating to biomedical waste management. The situation is closely similar to that observed in a study from South-Eastern Nigeria, where Anozie*et al.* (2017) reported that 98.1% of hospitals in the region practiced indiscriminate waste disposal, while 40% of healthcare managers reporting having received basic training in medical waste management. However, the above observations are in disagreement to the findings of a study conducted in Uganda by Wafula*et al.* (2019) who reported that the conduct and practices of health workers on HCW management were satisfactory. The finding from Uganda relates to appreciable knowledge as there was significant association between practice and knowledge scores ($p < 0.001$). It is very clear from the various studies reviewed in the literature that there is a big lack of knowledge, befitting attitudes and practices for effective BMW management amongst medical and health care staff especially in developing countries including Tanzania.

## V. CONCLUSIONS

Health care workers in Dodoma city demonstrated good awareness of the impact of improper management of health care waste. A total of 96.5% of health care workers were aware that improper waste management causes various health hazards and 97.9% were aware that improper waste management causes environmental problems.

It was also observed that two waste disposal methods (dumping directly into garbage bins and incineration) which were associated with the greatest health risk were mostly seen in many health facilities. 38.7% of wastes were disposed by dumping directly into garbage bins, and by incineration

(34.5%) making a total of 73.2% significant statistic for the two methods.

Guidelines related to biomedical waste management were not adequately implemented in some of the health facilities in Dodoma City. Different kinds of flyers were found for the purpose of creating public awareness about the risks of mismanaging biomedical wastes but most of the health workers were not aware of the existence of the fliers for the same were not placed in all units of health facilities.

On average it was interesting that most of health workers in Dodoma city had positive attitude and mindsets for safe management of health waste.

Generally, as explained above, based on the research findings relating to different practices, most health care workers in Dodoma city Tanzania did not practice nor demonstrate safe management of health care waste. Most of them did not make correct use of the coloured bags.

## VI. RECOMMENDATIONS

1. In Tanzania there is a need to build a comprehensive system that addresses and defines clearly the responsibilities, and resource allocation criteria for handling and disposing Biomedical wastes.
2. There is also the urgent need to improve awareness creation about the risks of poor handling and neglects in the management of biomedical wastes including the pertaining safe and sound practices in all the concerned areas.
3. Government commitment and support is needed for universal, long-term improve handling and management of BMW alongside immediate action at every health facility.
4. Tanzania Ministry responsible for local government has given local authorities, the mandate to handle health related matters in specific areas. The authorities can be used by the central government to establish a strict implementation and monitoring guidelines for effective and efficient handling and management of biomedical wastes.
5. The government, in collaboration with national training institutes should establish clear training centers to run courses in biomedical waste management and should make it compulsory for every healthcare facility to ensure that their healthcare personnel are trained in recognized and accredited training centers. The training sessions should not become merely a one-time activity but should be a continuous process and arrangement.
6. Training as an intervention for BMWM should be included in the overall health care related policy in Tanzania in order to regulate all operations and activities in both public and private sector health facilities. Implementation of training plans for the health and sanitary workers in health facilities will require uniform.
7. Guidelines tailored to local setting with regular follow up for improved health care waste management and the consequent quality of health services and of the people's lives.
8. The government is advised to establish an independent department to be responsible for biomedical waste. The unit should be headed by a professional person specialized in biomedical waste management. Such an officer should ensure, among other responsibilities, that the injuries inflicting health care personnel are promptly reported for health care actions and prevention of infections.

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