


Assessment of Environmental Cleaning Practices and the Impacts on Infection Prevention and Control in Selected Hospitals in Tanzania

Honest Anicetus^{1*} , Samwel Manyele², Michael Habtu³, Adolf Kiyunge¹, Josephat Saria⁴, Robert Njee⁵, Linda Thadei⁶, Khalid Massa¹, Grace Elizabeth Saguti³, Zabulon Yoti³

¹Ministry of Health, Community Development, Gender, Elderly and Children, Dodoma, Tanzania

²Department of Chemical and Mining Eng., University of Dar es Salaam, Dar es Salaam, Tanzania

³World Health Organization (WHO), Tanzania, Dar es Salaam, Tanzania

⁴Department of Environmental Studies, The Open University of Tanzania, Dar es Salaam, Tanzania

⁵National Institute of Medical Research, Dar es Salaam, Tanzania

⁶National Council for Technical Education, Dar es Salaam, Tanzania

Email: *hanicetus@gmail.com, smanyeles@udsm.ac.tz, habtum@who.int, akiyunge@gmail.com, joseph.saria@out.ac.tz, rnjee@gmail.com, thadeilinda@gmail.com, khalid.massa@afya.go.tz, sagutig@who.int, zabulony@who.int

How to cite this paper: Anicetus, H., Manyele, S., Habtu, M., Kiyunge, A., Saria, J., Njee, R., Thadei, L., Massa, K., Saguti, G.E. and Yoti, Z. (2022) Assessment of Environmental Cleaning Practices and the Impacts on Infection Prevention and Control in Selected Hospitals in Tanzania. *Journal of Environmental Protection*, 13, 698-715. <https://doi.org/10.4236/jep.2022.1310045>

Received: July 7, 2022

Accepted: October 10, 2022

Published: October 13, 2022

Copyright © 2022 by author(s) and Scientific Research Publishing Inc. This work is licensed under the Creative Commons Attribution International License (CC BY 4.0). <http://creativecommons.org/licenses/by/4.0/>



Open Access

Abstract

To achieve Sustainable Development Goal (SDG) in healthcare facilities (HCFs), the provision of water, sanitation, healthcare waste management, hand hygiene and environmental cleanliness services is crucial. Good WASH services in HCFs settings have the potential to reduce healthcare acquired infections (HAIs), increase trust and uptake of healthcare services, increase efficiency and improve staff morale. To address this, a National Assessment was carried out to ascertain environmental cleanliness condition of the healthcare facilities at all levels. The assessment of healthcare waste management in the facilities was conducted in all the 26 regions of Tanzania Mainland including districts and lower healthcare facilities. A standardized checklist and tools were used to assess and monitor various aspects related to healthcare waste management using open source software for data collection (ODK). Data were analyzed using SPSS computer software. It was observed that most of permanent staff (88%) in the Healthcare facilities had knowledge on hand hygiene, but the gap was observed to the waste handlers (12%) who were not equipped with the hand hygiene knowledge. About 89% of the hand washing stations were available at mortuary units, followed by 75% at main entrance and the lowest was 3% at waste zone areas of the healthcare facilities. Hand washing materials like soap were mainly found at theaters (64%) followed by mortuary

(60%) and last at waste zones. The assessment concludes that handling of healthcare wastes is not practiced to the expectations, and there is a need to strengthen the situation. The findings provide evidence for those engaged in improving HCF conditions to develop evidence-based policies and efficient programs, enhance service delivery systems, and make better use of available resources.

Keywords

Environmental Cleaning, Infection Prevention, Sanitation, Hand Hygiene and Water Supplies

1. Introduction

Healthcare Facilities (HCFs) with improved sanitation services play a major role for caring and improving health status of community. This includes preventing spread of Hospital Care Associated Infections (HCAIs) and minimizes their risk to patients, staff and visitors. The provision of sanitation services and handling of waste is essential for protecting human health during all infectious disease outbreaks, including COVID-19. During COVID-19 pandemic, World Health Organization [1], highlighted that the provision of safe water, sanitation and hygienic conditions is essential for protecting human health.

Poor sanitation has a range of negative impacts on society and the economy; from causing debilitating and deadly diseases via the contamination of drinking water sources and food with pathogen laden human waste. This is associated to losses in productivity due to sickness and increased healthcare costs. Healthcare facilities with poor sanitation services apart from becoming potential source of spreading infectious diseases as well as compromising quality healthcare, some literatures indicate that lack of adequate sanitation services may also discourage women from giving birth in HCFs, or cause delays in healthcare-seeking [2]. Research shows that the benefits of improved sanitation services in the HCFs extend far beyond the point of care to boosting staff morale and the performance of healthcare workers; minimizing the national healthcare burden and providing a platform to promote and improve client's satisfaction.

The latest WHO/UNICEF data shows that only 37% of healthcare facilities globally have basic sanitation services. This means that 1.8 billion people use facilities that lack basic water services, and 800 million people use facilities with no toilets. The problem is much greater in underdeveloped countries where half of the healthcare facilities lack basic sanitation services [3]. Inadequate supply of potable water for drinking and washing, poor sanitation and low hygiene practices are ingredients that pose health challenges particularly to patients, staff and relatives using the Healthcare facilities. Several studies conducted in developing counties including Tanzania show that there are gaps in WASH in healthcare facilities. Findings from 66,101 healthcare facilities in 54

low and middle-income countries reveal that 38% of facilities do not have access to any water source [4].

In addition, lack of water supply was found to be one of the challenges. It was also revealed that 19% of HCFs had no sanitation facilities, and 35% lacked water and soap for staff and patients to wash their hands and maintain basic hygiene. According to 2014 UN-Water Global Analysis and Assessment of Sanitation and Drinking water in Healthcare facilities, in Tanzania only 65% of HCFs were supplied with water [4]. This lack of WASH services compromises the ability to provide basic routine services such as child delivery, and hence jeopardizes the ability to prevent and control infections in healthcare facility settings. Moreover, most HCFs were lacking menstrual hygiene facilities, consequently posed risk of infections to staff, patients and relatives.

Many HCFs had inadequate latrines and those few with the latrines did not have provisions for people with disabilities. Latrines in HCFs should also consider accessibility and necessary provisions for people with disabilities [4]. They should also ensure availability of necessary equipment that is supportive for menstrual hygiene. There is limited data about existence, use and adequacy of latrines infrastructure in HCFs in Tanzania. Although most health facilities have some form of latrines for staff, but there is lack of adequate facilities for patients and their relatives. This study emphasizes that health plans should consider adequacy of basic sanitation services in an acceptable gender ratio, and disabled persons in all healthcare facilities.

Cleanliness in the healthcare facilities is usually done using different disinfectants and detergents [5]. Some sections need to be cleaned several times due to the nature of the activities carried within; these areas include theatre, laboratory and labour ward. These sections require high disinfectants materials like chlorine, lysol, and the like. Cleaning the health care facilities aims to remove visible dirt and dust, and reducing levels of harmful micro-organisms in the patients' surroundings. A clean patient environment contributes to the prevention of healthcare-associated infections. Thus, comprehensive environmental cleaning programs are most important at acute healthcare facilities and higher tiers of healthcare, where the burden of healthcare environmental infection is higher.

According to WHO [1] the extent of the healthcare environmental infection due to healthcare environment remains hidden because major gaps in data persist, especially on environmental cleaning. It is reported that, across the world's 47 least-developed countries, the problem is even greater since half of healthcare facilities lack basic water services. About 1.8 billion people use facilities that lack basic water services, and 800 million use facilities with no toilets. Effective functioning of health-care settings depends on several requirements including safe and sufficient water, basic sanitation, adequate management of health-care waste, appropriate knowledge and application of hygiene, and adequate ventilation. However, many of these requirements are not available in most of health-care settings across the world in which infections affect between 5% and 30% of patients or more [6].

A study conducted earlier [7], shows that about one tone of wastes can be produced per bed, and 700,000 tons of waste per year; that is equivalent to 3.5% of the national waste production. Wastewater generated from the HCF contains effluent loaded with harmful substances (solvents, heavy metals, radioactive materials) which require specific disinfection. Poor management of waste water can result into health effects to the patients, healthcare providers and community. In a study conducted earlier [8], shows that from 78 Low Middle Income Countries, some healthcare facilities revealed that most of the HCF (98%) lack piped water, improved sanitation, hand washing soap, adequate infectious waste disposal, sterilization of equipment, and reliable energy services. Only 2% from the six representative countries nationally provide all four; water, sanitation, hygiene, and waste management services.

Africa is among the continents in the world with the prevalence of health care environmental problems between 2.5% and 14.8% [9]. Tanzania like other developing countries, has an overall prevalence of 14.8% [10], making it one of the most affected countries in Africa. A study conducted in Zimbabwe showed that sanitation domain had the largest proportion of healthcare facilities with poor service coverage (42%). It was noted that one out of four HCFs did not have adequate services across the domains of water, sanitation, healthcare waste, hand hygiene, facility environment, cleanliness and disinfection, as well as waste management [11].

Hand hygiene practice is an act of cleaning one's hands with soap and water, or using alcohol-based hand rubs with the aim of removing potential pathogens, dust or other harmful substances on the hands. Hand washing with soap alone can protect about one out of every three young children who get sick with diarrhea, and one out of five young children with respiratory infections like pneumonia [12] [13]. Hand hygiene can be performed by washing hands with clean water and soap, or by using alcohol-based hand sanitizers. Hand hygiene is a core element of safety for the prevention of healthcare-associated infections [14] and the spread of other pathogenic microorganisms that can be transmitted through hand shaking, or any type of direct contact through hands.

In the context of healthcare waste management, hand hygiene in the healthcare facilities plays a vital role in generation of waste water and other solid waste. If not properly practiced, hand hygiene may pose a threat to human health and total surroundings. An extensive global assessment on water, hygiene and sanitation (WASH) conducted jointly [15], indicate that one out of six healthcare facilities (16%) worldwide is estimated to have no hygiene services at all; translating into 896 million people with no access to hygiene services in their healthcare facilities. A study conducted in Kenya [16], on water treatment and hand washing practices in rural Kenyan healthcare facilities and households revealed that among 30 HCFs, about 80.0% had at least one functional hand washing station. Only 83.7% were functional, and 72.1% had soap present, while about 60% of HCF had at least one functional hand washing station with soap.

The Tanzanian National Plan (2017-2022) on Antimicrobial Resistance in Priority Area 6 is focusing On Infection Prevention and Control (IPC) in healthcare systems with hand hygiene being a critical component [17]. A study conducted earlier [18] found that 44% of facilities conducting deliveries had basic WASH services. It was further shown that, only 24% of those facilities had WASH services in the delivery rooms). Apart from having a lot of studies for hand hygiene in Healthcare Facilities, still there is a gap existing; studies do not show how HCFs safely manage healthcare waste generated from hand hygiene practices.

Transmission of infections due to poor healthcare environmental remains to be a big challenge to many countries including Tanzania. About 10% - 30% of hospital admissions are associated with poor infection prevention and control [19]. Environmental cleaning refers to the process of cleaning and disinfecting the environment for purpose of avoiding the spread of diseases to the clients as well to the healthcare providers, visitors as well community [19] [20]. Environmental cleanliness in healthcare facilities is an important aspect since hospital environment contributes to high morbidity and mortality rate to patients, clients, healthcare providers and community [5].

Safe and adequate environmental conditions in healthcare facilities including the availability of water, sanitation, hygiene, energy, waste management, and the availability of standard precaution items like disposable gloves and masks are essential to protect and improve the health of patients, staff, visitors, and the wider community. In order to avoid risks, proper cleaning of the environment in HCF should be done correctly. This however, depends on the section and the activities conducted within. For instance, cleanliness and disinfection in theatres should be done every time after the procedure; while in other places like Out Patient Department (OPD), wards, cleanliness can be done twice a day (morning and evening).

In this study, several issues have been covered which have high impact into the environmental cleaning and practices at the respective healthcare facilities. These include responsibilities in issues of IPC, management of environmental cleanliness and capacity building of working staff, handling of waste during COVID-19, and compliance with recommended standards.

2. Methodology

A team of National and Regional level Assessors from different institutions was formed to assess regional and respective district hospitals including lower healthcare facilities within the region. The assessment of Healthcare Waste Management (HCWM) in the HCFs was conducted in all the 26 regions of Tanzania Mainland. From each region, at least four district/municipal/town councils were physically reached by the assessors, and the remaining councils were reached by mobile phones.

A standardized checklist and tools were used to assess and monitor various as-

pects related to healthcare waste. These were in form of ODK, which is open-source software for collection, managing, and using data in resource-constrained environments. The software was opted due to its ability to easily handle data, and it allows for offline data collection with mobile devices in remote areas. It also provides a room for data submission to a server when internet connectivity is available. There were three tools developed; a checklist for Regional Health Management Teams (RHMT), a checklist for Council Health Management Teams (CHMT), and the survey tool for facility assessment. The survey tool was accompanied by direct observation, where several pictures were taken to complement the information collected through other tools.

Since data sets were electronically prepared, they were coded with variable names, variable descriptions, and variable format. Thereafter, data were entered into a Statistical Package for Social Sciences (SPSS) computer software, and EXCEL sheet for further processing. This was followed by data cleaning process. This process involved checking the data carefully for errors, accuracy, and identifying and handling missing values. Checking data for accuracy responded to questions such as are the responses legible? Are the responses complete? Are the important questions answered? Is all relevant contextual information (e.g., data, time, place) included. Lastly, descriptive statistics such as frequencies, percentages, and means were performed and presented in tables and charts.

3. Results and Discussion

3.1. Knowledge and Behavior on Hand Hygiene Practices

Practicing hand hygiene either washing the hands with water and soap or using alcohol-based hand rub, is a simple and effective way to prevent infections. Any healthcare worker or waste handler who is involved in patient care directly or indirectly should be aware of the importance of hand hygiene. This can be attained by equipping knowledge to all groups of health workers within the health facility. By doing so, it will bring sustainable hand hygiene practice to health workers and patients; hence prevention of WASH related diseases.

One of the key strategies during the assessment was to assess if healthcare workers and waste handlers had the knowledge on hand hygiene. It was observed that most of permanent staff (88%) in the health facilities had knowledge on hand hygiene. However, the gap was observed to the waste handlers (12%) who were not equipped with the hand hygiene knowledge (**Figure 1**).

These results are in line with another study [11], which found that the proportion of knowledgeable participants is lower than studies in facilities in Bahir Dar city and Addis Ababa which reported 69% and 84.2% of healthcare workers had good infection control knowledge. Similarly, the result is inconsistent with that conducted earlier in Nepal [21], found that 77.3% of the respondents were knowledgeable on hand hygiene compliance. Another study [22] reported that 63.9% of the respondents had good knowledge on tuberculosis infection control, while [23] found that more than half (54%) of healthcare workers had good

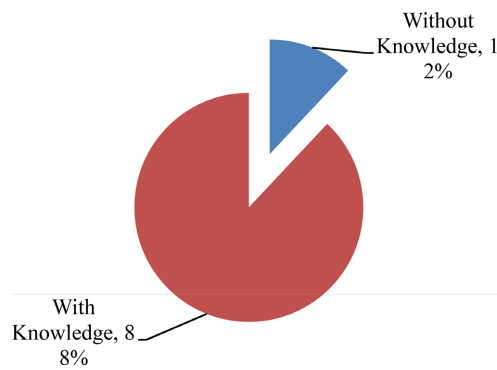


Figure 1. Percentage of healthcare workers with knowledge on hand hygiene practices.

level of knowledge on tuberculosis infection control in Nepal. The discrepancy in most of these studies may be due to differences in study settings and study variables, as all these studies focused only the two components of infection prevention (hand hygiene and tuberculosis infection control), while this study focused on all facilities in the country.

During interviews with some waste handlers, it was noticed that there was absence of regular session conducted to waste handlers on hand hygiene. One of the staff members said that the gap may be caused by negligence and high workload to health workers, hence no extra time for conducting sessions to waste handlers. This gap probably can be closed through training and education programs to waste handlers, and encouraging them to wash their hands during critical moments. Healthcare facility leaders should play a crucial role in capacitating waste handlers on hand hygiene instead of leaving this to lower level staff. This goes in hand with what is explained by Guidelines on Hand Hygiene in Healthcare education alone may not be sufficient to ensure compliance in hand hygiene [9].

Hand washing practice for health workers was observed to be unsatisfactory as there were signs of washing points lacking water supply. Absence of water stations at the waste zones was the most identified reason limiting hand washing practice. One of the waste handlers said that water and soap were readily available for hand washing in the waste zone occasionally (Figure 2).

About 89% of the hand washing stations were available at mortuary units, followed by 75% at main entrance of healthcare facilities, and the lowest was 3% at waste zone area. Hand washing materials like soap were found at theaters (64%), followed by mortuary (60%) and last at waste zone.

The discrepancy observed was in line with the previous study [24]. The study showed that entry/exit points where hand washing was available, about 36% of hand washing stations provided water that had been treated with detergent or chlorine. Of the stations with treated water, 79% provided bar or liquid soap. The data obtained in this study correspond to another study [25], which showed that over 41.6 of the healthcare facilities did not have a fully functional hand hygiene facility (HHF) in patient care areas; and only 56.6% had functional HHF with soap and water within five meters of the toilet block.

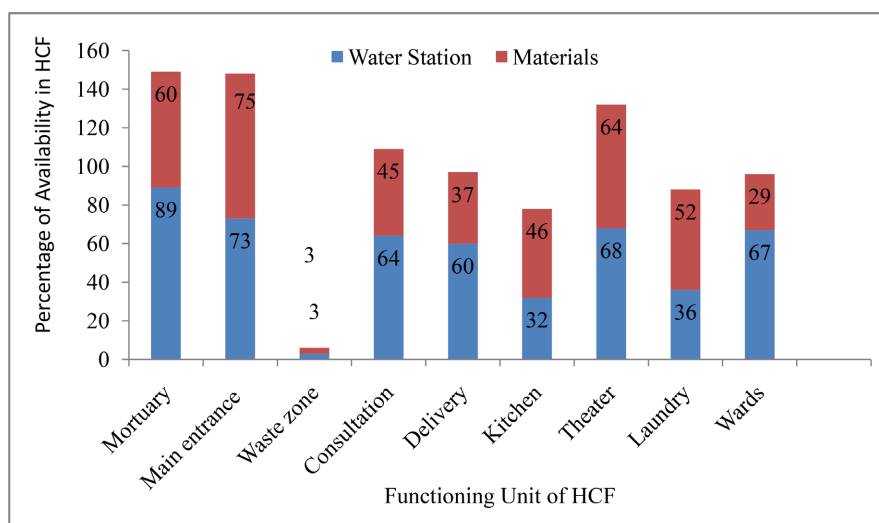


Figure 2. Availability of hand washing station and hand washing materials.

3.2. Infection Prevention and Control at Healthcare Facilities

The hospital's housekeeping is responsible for the regular and routine cleaning of all surfaces, and maintaining a high level of hygiene in the facility in collaboration with the healthcare facility management team. It is important to know a person involved in healthcare environmental cleaning because there should be a continuing training program for the respective staff. The training program should stress personal hygiene, the importance of frequent and careful washing of hands, and cleaning methods (e.g., sequence of rooms, correct use of equipment, dilution of cleaning chemicals and disinfectants, etc). It was expected that staff involved in cleaning healthcare facilities should understand some basic microbiology including the transmission of diseases, as well as understanding the source contamination and means of controlling cross-transmission of organisms within the healthcare environment. In healthcare facilities, it is very necessary to manage the cleanliness of the environment as to avoid or reduce healthcare acquired infections (HCAI) that occur due to poor management of healthcare waste within the health facility environment. Proper management and well-maintained healthcare facility environment require responsible personnel who will work to ensure facility's environments are clean.

3.3. Responsible Person in Environmental Cleaning at Health Facilities

Environment cleaning at the healthcare facility is very important aspect, due to the fact that, failure to keep the health environment clean may result into Healthcare acquired infection to all people around the environment including healthcare providers, clients and community members around. Environmental cleaning at the healthcare facility can be done by different group including, private company healthcare facility staff also the other workers (casual laborer's) who has been employed by the facility, this is done to ensure no any infection is

being spread due to unclean environment.

This is supported by other studies conducted in different areas including in low- and middle-income countries that lack of adequate environment cleaning has resulted into higher Healthcare Acquired Infection to health providers and clients [15] [26].

From the assessment, it was revealed that environment cleaning focal person in healthcare facilities had not been given a priority; something that can result into high spread of healthcare acquired infection. The health facility needs to have environmental cleaning focal person with specific responsibilities to oversee the environment condition of the hospital at all sections. S/he has to ensure that every place is clean through following standards required at the health facility so as to avoid/reduce the spread of HCAI.

3.4. Responsible Persons in Environmental Cleaning at Health Facilities

Environment cleaning at the healthcare facility is very important aspect, as failure to keep the health environment clean may result into Healthcare acquired infection to all people around the environment (including healthcare providers, clients and community members around). Environmental cleaning at the healthcare facility can be done by different groups including, private company, healthcare facility staff, and the other workers (casual laborer's) who are employed by the facility. All this is done to ensure no any infection is being spread due to unclean environment.

From the assessment conducted, most of the health facilities (68.8%) depended on casual laborers to clean the environment, while 27.4% was left to the healthcare facility staff, and 3.8% used companies in cleaning the environment (Figure 3).

The assessment revealed that there was a big problem of environmental cleaning in health facilities. Failure to have a known responsible person is a challenging problem in environment cleaning at the healthcare facility level. Also using staff in cleaning the healthcare environment is not that much perfect since these staff are also involved in providing other health services to the clients.

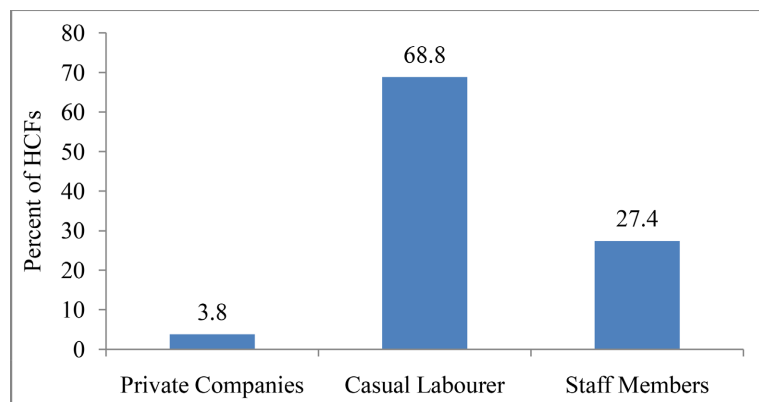


Figure 3. Responsible groups in environmental cleaning in the Tanzanian HCFs.

Due to overworking, cleaning of the environment of health facility cannot be perfectly done, and that can lead to unclean environment resulting into HCAI due to the fact that these pathogens have the ability to survive for more than a month in the environment [27].

The assessment concluded that most of the health facilities do not see the necessity of having the specific environmental cleaning person. This is not proper as poor management of healthcare environment is very dangerous, as they can be the source of infection to anyone visiting the health facilities. Healthcare facility should consider having the specific person or company to conduct thorough environmental cleaning within the health facility so as to avoid any infection that could be caused by the healthcare environment.

3.5. Number of Health Officers Supervising Environmental Cleaning Activities

Supervision of environmental cleaning at a health facility is very important. It has also to ensure that each section within the health facility is cleaned adhering to the health facility policies and procedures. The cleaning supervision should be done by a specific person with the knowledge and skills about how cleanliness is being conducted at the health facility. Having this person could help to have thorough and effective cleaning of the environment, and stop spreading of infections due to poor health environmental condition.

From the current assessment, it was revealed that 21% of the health facilities did not have an environmental cleaning supervisor, 76% have one health officer and 1.3% of the health facilities reported to have more than one health officers as supervisor for environmental cleaning (**Figure 4**).

Most of health facilities had one health officer due to the reason that there was shortage of health officers employed at their health facilities. For health facilities without the supervisor, they did not see the necessity of having them; this could result into improper cleaning.

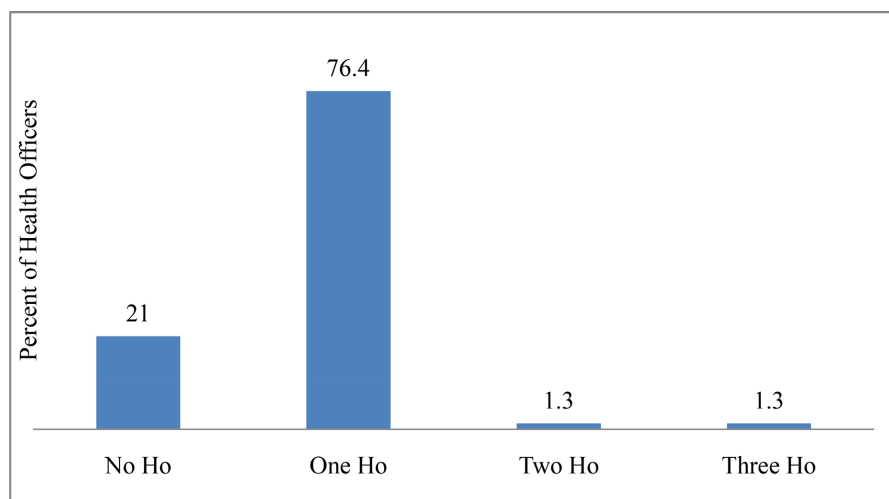


Figure 4. Number of health officers supervising environmental cleaning.

3.6. Presence of Infection Prevention and Control and WASH Focal Persons

Infection prevention and control (IPC) is a practical, evidence-based approach which prevents patients and health workers from being harmed by avoidable infections as a result of antimicrobial resistance. A health facility requires a designated IPC focal person who ensures that everything within the health facility is kept in such way it could not cause harm to anyone who visits the place. The current assessment conducted majority (83.4%) of the health facilities had IPC focal person, who also takes care of WASH services, while 16.6% do not have focal IPC/WASH focal person.

Study shows that about 10% of hospitalized patients globally suffer from HCAs [28]. This is primarily due to poor infection prevention and control practices in the hospitals. It is very risk to have healthcare facilities with no IPC focal person especially during the current COVID-19 pandemic that has emphasized the need for high levels of IPC in healthcare facilities and communities.

In another study [29], on the implementation of IPC in health facilities, shows that about 93.8% of healthcare facilities did not have an IPC committee, 93.8% reported irregular supply of disposables and other supplies (such as gloves, soap, disinfectants) similarly, most facilities had no structures to monitor HCAI, and 72.6% never had in-service IPC training. This is evident that having more than one IPC focal person is not so necessary, instead performing the required task is an essential for the purpose of preventing the spread of HCAI with regard to health services provided at the healthcare facility.

3.7. Management of Environmental Cleanliness and Capacity Building of Working Staff

The determination of environmental cleaning procedures for healthcare environment including frequency, method, and process, should be based on the risk of pathogen transmission [27]. Management of the environmental cleanliness in the healthcare facilities is an important aspect that could help the reduction of high morbidity and mortality rate that occurs due to poor management of healthcare environment. This goes together with capacity building to the healthcare workers and casual laborers who are working within the healthcare facility, mostly in healthcare waste sections. From the study conducted in 26 region of Tanzania Mainland, it was revealed that the frequency of cleaning the healthcare environment using different options differed (Table 1).

Table 1. Distribution of HCF cleanliness frequency in different healthcare facility levels.

Method	Regional level	District Level	Health centre
Routine	90.9	98.1	91.7
Terminal	45.5	36.5	33.3
Scrubbing	63.6	42.3	8.3

The assessment showed that at regional level, routine cleaning scored higher (90.9%), followed by terminal cleaning (63.6%) and scrubbing 45.5%. This was the same as in the District level where the highest option reported was routine cleaning (98.1%), followed by scrubbing (42.3%) and terminal (36.5%). There were also different options observed in healthcare centres where routine cleaning was the highest (91.7%), followed by terminal (33.3%) and scrubbing (8.3%). In order to minimize the risks to patients and workers, routine cleaning was very common at all levels where typical examples are floors, walls, or environmental surfaces out of reach or outside the patient zone [30]. When considered scrubbing at high touch surface indicated that these areas are usually close to the patients [31]. They are frequently touched by the patients or nursing staff, come in contact with the skin, and due to increased contact, they pose a particularly high risk of transmitting pathogens.

However, not all high-touch surfaces pose an equally high risk of infection, leading to a distinction between critical and noncritical surfaces. While non-critical surfaces only encounter intact skin and thus posing a low risk of infection, critical surfaces come into direct contact with either blood or mucous membranes, or critical items such as needles and intravenous catheters, thus carrying a high risk of infection [32]. Cleaning of the healthcare environment is an essential task in order to avoid health acquired infections due to healthcare environment. In Tanzania, the key elements for environmental cleanliness at healthcare facilities are essential (Table 2).

Among the key elements identified to be applied for environmental cleanliness in healthcare facilities include proper organization/administration, presence of staff, general training to staff, healthcare waste handlers and community. Others are special training in emerging diseases, availability of environmental cleanliness structure, presence of policies and procedures for environmental cleanliness, monitoring and evaluation of the environmental cleanliness and

Table 2. Percentage of application of key elements in environmental cleaning program.

	Regional Hospitals	District Hospitals	Health Centres
Feedback is given to the cleaning company	81.8	27.7	8.3
Feedback is given to the facility	81.8	72.3	66.7
Monitoring and Evaluation of the EC is conducted	81.8	74.5	50.0
Policies and procedure for EC exist	72.7	70.2	50.0
EC Infrastructure exist	100.0	74.5	41.7
Special training given in case of emerging infections like COVID-19	90.9	83.0	100.0
General Training	54.5	78.7	33.3
Staffing	81.8	89.4	83.3
Organization/administration	81.8	85.1	75.0

provision of feedback to the health facility.

This has also been reported [33], that key element in healthcare environment cleanliness is essential for the purpose of improving the environment, and avoids the spread of infections to clients, patients, healthcare providers and community. With these key elements, it is necessary to have a focal person who can be able to oversee the whole process regarding environmental cleaning at the healthcare facility. Such process involves provision of training to staff, basing on healthcare facility environmental cleaning guidelines and policies, as well as practical examples like hand washing practices, mixing disinfectants, and application of disinfectant according to the place to be decontaminated. All these are to be communicated before work. Findings from the current assessment show that meetings between environmental stakeholders and the healthcare facilities' staff for provision of feedback were normally conducted (Table 3).

Based on Table 3, it is evident that meetings with environmental cleanliness stakeholders, staff and other members were mostly conducted in quarterly bases in all health facility levels. For example, in regional hospitals, quarterly meetings were conducted by 63.6% of healthcare facilities; while in district and health centers, quarterly meetings were conducted by 66.6% and 55.6% respectively. It was further observed that monthly meetings were held less frequently than quarterly meetings at all levels as displayed in Table 3. This implies that conducting meeting with different stakeholder for feedback to address areas of weaknesses and commend on the strengths helps to get new ideas for improving the environment in healthcare facilities.

This is supported by the study conducted earlier [27], shows that meetings that involve environmental cleanliness and healthcare facilities stakeholders are an essential component to ensure that programmes are delivered as planned. Meetings with different stakeholders can help to formulate policies, procedures, and terms of services by using the strengths and weaknesses identified during the ongoing healthcare environment programme.

3.8. Handling of Healthcare Waste during COVID-19 and Compliance with Recommended Standards

Compliance to proper disposal of healthcare waste is among essential issues to ensure no infection occurs due to poor disposal of healthcare wastes. Proper

Table 3. Percentage of the meeting frequency with environmental cleaning stakeholders and staff in HCFs.

	Regional hospitals	District hospitals	Health Centres
Weekly	9.1	15.6	22.2
Monthly	54.5	35.6	44.4
Quarterly	63.6	66.7	55.6
Semi annually	72.7	75.6	0.0
Annually	90.9	80.0	0.0

disposal of healthcare waste at the source, storage, and transportation are required not only to prevent negative health and environmental impacts, but also to maintain resources efficiently and material recovery. In this assessment, disposal of wastewater and used masks was a challenging issue to different areas due to inadequate compliance of IPC protocol to healthcare workers, and lack of education on proper disposal to the community (**Table 4**).

In order to reduce and limit the spread of COVID-19 pandemic, numerous countries around the world enforced confinement and obliged the use of masks for active individuals as a preventive measure [34]. This kind of waste could be hazardous if it is misused and/or mismanaged. The assessment on how masks and wastewater are being disposed after use indicated that 45.5% at regional, 28.6% at district, and at 30.8% health centres dispose to the toilet, while disposal to the open space was practiced by 54.5%, 73.5% and 69.2% at Regional Hospitals, District hospitals and Health centres respectively. To the least extent, the wastewater and face masks were channeled to the sewage system in all health care levels.

This assessment demonstrated the real impact of the COVID-19 on human behavior, and the environment; and suggests a need for providing new didactic management of facemasks and gloves. This was also observed earlier [35], showed that 70% of the respondents threw their used masks and gloves in house trash, or trash bins after their first use. Also, nearly 30% of respondents admitted that they did not wear masks because they did not leave their homes during the lockdown, while 70% of facemasks, more than five million (equivalent to 40,000 kg) would be generated and disposed daily by the community of these regions, which presents 35% of the total engendered facemask waste [36].

4. Conclusions and Recommendation

4.1. Conclusion

Management of the environment cleanliness in the healthcare facilities is an important aspect that could help the reduction of high morbidity and mortality rate that occurs due to poor management of healthcare environment. This goes together with capacity building and close supervision of healthcare workers and casual laborers who are working within the healthcare facility, mostly in healthcare waste section. From the assessment findings, it has been observed that environmental cleanliness of the hospitals still is a major challenge for most of the

Table 4. Disposal of wastewater and used face masks during COVID-19 pandemic (multiple responses).

	Regional	District	Health Centre
Dispose to toilets	45.5	28.6	30.8
Dispose on open spaces	54.5	73.5	69.2
Channeled to the sewage systems	36.4	10.2	7.7

hospitals. The main challenges are on the provision of appropriate cleaning equipment, lack of cleaning plans per each functional area, and also standards and protocols. Regular training and supervision for staff are also key to enhance the quality and performance.

4.2. Recommendation

4.2.1. Prepare Protocols for Environmental Cleaning in Healthcare Facilities

Healthcare facilities must have basic protocols for cleaning, and must ensure all staff with cleaning responsibilities have been trained and classified as providing such a service. Facilities with cleaning protocols and/or where at least some staff with cleaning responsibilities have received training have limited service. If there are no cleaning protocols available and no staff have received training, the facility is considered to have no service. An advanced level of environmental cleaning might include whether disinfectants are available, or observed cleanliness of points of care.

4.2.2. Organize Programme for Enhancing Cleanliness

Effective education and training of hospital personnel for modern environmental hygiene maintenance are crucial. While the science of cleaning and disinfecting agents and equipment has evolved immensely in the last few decades, the education of cleaning personnel and their integration into healthcare worker teams has not. Cleaning and disinfecting hospitals is very different from cleaning public spaces such as hotels or offices; hospitals must realize this and adapt to the challenges. There is a range of environments within each hospital, from offices to intensive care units or hospital pharmacy services, some of which require specialized approaches to environmental hygiene maintenance.

Acknowledgements

The authors are grateful to the Ministry of Health, Community Development, Gender, Elderly and Children and the World Health Organization (WHO) for the assistance and support during data collection and analysis. Also, the completion of this study has been a result of assistance received from all management teams of the hospitals involved in the study.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

- [1] WHO (2020) Water, Sanitation, Hygiene, and Waste Management for the COVID-19 Virus, Interim Guidance. World Health Organization, Geneva. <https://apps.who.int/iris/handle/10665/331846>
- [2] Velleman, Y., Mason, E., Graham, W., Benova, L., Chopra, M., Campbell, O.M.R., *et al.* (2014) From Joint Thinking to Joint Action: A Call to Action on Improving Water, Sanitation, and Hygiene for Maternal and Newborn Health. *PLOS Medicine*,

- 11, e1001771. <https://doi.org/10.1371/journal.pmed.1001771>
- [3] WHO (2020) Water, Sanitation, Hygiene, and Waste Management for SARS-CoV-2, the Virus that Causes COVID-19: Interim Guidance. <https://www.who.int/publications/i/item/WHO-2019-nCoV-IPC-WASH-2020.4>
- [4] Ige, F., Ohihoin, A., Amuda, B., Amoo, O., Onwuamah, C., Okwurawe, A., Shaibu, J., Odewale, E., James, A., Kayode, A., Adeshina, A. and Audu, R. (2021) The Effectiveness of Infection Control Practices among Health Care Workers Responding to the COVID-19 Pandemic in Nigeria. *Advances in Infectious Diseases*, **11**, 232-239. <https://doi.org/10.4236/aid.2021.112021>
- [5] Saito, R., Virji, M.A., Henneberger, P.K., Humann, M.J., LeBouf, R.F., Stanton, M. L., Liang, X. and Stefaniak, A.B. (2015) Characterization of Cleaning and Disinfecting Tasks and Product Use among Hospital Occupations. *American Journal of Industrial Medicine*, **58**, 101-111. <https://doi.org/10.1002/ajim.22393>
- [6] WHO (2008) Core Components of Infection Prevention and Control Programmes in Healthcare. Report of Second Meeting on Infection Prevention and Control in Healthcare, Geneva, Switzerland, 26-27. <https://www.who.int/teams/integrated-health-services/infection-prevention-control/core-components>
- [7] Nyampundu, K., Mwegoha, W.J.S. and Millanzi, W.C. (2020) Sustainable Solid Waste Management Measures in Tanzania: An Exploratory Descriptive Case Study among Vendors at Majengo Market in Dodoma City. *BMC Public Health*, **20**, 1075-1083. <https://doi.org/10.1186/s12889-020-08670-0>
- [8] Cronk, R. and Bartram, J. (2018) Environmental Conditions in Health Care Facilities in Low- and Middle-Income Countries: Coverage and Inequalities. *International Journal of Hygiene and Environmental Health*, **221**, 409-422. <https://doi.org/10.1016/j.ijheh.2018.01.004>
- [9] Nejad, S.B., Allegranzi, B., Syed, S.B., Ellis, B. and Pittet, D. (2011) Healthcare Associated Infection in Africa: A Systematic Review. *Bulletin of the World Health Organization*, **89**, 757-765. <https://doi.org/10.2471/BLT.11.088179>
- [10] Elling, H., Behnke, N., Tseka, J.M., Kafanikhale, H., Mofolo, I., Hoffman, I., Reuland, F., McCord, R. and Cronk, R. (2022) Role of Cleaners in Establishing and Maintaining Essential Environmental Conditions in Healthcare Facilities in Malawi. *Journal of Water, Sanitation and Hygiene for Development*, **12**, 302-317. <https://doi.org/10.2166/washdev.2022.206>
- [11] Tenna, A., Stenehjem, E., Margoles, L., Kacha, E., Blumberg, H. and Kempker, R. (2013) Infection Control Knowledge, Attitudes, and Practices among Healthcare Workers in Addis Ababa, Ethiopia. *Infection Control & Hospital Epidemiology*, **34**, 1289-1286. <https://doi.org/10.1086/673979>
- [12] Huttinger, A., Dreibelbis, R., Kayigamba, F., Ngabo, F., Mfura, L., Merryweather, B., Cardon, A. and Moe, C. (2017) Water, Sanitation and Hygiene Infrastructure and Quality in Rural Healthcare Facilities in Rwanda. *BMC Health Services Research*, **17**, Article No. 517. <https://doi.org/10.1186/s12913-017-2460-4>
- [13] Anderson, D.M., Cronk, R., Fejfar, D., Pak, E., Cawley, M. and Bartram, J. (2021) Safe Healthcare Facilities: A Systematic Review on the Costs of Establishing and Maintaining Environmental Health in Facilities in Low- and Middle-Income Countries. *International Journal of Environmental Research and Public Health*, **18**, Article No. 817. <https://doi.org/10.3390/ijerph18020817>
- [14] WHO (2009) Guidelines on Hand Hygiene in Healthcare: First Global Patient Safety Challenge Clean Care Is Safer Care. <https://pubmed.ncbi.nlm.nih.gov/23805438/>

- [15] Wiedenmayer, K., Msamba, V.S., Chilunda, F., Kiologwe, J.C. and Seni, J. (2020) Impact of Hand Hygiene Intervention: A Comparative Study in Health Care Facilities in Dodoma Region, Tanzania using WHO Methodology. *Antimicrobial Resistance and Infection Control*, **9**, 2-9. <https://doi.org/10.1186/s13756-020-00743-4>
- [16] Ola-Adisa, E.O., Mangden, Y.E., Sati, Y.C. and Adisa, J.O. (2015) Knowledge, Attitudes/Beliefs and Practices in Medical Waste Management—An Appraisal of Jos North LGA, Plateau State, Nigeria. *International Journal of Research in Humanities and Social Studies*, **2**, 43-56. <https://irepos.unijos.edu.ng/jspui/bitstream/123456789/1723/1/5-1.pdf>
- [17] The United Republic of Tanzania (2017) The National Action Plan on Antimicrobial Resistance (2017-2022). Ministry of Health Community Development Gender Elderly and Children (MHCDGEC), Ministry of Agriculture, Livestock and Fisheries (MALF).
- [18] Batagarawa, R.L. (2011) Sustainability Appraisal of Waste Management in Nigeria: Development and Evaluation of an Index Based Tool. Department of Civil Engineering, University of Portsmouth, Portsmouth.
- [19] Lowe, H., Woodd, S., Lange, I.L., Janjanin, S., Barnet, J. and Graham, W. (2021) Challenges and Opportunities for Infection Prevention and Control in Hospitals in Conflict-Affected Settings: A Qualitative Study. *Conflict and Health*, **15**, Article No. 94. <https://doi.org/10.1186/s13031-021-00428-8>
- [20] Ogonsila, F.T. and Shaheen, M. (2020) Challenges Regarding the Control of Environmental Source of Contamination in Healthcare Settings in Low- and Middle-Income Countries. *Antimicrobial Resistance and Infection Control*, **9**, Article No. 81. <https://doi.org/10.1186/s13756-020-00747-0>
- [21] Abdella, N., Tefera, M., Eredie, A., Landers, T., Malefia, Y. and Alene, K. (2014) Hand Hygiene Compliance and Associated Factors among Health Care Providers in Gondar University Hospital, Gondar, North West Ethiopia. *BMC Public Health*, **14**, 190-203. <https://doi.org/10.1186/1471-2458-14-96>
- [22] Gizaw, G., Alemu, Z. and Kibret, K. (2015) Assessment of Knowledge and Practice of Health Workers towards Tuberculosis Infection Control and Associated Factors in Public Health Facilities of Addis Ababa, Ethiopia: A Cross-Sectional Study. *Archives of Public Health*, **73**, Article No. 15. <https://doi.org/10.1186/s13690-015-0062-3>
- [23] Shrestha, A., Bhattarai, D., Thapa, B., Basel, P. and Wagle, R. (2017) Healthcare Workers' Knowledge, Attitudes and Practices on Tuberculosis Infection Control, Nepal. *BMC Infectious Diseases*, **17**, Article No. 724. <https://doi.org/10.1186/s12879-017-2828-4>
- [24] Tantum, L.K., Gilstad, J.R., Bolay, F.K., Horng, L.M., Simpson, A.D., Letizia, A.G., Styczynski, A.R., Luby, S.P. and Ronan, F.A. (2021) Opportunities for Sustainable Hand Hygiene Interventions in Rural Liberian Hospitals. *International Journal of Environmental Research and Public Health*, **18**, Article No. 8588. <https://doi.org/10.3390/ijerph18168588>
- [25] Kaya, D., Mugambe, R.K., Mselle, J.S., Isunju, J.B., Ssempebwa, J.C., Wafula, S.T., et al. (2020) Assessment of Water, Sanitation and Hygiene Service Availability in Healthcare Facilities in the Greater Kampala Metropolitan Area, Uganda. *BMC Public Health*, **20**, Article No. 1767. <https://doi.org/10.1186/s12889-020-09895-9>
- [26] Ataiyero, Y., Dyson, J. and Graham, M. (2022) An Observational Study of Hand Hygiene Compliance of Surgical Healthcare Workers in a Nigerian Teaching Hospital. *Journal of Infection Prevention*, **23**, 59-66. <https://doi.org/10.1177/17571774211066774>

- [27] Dancer, S.J. (2009) The Role of Environmental Cleaning in the Control of Hospital Acquired Infection. *Journal of Hospital Infection*, **73**, 378-385. <https://doi.org/10.1016/j.jhin.2009.03.030>
- [28] Opollo, M.S., Otim, T.S., Kizito, W., Thekkur, P., Kumar, A.M., Kitutu, F.E., Kisaame, R. and Zolfo, M. (2021) Infection Prevention and Control at Lira University Hospital, Uganda: More Needs to Be Done. *Tropical Medicine and Infectious Disease*, **6**, Article No. 69. <https://doi.org/10.3390/tropicalmed6020069>
- [29] Wasswa, P., Nalwadda, C.K., Buregyeya, E., Gitta, S.N., Anguzu, P. and Nuwaha, F. (2015) Implementation of Infection Control in Health Facilities in Arua District, Uganda: Cross Sectional Study. *BMC Infectious Diseases*, **15**, Article No. 268. <https://doi.org/10.1186/s12879-015-0999-4>
- [30] Assadian, O., Harbarth, S., Vos, M., Knobloch, J.K., Asensio, A. and Widmer, A.F. (2021) Practical Recommendations for Routine Cleaning and Disinfection Procedures in Healthcare Institutions: A Narrative Review. *Journal of Hospital Infection*, **113**, 104-114. <https://doi.org/10.1016/j.jhin.2021.03.010>
- [31] Dancer, S.J. (2017) Controlling Hospital-Acquired Infection: Focus on the Role of the Environment and New Technologies for Decontamination. *Clinical Microbiology Reviews*, **27**, 665-690. <https://doi.org/10.1128/CMR.00020-14>
- [32] Peters, A., Otter, J., Moldovan, A., Parneix, P., Voss, A. and Pittet, D. (2018) Keeping Hospitals Clean and Safe without Breaking the Bank; Summary of the Healthcare Cleaning Forum. *Antimicrobial Resistance & Infection Control*, **7**, 132-141. <https://doi.org/10.1186/s13756-018-0420-3>
- [33] WHO (2010) Technical Options for Excreta Disposal in Emergencies. Technical notes on Drinking Water, Sanitation and Hygiene in Emergencies. World Health Organization, Geneva.
- [34] Mitze, T., Kosfeld, R., Rode, J. and Wälde, K. (2020) Face Masks Considerably Reduce COVID-19 Cases in Germany. *Proceedings of the National Academy of Sciences*, **117**, 32293-32301. <https://doi.org/10.1073/pnas.2015954117>
- [35] Dharmadhikari, A.S., Mphahlele, M., Stoltz, A., Venter, K., Mathebula, R., Masotla, T. and Nardell, E.A. (2012) Surgical Face Masks Worn by Patients with Multi-drug-Resistant Tuberculosis: Impact on Infectivity of Air on a Hospital Ward. *American Journal of Respiratory and Critical Care Medicine*, **185**, 1104-1109. <https://doi.org/10.1164/rccm.201107-1190OC>
<https://www.who.int/emergencies/diseases/novel-coronavirus-2019/question-and-answers-hub/q-a-detail/coronavirus-disease-covid-19-masks>
- [36] Mejjad, N., Cherif, E.K., Rodero, A., Krawczyk, D.A., Kharraz J., Moumen A., Laqbaqbi, M., Anna, D. and Fekri, A. (2021) Disposal Behavior of Used Masks during the COVID-19 Pandemic in the Moroccan Community: Potential Environmental Impact. *International Journal of Environmental Research and Public Health*, **18**, Article No. 4382. <https://doi.org/10.3390/ijerph18084382>