**Texila International Journal | Open Access | Peer Reviewed**

Journal: Texila International Journal of Academic Research
https://doi.org/10.21522/TIJAR.2014.13.03.Art021

ISSN: 2520-3088
Volume 13 Issue 3, 2026

# Assessment of Knowledge, Attitude and Practice toward Medical Waste Management among Healthcare Workers in Wau, Western Bahr El Ghazal State, South Sudan: Evidence for Action

**Emmanuel Aban Nyilek[1*], Peter Michael Marin[2,3], Sonika Raj[4]**

[1]*United Nations Children's Fund South Sudan Country Office, Juba, South Sudan*
[2]*Department of Public Health, University of Bahr El Ghazal, Wau, South Sudan*
[3]*Revelation 4 Solutions Consulting Group, Wau, South Sudan*
[4]*Department of Public Health, Texila American University, Guyana, South America*

***Correspondence to be addressed:** E-mail - emmaaban@gmail.com

**Cite this article as**: Nyilek EA, Marin PM, Raj S. Assessment of Knowledge, Attitude and Practice toward Medical Waste Management among Healthcare Workers in Wau, Western Bahr El Ghazal State, South Sudan: Evidence for Action. Texila Int J Acad Res. 2026;13(3).
https://doi.org/10.21522/TIJAR.2014.13.03.Art021

**Received**: 15.06.2026
**Accepted**: 14.07.2026
**Published**: 31.07.2026

***Abstract*** *Medical waste contains potentially harmful materials is a public health problem worldwide. This study describes knowledge, attitudes, and practices towards medical waste management among healthcare workers from selected healthcare facilities in Wau. A cross-sectional, descriptive, and mixed-approach study was conducted among 135 healthcare workers randomly selected from 14 healthcare facilities. A pre-tested, structured questionnaire, key informant interviews, and observation checklist were used to collect the intended data. Descriptive and thematic analyses were performed. Findings were presented using tables, graphs, pie charts, and quotes.Of 135 respondents, 55% (n=74) were females and 45% (n=61) were males. The majority, 91% (n=123), had good knowledge about medical waste management. Healthcare workers at primary healthcare and government facilities had slightly better knowledge compared to those at hospitals or private facilities. 74% (n=100) had a positive attitude and perceived medical waste management as a priority. Regarding practices 47% were unvaccinated against work-related illnesses, used gloves (58.5%) and overalls (24.4%) as personal protective equipment. Healthcare workers were found having good knowledge, positive attitudes, and fair practices. Thus, continuous training on medical waste management, awareness, vaccination, provision of adequate personal protective equipment, and supply of waste management facilities are required to improve the health and wellbeing of both patients and healthcare workers.*

***Keywords*** *Awareness, Healthcare Workers, Medical Waste Management, South Sudan.*

***This article is published under Creative Commons Attribution License (CC BY 4.0)***

https://doi.org/10.21522/TIJAR.2014.13.03.Art021

## Introduction

The concerns over medical waste management have increased in recent years globally due to improper disposal. This poses a public health risk coupled with the lack of knowledge and inappropriate attitude and practices among healthcare workers and the public at large.

Waste management is a conduit at the crossroads of inputs from producers, users, and outputs to environmental compartments, with the overall goal to clear the residues and reutilize cleared materials and natural resources [1, 15].

WHO and UNICEF, through the Joint Monitoring Programme, have placed three indicators to measure waste management at healthcare facilities. A basic waste management level is at least acceptable [2, 17]. At this level, waste is safely segregated into three bins, and sharps and infectious waste are treated and disposed of safely. The second lower level is a limited separation and/or treatment and disposal of sharps and infectious waste, but not all requirements for basic service are met. However, where there is no service, there are no separate bins for sharps or infectious waste, and sharps and/or infectious waste are not treated/disposed of safely [3].

In South Sudan, although a national action plan (2012 – 2016) was developed, there is no evidence of its implementation at the facility level. With support from the government of Canada through the World Health Organization (WHO), South Sudan has installed the first-ever medical waste management unit at Juba Teaching Hospital in 2023. The mounted facility is a temperature-controlled incinerator that is used to collect, transport, and treat infectious waste and sharps [4, 20].

So far, the majority of healthcare facilities in low-income countries, including South Sudan, don't adhere to medical waste management minimum standards. In addition, the current methods for treatment and disposal are dissatisfactory, and healthcare workers, both technical and non-technical, still face many serious risks to their health and safety. Therefore, the risk associated with medical waste management is high to very high, and public awareness on medical waste issues among the population is low [5]. This study aimed at assessing the knowledge, attitude, and practice toward medical waste management among healthcare workers drawn from fourteen (14) healthcare facilities operating in Wau Municipality, South Sudan.

## Materials and Methods

### Study Design and Study Area

A cross-sectional, descriptive, and mixed-approach (quantitative & qualitative) study was conducted from February to May 2026 among healthcare workers in Wau Municipality, Western Bahr el Ghazal State, South Sudan [6]. The state has a population of 127,384 people located at the eastern banks of the Jur River. The place is a home to several communities that mostly practice farming, livestock keeping, or working with government, private, or business sectors.

### Study Population

The study targeted healthcare workers, which included doctors, physicians, nurses, midwives, public health officers, pharmacists, lab technicians, waste collectors, and cleaners who are directly involved in medical waste management at the health facility level. The inclusion criteria included all who are 18 years and above, mentally sound, working at a healthcare facility, accepted to participate, and provided written informed consent. While exclusion criteria included those who were less than 18 years old or declined to consent or were not healthcare workers. The participants were interviewed face-to-face by trained research assistants at their respective healthcare facilities.

### Sample Size and Sampling

According to a previous study [7], the study sampled all 14 healthcare facilities operating in Wau Municipality according to the list provided by the Ministry of Health in Western Bahr el Ghazal State.

The list included three (3) hospitals, four (4) primary healthcare centers (PHCCs), four (4) primary healthcare units (PHCUs), and three (3) clinics.

The allocation of healthcare workers was done proportionally per healthcare facility as shown in Table 1, whereby 135 healthcare workers were selected using systematic random sampling. Every 3rd healthcare worker was selected randomly from the list of healthcare workers received. In addition, 14 health facilities in charge were selected for qualitative data collection.

### Data Collection

The study used a structured and pretested questionnaire to assess the knowledge, attitude, and practices of the respondents. The questionnaire was comprised of socio-demographic characteristics, knowledge, attitude, and practice-related questions, both open-ended and closed-ended.

The overall knowledge of the respondents was calculated from five major questions: “Are you aware of what medical waste is?" “If yes, are you trained on medical waste management?”, “Do you know the standards and regulations on medical waste management? And do you know that medical waste should be segregated?” The response to each of the questions was scored as either correct (2) or incorrect (0). The total sum of the scores was (2x5 = 10). The overall knowledge was finally categorized as: any respondent who scored 5 and above was considered to have good knowledge, and any respondent who scored below 5 was considered to have poor knowledge. For attitude and practices, any respondents who provide the most favorable responses are considered to have positive attitudes or good practices.

In addition, a key informant checklist was used to collect qualitative data from healthcare facilities in charge through face-to-face interviews and sound recording using a smartphone.

The questionnaire and key informant interview checklist were designed in English and translated verbally into the Arabic language, which is a common language spoken in the area, to those who don’t understand or write in English. Data collection was done by well-trained research assistants that were bilingual in English and Arabic.

### Data Management and Statistical Analysis

The collected data was cleaned and double-checked for consistency and completeness. After data entry, descriptive analyses were performed using IBM SPSS software (version 26). The analyses, such as frequencies, percentages, and chi-square tests, were used to examine the relationship between categorical variables, including age, sex, education, and awareness of medical waste management. The results were presented using tables, pie charts, and graphs.

Qualitative data was analyzed using NVivo software. After recording data, transcripts and major themes were extracted and summarized.

## Results

### Socio-demographic Characteristics

A total of 135 healthcare workers (55% females, 45% males) were interviewed. The majority, 67% (n=90), of the respondents were aged 20-30 years old, followed by 27% (n=36) who were aged 31-40 years old. The education background showed a majority, 60% (n=81), attended university, 24% (n=33) were uneducated, and 12% of respondents completed secondary school. Meanwhile, the majority, 19% (n=25), of respondents were from Mary Help Hospital; 15% (n=20) were from Wau

Teaching Hospital; and 7% (n=10) were from Comboni Hospital, while others were drawn from four primary healthcare centers (PHCCs), four primary healthcare units (PHCUs), and three private clinics (Table 1).

**Table 1.** Socio-demographic Characteristics of Respondents, Wau (n=135)

| **Characteristics** | **Variable** | **Frequency** | **%** |
|---|---|---|---|
| Sex | Male | 61 | 45 |
| | Female | 74 | 55 |
| | **Total** | **135** | **100** |
| Age | 20-30 years | 90 | 67 |
| | 31-40 years | 36 | 27 |
| | 41-50 years | 7 | 5 |
| | 51 years and above | 2 | 1 |
| | **Total** | **135** | **100** |
| Education | None | 33 | 24 |
| | Primary | 5 | 4 |
| | Secondary | 16 | 12 |
| | University | 81 | 60 |
| | **Total** | **135** | **100** |
| Health facility | Wau Teaching Hospital | 20 | 15 |
| | Comboni Hospital | 10 | 7 |
| | Mary Help Hospital | 25 | 19 |
| | Hai Dinka PHCC | 10 | 7 |
| | Lokoloko PHCC | 10 | 7 |
| | Muktah PHCC | 10 | 7 |
| | Sikka Hadid PHCC | 10 | 7 |
| | Aljazera PHCU | 10 | 7 |
| | Bazia PHCU | 5 | 4 |
| | Hai Bafra PHCU | 5 | 4 |
| | Jebel Khir PHCU | 5 | 4 |
| | Clinic I | 5 | 4 |
| | Clinic II | 5 | 4 |
| | Clinic III | 5 | 4 |
| | **Total** | **135** | **100** |

## Knowledge of Healthcare Workers towards Medical Waste Management

In table 2, most of the respondents, 96.3% (n=130), were aware of medical waste management. The majority (76.3%, n=103) of respondents were trained on medical waste management, and 52.6% (n=71) attended specialized training on medical waste management. Less than half, 43.7% (n=59), preferred awareness rising, and only 37% (n=50) of respondents chose on-the-job training. 75.6% (n=102) of respondents knew about medical waste management standards and regulations. Moreover, 88.9% (n = 120) of respondents were knowledgeable about infectious waste segregation according to color-coded bins, e.g., yellow, red, and blue. Generally, most 91% (n=123) of the respondents had good overall knowledge about

medical waste management compared to 9% (n=12) of respondents that had poor knowledge about medical waste management (Table 2).

**Table 2.** Knowledge of Respondents towards Medical Waste Management, Wau (n=135)

| Knowledge | Variable | Frequency | % |
|---|---|---|---|
| Awareness of medical waste management (MWM) | Yes | 130 | 96.3 |
| | No | 5 | 3.7 |
| | **Total** | **135** | **100** |
| Training on medical waste management | Yes | 103 | 76.3 |
| | No | 32 | 23.7 |
| | **Total** | **135** | **100** |
| MWM specialized training conducted during the last 2 years | Yes | 71 | 52.6 |
| | No | 64 | 47.4 |
| | **Total** | **135** | **100** |
| Mode of training preferred | on job training | 50 | 37.0 |
| | awareness | 59 | 43.7 |
| | programmes/posters | 24 | 17.8 |
| | others | 2 | 1.5 |
| | **Total** | **135** | **100** |
| Knowledge of MWM standard and regulations | Yes | 102 | 75.6 |
| | No | 33 | 24.4 |
| | **Total** | **135** | **100** |
| Knowledge of medical waste should be segregated? | Yes | 120 | 88.9 |
| | No | 15 | 11.1 |
| | **Total** | **135** | **100** |
| Do you know about color coding? | Yes | 109 | 80.7 |
| | No | 26 | 19.3 |
| | **Total** | **135** | **100** |
| If yes, what are the color- coded bins do you have at this facility? | Yellow | 54 | 46.2 |
| | Red | 45 | 38.5 |
| | Blue | 18 | 15.3 |
| | ***Total** | **117** | **86.7** |
| Overall knowledge | Good | 123 | 91 |
| | Poor | 12 | 9 |
| | **Total** | **135** | **100** |

## Attitude of Healthcare Workers towards Medical Waste Management

A majority, 43.7% (n=59), of respondents report injury while handling medical waste, while 38.5% (n=52) of respondents wash the injury sites after getting exposed to a medical waste injury. On the other hand, nearly three quarters of respondents, 74% (n=100), perceived waste management as a priority, and only 23% (n=31) of respondents perceived waste management as important for environmental safety. 60.8% (n=82) of respondents were satisfied with the way technical healthcare staff safely handle medical waste. However, 40% (n=54) of respondents

were unsatisfied with non-technical healthcare staff's safe handling of medical waste (Table 3).

**Table 3.** Attitude of Respondents towards Medical Waste Management, Wau (n=135)

| Attitude | Variable | Frequency | % |
|---|---|---|---|
| What do you do when exposed to injury while handling medical waste? | nothing | 10 | 7.4 |
| | wash the injury sites | 52 | 38.5 |
| | report | 59 | 43.7 |
| | PEP initiation | 14 | 10.4 |
| | **Total** | **135** | **100** |
| How do you perceive waste management? Is it priority? | no critical | 4 | 3.0 |
| | important for infection control | 100 | 74.0 |
| | important for environmental safety | 31 | 23.0 |
| | **Total** | **135** | **100** |
| To what extent, safe handling of medical wastes practiced by technical staff | unsatisfactory | 26 | 19.2 |
| | satisfactory | 41 | 30.4 |
| | good | 41 | 30.4 |
| | excellent | 27 | 20.0 |
| | **Total** | **135** | **100** |
| To what extent, safe handling of medical wastes practiced by non-technical staff | non-existent | 11 | 8.1 |
| | unsatisfactory | 54 | 40.0 |
| | satisfactory | 36 | 26.7 |
| | good | 26 | 19.3 |
| | excellent | 8 | 5.9 |
| | **Total** | **135** | **100** |

## Practices of Healthcare Workers towards Medical Waste Management

Table 4 showed the common personal protective equipment (PPE) used by healthcare workers was gloves (58.5%), followed by overalls (24.4%). The incident reporting system was confirmed by 68.9% of respondents; 80.7% recapped needles before passing them on to others or disposed of them to protect others.

More than half, 53.3% (n=72), of respondents obtained vaccination against hepatitis B at their respective healthcare facilities. However, the reason for not receiving HBV vaccination was due to lack of enough resources (62.2%, n=59). Regarding medical waste disposal, the majority, 24.4% (n=33) of respondents mentioned incineration, followed by open or pit burning (24.4%, n=33).

Whether your HCF has an incinerator, Metamiser, or autoclave, less than half, 47.4% (n=64), of respondents mentioned incinerator only, and 20.7% (n=28) said incinerator, Metamiser, or autoclave. 66.7% (n = 90) of respondents agreed that healthcare HCF staff were only responsible for operating and managing the on-site incinerator. The 42.2% (n=57), of respondents suggested the transfer of medical waste to a nearby treatment facility, while 31.1% (n=42) mentioned the safe storage of medical waste. On how the HCF is fed to the incinerator, the majority, 64.4% (n=87) of respondents, said manually through the door or using a screw feeder (26.7%, n=36).

https://doi.org/10.21522/TIJAR.2014.13.03.Art021

How is the ash from the incinerator disposed of? The ashes generated from the incinerators were disposed of through burying (33.3%, n=45) or open dumping (29.6%, n=40).

**Table 4.** Practice of Respondents towards Medical Waste Management, Wau (n=135)

| Practice | Variable | Frequency | % |
|---|---|---|---|
| What kind of personal protective equipment (PPE) is used by those medical staff who manage medical waste? | gloves | 79 | 58.5 |
| | heavy duty boots | 9 | 6.7 |
| | goggles | 4 | 3.0 |
| | surgical masks | 9 | 6.7 |
| | face shields | 1 | 0.7 |
| | overalls | 33 | 24.4 |
| | **Total** | **135** | **100** |
| Is there an incident reporting system in place, including needle prick injuries? | Yes | 93 | 68.9 |
| | No | 42 | 31.1 |
| | **Total** | **135** | **100** |
| Do you recap needles before passing on to others or dispose of them to protect others? | Yes | 109 | 80.7 |
| | No | 26 | 19.3 |
| | **Total** | **135** | **100** |
| Is vaccination against hepatitis B carried out for permanent/causal HCF staff? | Yes | 72 | 53.3 |
| | No | 63 | 46.7 |
| | **Total** | **135** | **100** |
| If not, please indicate the reasons for not vaccinating the HCF staff? | not enough resources | 59 | 62.2 |
| | frequent change of casual workers | 18 | 18.9 |
| | as per the government circular | 18 | 18.9 |
| | **Total** | **95** | **100** |
| How is the medical waste disposed of? | burial | 25 | 18.6 |
| | hand over to authorized third party | 18 | 13.3 |
| | incineration | 59 | 43.7 |
| | open or pit burning | 33 | 24.4 |
| | **Total** | 135 | 100 |
| Please indicate whether your HCF has an incinerator, metamiser, or autoclave | incinerator only | 64 | 47.4 |
| | metamiser only | 7 | 5.2 |
| | autoclave only | 29 | 21.5 |
| | incinerator and metamiser or (autoclave) | 28 | 20.7 |
| | none | 7 | 5.2 |
| | **Total** | **135** | **100** |
| Who is responsible for operating and managing the on-site incinerator? | HCF staff | 90 | 66.7 |
| | supplier of the facility itself | 40 | 29.6 |
| | others | 5 | 3.7 |
| | **Total** | **135** | **100** |

| | | | |
|---|---|---|---|
| What do you do when the on-site incinerator doesn't function? | transfer to a nearby treatment facility | 57 | 42.2 |
| | safe storage | 42 | 31.1 |
| | unsafe storing | 3 | 2.2 |
| | open dumping | 10 | 7.4 |
| | burial | 12 | 9.0 |
| | open burning | 11 | 8.1 |
| | **Total** | **135** | **100** |
| How is the HCF fed to the incinerator? | manually through the door | 87 | 64.4 |
| | through a screw feeder | 36 | 26.7 |
| | fully automated system | 12 | 8.9 |
| | **Total** | **135** | **100** |
| How the ash from the incinerator is is disposed of? | open dumping | 40 | 29.6 |
| | bury | 45 | 33.3 |
| | collected by the local authority | 28 | 20.7 |
| | secure land filling | 20 | 14.9 |
| | immobilized and secure land filling | 2 | 1.5 |
| | **Total** | **135** | **100** |

## Qualitative Findings

The study carried out 14 key informant interviews (KIIs) with the in-charge of health facilities, for instance: regarding the use of personal protective equipment (PPE), most informants agreed on lack of PPE and insufficient medical waste management facilities. For example, one informant from Wau Teaching Hospital said:

"*We are facing big problem here regarding medical waste management; we don't have enough waste management facilities such as waste bins, soaps, boats, overalls, gloves, etc. work is difficult… we risk our life … because what can we do. we reported … but no solution…***"Informant # 4"**

*Another informant suggested having a separate budget to buy related supplies locally: "I attended training on medical waste management last year; however, most of the things that taught us were not exist here… we can implement what they taught us… no PPE… cleaners don't have incentive and no salaries … that's why sometimes they don't come to work regularly… because no salary… no incentives… work become very difficult…* ***"Informant #12"***

Finally, the importance of training was emphasized by most of the informants:

*"Despite receiving training 2 years ago, we have new staff here that doesn't know how to handle medical waste… It's very dangerous because you can get injured or sick due to lack of knowledge and supplies… That is why I request continuous on-the-job training for all healthcare workers and cleaners… I ask the ministry and partners to support us here….* ***"Informant #3"***

## Discussion

This study provides important insight about medical waste management in healthcare settings in South Sudan, the country that is still struggling to improve its healthcare system, which entirely relies on humanitarian aid and donations to operate.

Understanding the level of knowledge, attitude, and practice among healthcare workers is critical in designing training, awareness, and management of medical waste management in South Sudan.

The current socio-demographic findings revealed a majority of younger healthcare workers with ages ranging from 20 to 40 years from all fourteen (14) healthcare facilities. During the time of data collection, a proportion of the healthcare workers interviewed were intern nurses, midwives, and clinical officers working under the supervision of senior healthcare workers at different healthcare facilities in Wau Municipality.

Regarding the knowledge of medical waste management, this study found overall good knowledge and awareness about medical waste management, for example, knowledge about medical waste and segregation according to WHO guidelines and standards. Despite this, there is still a knowledge gap among those healthcare workers who were not trained yet. These findings were consistent with a cross-sectional study conducted in Botswana (2018) among healthcare workers, which found that 67% of respondents attended training on medical waste management and 91% had good medical waste health risks [6]. On the other hand, the current findings were contrary to a study conducted in Nigeria (2011) that revealed more than half of respondents had average knowledge of medical waste management [8]. Moreover, this study agreed with study conducted in Sweden and Hungary in 2022 that showed more than half (58%) of Hungarian Healthcare workers demonstrated good knowledge of waste management guidelines, while 67% received training on waste handling and 84.0% had good knowledge of implementation of guidelines. On the contrary, Swedish healthcare workers demonstrated poor knowledge towards waste management guidelines (34.4%), training on waste handling (47.9%), and implementation of waste management guidelines (35.7%) [9, 18]. However, 40.5% lacked some knowledge at all, and the majority (87.1%) use latex gloves when handling waste [10].

The high level of knowledge found in our study may contribute to the deliberate intervention done by healthcare organizations and partners to ensure that all healthcare facilities comply with a minimum waste management standard, including training of healthcare workers.

Findings from qualitative data agreed with the previous studies and provided an important insight highlighting gaps in knowledge, waste management supplies, PPE, and training.

Importantly, this study revealed that the majority of healthcare workers had positive attitudes, for instance, perceived waste management as a priority, knew about segregation of waste, used gloves, reported any injury related to medical waste, and got vaccinated against waste-related illnesses.

This finding agreed with a study conducted in India (2016) that found most respondents agreed that medical waste should be segregated at the point where it is generated. This was consistent with the results from a study in India, where 96.9% of respondents agreed that waste should be segregated [11, 19].

These findings also agreed with a study from Botswana (2018) that found the majority of health workers had a positive attitude towards hospital waste management and only 44% had a negative attitude [6, 14]. Also, our study found a similar conclusion to a study among the Hungarian healthcare workers that revealed a good attitude towards hazardous waste disposal, labeling of containers, color coding, waste segregation, and occupation safety. Similarly, Swedish healthcare workers showed a good attitude towards hazardous waste disposal, labeling of containers, color coding, waste segregation, and occupation safety. Furthermore, the poor attitude was noted for the report of industrial accidents and safe management of waste. This finding agreed with a previous study conducted in Sweden &

Hungary (2022) that indicated a poor attitude (39.9%) on reports of industrial accidents and safe management of healthcare waste was observed [8]. This finding agreed with a study conducted in India (2025) that showed a strong positive attitude toward biomedical waste management among healthcare workers in India [12].

Regarding practices toward medical waste management, this study found the use of gloves and overalls as common personal protective equipment (PPE) used by healthcare workers in Wau Municipality. While the incident reporting system was confirmed by 68.9% of respondents, 80.7% recapped needles before passing them on to others or disposed of them to protect others. This study was consistent with studies conducted in Sweden/Hungary (2022) and India (2025) that found the majority of healthcare workers had good practices towards waste management, including following proper color-coding practices and waste segregation, and reported using PPE while handling biomedical waste management.

More than half, 53.3%, of respondents obtained vaccination against hepatitis B at their respective healthcare facilities. However, the reason for not receiving vaccination was due to lack of enough resources. This finding is contrary to a study done in India that found fewer respondents reported not following post-exposure prophylaxis protocols after experiencing needle-stick or percutaneous injuries [8, 12].

Regarding medical waste disposal, most respondents mentioned incineration, followed by open or pit burning. Whether your HCF has an incinerator, Metamiser, or autoclave, less than half of respondents mentioned incinerator only, and fewer said incinerator, Metamiser, or autoclave. This is inconsistent with a previous study conducted in India by Swetha Suram (2025) that found most respondents disposed of non-infectious waste in black containers, consistent with standard guidelines, and it agrees with waste management guidelines applied in South Sudan [13, 16]. The strength of this study relied on using a mixed approach, both quantitative and qualitative. This approach provided clear insight about medical waste management in Wau Municipality and South Sudan in general.

This study had some limitations: small sample size due to data was collected from one State only, this may limit the generalizability of the findings to other parts of South Sudan. In addition, the use of self-reported questionnaire may have introduced response bias and overestimated participants' knowledge and practices. However, KIIs were applied to complement the quantitative method. Moreover, despite the fact that the questionnaire was pretested to ensure accuracy of the questions, however, the study did not assess the reliability and validity of the questionnaire using standard statistical methods, which may affect the accuracy of the results. Finally, our study was limited to assessing the overall KAP and did not examine other important factors such as: funding, staff training or policy implementation though all these factors were described and identified.

Further studies are recommended to understand the relationship between poor medical waste management and quality of healthcare service and satisfaction of the patients and co-patients and assessing the relationship using structural equation modeling.

## Conclusion

This study revealed good knowledge and positive attitude and practice related to medical waste management and provided critical insight that will provide evidence-based information to Ministry of Health, Water, Sanitation and Hygiene (WASH) cluster partners such as UNICEF, WHO, government, and others. Therefore, on-the-job training of healthcare workers, especially interns and new recruits, and non-technical staff such as waste pickers and cleaners on medical waste management is critical. Provision of medical waste

management facilities (e.g., containers, protective personal equipment (PPE), incineration, etc.); motivation of healthcare workers, including cleaners; provision of a separate budget to handle medical waste management-related expenses; and formation of specialized waste management committees in all healthcare facilities to plan, fundraise, and supervise waste management activities.

## Conflict of Interest

The authors declare no competing interests.

## Acknowledgements

We would like to thank the Ministry of Health, Western Bahr el Ghazal State; Wau County Health Department (CHD); all healthcare workers; healthcare facility in-charges; research assistants; Texila University; and Revelation 4 Solutions Consulting (R4SG) for their cooperation and support.

## Ethical Approval

Participation in this study was completely voluntary. All participants provided written informed consent after the purpose of the study was clearly explained and understood. The participants were informed about their right to withdraw from the study at any time without any implications. The study was approved by the Research Ethics Review Board at Texila American University and the Ministry of Health, Western Bahr el Ghazal State, Wau, South Sudan.

## Funding

The authors declared that this study has received no financial support.

## Data Availability

All the supported data are available and can be access on request from the corresponding author.

## Authors' Contributions

- Conceptualization: Emmanuel Aban Nyilek, Dr. Sonika Raj
- Formal analysis**:** Emmanuel Aban Nyilek and Peter Marin
- Methodology: Emmanuel Aban Nyilek, Dr. Sonika Raj, Peter Marin
- Writing – original draft: Emmanuel Aban Nyilek
- Writing – review & editing: Emmanuel Aban Nyilek, Dr. Sonika Raj, Peter Marin

## References

[1]. Rahman Shabur M, Siddique AB. Solid waste management in an urban community of a developing country: An overview of 5 Rs strategies. World Dev Sustain. 2025;7:100254. Available from: https://doi.org/10.1016/j.wds.2025.100254

[2]. Ministry of Health. Development of Medical Waste Management Plan for South Sudan. Juba (South Sudan): Ministry of Health; 2011.

[3]. Kmentt L, Cronk R, Tidwell JB, Rogers E. Water, sanitation, and hygiene (WASH) in healthcare facilities of 14 low- and middle-income countries: To what extent is WASH implemented and what are the drivers of improvement in their service levels? H2Open J. 2021;4(1):130. doi:10.2166/h2oj.2021.095. Accessed May 2026.

[4]. World Health Organization. WHO handed over first-ever medical waste management to South Sudan's Ministry of Health. Available from: https://www.afro.who.int/countries/south-sudan/news/who-handed-over-first-ever-medical-waste-management-south-sudans-ministry-health. Accessed September 3, 2023.

[5]. Babanyara Y, Ibrahim D, Garba T, Bogoro A, Abubakar M. Poor medical waste management (MWM) practices and its risks to human health and the environment: A literature review. World Acad Sci Eng Technol Int J Environ Ecol Geol Geophys Eng. 2013;7(11).

[6]. United Nations Environment Programme. Health and Safety Guidelines for Waste Pickers in South Sudan. 2013. Available from:

https://wedocs.unep.org/handle/20.500.11822/19536

[7]. Asomugha AU, Benjamin N, Kiss I. Knowledge, attitude and practice of healthcare workers towards medical waste management: A comparative study of two geographical areas. J Waste Manag Dispos. 2022;5(1):101.

[8]. Namutebia I, Nanyunja Z. Knowledge, attitudes and practices towards medical waste management among health workers at Mityana District Hospital, Mityana District: A cross-sectional descriptive survey. Student's J Health Res. 2016.

[9]. Mugabi B, Hattingh S, Chima SC. Assessing knowledge, attitudes, and practices of healthcare workers regarding medical waste management at a tertiary hospital in Botswana: A cross-sectional quantitative study. Niger J Clin Pract. 2018.

[10]. Abah SO, Ohimain EI. Healthcare waste management in Nigeria: A case study. J Public Health Epidemiol. 2011;3(3):99-110.

[11]. Suram S, Rudra VG, Miryala RK, Parin NR. Knowledge, attitude, and practices toward biomedical waste management among healthcare workers. Asian J Water Environ Pollut. 2025;22(5):204-213. doi:10.36922/AJWEP025090058.

[12]. Mane V, Nimbannavar SM, Yuvaraj BY. Knowledge, attitude and practice of biomedical waste and its management among healthcare workers at a tertiary care hospital, Karnataka, India. Int J Community Med Public Health. 2016;3:2953-2957.

[13]. Nema A, Pathak A, Bajaj P, Singh H, Kumar S. A case study: Biomedical waste management practices at city hospital in Himachal Pradesh. Waste Manag Res. 2011;29(6):669-673. doi:10.1177/0734242X10396753.

[14]. Bouzid M, Cumming O, Hunter PR. What is the impact of water sanitation and hygiene in healthcare facilities on care seeking behaviour and patient satisfaction? A systematic review of the evidence from low-income and middle-income countries. BMJ Glob Health. 2018;3:e000648.

[15]. World Health Organization. Global Progress Report on WASH in Health Care Facilities: Fundamentals First. Geneva: World Health Organization; 2020.

[16]. Ishijima H, Miyamoto N, Masaule F, John R. Improvements to healthcare waste management at regional referral hospitals in Tanzania using the KAIZEN approach. TQM J. 2021. Available from: https://doi.org/10.1108/TQM-10-2020-0254

[17]. Olaniyi F, Ogola J, Tshitangano T. Challenges of effective management of medical waste in low-resource settings: Perception of healthcare workers in Vhembe district healthcare facilities, South Africa. Trans R Soc S Afr. 2021;76(1):81-88. Available from: https://doi.org/10.1080/0035919X.2021.1900949

[18]. Buxton H, Flynn E, Oluyinka O, Cumming O, Esteves Mills J, Shiras T, et al. Barriers and opportunities experienced by staff when implementing infection prevention and control guidelines during labour and delivery in healthcare facilities in Nigeria. J Hosp Infect. 2019;103(4):428-434.

[19]. Maina M, Tosas-Auguet O, McKnight J, Zosi M, Kimemia G, Mwaniki P, et al. Extending the use of the World Health Organization's Water Sanitation and Hygiene Assessment Tool for surveys in hospitals: From WASH-FIT to WASH-FAST. PLoS One. 2019;14(12):e0226548.

[20]. World Health Organization. Guidelines on Core Components of Infection Prevention and Control Programmes at the National and Acute Health Care Facility Level. Geneva: World Health Organization; 2016.