

## Research Article

# Assessing Knowledge, Attitudes, and Practices of Healthcare Workers regarding Biomedical Waste Management at Biyem-Assi District Hospital, Yaounde: A Cross-Sectional Analytical Study

Sylvain Honoré Woromogo <sup>1</sup>, Gwladys Guetsé Djeukang,<sup>1</sup> Félicité Emma Yagata Moussa,<sup>3</sup> Jesse Saint Saba Antaon,<sup>1,2</sup> Kingsley Ngah Kort,<sup>4</sup> and Pierre Marie Tebeu<sup>1,2</sup>

<sup>1</sup>Inter-State Centre of High School for Public Health Teaching for Central Africa (CIESPAC), Brazzaville, Congo

<sup>2</sup>Faculty of Medicine and Biomedical Sciences, University of Yaounde1, Cameroon (FMBS), Yaoundé, Cameroon

<sup>3</sup>Faculty of Health Sciences, University of Bangui, Bangui, Central African Republic

<sup>4</sup>Ministry of Public Health, Yaounde, Cameroon

Correspondence should be addressed to Sylvain Honoré Woromogo; woromogos@gmail.com

Received 10 November 2019; Revised 1 April 2020; Accepted 7 May 2020; Published 22 May 2020

Academic Editor: Carol J. Burns

Copyright © 2020 Sylvain Honoré Woromogo et al. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

**Background.** Biomedical waste (BMW) is defined as unwanted materials generated during diagnosis, treatment, operation, immunization, or in research activities including production of biologicals. Healthcare workers are responsible for the proper management of this waste for human safety and for the protection of the environment. **Methods.** An analytical knowledge, attitude, and practice (KAP) study was carried out at Biyem-Assi District Hospital from June 1st to July 5th, 2018, including 100 health workers from different departments. Variables of interest were knowledge, attitudes, and practices of the respondents. A structured and pretested questionnaire was used for data collection. Data analysis was carried out using software Epi Info version 7.2.2.6. Logistic regression was used to establish the relationship between knowledge, attitudes, and practices. **Results.** Nurses constituted 32.0% of the participants, and more than half of the participants had 1–4 years of working experience (56.0%). Overall, the level of knowledge was satisfactory at 50.0%, that of attitudes was as unfavorable at 83.0%, and that of practices was as poor at 50.0%. Favorable attitudes were associated to satisfactory level of knowledge (ORa = 5.14 [3.10–8.51] and  $p = 0.005$ ). Good practices were associated to good level of knowledge (ORa = 5.26 [3.17–8.7] and  $p < 0.001$ ) and a favorable attitude (ORa = 7.30 [2.25–23, 71] and  $p < 0.001$ ). **Conclusion.** The level of knowledge was considered unsatisfactory for half of the staff interviewed. Attitudes were unfavourable at 83.0% and poor practices at 50.0%. Staff with a good level of knowledge were more likely to have favourable attitudes towards BWM. Also, good knowledge and attitude positively influenced the practice with regard to BMW management.

## 1. Introduction

Biomedical waste (BMW) is defined as unwanted materials generated during diagnosis, treatment, operation, immunization, or in research activities including production of biologicals. It includes all the materials used while administering treatment to patients as well as all items contaminated by hazardous fluids, for example, blood, urine, feces, and other body fluids [1–4]. The magnitude of infectious risk associated with waste is high in low-income countries. Each year, Africa, Asia, and South America are the most affected

by the infectious risk for professionals and populations, estimated between 15 and 20% due to hospital waste or infectious healthcare waste (WHARI) [5, 6]. In Cameroon, the health and legislative development programs deal superficially with the question of biomedical waste management. Gaps in the legislative framework prevent the sound management of such waste [7, 8]. The role and responsibilities of those involved in biomedical waste management are not defined in a clear and precise manner. Healthcare institutions are concerned for two reasons: firstly, as health actors, they must ensure good hygiene in order to protect the

population and the environment through a good knowledge of the standards and regulations on health, BMW management; on the contrary, as waste producers, they are responsible for the disposal. In 2016, Biyem-Assi District Hospital had an overall attendance of 47,830 patients with an average attendance per month estimated at 4,933, or 160 patients received per day. This explains the significant weight of solid BMW produced in this district, considering that Africa is estimated to have 67,740 healthcare workers and produce approximately 282,447 tons of medical waste every year [9]. The aim of this study was to assess the knowledge, attitudes, and practices among the healthcare workers (HCWs) of Biyem-Assi District Hospital (Yaounde/Cameroon) with regard to BMW management, more specifically, to estimate the level of knowledge, attitudes, and practices of healthcare workers on BMW, to establish the relation between sociodemographic and professional characteristics and the level of knowledge, to determine the influence of the level of knowledge on healthcare workers' attitudes, and to report the influence of the level of knowledge and attitudes on healthcare workers' practices.

## 2. Methods

**2.1. Study Design: Population and Procedure Sampling.** This was an analytical KAP study conducted at the Biyem-Assi District Hospital in Yaounde. With the help of Daniel Schwartz's formula [10],  $N = z^2 pq / i^2$ , where  $z = 5\%$  (risk of error);  $p = 50\%$  (considering proportion of HCWs with good practice in BMW management);  $q = 1 - p$  and  $i = \text{precision}$  (10%). We obtained 94 respondents, in which we rounded up to 100. Biyem-Assi district Hospital had 196 healthcare workers including 19 general medical practitioners, 24 specialist doctors, and 153 paramedical staff. The weight was calculated by multiplying the number of staff in each category of healthcare workers by the coefficient  $(1/196) * 100$ . Thus, we obtained 10 general medical practitioners, 12 specialist doctors, and 78 paramedical staff. Then, a simple random sample was drawn from the official list of each category in order to retain the respondents.

**2.2. Inclusion and Exclusion Criteria.** The healthcare workers were retained after consent and by simple random draw.

Participants had to be employed by the hospital under study. All professional HCWs who were not permanently employed by the hospital and any staff members who were not willing to sign consent to participate were excluded from the study. The list of healthcare workers was made up of specialist and general practitioners and other care staff of all clinical domains.

**2.3. Data Analysis.** The main variables analyzed were sociodemographic characteristics of the participants, knowledge, attitude, and practice on the management of biomedical waste. A structured and pretested questionnaire and an interview guide were used for data collection. A face-to-face interview and observation were conducted by the investigator using an interview guide.

The data were entered and analyzed with Epi Info version 7.2.2.6 software.

Knowledge, attitudes, and practices included questions quantified at 13, 28, and 24 points, respectively. The points obtained made it possible to classify knowledge, attitudes, and practices into two categorized each: knowledge as satisfactory ( $>7$  points) and unsatisfactory ( $\leq 7$  points); attitudes as favourable ( $>14$  points) and unfavourable ( $\leq 14$  points), and practices as good ( $>12$  points) and bad ( $\geq 12$  points).

A simple logistic regression was used to establish the relationship between knowledge of sociodemographic characteristics (age and marital status) and professional (job description and seniority). The Chi-square and Wald tests were used as well as the odds ratio with their 95% confidence interval at the 5% threshold. Multiple logistic regression was used to establish the relationship between attitudes and knowledge and also practices with knowledge and attitudes. Multivariable logistic regression analyses with backward elimination stepwise selection with  $p < 0.20$  were used to identify baseline explication that predicts practices or attitudes of healthcare workers.

**2.4. Ethical Considerations.** Ethical clearance and research authorization were obtained for this study. Informed consent was written and submitted to HCWs who have read before agreeing to participate in this study. The ethics committee of the Inter-State Centre for Higher Education in Public Health in Central Africa (CIESPAC) had approved the study, and the ethical clearance had as number 003/CSERC/CIESPAC/2018. Further permission was obtained from the Cameroon Ministry of Health and the hospital under study.

## 3. Results

**3.1. Sociodemographic and Professional Characteristics of the Healthcare Workers.** We interviewed 100 healthcare workers; their ages ranged from 18 to 59 years with a median of 27 years. Female health workers accounted for 62.0% (62/100). Among the participants, nurses accounted for 32.0%. Finally, 56.0% of the respondents had 1 to 4 years of working experience (Table 1).

**3.2. Knowledge, Attitudes, and Practices of Healthcare Workers on Biomedical Waste Management.** Among participants, 86% (86/100) knew that waste could not be recycled. Standards and regulations in waste management were ignored in 71%. More than half of them, 64/100 (64.0%), did not know the meaning of WHARI. Only 45/100 (45.0%) knew what to do in case of blood exposure accident (BEA). Finally, of the healthcare workers, 91/100 (91.00%) stated that they had not received any information (Table 2).

More than half of the participants, 59/100 (59.0%), were not vaccinated against diseases attributable biomedical waste management. In addition, the majority of them, 79/100 (79.0%), reported having no source of information. Healthcare workers were dissatisfied with waste management at 66/100 (66.0%).

TABLE 1: Sociodemographic and professional characteristics of healthcare workers.

Characteristics	Healthcare workers (N = 100)	
	<i>n</i>	(%)
Sex		
Male	38	38.00
Female	62	62.00
Age, extremes (min; max)	(18; 59)	
Age, median (Q1; Q3) (years)	27 (23; 32)	
Age (class) (years)		
18–29	71	71.00
30–45	20	20.00
45–59	09	09.00
Marital status		
Single	60	60.00
Married	30.00	30.00
Divorced	03	03.00
Widow	07	07.00
Job description		
Medical doctor	25	25.00
Surgeon	20	20.00
Laboratory	08	08.00
Emergency	03	03.00
Maternity	10	10.00
Other clinical services	34	34.00
Qualification		
Specialised medical doctors	10	10.00
General practitioners	12	12.00
Nurses	32	32.00
Nurse assistants	30	30.00
Medical analysis technicians	08	08.00
Midwives	08	08.00
Extreme seniority (years)	1–29	
Median seniority (Q1-Q3) (year)	3 (2–6)	
Seniority		
<10 years	84	84.00
≥10 years	16	16.00

TABLE 2: Knowledge of healthcare workers on biomedical waste in June 2018.

Knowledge of staff	Healthcare workers N = 100	
	<i>n</i>	%
Definition of the word “waste”		
Residues that can be reused	14	14.00
Useless and worthless objects	54	54.00
Dirt	32	32.00
Do you know the standards and regulations on biomedical waste management?		
Yes	29	29.00
No	71	71.00
Are biomedical wastes recyclable ?		
Yes	14	14.00
No	86	86.00
Do you know the mean of the initials WHARI?		
Know	36	36.00
Don't know	64	64.00
What is the best course of action for blood exposure accident?		
Rinse the eye thoroughly with water in case of projections and declare it in occupational medicine	45	45.00
Do not know	08	08.00
Clean, disinfect, and protect the wound with a bandage	47	47.00
Have you received any information on biomedical waste management?		
Yes	09	09.00
No	91	91.00

A minority of (36/100) employees, or 36.0%, sorted the waste. In addition, the collection frequency was uncontrolled at 66/100 (66.0%). The means of transport used were mostly manual in 69.0% (69/100). More than half, 67/100 (67.0%), had undergone at least one bloodshed accident (BEA). One-third of only health personnel, 33/100 (33.0%), disinfected the storage room once a day. Practices were mostly poor in 50.0% of cases.

**3.3. Influence of Sociodemographic and Occupational Characteristics on the Knowledge of Healthcare Workers.** Compared to those aged 18–29 and 45–59, those aged 30–45 were more likely to have satisfactory knowledge of solid biomedical waste management (80% vs. 20%, OR: 6.14%) ([1.86–20.28] and  $p = 0.001$ ). In addition, laboratory/emergency personnel were more likely to have satisfactory knowledge of biomedical waste management (72.73% vs. 27.27%, OR: 4.48) ([1.08–21.95] and  $p = 0.02$ ) than other services; similar observation was done for the staff of the maternity. Working experience of more than 10 years was compared to those with a seniority of less than 10 years (75.00% vs. 25.00%, OR: 3.63) ([1.08–12.18] and  $p = 0.05$ ) (Table 3).

**3.4. Influence of the Level of Knowledge on the Attitude of Healthcare Workers towards BMW Management.** Considering age, position, and working experience, staff with a satisfactory level of knowledge were more likely to have favourable attitudes towards biomedical waste management (ORa = 5.14 [3.10–8.51];  $p = 0.005$ ) (Table 4).

**3.5. Influence of Levels of Knowledge and Attitudes on the Level of Practice.** Considering age, job position, and working experience in service, healthcare workers with a satisfactory level of knowledge were more likely to have good practices in managing solid biomedical waste than those with unsatisfactory level of knowledge (ORa = 5.26 [3.17–8.7] and  $p < 0.001$ ). Similar observation was done for the attitude where those with favourable attitude had better practice (ORa = 7.30 [2.25–23.71];  $p < 0.001$ ) (Table 5).

## 4. Discussion

**4.1. Sociodemographic and Professional Characteristics of Respondents.** Female workers dominated the healthcare workers at 62.0%. Our finding is higher than the report from Morocco in 2015 with female accounting for 40.0% of health workers [11]. This difference could be in agreement with the female-male ratio of healthcare workers in Cameroon, that is, at 1/3. Nursing staff dominated the healthcare workers, which contrasts with the ratio of nurse to doctor (1/5) required [12].

**4.2. Level of Knowledge, Attitudes, and Practices of Healthcare Workers.** Half of the respondents had an unsatisfactory level of knowledge, and 91.0% of them stated that they did not have training on management of biomedical waste. The lack of training was raised by Mouankie et al. in Congo in

2015 and Ndie Justin with, respectively, 51.0% and 75.0% [13, 14]. The level of attitudes was unfavourable at 83.0%. According to Saizonou in 2014, in Benin, 65.5% of carers had unfavourable attitudes about [15]. However, Catherine Perrot in France had noted the positive attitudes of care staff in managing biomedical waste [16]. This difference could be explained by the fact that working conditions are more favorable in developed countries than in developing countries. Lack of training could also be reflected in the lack of vaccination of staff against contractile conditions by handling of biomedical waste (59.0%). Similar results were reported by Mokoko et al. in 2018 (57.0%) [17]. The level of practice was poor at 83.0%. The poor management practice of biomedical waste could be explained by the insufficiency of human and material resources revealed by our interviews. The heavy workload could reduce the time devoted to waste management. Also, the inadequate equipment was an obstacle to good management practices since a minimum of logistical resources is required. In addition, 67/100 (67%) of caregivers did not perform sorting at source. This absence of sorting at source was noted by Ndiaye et al. in Senegal in 2012 (53.0%) [12]. Our findings could be justified by the low involvement of personnel in waste management as revealed by our interviews. However, the Sengodan study in 2014 noted that effective segregation protocols significantly reduced biomedical waste generated from 2011 to 2012 in India [18].

**4.3. Influence of Sociodemographic and Occupational Characteristics on the Level of Knowledge, Attitudes, and Practices of Healthcare Workers.** The effect of age on satisfactory knowledge in solid biomedical waste management was noted. Healthcare workers with more than 10 years of professional experience had better knowledge of biomedical waste management.

These results are similar to those obtained by Mohamed in Dakar in 2019 [19]. These results could be explained by the fact that professional experience offers the healthcare personnel the opportunities to be confronted with new situations and to learn from them.

**4.4. Influence of the Level of Knowledge on the Level of Attitudes of the Healthcare Workers.** A good knowledge of a given question raises the person's level of consciousness and consequently his level of attitude towards the subject. The healthcare workers with a satisfactory level of knowledge had a favorable attitude towards the management of biomedical waste.

**4.5. Influence of Knowledge and Attitude Levels on Healthcare Workers' Practices.** When comparing healthcare workers with unsatisfactory knowledge, those with satisfactory knowledge were more likely to have good practices in BMW management. This rating is maintained after adjusting for potential confounding factors such as age, position, and seniority. This observation is in agreement with the theory of "health belief model" [20]; which states that, when an

TABLE 3: Relation between knowledge and the sociodemographic and professional characteristics of healthcare workers.

Characteristics	Total N = 100	Level of knowledge of healthcare workers				OR (CI 95%)	p value
		Satisfactory		Not satisfactory			
		n	%	n	%		
Age (years)							
18–29	71	28	39.44	43	60.56	1	
30–45	20	16	80.00	04	20.00	6.14 (1.86–20.28)	<b>0.001</b>
45–59	09	06	66.67	03	33.33	3.07 (0.0–13.29)	0.15
Marital status							
Single	<b>60</b>	<b>26</b>	<b>43.33</b>	<b>34</b>	<b>56.67</b>	<b>1</b>	
Married	30	16	53.33	14	46.67	1.49 (0.61–3.60)	0.37
Widow	10	08	50.00	02	50.00	1.30 (0.43–3.94)	0.63
Job description							
Medical doctors	25	12	48.00	13	52.00	1.69 (0.59–4.85)	0.32
Surgeons	20	09	45.00	11	55.00	1.50 (0.48–4.63)	0.47
Laboratory/emergency	11	08	72.73	03	27.27	4.48 (1.08–21.95)	<b>0.02</b>
Maternity	10	09	90.00	01	10.00	16.50 (1.86–146.32)	<b>0.001</b>
Other hospital departments*	<b>34</b>	<b>12</b>	<b>35.29</b>	<b>22</b>	<b>64.71</b>	<b>1</b>	
Seniority							
Less than 10 years	<b>84</b>	<b>38</b>	<b>45.24</b>	<b>46</b>	<b>54.76</b>	<b>1</b>	
10 years and more	16	12	75.00	04	25.00	3.63 (1.08–12.18)	<b>0.05</b>

\*Other hospital departments: paediatrics, neonatology, vaccination, dermatology, and pharmacy.

TABLE 4: Relation between knowledge and attitudes of healthcare workers.

Performances	Total (N = 100)	Attitudes				OR (CI 95%)			
		Favorable (N = 17)		Unfavorable (N = 83)		Unadjusted	p	Adjusted	p
Level of knowledge									
Satisfactory	50	1	02.00	49	98.00	23.05 (2.91–182.21)	<0.001	5.14 (3.10–8.51)	0.05
Not satisfactory	50	16	32.00	34	68.00	1			

a = adjusted on age, the post and seniority at service. 4 5 67 22.

TABLE 5: Relation between practices and the levels of knowledge and attitudes of healthcare workers.

Performances	Total (N = 100)	Practices				OR (CI 95%)			
		Good (n = 50)		Bad (n = 50)		Unadjusted	p value	Adjusted*	p value
		n	%	n	%				
Level of knowledge									
Satisfactory	50	16	32.0	34	68.0	23.05 (2.91–182.21)	0.001	5.26 (3.17–8.70)	<0.001
Not satisfactory	50	01	2.0	49	98.0	1			
Level of attitudes									
Favorable	17	08	47.1	09	52.9	7.30 (2.25–23.71)	0.001	4.71 (2.89–7.66)	<0.001
Unfavorable	83	09	10.8	74	89.2	1			

\*Adjusted on age, post and seniority.

individual is informed about a situation, he is more likely to adopt a positive behaviour towards the situation. This difference could be explained by the theory of “planned behaviour” which states that the adoption of a good practice depends on the self-efficacy of the individual; this self-efficacy is being reinforced by knowledge [20]. The same observation was made on favorable attitudes towards good practices. However, a recent inconsistency report was done by others who revealed that level of knowledge was not associated with better practice of in preventing mother-to-

child transmission of hepatitis B in 2017 by medical staff in Yaounde [20].

4.6. *Limitation of the Study.* Methodologically, the study focuses on a single health district. We do not have information on other hospitals and districts in Yaounde, Cameroon. This study does not evaluate the impact of hospital waste on the environment. In addition, we were unable to interview the sanitation staff. The limited sample

size of 100 and the noninclusion of sanitation staff are also a major limitation to the conclusions that can be drawn from this study and its generalization to knowledge, attitudes, and practices regarding biomedical waste management by healthcare workers in Cameroon.

## 5. Conclusion

This study helped highlight the knowledge, attitudes, and practices of Biyem-Assi District Hospital healthcare workers on biomedical waste. We found that the factors associated with a higher rating of having satisfactory knowledge were older age (30–45 years), working in the lab/emergency department and maternity, and having more experience (10 years or more). Satisfactory knowledge was associated with favorable attitudes. This result remains unchanged after adjusting for possible confounding factors such as age, position, and seniority. Satisfactory knowledge was related to good practices. Favorable attitudes were associated with good practices in BMW management. It is important to develop a continuing training programme for the healthcare workers on biomedical waste management in different departments. Also, the healthcare workers must be sensitized on the management of biomedical waste with emphasis on the consequences of inappropriate waste management practices.

## Data Availability

The datasets generated and/or analyzed during the current study are not publicly available due to the promise made to health staff to keep the data confidential when they are questioned but are available from the corresponding author on reasonable request.

## Conflicts of Interest

The authors declare that they have no conflicts of interest.

## Authors' Contributions

Woromogo Sylvain Honore initiated the study and contributed to drafting the manuscript. Guetse Djeukang Gwladys and Yagata Moussa Félicité Emma wrote the research protocol, collected the data, and contributed to drafting the manuscript. Antaon Jesse Saint Saba, Kingsley Ngah Kort, and Tebeu Pierre Marie contributed to writing the manuscript and proofread the manuscript. All the authors have read and approved the final version of the manuscript.

## Acknowledgments

The research team is extremely grateful for the collaboration of Biyem-Assi District Hospital, Yaoundé, Cameroon.

## References

- [1] E. A. Udofia, J. N. Fobil, and G. Gulis, "Solid medical waste management in Africa," *African Journal of Environmental Science and Technology*, vol. 9, no. 3, pp. 244–254, 2015.
- [2] B. Mugabi, S. Hattingh, and S. C. Chima, "Assessing knowledge, attitudes, and practices of healthcare workers regarding medical waste management at a tertiary hospital in Botswana: a cross-sectional quantitative study," *Nigerian Journal of Clinical Practice*, vol. 21, pp. 1627–1638, 2018.
- [3] B. Nagaraju, G. Padmavathi, D. Puranik, M. Shantharaj, and S. Sampulatha, "A study to assess the knowledge and practice on bio-medical waste management among the health care providers working in PHCs of Bagepalli Taluk with the view to prepare informational booklet," *International Journal of Medicine and Biomedical Research*, vol. 2, no. 1, pp. 28–35, 2013.
- [4] M. A. Sarker, M. Harun-Or-Rashid, T. Hiroswawa et al., "Evaluation of knowledge, practices, and possible barriers among healthcare providers regarding medical waste management in Dhaka, Bangladesh," *Medical Science Monitor: International Medical Journal of Experimental and Clinical Research*, vol. 20, no. 20, pp. 2590–2597, 2014.
- [5] I. M. Ismail, A. G. Kulkarni, S. V. Kamble, S. A. Borker, R. Rekha, and M. Amruth, "Knowledge, attitude and practice about bio-medical waste management among personnel of a tertiary health care institute in Dakshina Kannada, Karnataka," *Al Ameen Journal of Medical Sciences*, vol. 6, no. 4, pp. 376–380, 2013.
- [6] World Health Organization (WHO), *Waste Related to Health Care. Aide-Memoire No. 253*, World Health Organization (WHO), Geneva, Switzerland, 2015, <https://www.who.int/en/news-room/factsheets/detail/health-care-waste>.
- [7] J. D. Ntirenganya, *Knowledge, Attitudes and Practices of Health Professionals on the Management of Hospital Waste*, Saint Joseph University, Goma, Congo, 2010, <https://www.memoireonline.com/11/13/7979/Connaissances-attitudes-et-pratiques-des-professionnels-de-sante-sur-la-gestion-des-dechets-hosp.html>.
- [8] Ministry of Public Health (MINSANTE), *Sectoral Strategy for Health. Yaoundé, Republic of Cameroon*, Ministry of Public Health (MINSANTE), Nonthaburi, Thailand, 2016, [http://www.nationalplanningcycles.org/sites/default/files/planning\\_cycle\\_%20repository/cameroon/sss\\_officiel\\_2001-2015.pdf](http://www.nationalplanningcycles.org/sites/default/files/planning_cycle_%20repository/cameroon/sss_officiel_2001-2015.pdf).
- [9] Ministry of Public Health (MINSANTE), *National Plan of Sanitary Development. Yaoundé: Republic of Cameroon*, Ministry of Public Health (MINSANTE), Nonthaburi, Thailand, 2014, [https://www.uhc2030.org/fileadmin/uploads/ihp/Documents/Country\\_Pages/Cameroon/Cameroon\\_National\\_Health\\_Plan\\_2011-2015\\_French.pdf](https://www.uhc2030.org/fileadmin/uploads/ihp/Documents/Country_Pages/Cameroon/Cameroon_National_Health_Plan_2011-2015_French.pdf).
- [10] D. SCHWARTZ, *Statistical Methods for Physicians and Biologists*, Flammarion Médecins Sciences, Paris, France, 1969.
- [11] A. Younes, E. B. Mohamed, H. Mohamed, K. Abderrazzak, O. T. Ahmed, and S. H. Ahami, "Waste management of infectious risk care activities in diffuse environments: medical analysis laboratories, in the Gharb region of Morocco," *International Journal of Science and Research*, vol. 13, pp. 163–172, 2015.
- [12] M. Ndiaye, L. El Metghari, M. M. Soumah, and M. L. Sow, "Gestion des déchets biomédicaux au sein de cinq structures hospitalières de Dakar, Sénégal," *Bulletin de la Société de pathologie exotique*, vol. 105, no. 4, pp. 296–304, 2012.
- [13] J. Ndie, "Study of the management of hospital structures in the reference health structures of the North-Cameroon region," *European Scientific Journal*, vol. 2, pp. 362–364, 2015.

- [14] J. Mouankie, B. Abena, and A. DiakoukaDiambou, "Management of biomedical waste in Brazzaville, Congo," *European Scientific Journal*, vol. 11, no. 23, pp. 317–324, 2015.
- [15] J. Saizonou, E. M. Ouendo, V. Agueh, E. Tokplonou, and M. Makoutodé, "Evaluation of the quality of solid biomedical waste management in Klouekane and Toviklin-Lalo health zones in Benin," *International Journal of Travel Medicine and Global Health*, vol. 1, pp. 1–11, 2014.
- [16] C. Perrot, *Management of Waste from Pharmacy and Laboratory Activities in Health Facilities*, National School of Public Health (ENSP), Rennes, Portugal, 2011, <https://documentation.ehesp.fr/memoires/2001/phisp/perrot.pdf>.
- [17] J. B. Mokoko, B. I. Atipo, J. F. Mimiesse, P. J. Iloukou, and R. Takale, "Management of hospital waste and biomedical equipment of the University Hospital in Brazzaville," *Health and Medical Sciences*, vol. 19, pp. 1–5, 2017.
- [18] V. Sengodan, "Segregation of biomedical waste in an South Indian tertiary care hospital," *Journal of Natural Science, Biology and Medicine*, vol. 5, no. 2, pp. 378–382, 2014.
- [19] A. S. Mohamed, S. A. Dia, A. Diaby, A. Fahad, and A. Ouledi, "Assessment of biomedical waste management at children's hospital albert royer (HEAR) of dakar," *Jaccr Africa*, vol. 3, no. 2, pp. 181–191, 2019.
- [20] P. Talla, P. M. Tebeu, and B. Efuetskeng, "Knowledge, attitude and practice of staff of 4 hospitals in Yaounde on the prevention of vertical transmission of hepatitis B," *World Food Programme*, vol. 28, pp. 1–9, 2017.