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Assessing healthcare workers' confidence levels in diagnosis and management of emerging infectious virus of human monkeypox at Amhara Region.

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ABSTRACT

Objective To assess confidence levels of healthcare workers diagnosis and management of emerging infectious viruses of human monkeypox and associated factors.

Design: Institution-based cross-sectional study

Setting: Amhara region hospitals, Ethiopia.

Participants: An aggregate of 640 healthcare workers were participated from October one - 30 December 2023. A multistage stratified random sampling technique with proportional allocation was used to recruit study units by using lottery method. Data were collected by using the KoboCollect toolbox and exported to STATA Version-17, for data cleaning and analysis. Descriptive statistics were used to describe the data. Ordinal logistic regression analysis was used to identify factors associated with confidence level to diagnose and manage HMPX at $p<0.005$.

Primary outcome: confidence levels diagnose and manage HMPX and associated factors.

Results: The overall confidence of healthcare workers in diagnosing and managing the monkeypox virus was medium level 26.8% (95% CI: 23.2%, 30.3%) and higher level 31.5% (95% CI: 27.9%, 35.2%), respectively. The odds of higher confidence versus lower or medium confidence were greater for healthcare workers who regularly visit amenable websites (OR = 1.59, 95% CI: 1.16, 2.2), being general practitioners (OR = 1.9, 95% CI: 1.32, 2.73), age between 30–35 years (OR = 1.64, 95% CI: 1.12, 2.39), training (OR = 2.8, 95% CI: 1.94, 4.04), and positive attitudes (OR = 1.72, 95% CI: 1.26, 2.36) were positively associated with increase the odds of confidence level of HMPX.

Conclusion The overall confidence level of healthcare workers about monkeypox virus in the study area was low. The odds of higher confidence level vs. lower or medium was greater for

healthcare workers regularly amenable websites; having positive attitude; being general practitioners; age between 30-35 years old and getting public health epidemic related training were identified factors. Therefore, the identified modifiable factors need to be areas of intervention.

Keywords: Healthcare worker, confidence level, human monkeypox, Amhara region.

Introduction

Monkeypox is an illness caused by viral zoonotic infection caused by the monkeypox virus, which spreads from animals to humans, humans to other humans, and from the environment to humans (1, 2). Although the first two flare-ups of a nonlethal skin disorder or pox-like disease were detected in Macaca fascicularis monkeys in Copenhagen, Denmark in 1958 during the summer and autumn seasons (3, 4), the first recognized case of human monkeypox was detected in 1970 in a 9-month-old child in the Democratic Republic of Congo (5). The first outbreak of human monkeypox was registered in the USA in 2003 indirectly related to various infected rodent species imported from west Africa, outside its endemic region (6). However, following the initial case diagnosed in the United Kingdom, the number of monkeypox infections has dramatically increased and we now face a period of multiple outbreaks in countries without clear epidemiological links to endemic countries (7, 8).

According to different report sources up to 25 October 2022 there have been 75,885 confirmed monkeypox cases, of which 74,994 were reported from 101 non-endemic countries or from countries which had not previously reported cases (9-12). Although, in most cases, monkeypox virus disease is self-limited (12, 13), some patients develop complications and severe illness due to risk factors that may lead to fatal outcomes. During the above time period a total of 34 deaths have occurred, of these 21 were reported in countries not considered endemic for monkeypox virus disease (9, 14). The case-fatality-ratio (CFR) of monkeypox is lower than that of smallpox (15), as its case fatality reaches 17% which is well below that of smallpox (25–40%) (16).

Human monkeypox (HMPX) is primarily a cutaneous disease with lymphadenopathy and a transmission route of direct or indirect close contact with droplets, fomites, skin lesions, or

contaminated body fluids (17-22). In addition, monkeypox viruses can also be transmitted through sexual intercourse and mother-to-fetus transmission (23, 24). HMPX is self-limiting and symptoms usually disappear within 14–21 days, with an incubation period of 5–21 days (22, 25). In contrast, HMPX symptoms range from mild to severe and are characterized mainly by itchy to painful skin lesions, including fever, generalized headache, fatigue, lymphadenopathy, back pain, and myalgia (22-24). The most noticeable clinical sign was a skin rash that appeared up to three days after the fever had subsided. It is frequently observed on the face and quickly appears in a centrifugal distribution on the body, including the extremities, but it can be observed throughout the body in more severe cases (26, 27). Hospital admission of patients show clinical manifestations of complications such as super-infection by bacteria, dehydration, and respiratory distress (19, 28). Several risk factors are linked to an increase in monkeypox outbreaks, including the interruption of smallpox vaccination that leads to increased susceptibility to monkeypox infection; extensive consumption of animals as a protein source, which are potential monkeypox (MPX) virus reservoirs; increased population density; ease of travel; and ecological and environmental factors, such as clearing of tropical rainforests with an increased risk of exposure to reservoir animals (29-33). The diseases are rare and can cause outbreaks with high fatality rates.

Enhancing case definition, epidemiological, clinical, genomic, and molecular surveillance alone is not enough to prevent HMPX pandemics, but it needs integrated health promotion or education, and announcing or implementing prevention mechanisms is critical for disease control (34). Based on these global efforts, effective and safe vaccines are ongoing, with licenses being used in countries such as the United Kingdom, Canada, and USA for high-risk populations. Moreover, basic public health interventions, such as the use of personal protective equipment (PPE), practicing good hand hygiene, immediate case isolation, contact tracing, and avoiding contact with

infected animals or materials, are effective means of controlling the spread of human monkeypox (35, 36). Similar to communities, healthcare workers should practice strict use of PPE such as wearing well-fitted N95 masks, gloves, and other PPE before any contact with a suspected case (37).

Currently, one of the challenges represented by the rapid increase in MPX pandemics is the lack of knowledge, confidence, and attitude towards this pathogen, particularly among healthcare workers (HCWs), which may contribute to its evolution to a global pathogen (8, 35), the limiting of which is the primary role of health professionals in responding to the ongoing HMPX pandemic (38-40). Ethiopia is the third most populous country in Africa, with more than 100,000,000 people living at risk of contagious diseases, with there being a rapid increase of the virus worldwide and cases are reported in neighboring countries, such as Kenya. Therefore, vigilance is needed to assess HCWs' preparedness and knowledge level.

Therefore, Ethiopia is at risk of the monkeypox virus alongside other horn of Africa countries, so the aim of this study is to assess healthcare workers' confidence levels in diagnosis and management of emerging infectious viruses of human monkeypox in the Amhara region

Methods

Study design, setting and period

This institution-based cross-sectional study was conducted in the Amhara region of Ethiopia from 1 October to 30 December 2023.

Source and study population

All health professionals working in governmental public hospitals in the Amhara region were taken as the source population, and those working in randomly selected government hospitals were selected as the study population.

Inclusion and exclusion criteria

All health professionals working in government hospitals in the Amhara region were included; however, health professionals not available during data collection and healthcare workers on annual/maternal leave were excluded from the study.

Sample size determination

The minimum sample size that represents the source population was estimated considering the following assumptions: 95% confidence interval (CI), 80% power, the magnitude of the level of HCWs' confidence in the management of monkey pox infection (p = 50%) will be used to estimate the sample sizes, because there is no study conducted that directly measured the magnitude of confidence level of healthcare workers in Ethiopia (41).

$$n = \frac{(Za/2)^2\, p\,(1-p)}{d^2}$$

where n = sample size; Z = standard normal distribution corresponding to significance level at a = 0.05, or confidence interval (CI), 95% = 1.96; P = expected proportion (0.5) of and HCWs confidence level in diagnosis and management; d = margin of error (5%) = 0.05 around P.

Therefore: $n = \frac{(1.96)^2 \times 0.5 \times 0.5}{(0.05)^2} = 384$

Therefore, $n_1 = 384$, design effect = 384 × 1.5 = 576, and the sample was included.

$$\text{The sample size was including nonresponse rate} = \frac{\text{sample size}}{(1 - \text{non} - \text{response rate in })}$$

The total sample size was 640 (including a 10% nonresponse rate). Therefore, the final sample size for healthcare workers' confidence level in diagnosis and management was 640.

Sampling procedure and technique

A total of 98 hospitals (eight comprehensively specialized, 20 generals, and 69 primary) are found in the Amhara region, which comprises 15 zones. Multistage stratified random sampling was employed to select 28 hospitals (9 from general and comprehensive specialized hospitals (CSHPs), and 19 from primary hospitals) in the region. The sample size was proportionally allocated to each selected hospital and similarly to each professional stratification. Finally, the healthcare workers who provided their responses in the data collection were selected using simple random sampling.

Variables

Dependent variables:

The confidence level of the HCWs (poor, medium, or high confidence) was the dependent variable.

Independent variables

Variables such as age, residence, occupation, educational status, marital status, level of education of healthcare workers, training given about public health emergency epidemic disease management (PHEM), years of experience, regular participation in the morning session, occupational category (general practitioner and specialist as well as nurse and other professionals),

visiting the World Health Organization (WHO), Center for Disease Control (CDC), and other websites and attitudes were used as independent variables.

Operational definition

Confidence level HCW: A composite of 44 diagnoses and management of related measuring questions. If healthcare workers' response scores ≥80% classified as higher confidence, 50–79% is medium confidence and also <50% was classified as poor confidence level (42).

Knowledge: This was assessed by developing 35 questions on transmission, prevention, and control measures for human monkeypox (HMPX). If the HCW responder scored between 80–100% from knowledge measuring HMPX questions, they were classified as knowledgeable, 50–79% was classified as moderately knowledgeable, and <50% was classified as less-knowledgeable (18).

Attitude: The HCWs' attitudes were assessed using 14 questions on a 7-point Likert scale (strongly disagree (1), disagree (2), somewhat disagree (3), neutral/no opinion (4), somewhat agree (5), agree (6), and strongly agree (7). Each question was scored out of 7, resulting in a total maximum score of 98 and a minimum score of 14. Based on this, a score of less than 70% was considered to not be a good attitude whereas healthcare workers who scored >=70% were considered to have a good attitude (42).

Data collection tools and procedure

The questionnaire was prepared after reviewing different studies developed for similar purposes by different authors (43-48). The questionnaire was developed in English, translated into the local language Amharic, and finally translated back into English to check its consistency. Data were collected using a structured pre-test questionnaire. The questionnaire contained sociodemographic

characteristics and habit-related factors of the healthcare workers. Training was provided to 29 general practitioners (GP) who participated in the data collection and five master's educated health professionals who were involved as supervisors during data collection for 2 days. The data were collected through an electronic data collection method using KoboCollect (version 2022.4.4).

Data quality assurance

Data quality was assured using a properly designed questionnaire adapted from the literature. Data quality was also ensured by providing training to both data collectors and supervisors for the purpose of the study, data collection techniques, and tools by the principal investigator for two days. Then, prior to the actual data collection, a pre-test was conducted with the trained data collectors in 5% of the sample size at Injebara Health Center, which has similar socio-demographic characteristics to the actual study setting. Amendments to the questionnaires were completed based on the findings of the pre-test. Every day after data collection, the principal investigator reviewed the questionnaires to ensure the completeness of each response. The principal investigator and supervisor closely monitored the data-collection process. Once the data were entered, the basic quality assurance measures were implemented.

Data management and analysis

Data were exported to STATA version 17 from the KoboCollect data collection toolbox. Data were cleaned (categorization for continuous variables and re-categorization for categorical variables) and descriptive statistics such as frequency distribution tables, means, and standard deviations were computed to describe the data. Ordinal logistic regression analysis was performed to obtain a final fitted model. Multivariable ordinal logistic regression analysis was employed to identify factors associated with HCWs' confidence levels in the diagnosis and management of

monkey pox, and to control for confounding effects. Variables with a significance level of $p < 0.05$, from the multivariable ordinal logistic regression analysis, were considered statistically significant. The proportional odds assumption was checked (chi^2 p-value > 0.05); therefore, the study chi^2 p-value was 0.0540.

RESULTS

Socio-demographic characteristics of healthcare workers

Six hundred and twenty healthcare workers (with a response rate of 96.9%) gave a complete response. The majority of healthcare providers, 312 (50.3%) were Orthodox Christian followers. Similarly, 63.9% of the healthcare workers had more than five years' experience. The mean (±SD) age of the healthcare workers was 31.67 (±5.355) years old and 432 (69.7%) of the healthcare workers were male. Only 153 (24.7%) healthcare workers had not received any training from the health bureau institution as well as NGOs about public health epidemic prone diseases such as monkeypox virus (Table 1).

Confidence level and attitude of healthcare professionals

The monkeypox epidemic is a global public health problem. So, assessing healthcare workers' confidence and attitude is very important for diagnosing and managing emerging and re-emerging viruses. Among the 620 HCWs, 26.8% (95% CI: 23.2%, 30.3%) and higher level 31.5% (95% CI: 27.9%, 35.2%) had medium and higher-level confidence about monkeypox virus etiologic agent, transmission and management, as well as prevention mechanisms. However, 41.8% [95% CI: 38.1%, 45.4%] of healthcare professionals had low confidence to diagnose, manage, and prevent monkeypox pandemics. Beside of this, the health care workers who had medium and higher-level diagnose confidence level about human monkeypox were 22.1% [95% CI: 19.0%, 25.5%] and

35.0% [95% CI: 31.3%, 38.7%] respectively. Similarly, 20.2% [95% CI: 17.2%, 23.4%] and 32.1% [95% CI: 28.2%, 35.7%] health care workers had medium and higher-level management confidence if the pandemic is emerged in the region. (Figure 2).

From the confidence measuring questions, 361(58.2%) of HCWs aware of monkeypox were prevented by frequent hand washing for at least 20 s with soap and water or alcohol. On the other hand, 328(52.9%) health care workers were thinking that antibiotics are used to treat human monkeypox. However, only 36.9% of healthcare workers were aware that monkeypox spreads from person-to-person by Environments contacts and 34.3% of healthcare workers thought that monkeypox was a bacterial disease (Figure 1).

This study also indicates healthcare workers' attitudes or beliefs about the emergence of viral infections (EVICS). Of the 142 general practitioners and specialists, 22.5% and 50.7% had higher- and medium-level knowledge while 42.3% had positive attitudes towards diagnosis, management, and control of the monkeypox virus. Similarly, 157 (25.3%) male healthcare workers had a positive attitude toward diagnosing, managing, and controlling monkeypox viruses. In addition to this 148 (23.9%) and 74 (11.9%) healthcare workers who were working in CSHPs and primary hospitals had positive attitudes. On the other hand, 57 (9.2%) and 148 (23.9%) healthcare workers who are working in CSHP and primary hospitals had medium- and high-level knowledge (Table 2).

Factors associated with the confidence level of healthcare workers

Variables such as working hospital standards, sex, work experience, occupational category, regular participation in morning sessions, public health emergency management (PHEM) training, attitude, visiting WHO, CDC, and other websites, as well as age, were candidates for multivariable ordinal logistic regression analysis. During the multivariable ordinal logistic regression analysis,

variables such as attitude, age, professional category and visiting the WHO, CDC, and other amenable websites were found to be significantly associated with the outcome variable.

Healthcare workers with a value of 0.8603 or less were classified as having a low confidence level, given that they were working in a primary hospital, being female, less than five years of work experience, being a nurse and other health professionals, not participating in a morning session, not receiving public health emergency management training, having a negative attitude, not visiting the WHO, CDC, and other websites, as well as the age of the healthcare workers being less than 30 as opposed to between 30–35 years. Similarly, HCWs with a value of 2.083 or greater were classified as having a higher confidence level, given that the above variables were kept with their reference. Additionally, participants with a value between 0.8603 and 2.083 were considered to have medium confidence when the independent variables were kept with their reference.

Healthcare workers regularly visiting the WHO, CDC, and other potential websites, the odds of higher confidence vs. lower or medium confidence were 1.59 times (OR = 1.596, 95% CI: 1.158, 2.198) higher than not visit the websites to diagnose and manage monkeypox viruses when other variables were kept constant. The odds of higher confidence vs. lower or medium is 1.9 times (OR = 1.899, 95% CI: 1.318, 2.734) times higher for general practitioners and specialist doctors in comparison to being nurses and other professionals when the other variables are kept constant. Similarly, the odds of higher versus lower or medium confidence levels of healthcare workers for managing and controlling monkeypox disease were 1.6 times (OR = 1.637, 95% CI: 1.118, 2.397) times greater for healthcare workers if their age is 30–35 years compared to less than 30 years old when the other variables were kept constant. Moreover, the odds of higher versus lower or medium confidence levels of healthcare workers in managing and controlling monkeypox virus were 2.8 times (OR = 2.799, 95% CI: 1.942, 4.035) times greater for healthcare workers receiving public

health emergency (PHEM) epidemic related training than their counterparts. Lastly, the odds of higher confidence level vs. lower or medium was 1.72 times (OR = 1.724, 95% CI: 1.258, 2.362) greater for healthcare workers who had positive attitudes than their counterparts when the other variables were kept constant (Table 3).

Discussion

The timely and proper response of HCWs is an important prerequisite to challenge ongoing HMPX. This study assessed the level of confidence in the diagnosis and management of HMPXs among HCWs in the Amhara region. This can help raise awareness of the epidemic, conduct well-informed training among HCWs, and strengthen HCWs' preparedness for mitigation and response to face the emerging threat posed by HMPX, as advocated by the WHO (49). The current re-emergence of HMPX requires not only a prevention strategy but also early detection, quick response, and proper management of frontline HCWs in the region. HCWs should be knowledgeable about the clinical symptoms of HMPX and be able to quickly identify, report, and manage new cases to prevent outbreaks. This region has very rare cases and it is a relatively new diseases (50).

This study revealed that HCWs had a relatively low level of confidence in diagnosing and managing the HMPX disease pandemic. Only 31.5% [95% CI: 27.7%, 35.2%] of HCWs had high levels of confidence in their ability to diagnose and manage a bout of HMPX disease. Even though the differences in the cut of points in determining the outcome and the study participants, similar prevalence (34.9%) was reported by the study conducted in Indonesia (51).

Regarding the HCWs confidence level in managing the HMPX diseases, only 32.1% [95% CI: 28.2%, 35.7%] of them had higher confidence level. However, higher prevalence(P = 47.5%) (43)

and (P = 38.9%) (18) was reported in studies conducted in Kuwait and Jordan, respectively. Similarly, the HCWs higher confidence level for the ability to diagnose the disease was 35.0% [95% CI: 31.3%, 38.7%]. This finding was similar to that of the confidence level reported by studies conducted in Kuwait (32.3%) and Jordan (38.0%) (18, 43).

The age category (30–35 years) is another factor that increases the level of confidence in the diagnosis and management of HMPXs compared to HCWs aged less than 30 years. The reason behind this is that healthcare professionals in this age category have plenty of experience and exposure combined with their energetic force to know and accept new facts. In addition, this age category has the potential to search for and update emerging and re-emerging epidemics. Besides, health workers in this age category might have a better attitude about emerging and re-emerging diseases. Our findings supported this contemplation as those HCWs with positive attitude had higher confidence in managing and diagnosing HMPX diseases compared to those HCWs with negative attitude. This might be due to the positive attitude towards the diseases may help HCWs thrive in search of new information regarding the management and diagnosis of HMPX outbreaks. The information seeking behavior makes the HCWs to develop higher level of confidence towards the management and diagnosis of the disease. This was also supported by the current study, which revealed that those HCWs who had visited different websites such as the WHO and CDC websites had higher odds of high level of confidence in managing and diagnosing the HMPX diseases compared to those who had not. The mere reason behind this might be due to WHO and other partners like CDC might release accurate and updated information on daily basis regarding the signs and symptoms, transmission, prevention, and treatment the virus and the global strategies for the prevention and control of HMPX outbreaks (52). The importance of prior information about the HMPX virus was mentioned an independent predictor of higher level of confidence among

general practitioners as those general practitioners who had received information of HMPX virus during their medical education had higher confidence than those who had never received such information(53). Therefore, visiting different websites could improve HCWs' knowledge and attitude about HMPXs, leading to a high level of confidence in the diagnosis and management of re-emerging viruses.

Like other study conducted in Jordan (18), this study reported that higher confidence levels were found among healthcare workers who were GPs and specialists compared to nurses and other professionals. The possible explanation might be due to higher and intensive educational exposure in medical education of the HCWs may have paramount importance in the understanding of the fundamental sciences of communicable diseases like monkeypox virus. In addition, GPs and specialist doctors might have an opportunity to attend regional and international conferences during such type of pandemics, which updates them with the current worldwide understanding about the diseases. This was explained by the study conducted in Indonesia, which suggested that, attending national conferences (at least one) helps general practitioners equip with better confidence (51). Another possible reason might be due to those HCWs who had higher level of education such as specialists may have practical experiences in the management and diagnosis of similar pandemics such as COVID 19, which help them to be sensitive to potentially threatening monkeypox virus pandemics across the globe. In contrast to our finding and these justifications, a study conducted in Kuwait(43) reported nurses displayed higher self-reported confidence levels to diagnose and manage the disease. The possible reason might be the differences in the variable categorization, this study categorized the variable into dichotomizes variable (GPs and specialists Vs Nurse and other professionals); however, the later study categorized the variable into four categories.

Training about public health epidemic-prone diseases through different channels was a predictor of a high level of confidence in the diagnosis and management of the re-emerging virus among HCWs. Previous studies conducted in Asian countries, Indonesia (51), Australia (54) and Italy (55) agreed with our findings that receiving information during medical training was significantly associated with goods knowledge about monkey pox, which leads increasing confidence. One explanation for this predictor was that the level of confidence increased over the training period (54), which means that prolonged attachment and training in healthcare centers increased self-confidence in HCWs. Therefore, it is important to ensure that more experienced HCWs receive adequate training and continuing medical education activities (56). Those professional acquiring training through different methods should adhere to standards of practice for diagnosis, screening and prevention of the outbreak.

Conclusion

The overall confidence level of HCWs in the Amhara region was lower than that recommended by the WHO. Attitude, professional category (being a GP and specialist doctor), age, and visiting the WHO, CDC, and other amenable websites were found to be significantly associated with the confidence level of HCWs. Monkeypox is a pandemic; therefore, knowing HCWs' confidence is an important prerequisite for tackling the HMPX pandemic. Raising awareness and confidence in the epidemic can strengthen HCWs' preparedness for mitigation and response to the emerging threat of HMPX, as advocated by the WHO. An important emphasis is placed on the training and attitude of healthcare workers, as well as experienced GPs and specialty doctors who can share their knowledge and skills with nurses and other health professionals.

Strength and limitation of the study

- This study used relatively a large sample size using a design effect to increase the power of the study.
- This study used a multivariate ordinal logistic regression analysis to control all possible confounders.
- This study was conducted at health facility level other than the community level
- Social desirability bias and recall bias were the limitation of the study.

Ethics approval and consent to participate

Ethical approval was obtained from the Institutional Review Board (IRB) of the Debretabor University College of Medicine and Health Science (CMHS) with protocol no 087/2022. Before data collection, formal permission letters were obtained from each hospital. Similarly, Facility heads were communicated through supporting letters and informed about the purpose of the study before actual data collection. Data confidentiality was maintained by avoiding possible identifiers, such as exchanging the names of study participants with identification numbers.

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author upon reasonable request.

Competing interests

The authors declare that they have no conflicts of interest regarding any aspect of this article.

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Authors' contributions

AG - conceived and designed the study, collected and analyzed the data. AT - designed the study and analyzed, interpreted, and wrote the manuscript. CY - designed, interpreted, and wrote the manuscript. GM - conceived the study and reviewed and wrote the manuscript. TDT, DT, MA, EM, ASA and AS edited the manuscript.

Reference

1. Perramon A, Álvarez E, Català M, López V, Alonso S, Prats C, et al. Analysis of the epidemiological dynamic of monkeypox from 15th May to 31st August 2022. Disponible en: www enfermedadesemergentes com. 2022:160.

2. Ilic I, Zivanovic Macuzic I, Ilic M. Global outbreak of human Monkeypox in 2022: Update of epidemiology. Tropical Medicine and Infectious Disease. 2022;7(10):264.

3. Xiang Y, White A. Monkeypox virus emerges from the shadow of its more infamous cousin: family biology matters. Emerging microbes & infections. 2022;11(1):1768-77.

4. Cheema A, Ogedegbe O, Munir M, Alugba G, Ojo T. Monkeypox: A Review of Clinical Features, Diagnosis, and Treatment. Cureus 2022, 14, e26756.

5. Ladnyj I, Ziegler P, Kima E. A human infection caused by monkeypox virus in Basankusu Territory, Democratic Republic of the Congo. Bulletin of the World Health Organization. 1972;46(5):593.

6. Antunes F, Cordeiro R, Virgolino A. Monkeypox: From A Neglected Tropical Disease to a Public Health Threat. Infectious Disease Reports. 2022;14(5):772-83.

7. Kraemer MU, Tegally H, Pigott DM, Dasgupta A, Sheldon J, Wilkinson E, et al. Tracking the 2022 monkeypox outbreak with epidemiological data in real-time. The Lancet Infectious Diseases. 2022.

8. Update E. Monkeypox multi-country outbreak. European Centre for Disease Prevention and Control. 2022.

9. Benites-Zapata VA, Ulloque-Badaracco JR, Alarcon-Braga EA, Hernandez-Bustamante EA, Mosquera-Rojas MD, Bonilla-Aldana DK, et al. Clinical features, hospitalisation and deaths associated with monkeypox: a systematic review and meta-analysis. Annals of clinical microbiology and antimicrobials. 2022;21(1):1-18.

10. Farahat RA, Abdelaal A, Shah J, Ghozy S, Sah R, Bonilla-Aldana DK, et al. Monkeypox outbreaks during COVID-19 pandemic: are we looking at an independent phenomenon or an overlapping pandemic? : Springer; 2022. p. 1-3.

11. Rodriguez-Morales AJ, Lopardo G, Verbanaz S, Orduna T, Lloveras S, Azeñas-Burgoa JM, et al. Latin America: Situation and preparedness facing the multi-country human monkeypox outbreak. The Lancet Regional Health–Americas. 2022;13.

12. Ortiz-Martínez Y, Rodríguez-Morales AJ, Franco-Paredes C, Chastain DB, Gharamti AA, Vargas Barahona L, et al. Monkeypox–a description of the clinical progression of skin lesions: a case report from Colorado, USA. Therapeutic Advances in Infectious Disease. 2022;9:20499361221117726.

13. Farahat RA, Sah R, El-Sakka AA, Benmelouka AY, Kundu M, Labieb F, et al. Human monkeypox disease (MPX). Infez Med. 2022;30(3):1.

14. Sah R, Mohanty A, Abdelaal A, Reda A, Rodriguez-Morales AJ, Henao-Martinez AF. First Monkeypox deaths outside Africa: no room for complacency. SAGE Publications Sage UK: London, England; 2022. p. 20499361221124027.

15. Ilic I, Ilic M. Historical review: Towards the 50th anniversary of the last major smallpox outbreak (Yugoslavia, 1972). Travel Medicine and Infectious Disease. 2022;48:102327.

16. Yousaf M, Ismail S, Ullah A, Bibi S. Immuno-informatics profiling of monkeypox virus cell surface binding protein for designing a next generation multi-valent peptide-based vaccine. Frontiers in Immunology. 2022;13.

17. Titanji BK, Tegomoh B, Nematollahi S, Konomos M, Kulkarni PA, editors. Monkeypox: a contemporary review for healthcare professionals. Open forum infectious diseases; 2022: Oxford University Press.

18. Sallam M, Al-Mahzoum K, Al-Tammemi AaB, Alkurtas M, Mirzaei F, Kareem N, et al., editors. Assessing Healthcare Workers' Knowledge and Their Confidence in the Diagnosis and Management of Human Monkeypox: A Cross-Sectional Study in a Middle Eastern Country. Healthcare; 2022: MDPI.

19. Tarín-Vicente EJ, Alemany A, Agud-Dios M, Ubals M, Suñer C, Antón A, et al. Clinical presentation and virological assessment of confirmed human monkeypox virus cases in Spain: a prospective observational cohort study. The Lancet. 2022;400(10353):661-9.

20. Morgan CN, Whitehill F, Doty JB, Schulte J, Matheny A, Stringer J, et al. Environmental persistence of monkeypox virus on surfaces in household of person with travel-associated infection, Dallas, Texas, USA, 2021. Emerging Infectious Diseases. 2022;28(10):1982-9.

21. Peiró-Mestres A, Fuertes I, Camprubí-Ferrer D, Marcos MÁ, Vilella A, Navarro M, et al. Frequent detection of monkeypox virus DNA in saliva, semen, and other clinical samples from 12 patients, Barcelona, Spain, May to June 2022. Eurosurveillance. 2022;27(28):2200503.

22. Vaughan A, Aarons E, Astbury J, Brooks T, Chand M, Flegg P, et al. Human-to-human transmission of monkeypox virus, United Kingdom, October 2018. Emerging infectious diseases. 2020;26(4):782.

23. Al-Tammemi AaB, Albakri R, Alabsi S. The Outbreak of Human Monkeypox in 2022: A Changing Epidemiology or an Impending Aftereffect of Smallpox Eradication? Frontiers in Tropical Diseases. 2022;3:951380.

24. Mbala PK, Huggins JW, Riu-Rovira T, Ahuka SM, Mulembakani P, Rimoin AW, et al. Maternal and fetal outcomes among pregnant women with human monkeypox infection in the Democratic Republic of Congo. The Journal of infectious diseases. 2017;216(7):824-8.

25. Rodriguez-Morales AJ, Lopardo G. Monkeypox: another sexually transmitted infection? Pathogens. 2022;11(7):713.

26. Bunge EM, Hoet B, Chen L, Lienert F, Weidenthaler H, Baer LR, et al. The changing epidemiology of human monkeypox—A potential threat? A systematic review| PLOS Neglected Tropical Diseases. 2022.

27. Simpson K, Heymann D, Brown CS, Edmunds WJ, Elsgaard J, Fine P, et al. Human monkeypox–After 40 years, an unintended consequence of smallpox eradication. Vaccine. 2020;38(33):5077-81.

28. Weinstein RA, Nalca A, Rimoin AW, Bavari S, Whitehouse CA. Reemergence of monkeypox: prevalence, diagnostics, and countermeasures. Clinical infectious diseases. 2005;41(12):1765-71.

29. Beer EM, Rao VB. A systematic review of the epidemiology of human monkeypox outbreaks and implications for outbreak strategy. PLoS neglected tropical diseases. 2019;13(10):e0007791.

30. Rimoin AW, Mulembakani PM, Johnston SC, Lloyd Smith JO, Kisalu NK, Kinkela TL, et al. Major increase in human monkeypox incidence 30 years after smallpox vaccination campaigns cease in the Democratic Republic of Congo. Proceedings of the National Academy of Sciences. 2010;107(37):16262-7.

31. Petersen BW, Kabamba J, McCollum AM, Lushima RS, Wemakoy EO, Tamfum J-JM, et al. Vaccinating against monkeypox in the Democratic Republic of the Congo. Antiviral research. 2019;162:171-7.

32. Khodakevich L, Szczeniowski M, Jezek Z, Marennikova S, Nakano J, Meier F. Monkeypox virus in relation to the ecological features surrounding human settlements in Bumba zone, Zaire. Tropical and geographical medicine. 1987;39(1):56-63.

33. Haider N, Guitian J, Simons D, Asogun D, Ansumana R, Honeyborne I, et al. Increased outbreaks of monkeypox highlight gaps in actual disease burden in Sub-Saharan Africa and in animal reservoirs. International Journal of Infectious Diseases. 2022.

34. Ortiz-Martínez Y, Galvis-Cataño LM, Arias-Rodríguez D, Romero-Dager C, Bonilla-Aldana DK, Rodriguez-Morales AJ. YouTube and 2022 Monkeypox outbreak: opportunities for awareness and infection control. Journal of Hospital Infection. 2022.

35. ASSESSMENT RR. Monkeypox multi-country outbreak. 2022.

36. Sah R, Mohanty A, Hada V, Singh P, Govindaswamy A, Siddiq A, et al. The Emergence of Monkeypox: A Global Health Threat. Cureus. 2022;14(9).

37. Al-Musa A, Chou J, LaBere B. The resurgence of a neglected orthopoxvirus: Immunologic and clinical aspects of monkeypox virus infections over the past six decades. Clinical Immunology. 2022:109108.

38. Antunes F, Virgolino A. Monkeypox Mysteries of the New Outbreak in Non-Endemic Areas. International Journal of Environmental Research and Public Health. 2022;19(22):14881.

39. Shariq A, Rasheed Z, Al Abdulmonem W. Human monkeypox: An update on knowledge and future implications. International Journal of Health Sciences. 2022;16(4):1-2.

40. Koenig KL, Beÿ CK, Marty AM. Monkeypox 2022: a primer and identify-isolate-inform (3I) tool for Emergency Medical Services professionals. Prehospital and Disaster Medicine. 2022;37(5):687-92.

41. Taherdoost H. Determining sample size; how to calculate survey sample size. International Journal of Economics and Management Systems. 2017;2.

42. Sallam M, Al-Mahzoum K, Dardas LA, Al-Tammemi AaB, Al-Majali L, Al-Naimat H, et al. Knowledge of human monkeypox and its relation to conspiracy beliefs among students in Jordanian health schools: filling the knowledge gap on emerging zoonotic viruses. Medicina. 2022;58(7):924.

43. Alsanafi M, Al-Mahzoum K, Sallam M. Monkeypox Knowledge and Confidence in Diagnosis and Management with Evaluation of Emerging Virus Infection Conspiracies among Health Professionals in Kuwait. Pathogens. 2022;11(9):994.

44. Alshahrani NZ, Alzahrani F, Alarifi AM, Algethami MR, Alhumam MN, Ayied HAM, et al. Assessment of knowledge of monkeypox viral infection among the general population in Saudi Arabia. Pathogens. 2022;11(8):904.

45. Alshahrani NZ, Alzahrani F, Alarifi AM, Algethami MR, Alhumam MN, Ayied HAM, et al. Assessment of Knowledge of Monkeypox Viral Infection among the General Population in Saudi Arabia. pathogens. 2022;11:904.

46. Hasan S, Saeed S. Monkeypox disease: An emerging public health concern in the shadow of COVID-19 pandemic: An update. Tropical Medicine and Infectious Disease. 2022;7(10):283.

47. Hong J, Pan B, Jiang HJ, Zhang QM, Xu XW, Jiang H, et al. The willingness of Chinese healthcare workers to receive monkeypox vaccine and its independent predictors: A cross-sectional survey. Journal of Medical Virology. 2023;95(1):e28294.

48. Huang Y, Mu L, Wang W. Monkeypox: epidemiology, pathogenesis, treatment and prevention. signal Transduction and Targeted Therapy 2022(7):373.

49. Wenham C, Eccleston-Turner M. Monkeypox as a PHEIC: implications for global health governance. The Lancet. 2022;400(10369):2169-71.

50. Ng OT, Lee V, Marimuthu K, Vasoo S, Chan G, Lin RTP, et al. A case of imported Monkeypox in Singapore. The Lancet Infectious Diseases. 2019;19(11):1166.

51. Harapan H, Setiawan AM, Yufika A, Anwar S, Wahyuni S, Asrizal FW, et al. Confidence in managing human monkeypox cases in Asia: A cross-sectional survey among general practitioners in Indonesia. Acta tropica. 2020;206:105450.

52. Organization WH. Obesity: preventing and managing the global epidemic. 2000.

53. Harapan H, Setiawan AM, Yufika A, Anwar S, Wahyuni S, Asrizal FW, et al. Knowledge of human monkeypox viral infection among general practitioners: a cross-sectional study in Indonesia. Pathogens and Global Health. 2020;114(2):68-75.

54. McNair R, Griffiths L, Reid K, Sloan H. Medical students developing confidence and patient centredness in diverse clinical settings: a longitudinal survey study. BMC Medical Education. 2016;16(1):1-8.

55. Gallè F BL, Da Molin G, Mancini R, Sciacchitano S, Ferracuti S et al,. "Monkeypox: What Do You Know about That?" Italian Adults' Awareness of a New Epidemic. Pathogens 11:1285. doi:10.3390/pathogens11111285. 2022.

56. Choudhry NK, Fletcher, R.H., Soumerai, S.B.,. Systematic review: the relationship between clinical experience and quality of health care. Ann Intern Med. 2005(142):260–73.

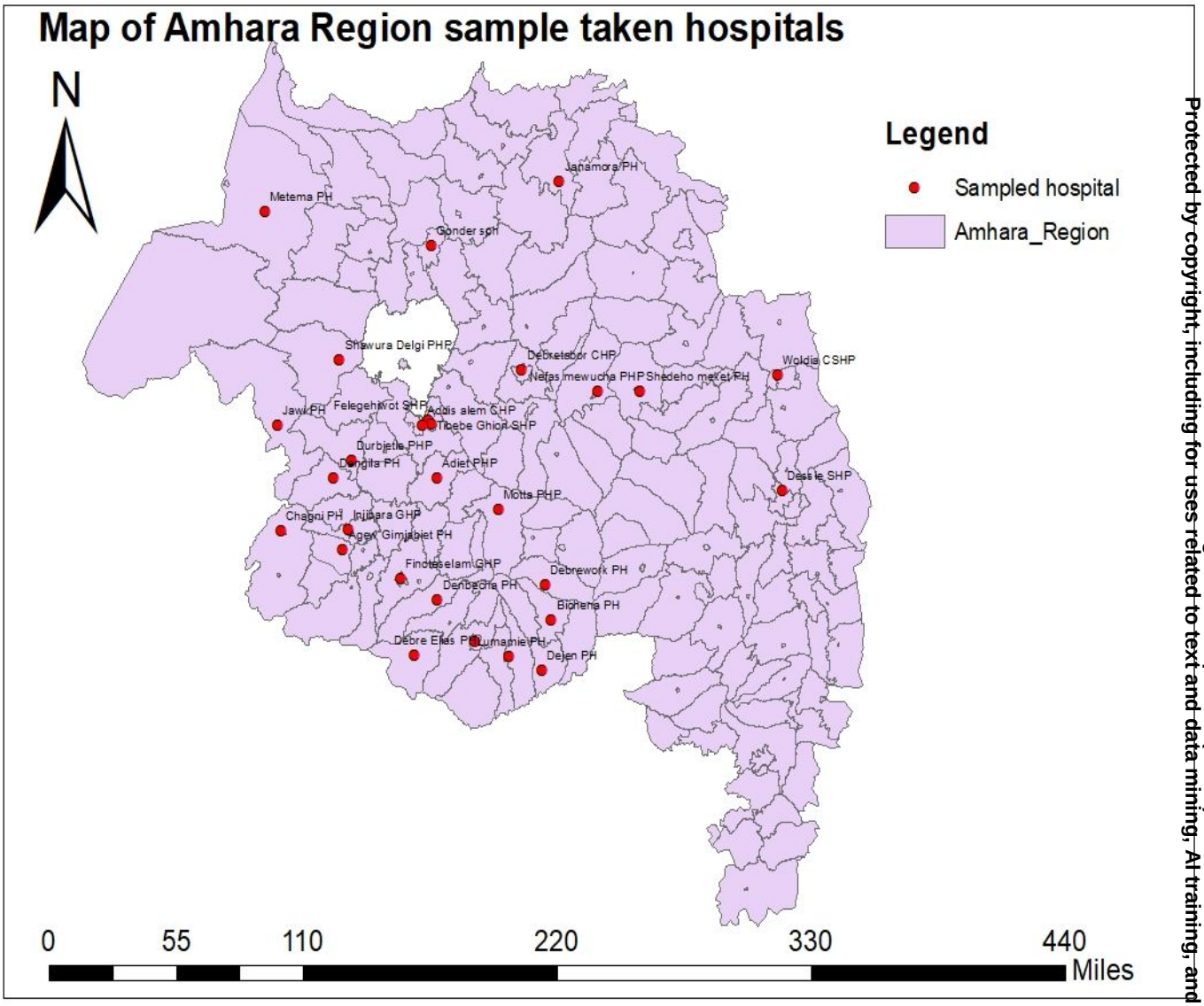

Figure 1: Mape of Amhara region and hospitals sample taken about confidence level of Monkeypox virus disease at health care workers, Northern Ethiopia, 2023.

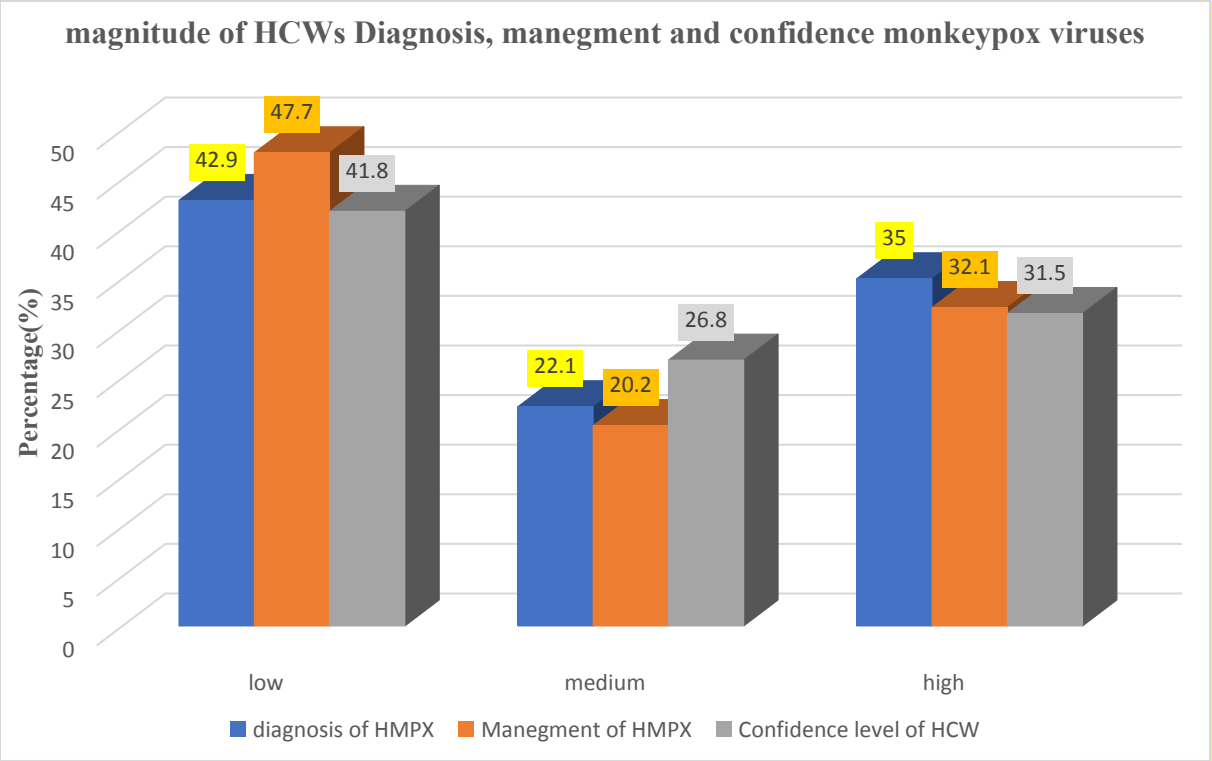

Figure 1: - magnitude of HCWs Diagnose, management and the overall confidence level about Monkeypox virus in Amhara region, northern Ethiopia, 2023.

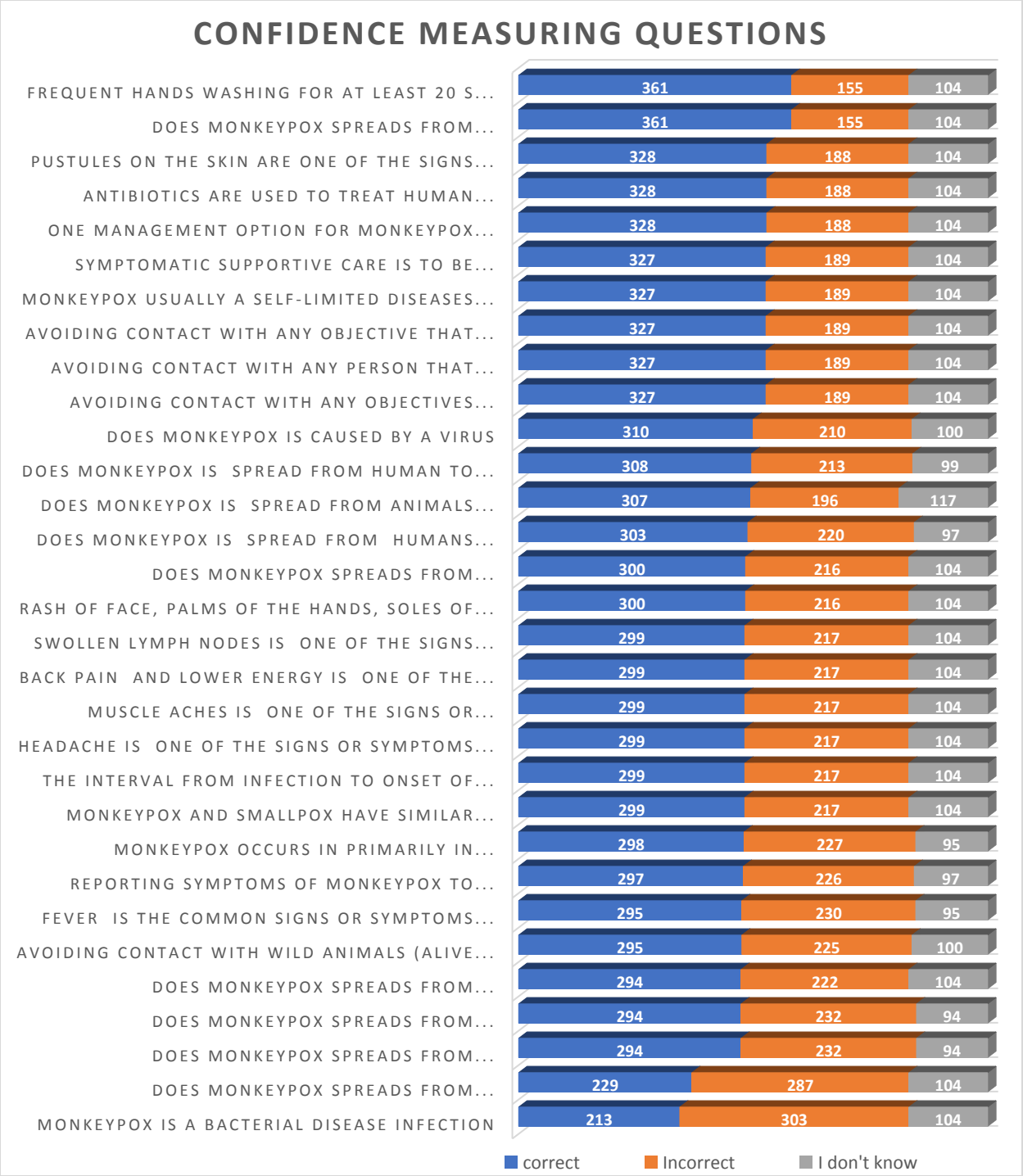

Figure 3: - Assessment of health care workers confidence level measuring questions response score about Monkeypox virus disease, in Amhara region, northern Ethiopia, 2023.

Table 1: Assessing healthcare workers confidence level in diagnosis and management of emerging infectious virus of human monkeypox at Amhara region, 2023.

Characteristics	Confidence levels of HCW				
	Low confidence	Medium confidence	High confidence	X^2	P-value
Religion of HCW					
Orthodox	136	79	97	4.047	0.670
Muslim	70	49	52		
Protestant	36	30	29		
Others*	17	8	17		
Visiting (WHO, CDC and other websites)					
No	189	104	121	7.718	0.021
Yes	70	62	74		
Occupational category					
GP and specialist*	50	29	63	14.442	0.001
nurse and others**	209	137	132		
Year of experience					
< 5 years	100	57	67	1.187	0.553
>5 years	159	109	128		
Working hospital					
working CSPH	177	108	132	0.518	0.772
primary hospital	82	58	63		
Sex					
Male	179	118	140	0.424	0.809
Female	80	48	55		
Participate morning session					
No	142	74	96	4.385	0.112
Yes	117	92	99		
PHEM training					
No	215	135	117	36.086	0.001
Yes	44	31	78		
Age of HCW					
<30 years	142	86	83	9.691	0.046
30-35 years	49	38	59		
> 35 years	68	42	53		
The Highest level of formal education					
Diploma	22	20	21	5.923	0.432
Degree	184	119	126		
masters (MPH/MSC)	30	13	24		
Specialist	23	14	24		

Note: CSPH -comprehensive specialized hospital, **GP**- General practitioner, **other**-** (health officer, midwife, Laboratory professional, Environmental health, pharmacist and Dentist), **Specialist***- gynecologist, Internist, Surgeon, Neurologist, Ophthalmologist, Dentist, Radiologist. **Others*- Catholic, Jobha, etc.**

Table 2: Assessing confidence level and attitude of health care workers in diagnosis and management of emerging infectious virus of human monkeypox viruses at Amhara region, 2023.

Characteristics	Confidence level of HCW			p-value	Attitude of HCW		p-value
	Lower	Medium	higher		Negative	Positive	
Year of experience							
< 5 years	100	57	67	0.218	155	69	0.051
>5 years	159	109	128		243	153	
Sex of HCW							
Male	80	48	55	0.372	280	157	0.50
Female	179	118	140		118	65	
Age of HCW							
<30 years	142	86	83	0.042	199	112	0.481
30-35 years	49	38	59		99	47	
> 35 years	68	42	53		100	63	
Working hospital							
working CHP & SPH	82	58	63	0.001	269	148	0.068
primary hospital	177	108	132		129	74	
The Highest level of formal education							
Diploma	22	20	21	0.001	43	20	0.187
Degree	184	119	126		272	157	
masters (MPH/MSC)	30	13	24		49	18	
Specialist	23	14	24		34	27	
HCWs Profession							
Pharmacist	26	12	12	0.003	38	12	0.72
Nurse	86	66	55		138	69	
health officer	20	16	11		27	20	
Midwife	40	22	26		57	31	
General practitioner	23	19	29		42	29	
Laboratory professional	15	11	7		24	9	
Anastasia	7	6	10		13	10	
Environmental health	7	2	4		9	4	
Gynecologist	4	3	4		7	4	
Internist	7	5	11		12	11	
IESPS	5	0	6		7	4	
Surgeon	5	2	10		8	9	
Neurologist	1	0	1		2	0	
Ophthalmologist	1	0	1		1	1	
Dentist	2	0	0		1	1	
Radiologist	2	0	1		1	2	
Ophthalmic nurse	1	0	3		3	1	
Others*	7	2	4		8	5	

Notes: **Others***- psychiatric, nurse, neurology, **IESPS**- integrated emergency surgery professional specialty.

Table 3: Ordinal logistic regression analysis of associated factors of health care workers confidence level in diagnosis and management of emerging infectious virus of human monkeypox virus at Amhara region, 2023.

Characteristics	Confidence levels of HCW			Std. Error	Odds Ratio [95% conf. interval]	P-value
	Low	Medium	High			
visiting (WHO, CDC and other websites)						
No	189	104	121	1	1	
Yes	70	62	74	0. 261	1.596[1.158, 2.198]	0.004
Occupational category						
nurse and others*	209	137	132	1	1	
GP and specialist*	50	29	63	1.353	1.899[1.318, 2.734]	0.001
Year of experience						
< 5 years	100	57	67	1	1	
>5 years	159	109	128	0.212	1.297[0.94, 1.789]	0.113
Working hospital						
Primary	82	58	63	1	1	
working CSHP	177	108	132	0.165	0.989[0.714, 1.372]	0.950
Sex						
Female	80	48	55	1	1	
Male	179	118	140	0.187	1.096(0.783, 1.532)	0.594
Participate morning session						
No	142	74	96	1	1	
Yes	117	92	99	0.194	1.253[0.925, 1.699]	0.145
PHEM training						
No	215	135	117	1	1	
Yes	44	31	78	0.522	2.799[1.942, 4.035]	0.001
Age of HCW						
<30 years	142	86	83	0.318	1	
30-35 years	49	38	59	0.221	1.637[1.118, 2.397]	0.011
> 35 years	68	42	53	1	1.202[0.834, 1.731]	0.322
Attitude						
Negative attitude	239	113	46	1	1	
Positive attitude	122	72	28	0.277	1.724[1.258, 2.362]	0.001
Cut1				0.274	0.860[0.324, 1.396]	
Cut2				0.284	2.084[1.527, 2.641]	

STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	Recommendation	Page No
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	3
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	3 & 4
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	5-7
Objectives	3	State specific objectives, including any prespecified hypotheses	7
Methods			
Study design	4	Present key elements of study design early in the paper	7
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	7
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	8
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	9
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	*10*
Bias	9	Describe any efforts to address potential sources of bias	11
Study size	10	Explain how the study size was arrived at	8-9
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	11
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	11& 12
		(*b*) Describe any methods used to examine subgroups and interactions	11
		(*c*) Explain how missing data were addressed	12
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	11 & 12
		(*e*) Describe any sensitivity analyses	
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	12
		(b) Give reasons for non-participation at each stage	12
		(c) Consider use of a flow diagram	
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	12
		(b) Indicate number of participants with missing data for each variable of interest	12
Outcome data	15*	Report numbers of outcome events or summary measures	13

Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	13 & 14
		(*b*) Report category boundaries when continuous variables were categorized	13 & 14
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	14
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	-
Discussion			
Key results	18	Summarise key results with reference to study objectives	15, 16, 17 and 18
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	19
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	15, 16, 17 and 18
Generalisability	21	Discuss the generalisability (external validity) of the study results	15, 16, 17 and 18
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	20

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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Assessing healthcare workers' confidence level in diagnosis and management of emerging infectious virus of human monkeypox in Hospitals in Amhara Region, Northwest Ethiopia.

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ABSTRACT

Objective: To assess the healthcare workers' (HCWs) confidence level in diagnosing and managing monkeypox (mpox) disease and its associated factors in hospitals in Amhara Region.

Design: Institution-based cross-sectional study

Setting: Hospitals in Amhara region, Northwest Ethiopia.

Participants: A total of 640 HCWs, with a response rate of 96.9%, were participated from October 1- 30 December**,** 2022. A multistage stratified random sampling technique with proportional allocation was used to recruit study participants. Data were collected using the KoboCollect toolbox and exported to STATA Version-17 for analysis. Descriptive statistics were used to describe data. Ordinal logistic regression analysis was used to identify predictors of confidence level to diagnose and manage mpox at $p<0.05$.

Primary outcome: HCWs confidence level in diagnosing and managing mpox disease and its associated factors.

Results: The overall proportion of HCWs who had high confidence level in diagnosis and managing mpox disease was found to be 31.5%[95% CI: 27.9%, 35.2%]. Similarly, 26.8%[95% CI: 23.2%, 30.3%] and 41.8%[95% CI: 38.1%, 45.4%] of HCWs expressed medium and low confidence level to diagnose and manage the disease, respectively. The odds of higher confidence versus lower or medium confidence level in diagnosing and managing mpox were greater for HCWs who regularly visit amenable websites(AOR = 1.59, 95% CI: 1.16, 2.2), were physicians(AOR = 1.9, 95% CI: 1.32, 2.73), aged 30–35 years old(AOR = 1.64, 95% CI: 1.12, 2.39), had got PHEM training(AOR = 2.8, 95% CI: 1.94, 4.04), and had positive attitudes(AOR = 1.72, 95% CI: 1.26, 2.36) compared to their counterparts.

Conclusion: The overall HCWs confidence level in diagnosis and management of mpox disease in the study area was low. Therefore, the HCWs should be regularly updated about mpox disease through morning sessions and trainings on the diagnosis and clinical management mpox disease including infection prevention and control (IPC) of mpox.

Keywords: Healthcare worker, confidence level, human mpox, Amhara region.

Strengths and limitations of the study

- This study has used relatively a larger sample size, which increases the study' power and generalizability of its findings.
- The study has also employed multivariate ordinal logistic regression analysis to control the effect of confounders.
- The possibility of social desirability bias, such as some respondents i.e. physicians, might give positive responses that was not actually true and recall bias such as remembering frequency of handwashing, were the limitations of this study.

Introduction

Monkeypox is an illness caused by the monkeypox (mpox) virus, a double-stranded Deoxyribonucleic Acid (DNA) virus belonging to the genus *Orthopoxvirus* within the Poxviridae family, almost similar to variola virus responsible for smallpox[1, 2]. The mpox disease is originally a viral zoonotic infection that spreads from animals to humans. However, human to other human and environment to human transmissions were also evident recently [3, 4].

The mpox virus was first isolated from monkeys in laboratories in Copenhagen, Denmark in 1958 [5, 6] and the first human case, 9-month-old child patient, was identified in Democratic Republic of Congo (DRC) in 1970 [7]. The first mpox outbreak outside Africa was documented in the USA in 2003 after an infected rodent species imported from West Africa [8]. Since then, there was sporadic occurrence of mpox outbreaks in endemic regions in Africa. The problem is particularly severe in the DRC, where a survey study found that of 77 suspected cases distributed among 138 households, 27.3% PCR tested were positive for monkeypox, the highest reported of cases (882) and deaths (2) are reported [9]. Moreover, the Nigerian mpox outbreak in 2017 leads to the spread of the disease to the United Kingdom and elsewhere in Europe followed by dramatic increase in the number of monkeypox infections and we now face a period of multiple outbreaks in countries without clear epidemiological links to endemic countries [10, 11].

Although variabilities in the actual number of cases reported, as of 30th, December 2023, about 92,783 confirmed cases and 660 probable cases, including 171 death were reported in 116 countries since 1st, January 2022, and almost 98% of cases and 88% of deaths were reported from countries that have not historically reported mpox [12, 13]. The case-fatality-ratio (CFR) of Mpox

is lower than that of smallpox [14], as its case fatality reaches 17% which is well below that of smallpox (25–40%) [15].

The mpox disease is primarily cutaneous illness with lymphadenopathy that is transmitted through direct or indirect close contact with droplets, fomites, skin lesions, or contaminated body fluids [16-21] as well as sexual intercourse and mother-to-fetus transmission [22, 23]. The disease is also self-limiting, with symptoms ranging from mild to severe, including itchy to painful skin lesions, fever, generalized headache, fatigue, lymphadenopathy, back pain, and myalgia[21-23]. The symptoms of mpox normally disappear after 14-21 days, following a 5-21 day incubation period [21, 24]. The most prominent clinical symptom was a skin rash that occurred up to three days after fever, but it can be observed throughout the body in more severe cases [25, 26]. Patients admitted to the hospital show clinical manifestations of complications such as s bacterial super-infection, dehydration, and respiratory distress [18, 27].

Several risk factors are linked to an increase in mpox outbreaks, including the interruption of smallpox vaccination that leads to increased susceptibility to mpox infection. The extensive consumption of animals as a protein source, which are potential mpox virus reservoirs; increased population density; ease of travel; and ecological and environmental factors, such as clearing of tropical rainforests with an increased risk of exposure to reservoir animals [28-32].

Enhancing case definition, epidemiological, clinical, genomic, and molecular surveillance alone is not enough to prevent mpox pandemics, but it needs integrated health promotion or education, and announcing or implementing prevention mechanisms is critical for disease control [33]. Based on these global efforts, effective and safe vaccines are ongoing, with licenses being used in countries such as the United Kingdom, Canada, and USA for high-risk populations. Moreover, basic public health interventions, such as the use of personal protective equipment (PPE),

practicing good hand hygiene, immediate case isolation, contact tracing, and avoiding contact with infected animals or materials, are effective means of controlling the spread of human monkeypox [34, 35]. Similar to communities, healthcare workers should practice strict use of PPE such as wearing well-fitted N95 masks, gloves, and other PPE before any contact with a suspected case [36].

The HCWs confidence level in diagnosing and managing mpox disease is challenging due to inadequate capacity to diagnose and clinically manage patients and to identify exposure accurately[37]. Moreover, the Orthopoxvirus testing capacity in endemic areas in Africa is reported to be very low [37]. Therefore, the rapid increase in mpox pandemics calls investigations on the HCWs' knowledge, confidence, and attitude towards their ability to diagnose and manage mpox patients [11, 34], which is the primary role of healthcare professionals in responding the ongoing mpox pandemic [38-40].

Ethiopia, the third populous country in Africa, is at risk of the mpox virus alongside other countries in the horn of Africa. Sudan, sharing its border with Amhara Region, Northwest Ethiopia, reported 19 mpox cases and 1 death since August 2022 [12, 13]. The continued political instabilities and unrest in Sudan forced civilians to migrate into Ethiopia through the border of Metema, West Amhara Region. Moreover, the current political instability in Amhara Region also deteriorates the capacity of healthcare facilities, which makes testing of Orthopoxvirus very difficult. Considering such scenarios, assessing the HCWs' confidence level in diagnosis and management of mpox at Amhara Region will have paramount importance. Therefore, the aim of this study is to assess HCWs' confidence level in diagnosis and management of emerging infectious viruses of mpox in hospitals in Amhara region, Northwest Ethiopia.

Methods

Study design, setting and period

An institution-based cross-sectional study was conducted in hospitals found in the Amhara region, Northwest Ethiopia from 1 October to 30 December 2022. Bahir Dar city is the capital city of Amhara Region, which is located at 575 km in the Northwest direction of Addis Ababa, the capital city of Ethiopia. It is also located at 340 km from Metema, which is a border route to Sudan. The Region has 15 zones and 98 public hospitals (eight comprehensively specialized, 20 generals, and 69 primary) (Figure 1).

Source and study population

All HCWs working in public hospitals in the Amhara region were taken as the source population, and those HCWs working in randomly selected public hospitals were considered as the study population.

Inclusion and exclusion criteria

All HCWs working in public hospitals in the Amhara region were included in this study; however, those HCWs who are not available during data collection and who are on annual/maternal leave were excluded from the study.

Patient and Public Involvement

None or there is no involvement of patients and/or the health care workers in the design, or conduct, or reporting or dissemination plans of this research.

Sample size determination

The minimum sample size that represents the source population was estimated considering the single population proportion formula with the following assumptions; 95% confidence interval Power (β = 80%), Proportion of HCWs confidence level in diagnosing and managing mpox patients (P = 50%), considering no previous study in Ethiopia [41], standard normal distribution($Z_{a/2}$= 1.96), margin of error (d=5%) and design effect(1.5). Therefore, the final adequate sample size including 10% non-response rate was 640 HCWs.

Sampling procedure and technique

A multistage stratified random sampling was employed to select HCWs working in hospitals in Amhara Region. Twenty-eight hospitals (9 from general and comprehensive specialized hospitals (CSHPs), and 19 from primary hospitals), representing 28.6 % of the total hospitals in the Region, were selected randomly. The sample size was proportionally allocated to each selected hospital and similarly to each professional stratification. Finally, the healthcare workers who provided their responses in the data collection were selected using simple random sampling.

Variables

The dependent variable was HCWs' confidence level in diagnosing and managing mpox disease (categorized as poor, medium, or high confidence). The independent variables included the socio-demographic characteristics such as age, residence, marital status, and level of education, professional category and years of experience. The independent variables also included some personal behaviors such as the knowledge and attitude about mpox disease, previous training exposure on public health emergency epidemic disease management (PHEM), habit of regular participation in the morning session and the habit of visiting websites of WHO, CDC, and other websites.

Operational definitions

HCWs confidence level: A total of 44 questions (9 related to preparedness, 28 related to diagnoses, 7 related to management of mpox disease) were used to measure HCWs confidence level. Each questions had three responses, 'Yes coded as +1', 'No coded as 0' and 'I do not know coded as – 1'. The responses from each respondents were summed and the percentage score of ≥80% labeled as higher confidence, 50–79% labeled as medium confidence and <50% labeled as poor confidence level[42, 43].

Knowledge: The knowledge score was calculated from 35 questions (28 related to diagnosis and 7 related to management of mpox disease) with three responses, 'Yes coded as +1', 'No coded as 0' and 'I do not know coded as – 1'. The percentage of knowledge score for each respondents categorized in to three labels: Percentage of knowledge scores, <50% was labeled as less-knowledgeable, 50%-79% was labeled as moderately knowledgeable and ≥80% was labeled as knowledgeable [17, 43].

Attitude: The HCWs' attitude was assessed using 7-point Likert scale 14 questions (strongly disagree (1), disagree (2), somewhat disagree (3), neutral/no opinion (4), somewhat agree (5), agree (6), and strongly agree (7). The sum of their responses was calculated as attitude score between 14 and 98. Then those HCWs who scored less than 70% were considered to have negative attitude and those who scored ≥70% were considered to have positive attitude [42].

Validity and reliability of the questionnaire

The tool's validity and reliability were also assessed. The degree to which all items in the questionnaire reflect the contents to which the instrument will be generalized was assessed using reliability and validity tests. Five general practitioners (GPs) reviewed the questionnaires. The

content validity ratio (CVR) formula, CVR = (Ne-n/2) /(n/2), was used to determine whether the questionnaires were relevant, needed revision or were removed [44]. The CVR scored of diagnosis, management and preparedness questionnaires were 0.952, 1.00, and 0.963 respectively. Besides the CVR scored for knowledge, attitude and confidence level were 0.9619, 0.8815 and 0.9619 respectively (Supplementary file 1 and 2). The instrument has an overall Cronbach's Alpha coefficient value of 0.846, which is used to evaluate the questionnaire's consistency across all items.

Data collection tools and procedure

Data were collected using a structured questionnaire, which was prepared after reviewing previous studies conducted for similar purposes [45-50]. The questionnaire was developed in English, then translated into Amharic (local language), then back to English to ensure its consistency. The questionnaire contained sociodemographic characteristics and habit-related factors of the healthcare workers. Data collection was conducted, using KoboCollect (version 2022.4.4) twenty-nine by general practitioners (GP) and five master's holder health professionals were recruited to manage the data collection processes.

Data quality assurance

Data quality was assured using a properly designed questionnaire adapted from literatures. Training was provided for both data collectors and supervisors on the purpose of the study, data collection techniques, and tools by the principal investigators for two days. The data collectors pre-tested the questionnaires, on 5% of the sample size at Injebara Health Center where the study was not undertaken, and necessary amendments were taken based on the findings of the pre-test. Every day after data collection, the principal investigator reviewed the questionnaires to ensure

the completeness of each response. The principal investigator and supervisor closely monitored the data-collection process.

Data management and analysis

Data were exported to STATA version 17 from the KoboCollect data collection toolbox. Data were cleaned (categorization for continuous variables and re-categorization for categorical variables) and descriptive statistics such as frequency distribution tables, means, and standard deviations were computed to describe the data. Bivariate and multivariable ordinal logistic regressions were used to identify predictors of HCWs' confidence level in diagnosing and managing mpox disease. The proportional odds assumption was checked (chi^2 P-value = 0.054) to evaluate the distance between each category of the outcome was equivalent or not. The two cut of points, cut1= 0.8603 and cut2 = 2.083, was estimated to see the inherently ordered distances between low, medium and high confidence level in diagnosing and management mpox disease. A p-value < 0.25 was used as criteria during bivariate analysis to retain variables for the multivariable ordinal logistic regression model. Crude and adjusted odds ratios with 95% confidence interval were calculated to measure the degree of association between independent variables and HCWs' confidence level in diagnosing and managing mpox disease. A p-value < 0.05 was considered as a level of statistical significance in multivariable ordinal logistic regression analysis.

Results

Socio-demographic characteristics of HCWs

Six hundred twenty HCWs (with a response rate of 96.9%) gave a complete response. The majority 312 (50.3%) of HCWs were Orthodox Christian followers. Similarly, 63.9% of the HCWs had more than five years of experience. The mean (±SD) age of the HCWs was 31.67 (±5.355) years old and 432 (69.7%) of them were male. Only 153 (24.7%) HCWs had gotten public health emergency training (PHEM) from governmental and non-governmental organizations (NGO) (Table 1).

Table 1: The HCWs confidence level in diagnosis and management of mpox disease in Hospitals in Amhara region, Northwest Ethiopia, 2022.

Characteristics	Confidence levels of HCW				
	Low confidence	Medium confidence	High confidence	X^2	P-value
Religion of HCW					
Orthodox	136	79	97	4.047	0.670
Muslim	70	49	52		
Protestant	36	30	29		
Others*	17	8	17		
Visiting (WHO, CDC and other amenable websites)					
No	189	104	121	7.718	0.021
Yes	70	62	74		
Occupational category					
Physician	50	29	63	14.442	0.001
Nurse and others**	209	137	132		
Year of experience					
< 5 years	100	57	67	1.187	0.553
>5 years	159	109	128		
Working hospital					
working CSPH	177	108	132	0.518	0.772
primary hospital	82	58	63		
Sex					
Male	179	118	140	0.424	0.809
Female	80	48	55		
Participate morning session					
No	142	74	96	4.385	0.112
Yes	117	92	99		
PHEM training					
No	215	135	117	36.086	0.001
Yes	44	31	78		
Age of HCW					
<30 years	142	86	83	9.691	0.046
30-35 years	49	38	59		

> 35 years	68	42	53		
The Highest level of formal education					
Diploma	22	20	21	5.923	0.432
Degree	184	119	126		
masters (MPH/MSC)	30	13	24		
Specialist	23	14	24		
HCWs Profession					
Pharmacist	26	12	12	40.79	0.197
Nurse	86	66	55		
health officer	20	16	11		
Midwife	40	22	26		
General practitioner	23	19	29		
Laboratory professional	15	11	7		
Anastasia	7	6	10		
Environmental health	7	2	4		
Gynecologist	4	3	4		
Internist	7	5	11		
IESPS	5	0	6		
Surgeon	5	2	10		
Neurologist	1	0	1		
Ophthalmologist	1	0	1		
Dentist	2	0	0		
Radiologist	2	0	1		
Ophthalmic nurse	1	0	3		
Others****	7	2	4		
Attitude					
Negative attitude	239	113	46	11.37	0.003
Positive attitude	122	72	28		

Note: other-** (health officer, midwife, Laboratory professional, Environmental health, pharmacist and Dentist), **Specialist*-** gynecologist, Internist, Surgeon, Neurologist, Ophthalmologist, Dentist, Radiologist. **Others*- Catholic, Jobha, etc.,** Others****- **Others***- psychiatric, nurse, neurology. **Physician-** GP and any specialist doctors.

HCWs confidence level in diagnosis and management of mpox

The overall proportion of HCWs who had high confidence level in diagnosis and management of mpox disease was found to be 31.5% [95% CI: 27.9%, 35.2%]. Similarly, 26.8% [95% CI: 23.2%, 30.3%] and 41.8% [95% CI: 38.1%, 45.4%] of HCWs expressed medium and low confidence level in their ability to diagnose and manage mpox disease, respectively. Aside from that, 22.1% [95%

CI: 19.0%, 25.5%] of HCWs had higher confidence level in diagnosis and 20.2% [95% CI: 17.2%, 23.4%] of them had higher confidence level in management of mpox disease (Figure 2).

HCWs knowledge and attitude towards mpox

Although about 41.7% [95% CI: 37.9%, 45.8%] of HCWs were less knowledgeable, more than half 361(58.2%) of them responded that mpox virus is prevented by frequent hand washing for at least 20 s with soap and water or alcohol. Similarly, beyond half 328(52.9%) of them responded that antibiotics can be used to treat mpox disease. However, only 36.9% of HCWs had knowledge on contaminated environment-to-person transmissions of mpox and 34.3% of them responded that mpox is a bacterial disease. About 44.4% of physicians and only 27.6% of nurses and other professionals had higher knowledge about mpox (Figure 3).

Regarding the HCWs attitude towards mpox, only 35.8% [95% CI: 32.3, 39.6] of them had positive attitude leaving the majority 64.2 % [95% CI: 60.4, 67.7] of the HCWs with negative attitude. Higher percentage (42.3%) of physicians had positive attitude towards mpox virus compared to nurses and other professionals (33.9%) (Figure 3).

Factors associated with HCWs confidence level in diagnosing and managing mpox disease

In binary ordinal logistic regression analysis, variables such as working hospital standards, sex, work experience, occupational category, regular participation in morning sessions, exposure PHEM training, attitude, visiting WHO, CDC, and other websites, and age group, were selected as candidate for multivariable ordinal logistic regression analysis. During the multivariable ordinal logistic regression analysis, variables such as positive attitude, aged 30 – 35 years old, professional

category and habit of visiting the WHO, CDC, and other amenable websites were found to be significantly associated with the outcome variable.

The HCWs with a cut of point value ≤ 13.97% were classified as having a low confidence level, given that they were working in a primary hospital, being female, having < 5 years of work experience, being a nurse and other health professionals, not participating in a morning session, not receiving PHEM training, having a negative attitude, not visiting the WHO, CDC, and other websites, and aged < 30 years old as opposed to between 30–35 years. Similarly, the HCWs with a cut of point value ≥ 2.083 were classified as having a higher confidence level, given that the above variables were kept similar with their reference. Additionally, participants with a cut of point value between 0.8603 and 2.083 were considered to have medium confidence level where the independent variables were kept similar with their reference.

The odds of higher confidence level vs. lower or medium confidence level in diagnosing and managing mpox disease was 1.59 times (AOR = 1.596, 95% CI: 1.158, 2.198) higher for the HCWs who regularly visit the WHO, CDC, and other potential websites than those who do not visit the websites when other variables were kept constant. The odds of higher confidence vs. lower or medium confidence level was 1.9 times (AOR = 1.899, 95% CI: 1.318, 2.734) higher for physicians in comparison to being nurses and other professionals when the other variables are kept constant. Similarly, the odds of higher versus lower or medium confidence level in managing and diagnosing mpox disease was 1.6 (AOR = 1.637, 95% CI: 1.118, 2.397) times greater for HCWs if their age is 30–35 years compared to less than 30 years old when the other variables were kept constant.

Moreover, the odds of higher versus lower or medium confidence level in managing and diagnosing mpox disease was 2.8 times (AOR = 2.799, 95% CI: 1.942, 4.035) greater for HCWs

who had exposure PHEM training than their counterparts. Lastly, the odds of higher confidence level vs. lower or medium confidence level in managing and diagnosing mpox disease was 1.72 times (AOR = 1.724, 95% CI: 1.258, 2.362) greater for HCWs who had positive attitudes than their counterparts when the other variables were kept constant (Table 2).

Table 2: Multivariable ordinal logistic regression of factors associated with HCWs Confidence level in diagnosis and management of mpox disease in hospitals in Amhara Region, Northwest Ethiopia, 2022.

Characteristics	Confidence levels of HCW			Std. Error	AOR [95% conf. interval]	P-value
	Low	Medium	High			
visiting (WHO, CDC and other websites)						
No	189	104	121	1	1	
Yes	70	62	74	0. 261	1.596[1.158, 2.198]	0.004
Occupational category						
nurse and others*	209	137	132	1	1	
Physician	50	29	63	1.353	1.899[1.318, 2.734]	0.001
Year of experience						
< 5 years	100	57	67	1	1	
>5 years	159	109	128	0.212	1.297[0.94, 1.789]	0.113
Working hospital						
Primary	82	58	63	1	1	
working CSHP	177	108	132	0.165	0.989[0.714, 1.372]	0.950
Sex						
Female	80	48	55	1	1	
Male	179	118	140	0.187	1.096(0.783, 1.532)	0.594
Participate morning session						
No	142	74	96	1	1	
Yes	117	92	99	0.194	1.253[0.925, 1.699]	0.145
PHEM training						
No	215	135	117	1	1	
Yes	44	31	78	0.522	2.799[1.942, 4.035]	0.001
Age of HCW						
<30 years	142	86	83	0.318	1	
30-35 years	49	38	59	0.221	1.637[1.118, 2.397]	0.011

> 35 years	68	42	53	1	1.202[0.834, 1.731]	0.322
Attitude						
Negative attitude	239	113	46	1	1	
Positive attitude	122	72	28	0.277	1.724[1.258, 2.362]	0.001
Cut1				0.274	0.860[0.324, 1.396]	
Cut2				0.284	2.084[1.527, 2.641]	

Discussions

The HCWs should be equipped with the required knowledge and confidence in clinically diagnosing and managing mpox disease in areas where there is scarce resources to install testing laboratories. However, this is a predominant challenge that the HCWs faced in the current mpox outbreak, which requires not only an intensive prevention strategy including vaccination but also early detection, quick response, and proper management of affected patients. This study was designed to assess the HCWs confidence level in diagnosing and management of mpox disease in hospitals in Amhara Region. The findings of this study is important to design interventions that strengthen HCWs' preparedness for mitigations and responses towards the outbreak [51].

The overall proportion of HCWs who had high confidence level in managing and diagnosing mpox disease was 31.5% [95% CI: 27.7%, 35.2%]. Even though the differences in the cut of points in determining the outcome and the study participants, similar proportion (34.9%) was reported by the study conducted in Indonesia [52].

Similarly, the proportion of HCWs who had higher confidence level in managing the mpox diseases was found to be 32.1% [95% CI: 28.2%, 35.7%]. However, higher proportions (P = 47.5%) [45] and (P = 38.9%) [17] was reported in studies conducted in Kuwait and Jordan, respectively. Likewise, the proportion of HCWs who had higher confidence level to diagnose the

disease was also determined to be 35.0% [95% CI: 31.3%, 38.7%]. Similar proportions was reported by studies conducted in Kuwait (32.3%) and Jordan (38.0%) [17, 45].

In this study, those HCWs aged 30–35 years old had higher confidence level in diagnosing and management of mpox disease compared to those HCWs aged less than 30 years old. The reason for this finding might be due to the HCWs who had higher age group might have helpful experiences and exposures on their clinical practices in similar epidemics such as COVID 19. In addition, HCWs in this age category may have a habit of searching new facts and updates about emerging and re-emerging epidemics. This study also found that those HCWs with positive attitude had higher confidence in diagnosing and managing mpox diseases compared to those HCWs with negative attitude. This might be due to the positive attitude towards the diseases may help HCWs thrive in search of new information regarding the management and diagnosis of the disease. The information seeking behavior might help the HCWs to develop higher level of confidence towards the management and diagnosis of the disease. This contemplation was also supported by the current study, which revealed that those HCWs who had visited different websites such as the WHO and CDC websites had higher odds of high level of confidence in diagnosing and managing mpox diseases compared to those who had not. The mere reason behind this might be due to WHO and other partners like CDC might release accurate and updated information on daily basis regarding the signs and symptoms, transmission, prevention, and treatment the virus and the global strategies for the prevention and control of mpox outbreaks [53]. The importance of prior information about the mpox virus was mentioned an independent predictor of higher level of confidence among general practitioners as those general practitioners who had received information of mpox virus during their medical education had higher confidence than those who had never received such information[54]. Therefore, visiting different websites could improve

HCWs' knowledge and attitude about mpox, leading to a high level of confidence in the diagnosis and management of re-emerging viruses.

Like other study conducted in Jordan[17], this study identified that physicians (GPs and Specialists) had higher confidence level in diagnosing and managing mpox disease compared to nurses and other professionals. The possible explanation might be due to the physicians' higher and intensive educational exposure during their medical education might help them understand the fundamental sciences of communicable diseases like mpox virus. In addition, the physicians might have an opportunity to attend regional and international conferences during such type of pandemics, which updates them with the current worldwide understanding about the diseases. This was explained by the study conducted in Indonesia, which suggested that, attending national conferences (at least one) helps general practitioners equip with better confidence [52]. Another possible reason might be due to physicians such as specialists may have practical experiences in the management and diagnosis of similar pandemics such as COVID 19, which help them to be sensitive to potentially threatening mpox virus pandemics across the globe. In contrast to our finding and these justifications, a study conducted in Kuwait[45] reported nurses displayed higher self-reported confidence levels to diagnose and manage the disease. The possible reason might be the differences in the variable categorization, this study categorized the variable into dichotomizes variable (GPs and specialists Vs Nurse and other professionals); however, the later study categorized the variable into four categories.

Those HCWs who had got training about public health epidemic-prone diseases had higher confidence level in diagnosis and management of mpox disease. Previous studies conducted in Indonesia [52], Australia [55] and Italy [56] agreed with our findings that receiving information during medical training was significantly associated with goods knowledge about mpox, which

increases their confidence level. The level of HCWs' confidence increased with prolonged attachment and trainings in healthcare centers [55], as adequate training and continuing medical education are important to ensure the buildup of confidences in diagnosing and management of infectious diseases[57].

Conclusions

The overall HCWs' confidence level in diagnosing and managing mpox disease in Amhara region was low compared to what was recommended by WHO. Those modifiable variables such as positive attitude, professional category (being a GP and specialist doctor), age, and visiting the WHO, CDC, and other amenable websites were found to be significantly associated with higher HCWs' confidence level in diagnosing and managing mpox disease. Raising awareness and confidence level of HCWs in diagnosing and managing mpox disease can strengthens their preparedness for the mitigation and response of the emerging threat of mpox. For instance, training on the WHO's rapid interim guideline for the clinical management and infection prevention and control (IPC) of mpox should be given for all HCWs in the study area [58]. Additionally, those physicians with higher confidence level in diagnosing and managing should share their knowledge and skills with nurses and other health professionals.

Ethics approval and consent to participate

Ethical approval was obtained from the Institutional Review Board (IRB) with protocol number: No./RCS/70024/26 of the Debretabor University, College of Medicine and Health Sciences. Before data collection, formal permission letters were obtained from each hospital. Similarly, facility heads were communicated through supporting letters and informed about the purpose of the study before actual data collection. Informed verbal consent were obtained from the sampled HCWs. The respondents were also informed that they have the full right to withdraw or refuse at

any time during interviewing. Data confidentiality was maintained by avoiding possible identifiers, such as exchanging the names of study participants with identification numbers.

Abbreviation and Acronyms

AOR: Adjusted Odds Ratio; **CDC**: Center for Disease Control and Prevention; **CSPH**: Comprehensive Specialized Hospital; **GP**: General Practitioner; **HCWs**: Healthcare Workers; **IESPS**: Integrated Emergency Surgery Professional Specialty; **mpox**: Monkeypox; PHEM: Public Health Emergency Management; **WHO**: World Health Organization.

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author upon reasonable request.

Competing interests

The authors declare that they have no conflicts of interest regarding any aspect of this article.

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Authors' contributions

AGY- Conception, design, acquisition of data or analysis and interpretation of data and wrote the manuscript. **AT** - designed the study and analyzed, interpreted, and wrote the manuscript. **GM** - conceived the study and reviewed and wrote the manuscript. **TD-** reviewed and wrote the manuscript, **AM-** reviewed and wrote the manuscript, **HT-** reviewed and wrote the manuscript, **ASA**- reviewed and wrote the manuscript, **MA**- reviewed the manuscript, **AS-** edited the manuscript, **DT-** edited the manuscript, **EM-** edited the manuscript, **TDT-** edited the manuscript

and **CY -** Design, acquisition of data or analysis and interpretation of data and wrote the manuscript.

Reference

1. Karagoz, A., et al., *Monkeypox (mpox) virus: Classification, origin, transmission, genome organization, antiviral drugs, and molecular diagnosis.* Journal of Infection and Public Health, 2023.
2. Hirani, R., et al., *A Review of the Past, Present, and Future of the Monkeypox Virus: Challenges, Opportunities, and Lessons from COVID-19 for Global Health Security.* Microorganisms, 2023. **11**(11): p. 2713.
3. Perramon, A., et al., *Analysis of the epidemiological dynamic of monkeypox from 15th May to 31st August 2022.* Disponible en: www. enfermedadesemergentes. com, 2022: p. 160.
4. Ilic, I., I. Zivanovic Macuzic, and M. Ilic, *Global outbreak of human Monkeypox in 2022: Update of epidemiology.* Tropical Medicine and Infectious Disease, 2022. **7**(10): p. 264.
5. Xiang, Y. and A. White, *Monkeypox virus emerges from the shadow of its more infamous cousin: family biology matters.* Emerging microbes & infections, 2022. **11**(1): p. 1768-1777.
6. Cheema, A., et al., *Monkeypox: A Review of Clinical Features, Diagnosis, and Treatment. Cureus 2022, 14, e26756*.
7. Ladnyj, I., P. Ziegler, and E. Kima, *A human infection caused by monkeypox virus in Basankusu Territory, Democratic Republic of the Congo.* Bulletin of the World Health Organization, 1972. **46**(5): p. 593.
8. Antunes, F., R. Cordeiro, and A. Virgolino, *Monkeypox: From A Neglected Tropical Disease to a Public Health Threat.* Infectious Disease Reports, 2022. **14**(5): p. 772-783.
9. Mande, G., et al., *Enhanced surveillance of monkeypox in Bas-Uélé, Democratic Republic of Congo: the limitations of symptom-based case definitions.* International Journal of Infectious Diseases, 2022. **122**: p. 647-655.
10. Kraemer, M.U., et al., *Tracking the 2022 monkeypox outbreak with epidemiological data in real-time.* The Lancet Infectious Diseases, 2022.
11. Update, E., *Monkeypox multi-country outbreak.* European Centre for Disease Prevention and Control, 2022.
12. WHO, *2022-23 Mpox (Monkeypox) Outbreak: Global Trends; Produced on 19 December 2023: https://worldhealthorg.shinyapps.io/mpx_global/*. 2023.
13. CDC, *2022-2023 Mpox Outbreak Global Map, Data as of 27 Dec 2023: https://www.cdc.gov/poxvirus/mpox/response/2022/world-map.html. 2023.* 2023.
14. Ilic, I. and M. Ilic, *Historical review: Towards the 50th anniversary of the last major smallpox outbreak (Yugoslavia, 1972).* Travel Medicine and Infectious Disease, 2022. **48**: p. 102327.
15. Yousaf, M., et al., *Immuno-informatics profiling of monkeypox virus cell surface binding protein for designing a next generation multi-valent peptide-based vaccine.* Frontiers in Immunology, 2022. **13**.
16. Titanji, B.K., et al. *Monkeypox: a contemporary review for healthcare professionals*. in *Open forum infectious diseases*. 2022. Oxford University Press.
17. Sallam, M., et al. *Assessing Healthcare Workers' Knowledge and Their Confidence in the Diagnosis and Management of Human Monkeypox: A Cross-Sectional Study in a Middle Eastern Country*. in *Healthcare*. 2022. MDPI.

18. Tarín-Vicente, E.J., et al., *Clinical presentation and virological assessment of confirmed human monkeypox virus cases in Spain: a prospective observational cohort study.* The Lancet, 2022. **400**(10353): p. 661-669.
19. Morgan, C.N., et al., *Environmental persistence of monkeypox virus on surfaces in household of person with travel-associated infection, Dallas, Texas, USA, 2021.* Emerging Infectious Diseases, 2022. **28**(10): p. 1982-1989.
20. Peiró-Mestres, A., et al., *Frequent detection of monkeypox virus DNA in saliva, semen, and other clinical samples from 12 patients, Barcelona, Spain, May to June 2022.* Eurosurveillance, 2022. **27**(28): p. 2200503.
21. Vaughan, A., et al., *Human-to-human transmission of monkeypox virus, United Kingdom, October 2018.* Emerging infectious diseases, 2020. **26**(4): p. 782.
22. Al-Tammemi, A.a.B., R. Albakri, and S. Alabsi, *The Outbreak of Human Monkeypox in 2022: A Changing Epidemiology or an Impending Aftereffect of Smallpox Eradication?* Frontiers in Tropical Diseases, 2022. **3**: p. 951380.
23. Mbala, P.K., et al., *Maternal and fetal outcomes among pregnant women with human monkeypox infection in the Democratic Republic of Congo.* The Journal of infectious diseases, 2017. **216**(7): p. 824-828.
24. Rodriguez-Morales, A.J. and G. Lopardo, *Monkeypox: another sexually transmitted infection?* Pathogens, 2022. **11**(7): p. 713.
25. Bunge, E.M., et al., *The changing epidemiology of human monkeypox—A potential threat? A systematic review| PLOS Neglected Tropical Diseases.* 2022.
26. Simpson, K., et al., *Human monkeypox–After 40 years, an unintended consequence of smallpox eradication.* Vaccine, 2020. **38**(33): p. 5077-5081.
27. Weinstein, R.A., et al., *Reemergence of monkeypox: prevalence, diagnostics, and countermeasures.* Clinical infectious diseases, 2005. **41**(12): p. 1765-1771.
28. Beer, E.M. and V.B. Rao, *A systematic review of the epidemiology of human monkeypox outbreaks and implications for outbreak strategy.* PLoS neglected tropical diseases, 2019. **13**(10): p. e0007791.
29. Rimoin, A.W., et al., *Major increase in human monkeypox incidence 30 years after smallpox vaccination campaigns cease in the Democratic Republic of Congo.* Proceedings of the National Academy of Sciences, 2010. **107**(37): p. 16262-16267.
30. Petersen, B.W., et al., *Vaccinating against monkeypox in the Democratic Republic of the Congo.* Antiviral research, 2019. **162**: p. 171-177.
31. Khodakevich, L., et al., *Monkeypox virus in relation to the ecological features surrounding human settlements in Bumba zone, Zaire.* Tropical and geographical medicine, 1987. **39**(1): p. 56-63.
32. Haider, N., et al., *Increased outbreaks of monkeypox highlight gaps in actual disease burden in Sub-Saharan Africa and in animal reservoirs.* International Journal of Infectious Diseases, 2022.
33. Ortiz-Martínez, Y., et al., *YouTube and 2022 Monkeypox outbreak: opportunities for awareness and infection control.* Journal of Hospital Infection, 2022.
34. ASSESSMENT, R.R., *Monkeypox multi-country outbreak.* 2022.
35. Sah, R., et al., *The Emergence of Monkeypox: A Global Health Threat.* Cureus, 2022. **14**(9).
36. Al-Musa, A., J. Chou, and B. LaBere, *The resurgence of a neglected orthopoxvirus: Immunologic and clinical aspects of monkeypox virus infections over the past six decades.* Clinical Immunology, 2022: p. 109108.
37. mondiale de la Santé, O. and W.H. Organization, *Epidemiology of human monkeypox (mpox)–worldwide, 2018–2021–Épidémiologie de la variole simienne chez l'humain–dans le monde, 2018-2021.* Weekly Epidemiological Record= Relevé épidémiologique hebdomadaire, 2023. **98**(03): p. 29-36.

38. Antunes, F. and A. Virgolino, *Monkeypox Mysteries of the New Outbreak in Non-Endemic Areas.* International Journal of Environmental Research and Public Health, 2022. **19**(22): p. 14881.
39. Shariq, A., Z. Rasheed, and W. Al Abdulmonem, *Human monkeypox: An update on knowledge and future implications.* International Journal of Health Sciences, 2022. **16**(4): p. 1-2.
40. Koenig, K.L., C.K. Beÿ, and A.M. Marty, *Monkeypox 2022: a primer and identify-isolate-inform (3I) tool for Emergency Medical Services professionals.* Prehospital and Disaster Medicine, 2022. **37**(5): p. 687-692.
41. Taherdoost, H., *Determining sample size; how to calculate survey sample size.* International Journal of Economics and Management Systems, 2017. **2**.
42. Sallam, M., et al., *Knowledge of human monkeypox and its relation to conspiracy beliefs among students in Jordanian health schools: filling the knowledge gap on emerging zoonotic viruses.* Medicina, 2022. **58**(7): p. 924.
43. Ramli, N., N.A.A. Rahman, and M. Haque, *Knowledge, Attitude, and Practice Regarding Osteoporosis Among Allied Health Sciences Students in a Public University in Malaysia.* Erciyes Medical Journal/Erciyes Tip Dergisi, 2018. **40**(4).
44. Rony, M.K.K., et al., *Knowledge and Attitude Regarding Human Monkeypox Virus Infection among Nurses: A Cross-Sectional Study.* SAGE Open Nursing, 2023. **9**: p. 23779608231216619.
45. Alsanafi, M., K. Al-Mahzoum, and M. Sallam, *Monkeypox Knowledge and Confidence in Diagnosis and Management with Evaluation of Emerging Virus Infection Conspiracies among Health Professionals in Kuwait.* Pathogens, 2022. **11**(9): p. 994.
46. Alshahrani, N.Z., et al., *Assessment of knowledge of monkeypox viral infection among the general population in Saudi Arabia.* Pathogens, 2022. **11**(8): p. 904.
47. Alshahrani, N.Z., et al., *Assessment of Knowledge of Monkeypox Viral Infection among the General Population in Saudi Arabia.* pathogens, 2022. **11**: p. 904.
48. Hasan, S. and S. Saeed, *Monkeypox disease: An emerging public health concern in the shadow of COVID-19 pandemic: An update.* Tropical Medicine and Infectious Disease, 2022. **7**(10): p. 283.
49. Hong, J., et al., *The willingness of Chinese healthcare workers to receive monkeypox vaccine and its independent predictors: A cross-sectional survey.* Journal of Medical Virology, 2023. **95**(1): p. e28294.
50. Huang, Y., L. Mu, and W. Wang, *Monkeypox: epidemiology, pathogenesis, treatment and prevention.* signal Transduction and Targeted Therapy 2022(7): p. 373.
51. Wenham, C. and M. Eccleston-Turner, *Monkeypox as a PHEIC: implications for global health governance.* The Lancet, 2022. **400**(10369): p. 2169-2171.
52. Harapan, H., et al., *Confidence in managing human monkeypox cases in Asia: A cross-sectional survey among general practitioners in Indonesia.* Acta tropica, 2020. **206**: p. 105450.
53. Organization, W.H., *Obesity: preventing and managing the global epidemic.* 2000.
54. Harapan, H., et al., *Knowledge of human monkeypox viral infection among general practitioners: a cross-sectional study in Indonesia.* Pathogens and Global Health, 2020. **114**(2): p. 68-75.
55. McNair, R., et al., *Medical students developing confidence and patient centredness in diverse clinical settings: a longitudinal survey study.* BMC Medical Education, 2016. **16**(1): p. 1-8.
56. Gallè F, B.L., Da Molin G, Mancini R, Sciacchitano S, Ferracuti S et al,, *"Monkeypox: What Do You Know about That?" Italian Adults' Awareness of a New Epidemic. Pathogens 11:1285. doi:10.3390/pathogens11111285.* 2022.
57. Choudhry, N.K., Fletcher, R.H., Soumerai, S.B.,, *Systematic review: the relationship between clinical experience and quality of health care.* Ann. Intern. Med, 2005(142): p. 260–273.
58. WHO, *Clinical management and infection prevention and control guideline;* https://iris.who.int/bitstream/handle/10665/355798/WHO-MPX-Clinical_and_IPC-2022.1-eng.pdf?sequence=1. 2022

Figure 1: Map of Amhara region and hospitals sample taken about confidence level of mpox disease at health care workers, Northwest Ethiopia, 2022.

Figure 1: HCWs confidence level in diagnosing and management of mpox disease in Hospitals in Amhara region, northwest Ethiopia, 2022.

Figure 3: HCWs knowledge on questions related to the diagnosing, management, prevention and control of mpox disease in Hospitals in Amhara region, northwest Ethiopia, 2022.

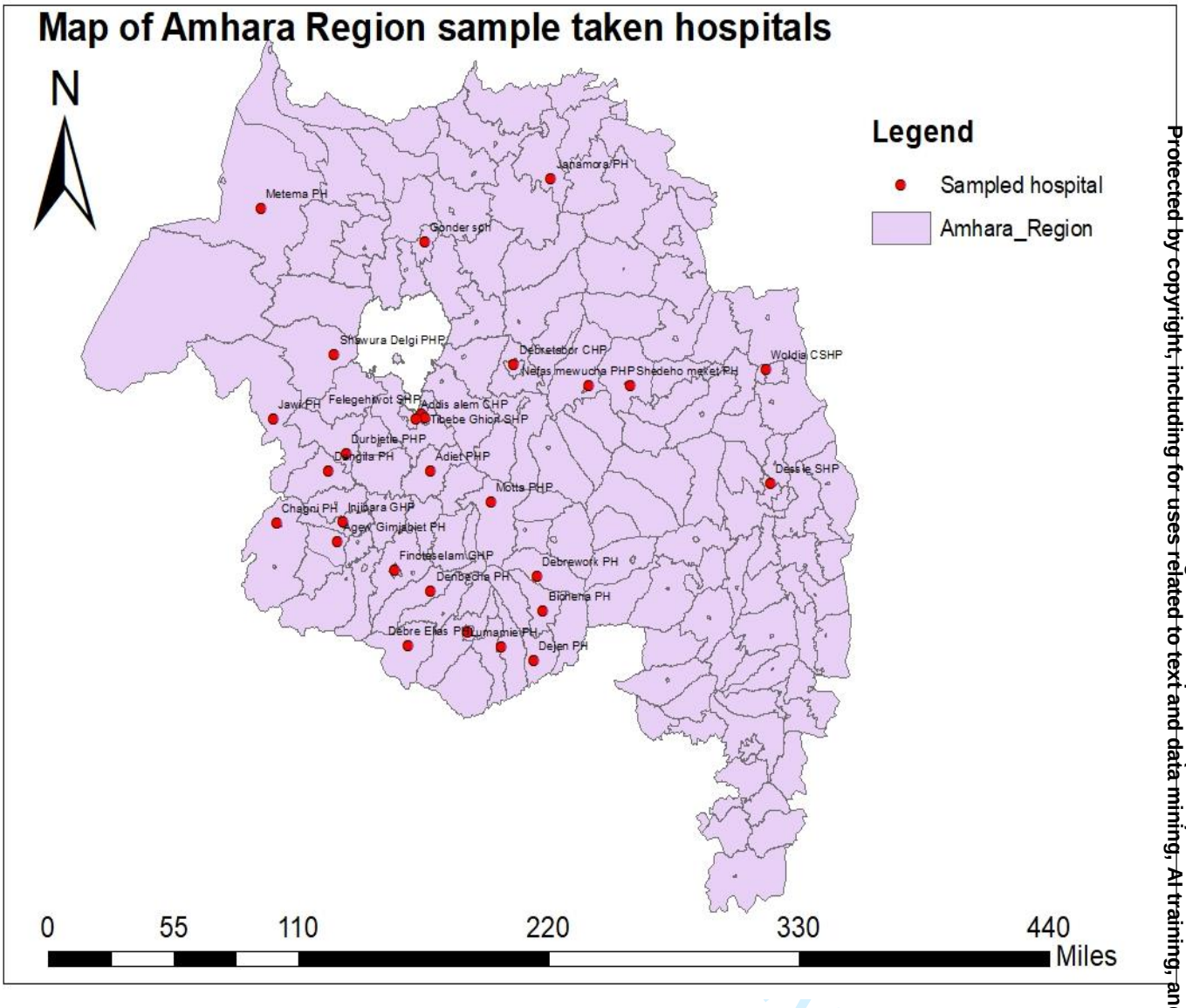
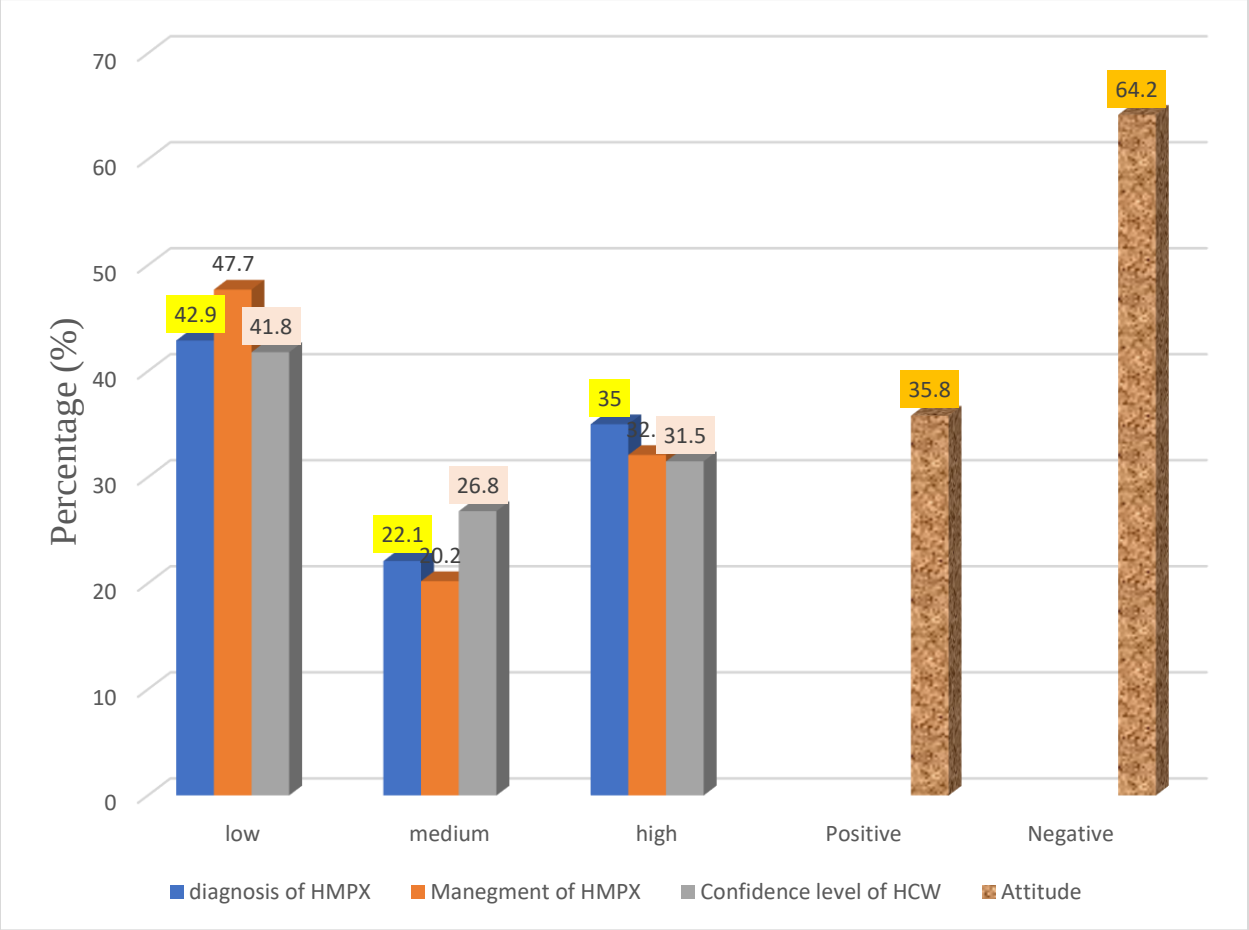


Figure 1: Map of Amhara region and hospitals sample taken about confidence level of mpox disease at health care workers, Northwest Ethiopia, 2022.



Note: HMPX- human monkeypox virus, HCW- health care worker

Figure 1: HCWs confidence level in diagnosing and management of mpox disease in Hospitals in Amhara region, northwest Ethiopia, 2022.

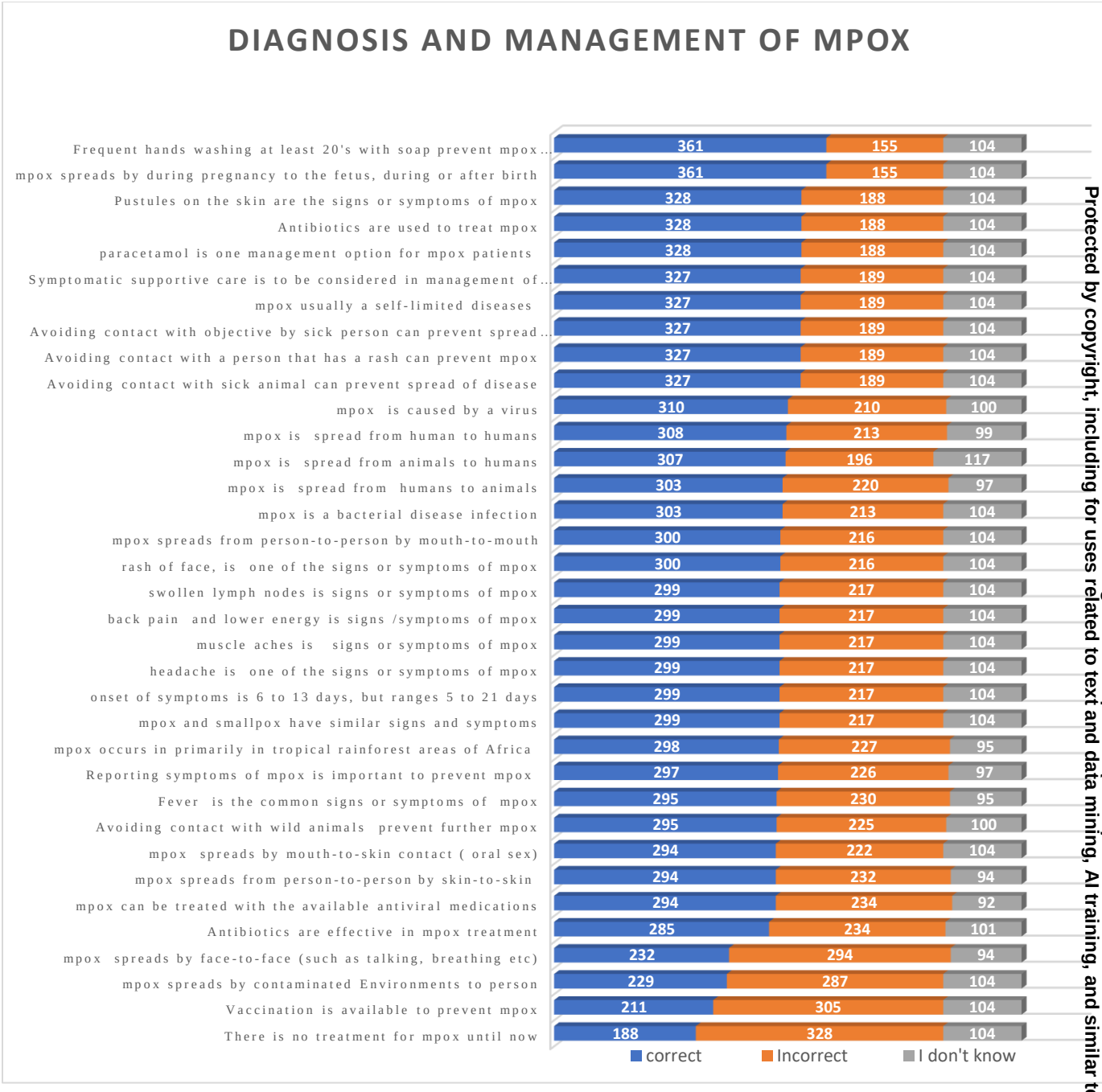


Figure 3: HCWs knowledge on questions related to the diagnosing, management, prevention and control of mpox disease in Hospitals in Amhara region, northwest Ethiopia, 2022.

Content validity format

Title of the tools validated: Assessing healthcare workers' confidence levels in diagnosis and management of emerging infectious virus of human monkeypox at Amhara Region.

Dear experts!!

We beseech your expert opinion and on the degree of relevance of each item being measured. This instrument will be used to our study entitled "Assessing healthcare workers' confidence levels in diagnosis and management of emerging infectious virus of human monkeypox at Amhara Region".

This instrument are provided below to guide you in your analysis. Please use the following rating scales and rate each item as objective as possible in your view.

Degree of relevance

1= the item is not relevant for measured outcome.

2= the item is somewhat relevant for measured outcome

3= the item is relevant for measured outcome

4= the item is highly relevant for measured outcome

C					
S.No	**Questionaries**	Not relevant (1)	Somewhat relevant (2)	Relevant (3)	Highly relevant (4)
	Diagnosis related questions of mpox				
1	Does Monkeypox is spread from animals to humans				
2	Does Monkeypox is caused by a virus				
3	Does Monkeypox is spread from human to humans				
4	Does Monkeypox is spread from humans to animals				

5	Monkeypox occurs in primarily in tropical rainforest areas of Africa and is occasionally exported to other region				
6	Does monkeypox spreads from person-to-person by skin-to-skin (such as touching or vaginal/anal sex)				
7	Does monkeypox spreads from person-to-person by Close contact or face-to-face (such as talking, breathing or singing close to one another which can generate droplets or short-range aerosols)				
8	Does monkeypox spreads from person-to-person by mouth-to-skin contact (such as oral sex or kissing the skin)				
9	Reporting symptoms of Monkeypox to local health authorities is important to prevent further disease transmission				
10	Avoiding contact with wild animals (alive or dead) essential to prevent further monkeypox transmission				
11	Fever is the common signs or symptoms of human monkeypox				
12	Does monkeypox spreads by contaminated environment from person-to-person with the monkeypox virus:				
13	Monkeypox is a bacterial disease infection				
14	Monkeypox and smallpox have similar signs and symptoms				
15	The interval from infection to onset of symptoms is usually from 6 to 13 days but can range from 5 to 21 days				

16	headache is one of the signs or symptoms of human monkeypox				
17	muscle aches is one of the signs or symptoms of human monkeypox				
18	back pain and lower energy is one of the signs or symptoms of human monkeypox				
19	swollen lymph nodes is one of the signs or symptoms of human monkeypox				
20	rash of face, palms of the hands, soles of the feet, groin, genital and/or anal regions is one of the signs or symptoms of human monkeypox				
21	Does monkeypox spreads from person-to-person by mouth-to-mouth (such as kissing)				
22	Does monkeypox spreads from person-to-person by the virus can also spread during pregnancy to the fetus, during or after birth				
23	Frequent hands washing for at least 20 s with soap and water or alcohol based hand sanitizers is essential to prevent further monkeypox transmission				
24	Pustules on the skin are one of the signs or symptoms of human Monkeypox				
25	Avoiding contact with any objectives that have been in contact with sick animal can prevent spread of disease				
26	Avoiding contact with any person that has a rash can prevent spread of disease				

27	Avoiding contact with any objective that has been in contact with sick person can prevent spread of disease				
28	Monkeypox usually a self-limited disease with the symptoms lasting from 2 to 4 weeks				
	Management related questions of mpox				
1	Monkeypox can be treated with the available antiviral medications				
2	Antibiotics are effective in monkeypox treatment				
3	Vaccination is available to prevent human monkeypox				
4	Symptomatic supportive care is to be considered in the management of Monkeypox disease				
5	One management option for monkeypox patients who are symptomatic is to use paracetamol				
6	Antibiotics are used to treat human monkeypox				
7	There is no treatment for monkeypox until now				
	Preparedness related questions of mpox				
1	Diagnose monkeypox virus based on your current status?				
2	Diagnoses monkeypox virus based your current facility diagnostic test?				
3	Do you manage monkey poxvirus cases, in this situation?				

4	Does rapid response team (RRT) ready to manage unusual events like monkeypox virus cases, in this situation?				
5	Do you participate rapid response team (RRT) activities to manage unusual events like monkeypox virus?				
6	Do you face public health threatening events like COVID-19 in the previous working time that helps to cope the current and future emerging events like manage monkeypox virus?				
7	is there any strong triage room in your health facility to diagnose unusual events				
8	Is there enough medical equipment to manage monkeypox cases?				
9	Do you manage monkeypox cases, based on your facility medication commodities				
	Attitude related questions of mpox				
1	Monkeypox spread worldwide due to the role of male homosexuals				
2	I am skeptical about the official explanation regarding the cause of virus emergence				
3	I do not trust the information about the viruses from scientific experts				
4	I do not trust the information about the viruses from scientific experts				
5	The spread of viruses is a deliberate attempt to reduce the size of the global population				

6	The spread of viruses is a deliberate attempt by governments to gain political control				
7	The spread of viruses is a deliberate attempt by global companies to take control				
8	Lockdowns in response to emerging infection are aimed for mass surveillance and to control every aspect of our lives				
9	Lockdowns in response to emerging infection are aimed for mass surveillance and to destabilize the economy for financial gain				
10	Lockdown is a way to terrify, isolate, and demoralize a society as a whole in order to reshape society to fit specific interests				
11	Viruses are biological weapons manufactured by the superpowers to take global control				
12	The mainstream media is deliberately feeding us misinformation about the virus and lockdown				
13	Monkeypox was a plot by globalists to destroy religion by banning gatherings				

Name and signature of experts---------- date----------

No	Questionaries	Exp1	Exp2	Exp3	Exp4	Exp5	Exp6	Number of agreements	Item content validity ratio (I-CVR)	UA
Part-1	**Diagnosis related questions**									
1	Does Monkeypox is spread from animals to humans	4	3	3	3	4	4	6	1	6
2	Does Monkeypox is caused by a virus	4	4	4	4	4	4	6	1	6
3	Does Monkeypox is spread from human to humans	4	4	3	3	4	4	6	1	6
4	Does Monkeypox is spread from humans to animals	4	3	2	4	4	4	5	0.8333333	5
5	Monkeypox occurs in primarily in tropical rainforest areas of Africa and is occasionally exported to another region	2	4	4	4	3	4	5	0.8333333	5
6	Does monkeypox spreads from person-to-person by skin-to-skin (such as touching or vaginal/anal sex)	4	4	4	3	4	4	6	1	6
7	Does monkeypox spreads from person-to-person by Close contact or face-to-face (such as talking, breathing or singing close to one another which can generate droplets or short-range aerosols)	3	4	3	4	4	4	6	1	6
8	Does monkeypox spreads from person-to-person by mouth-to-skin contact (such as oral sex or kissing the skin)	4	4	3	3	4	4	6	1	6

9	Reporting symptoms of Monkeypox to local health authorities is important to prevent further disease transmission	4	4	2	4	4	4	5	0.8333333	5
10	Avoiding contact with wild animals (alive or dead) essential to prevent further monkeypox transmission	4	2	4	4	4	4	5	0.8333333	5
11	Fever is the common signs or symptoms of human monkeypox	4	4	4	4	4	4	6	1	6
12	Does monkeypox spreads by contaminated environment from person-to-person with the monkeypox virus:	4	3	4	4	4	4	6	1	6
13	Monkeypox is a bacterial disease infection	4	2	4	4	4	3	5	0.8333333	5
14	Monkeypox and smallpox have similar signs and symptoms	4	4	4	4	4	4	6	1	6
15	The interval from infection to onset of symptoms is usually from 6 to 13 days but can range from 5 to 21 days	4	3	3	2	4	4	5	0.8333333	5
16	headache is one of the signs or symptoms of human monkeypox	4	4	4	4	3	4	6	1	6
17	muscle aches is one of the signs or symptoms of human monkeypox	4	4	4	4	4	4	6	1	6
18	back pain and lower energy is one of the signs or symptoms of human monkeypox	4	4	3	4	4	4	6	1	6
19	swollen lymph nodes is one of the signs or symptoms of human monkeypox	4	4	4	4	4	4	6	1	6

20	rash of face, palms of the hands, soles of the feet, groin, genital and/or anal regions is one of the signs or symptoms of human monkeypox	4	4	2	4	4	4	5	0.8333333	5
21	Does monkeypox spreads from person-to-person by mouth-to-mouth (such as kissing)	4	4	4	4	4	4	6	1	6
22	Does monkeypox spreads from person-to-person by the virus can also spread during pregnancy to the fetus, during or after birth	4	4	4	4	4	3	6	1	6
23	Frequent hands washing for at least 20 s with soap and water or alcohol-based hand sanitizers is essential to prevent further monkeypox transmission	4	4	4	4	4	4	6	1	6
24	Pustules on the skin are one of the signs or symptoms of human Monkeypox	4	2	4	4	3	4	5	0.8333333	5
25	Avoiding contact with any objectives that have been in contact with sick animal can prevent spread of disease	4	4	4	4	4	4	6	1	6
26	Avoiding contact with any person that has a rash can prevent spread of disease	4	4	3	4	4	4	6	1	6
27	Avoiding contact with any objective that has been in contact with sick person can prevent spread of disease	4	4	4	4	3	4	6	1	6

28	Monkeypox usually a self-limited disease with the symptoms lasting from 2 to 4 weeks	4	4	4	4	4	4	6	1	6
Part-2	**Management related question**									
1	Monkeypox can be treated with the available antiviral medications	4	4	4	4	4	4	6	1	6
2	Antibiotics are effective in monkeypox treatment	4	4	4	4	4	4	6	1	6
3	Vaccination is available to prevent human monkeypox	4	4	4	4	4	4	6	1	6
4	Symptomatic supportive care is to be considered in the management of Monkeypox disease	4	4	4	4	3	4	6	1	6
5	One management option for monkeypox patients who are symptomatic is to use paracetamol	4	4	4	4	4	4	6	1	6
6	Antibiotics are used to treat human monkeypox	4	4	4	3	4	3	6	1	6
7	There is no treatment for monkeypox until now	4	4	4	4	4	4	6	1	6
Part-3	**Preparedness related question**									
1	Diagnose monkeypox virus based on your current status?	4	4	4	4	3	4	6	1	6
2	Diagnoses monkeypox virus based your current facility diagnostic test?	4	4	4	4	2	4	5	0.8333333	5
3	Do you manage monkey poxvirus cases, in this situation?	4	4	4	4	4	4	6	1	6

4	Does rapid response team (RRT) ready to manage unusual events like monkeypox virus cases, in this situation?	4	4	4	4	2	4	5	0.8333333	5
5	Do you participate rapid response team (RRT) activities to manage unusual events like monkeypox virus?	4	4	4	4	4	4	6	1	6
6	Do you face public health threatening events like COVID-19 in the previous working time that helps to cope the current and future emerging events like manage monkeypox virus?	4	4	4	4	4	4	6	1	6
7	is there any strong triage room in your health facility to diagnose unusual events	4	4	4	4	4	3	6	1	6
8	Is there enough medical equipment to manage monkeypox cases?	4	4	4	4	3	4	6	1	6
9	Do you manage monkeypox cases, based on your facility medication commodities	4	4	4	4	4	4	6	1	6
Part-4	**Attitude related questions**									
1	Monkeypox spread worldwide due to the role of male homosexuals	4	4	4	4	4	4	6	1	6
2	I am skeptical about the official explanation regarding the cause of virus emergence	4	4	4	4	2	4	5	0.8333333	5

3	I do not trust the information about the viruses from scientific experts	4	4	4	4	4	4	6	1	6
4	I do not trust the information about the viruses from scientific experts	4	4	4	4	4	3	6	1	6
5	The spread of viruses is a deliberate attempt to reduce the size of the global population	4	4	4	4	3	4	6	1	6
6	The spread of viruses is a deliberate attempt by governments to gain political control	4	4	4	4	4	4	6	1	6
7	The spread of viruses is a deliberate attempt by global companies to take control	4	4	4	4	4	4	6	1	6
8	Lockdowns in response to emerging infection are aimed for mass surveillance and to control every aspect of our lives	4	4	4	2	4	4	5	0.8333333	6
9	Lockdowns in response to emerging infection are aimed for mass surveillance and to destabilize the economy for financial gain	4	4	3	4	4	4	6	1	6
10	Lockdown is a way to terrify, isolate, and demoralize a society as a whole in order to reshape society to fit specific interests	4	3	2	4	4	4	5	0.8333333	6
11	Viruses are biological weapons manufactured by the superpowers to take global control	4	4	4	4	4	3	6	1	6
12	The mainstream media is deliberately feeding us misinformation about				4	4	4	6	1	6

	the virus and lockdown	4	4	4						
13	Monkeypox was a plot by globalists to destroy religion by banning gatherings	4	4	4	4	3	4	6	1	
	Totall	**225**	**217**	**212**	**219**	**213**	**222**	**329**	**54.8333333**	**3**
	Proportion of relevance	0.99	1	0.9	1	0.93	1	0.962	0.96199	
	Average proportion of items judged as relevance across the 6 experts								0.9561	

Calculated content validity ratio part by part

Diagnosis related Questions	**Score**		**Management related Questions**	**Score**
SUM of (I-CVI)	26.66666667		SUM of (I-CVI)	7
S-CVI Average (sum of I-CVI/No of questions)	0.952380952		S-CVI Average (sum of I-CVI/No of questions)	1
Total universal agreement	160		Total universal agreement	42
UA = Total agreement/ No. Items	0.952380952		UA = Total agreement/ No. Items	1
S-CVI Relevance (sum of UA/ Number of questions	0.952380952		S-CVI Relevance (sum of UA/ Number of questions	1

For Knowledge	**Score**		**Preparedness related Questions**	**Score**
SUM of (I-CVI)	33.66667		SUM of (I-CVI)	8.6667
S-CVI Average (sum of I-CVI/No of questions)	0.961905		S-CVI Average (sum of I-CVI/No of questions)	0.963
Total universal agreement	202		Total universal agreement	52

UA = Total agreement/ No. Items	0.961905		UA = Total agreement/ No. Items	0.963
S-CVI Relevance (sum of UA/ Number of questions	0.961905		S-CVI Relevance (sum of UA/ Number of questions	0.963

For Confidence level	**Score**		**Attitude related Questions**	**Score**
SUM of (I-CVI)	42.33333333		SUM of (I-CVI)	11.5
S-CVI Average (sum of I-CVI/No of questions)	0.962121212		S-CVI Average (sum of I-CVI/No of questions)	0.884615
Total universal agreement	254		Total universal agreement	69
UA = Total agreement/ No. Items	0.962121212		UA = Total agreement/ No. Items	0.884615
S-CVI Relevance (sum of UA/ Number of questions	0.962121212		S-CVI Relevance (sum of UA/ Number of questions	0.884615

The overall the questionnaire CVR	
SUM of (I-CVI)	54.83333333
S-CVI Average (sum of I-CVI/No of questions)	0.961988304
Total universal agreement	329
UA = Total agreement/ No. Items	0.961988304
S-CVI Relevance (sum of UA/ Number of questions	0.961988304
Legends:	
CVI = content validity index	
I-CVI = Item- content validity index	
S-CVI = Scale - content validity index	
UA = universal agreement	
UA = Total agreement/ No. Items	
I-CV = Number of agreement (per item) / Number of experts	
S-CVI = I-CVI/Number of items	
recorded for at least six= 0.8333	

STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	Recommendation	Page No
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1, 3, &4
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	1, 3, &4
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	6, 7 & 8
Objectives	3	State specific objectives, including any prespecified hypotheses	
Methods			
Study design	4	Present key elements of study design early in the paper	9
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	9
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	9
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	11
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	*10*
Bias	9	Describe any efforts to address potential sources of bias	12
Study size	10	Explain how the study size was arrived at	10
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	10
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	13
		(*b*) Describe any methods used to examine subgroups and interactions	13
		(*c*) Explain how missing data were addressed	13
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	13
		(*e*) Describe any sensitivity analyses	
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	13
		(b) Give reasons for non-participation at each stage	13
		(c) Consider use of a flow diagram	
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	14 &15
		(b) Indicate number of participants with missing data for each variable of interest	14 & 15
Outcome data	15*	Report numbers of outcome events or summary measures	15,16,17 & 18

Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	15,16,17 & 18
		(*b*) Report category boundaries when continuous variables were categorized	15,16,17 & 18
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	15,16,17 & 18
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	
Discussion			
Key results	18	Summarise key results with reference to study objectives	19, 20 &21
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	19, 20 &21
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	19, 20 &21
Generalisability	21	Discuss the generalisability (external validity) of the study results	19, 20 &21
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	23

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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Assessing healthcare workers' confidence level in diagnosis and management of emerging infectious virus of human monkeypox in Hospitals in Amhara Region, Northwest Ethiopia. Multicentered institution based cross-sectional study.

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ABSTRACT

Objective: To assess the healthcare workers' (HCWs) confidence level in diagnosing and managing monkeypox (mpox) disease and its associated factors in hospitals in Amhara Region.

Design: Institution-based cross-sectional study

Setting: Hospitals in Amhara region, Northwest Ethiopia.

Participants: A total of 640 HCWs, with a response rate of 96.9%, were participated from October 1- 30 December**,** 2022. A multistage stratified random sampling technique with proportional allocation was used to recruit study participants. Data were collected using the KoboCollect toolbox and exported to STATA Version-17 for analysis. Descriptive statistics were used to describe data. Ordinal logistic regression analysis was used to identify predictors of confidence level to diagnose and manage mpox at $p<0.05$.

Primary outcome: HCWs confidence level in diagnosing and managing mpox disease and its associated factors.

Results: The overall proportion of HCWs who had high confidence level in diagnosis and managing mpox disease was found to be 31.5%[95% CI: 27.9%, 35.2%]. Similarly, 26.8%[95% CI: 23.2%, 30.3%] and 41.8%[95% CI: 38.1%, 45.4%] of HCWs expressed medium and low confidence level to diagnose and manage the disease, respectively. The odds of higher confidence versus lower or medium confidence level in diagnosing and managing mpox were greater for HCWs who regularly visit amenable websites(AOR = 1.59, 95% CI: 1.16, 2.2), were physicians(AOR = 1.9, 95% CI: 1.32, 2.73), aged 30–35 years old(AOR = 1.64, 95% CI: 1.12, 2.39), had got PHEM training(AOR = 2.8, 95% CI: 1.94, 4.04), and had positive attitudes(AOR = 1.72, 95% CI: 1.26, 2.36) compared to their counterparts.

Conclusion: The overall HCWs confidence level in diagnosis and management of mpox disease in the study area was low. Therefore, the HCWs should be regularly updated about mpox disease through morning sessions and trainings on the diagnosis and clinical management mpox disease including infection prevention and control (IPC) of mpox.

Keywords: Healthcare worker, confidence level, human mpox, Amhara region.

Strengths and limitations of the study

- This study has used relatively a larger sample size, which increases the study' power and generalizability of its findings.
- The study has also employed multivariate ordinal logistic regression analysis to control the effect of confounders.
- The possibility of social desirability bias, such as some respondents i.e. physicians, might give positive responses that was not actually true and recall bias such as remembering frequency of handwashing, were the limitations of this study.

Introduction

Monkeypox is an illness caused by the monkeypox (mpox) virus, a double-stranded Deoxyribonucleic Acid (DNA) virus belonging to the genus *Orthopoxvirus* within the Poxviridae family, almost similar to variola virus responsible for smallpox[1, 2]. The mpox disease is originally a viral zoonotic infection that spreads from animals to humans. However, human to other human and environment to human transmissions were also evident recently [3, 4]. The genetic changes of virus over time enhanced its ability to infect different species and adapt to new environments. Furthermore, the zoonotic spillover of mpox has also provided the virus to jump from animals to humans and raised concerns about the potential for increased virulence or the emergence of more transmissible strains in the future [5].

The mpox virus was first isolated from monkeys in laboratories in Copenhagen, Denmark in 1958 [6, 7] and the first human case, 9-month-old child patient, was identified in Democratic Republic of Congo (DRC) in 1970 [8]. The first mpox outbreak outside Africa was documented in the USA in 2003 after an infected rodent species imported from West Africa [9]. Since then, there was sporadic occurrence of mpox outbreaks in endemic regions in Africa. The problem is particularly severe in the DRC, the country where a survey research revealed that of 77 suspected cases spread across 138 homes, 27.3% of PCR tests were positive for monkeypox, the largest recorded number of cases (882) and deaths (2) are documented [10]. Moreover, the Nigerian mpox outbreak in 2017 leads to the spread of the disease to the United Kingdom and elsewhere in Europe followed by dramatic increase in the number of monkeypox infections and we now face a period of multiple outbreaks in countries without clear epidemiological links to endemic countries [11, 12].

As of December 30, 2023, approximately 92,783 confirmed cases and 660 probable cases, including 171 deaths, have been reported across 116 countries since January 1, 2022. Notably,

nearly 98% of cases and 88% of deaths were reported from countries that have not historically reported mpox.

[13, 14]. The case-fatality-ratio (CFR) of Mpox is lower than that of smallpox [15], as its case fatality reaches 17% which is well below that of smallpox (25–40%) [16].

The Mpox disease is primarily a cutaneous illness with lymphadenopathy. It is transmitted through direct or indirect close contact with droplets, fomites, skin lesions, or contaminated body fluids[17-22]. Additionally, it can be transmitted through sexual intercourse and mother-to-fetus transmission [23, 24]. The Mpox disease is also self-limiting, with symptoms ranging from mild to severe. These symptoms include itchy to painful skin lesions, fever, generalized headache, fatigue, lymphadenopathy, back pain, and myalgia [22-24]. . The symptoms of mpox normally disappear after 14-21 days, following a 5-21 day incubation period [22, 25]. The most prominent clinical symptom of Mpox is a skin rash that typically appears up to three days after fever. However, in more severe cases, this rash can be observed throughout the body [26, 27].. Patients admitted to the hospital show clinical manifestations of complications such as s bacterial super-infection, dehydration, and respiratory distress [19, 28].

Several risk factors are linked to an increase in mpox outbreaks, including the interruption of smallpox vaccination, which leads to increased susceptibility to mpox infection, the extensive consumption of animals as a protein source, which are potential mpox virus reservoirs; increased population density; ease of travel; and ecological and environmental factors, such as clearing of tropical rainforests with an increased risk of exposure to reservoir animals [29-33].

Enhancing case definition, epidemiological, clinical, genomic, and molecular surveillance alone is not enough to prevent Mpox pandemics. Instead, it requires integrated health promotion or

education, as well as announcing or implementing prevention mechanisms. These measures are critical for disease control [34].

Based on these global efforts, effective and safe vaccines are ongoing, with licenses being used in countries such as the United Kingdom, Canada, and USA for high-risk populations. Moreover, basic public health interventions, such as the use of personal protective equipment (PPE), practicing good hand hygiene, immediate case isolation, contact tracing, and avoiding contact with infected animals or materials, are effective means of controlling the spread of human monkeypox [35, 36]. Similar to communities, healthcare workers should practice strict use of PPE such as wearing well-fitted N95 masks, gloves, and other PPE before any contact with a suspected case [37].

The HCWs confidence level in diagnosing and managing mpox disease is challenging due to inadequate capacity to diagnose and clinically manage patients and to identify exposure accurately[38]. Moreover, the Orthopoxvirus testing capacity in endemic areas in Africa is reported to be very low [38]. Therefore, the rapid increase in mpox pandemics calls investigations on the HCWs' knowledge, confidence, and attitude towards their ability to diagnose and manage mpox patients [12, 35], which is the primary role of healthcare professionals in responding the ongoing mpox pandemic [39-41].

Ethiopia, as the third most populous country in Africa, is at risk of the Mpox virus, along with other countries in the Horn of Africa. Sudan, which shares its border with the Amhara Region in Northwest Ethiopia, has reported 19 Mpox cases and 1 death since August 2022, [13, 14].

The continued political instabilities and unrest in Sudan forced civilians to migrate into Ethiopia through the border of Metema, West Amhara Region. Moreover, the current political instability in Amhara Region also deteriorates the capacity of healthcare facilities, which makes testing of

Orthopoxvirus very difficult. Considering such scenarios, assessing the HCWs' confidence level in diagnosis and management of mpox at Amhara Region will have paramount importance. Therefore, the aim of this study is to assess HCWs' confidence level in diagnosis and management of emerging infectious viruses of mpox in hospitals in Amhara region, Northwest Ethiopia.

Methods

Study design, setting and period

An institution-based cross-sectional study was conducted in hospitals found in the Amhara region, Northwest Ethiopia from 1 October to 30 December 2022. Bahir Dar city is the capital city of Amhara Region, which is located at 575 km in the Northwest direction of Addis Ababa, the capital city of Ethiopia. It is also located at 340 km from Metema, which is a border route to Sudan. The Region has 15 zones and 98 public hospitals (eight comprehensively specialized, 20 generals, and 69 primary) (Figure 1).

Source and study population

All HCWs working in public hospitals in the Amhara region were taken as the source population, and those HCWs working in randomly selected public hospitals were considered as the study population.

Inclusion and exclusion criteria

All HCWs working in public hospitals in the Amhara region were included in this study; however, those HCWs who are not available during data collection and who are on annual/maternal leave were excluded from the study.

Patient and Public Involvement

None or there is no involvement of patients and/or the health care workers in the design, or conduct, or reporting or dissemination plans of this research.

Sample size determination

The minimum sample size that represents the source population was estimated considering the single population proportion formula with the following assumptions; 95% confidence interval Power (β = 80%), Proportion of HCWs confidence level in diagnosing and managing mpox patients (P = 50%), considering no previous study in Ethiopia [42], standard normal distribution($Z_{a/2}$= 1.96), margin of error (d=5%) and design effect(1.5). Therefore, the final adequate sample size including 10% non-response rate was 640 HCWs.

Sampling procedure and technique

A multistage stratified random sampling was employed to select HCWs working in hospitals in Amhara Region. Twenty-eight hospitals (9 from general and comprehensive specialized hospitals (CSHPs), and 19 from primary hospitals), representing 28.6 % of the total hospitals in the Region, were selected randomly. The sample size was proportionally allocated to each selected hospital and similarly to each professional stratification. Finally, the healthcare workers who provided their responses in the data collection were selected using simple random sampling.

Variables

The dependent variable was HCWs' confidence level in diagnosing and managing mpox disease (categorized as poor, medium, or high confidence). The independent variables included the socio-demographic characteristics such as age, residence, marital status, and level of education,

professional category and years of experience. The independent variables also included some personal behaviors such as the knowledge and attitude about mpox disease, previous training exposure on public health emergency epidemic disease management (PHEM), habit of regular participation in the morning session and the habit of visiting websites of WHO, CDC, and other websites.

Operational definitions

HCWs confidence level: A total of 44 questions (9 related to preparedness, 28 related to diagnoses, 7 related to management of mpox disease) were used to measure HCWs confidence level. Each questions had three responses, 'Yes coded as +1', 'No coded as 0' and 'I do not know coded as – 1'. The responses from each respondents were summed and the percentage score of ≥80% labeled as higher confidence, 50–79% labeled as medium confidence and <50% labeled as poor confidence level[43, 44].

Knowledge: The knowledge score was calculated from 35 questions (28 related to diagnosis and 7 related to management of mpox disease) with three responses, 'Yes coded as +1', 'No coded as 0' and 'I do not know coded as – 1'. The percentage of knowledge score for each respondents categorized in to three labels: Percentage of knowledge scores, <50% was labeled as less-knowledgeable, 50%-79% was labeled as moderately knowledgeable and ≥80% was labeled as knowledgeable [18, 44].

Attitude: The HCWs' attitude was assessed using 7-point Likert scale 14 questions (strongly disagree (1), disagree (2), somewhat disagree (3), neutral/no opinion (4), somewhat agree (5), agree (6), and strongly agree (7). The sum of their responses was calculated as attitude score

between 14 and 98. Then those HCWs who scored less than 70% were considered to have negative attitude and those who scored ≥70% were considered to have positive attitude [43].

Validity and reliability of the questionnaire

The tool's validity and reliability were also assessed. The degree to which all items in the questionnaire reflect the contents to which the instrument will be generalized was assessed using reliability and validity tests. Five general practitioners (GPs) reviewed the questionnaires. The content validity ratio (CVR) formula, CVR = (Ne-n/2) /(n/2), was used to determine whether the questionnaires were relevant, needed revision or were removed [45]. The CVR scored of diagnosis, management and preparedness questionnaires were 0.952, 1.00, and 0.963 respectively. Besides the CVR scored for knowledge, attitude and confidence level were 0.9619, 0.8815 and 0.9619 respectively (Supplementary file 1 and 2). The instrument has an overall Cronbach's Alpha coefficient value of 0.846, which is used to evaluate the questionnaire's consistency across all items.

Data collection tools and procedure

Data were collected using a structured questionnaire, which was prepared after reviewing previous studies conducted for similar purposes [46-51]. The questionnaire was developed in English, then translated into Amharic (local language), then back to English to ensure its consistency. The questionnaire contained sociodemographic characteristics and habit-related factors of the healthcare workers. Data collection was conducted, using KoboCollect (version 2022.4.4) twenty-nine by general practitioners (GP) and five master's holder health professionals were recruited to manage the data collection processes.

Data quality assurance

Data quality was assured using a properly designed questionnaire adapted from literatures. Training was provided for both data collectors and supervisors on the purpose of the study, data collection techniques, and tools by the principal investigators for two days. The data collectors pre-tested the questionnaires, on 5% of the sample size at Injebara Health Center where the study was not undertaken, and necessary amendments were taken based on the findings of the pre-test. Every day after data collection, the principal investigator reviewed the questionnaires to ensure the completeness of each response. The principal investigator and supervisor closely monitored the data-collection process.

Data management and analysis

Data were exported to STATA version 17 from the KoboCollect data collection toolbox. Data were cleaned (categorization for continuous variables and re-categorization for categorical variables) and descriptive statistics such as frequency distribution tables, means, and standard deviations were computed to describe the data. Bivariate and multivariable ordinal logistic regressions were used to identify predictors of HCWs' confidence level in diagnosing and managing mpox disease. The proportional odds assumption was checked (chi^2 P-value = 0.054) to evaluate the distance between each category of the outcome was equivalent or not. The two cut of points, cut1= 0.8603 and cut2 = 2.083, was estimated to see the inherently ordered distances between low, medium and high confidence level in diagnosing and management mpox disease. A p-value < 0.25 was used as criteria during bivariate analysis to retain variables for the multivariable ordinal logistic regression model. Crude and adjusted odds ratios with 95% confidence interval were calculated to measure the degree of association between independent variables and HCWs' confidence level in diagnosing and managing mpox disease. A p-value < 0.05 was considered as a level of statistical significance in multivariable ordinal logistic regression analysis.

Results

Socio-demographic characteristics of HCWs

Six hundred twenty HCWs (with a response rate of 96.9%) gave a complete response. The majority 312 (50.3%) of HCWs were Orthodox Christian followers. Similarly, 63.9% of the HCWs had more than five years of experience. The mean (±SD) age of the HCWs was 31.67 (±5.355) years old and 432 (69.7%) of them were male. Only 153 (24.7%) HCWs had gotten public health emergency training (PHEM) from governmental and non-governmental organizations, (NGO), (Table 1).

Table 1: The HCWs confidence level in diagnosis and management of mpox disease in Hospitals in Amhara region, Northwest Ethiopia, 2022.

Characteristics	Confidence levels of HCW				
	Low confidence	Medium confidence	High confidence	X^2	P-value
Religion of HCW					
Orthodox	136	79	97	4.047	0.670
Muslim	70	49	52		
Protestant	36	30	29		
Others*	17	8	17		
Visiting (WHO, CDC and other amenable websites)					
No	189	104	121	7.718	0.021
Yes	70	62	74		
Occupational category					
Physician	50	29	63	14.442	0.001
Nurse and others**	209	137	132		
Year of experience					
< 5 years	100	57	67	1.187	0.553
>5 years	159	109	128		

Working hospital					
working CSPH	177	108	132	0.518	0.772
primary hospital	82	58	63		
Sex					
Male	179	118	140	0.424	0.809
Female	80	48	55		
Participate morning session					
No	142	74	96	4.385	0.112
Yes	117	92	99		
PHEM training					
No	215	135	117	36.086	0.001
Yes	44	31	78		
Age of HCW					
<30 years	142	86	83	9.691	0.046
30-35 years	49	38	59		
> 35 years	68	42	53		
The Highest level of formal education					
Diploma	22	20	21	5.923	0.432
Degree	184	119	126		
masters (MPH/MSC)	30	13	24		
Specialist	23	14	24		
HCWs Profession					
Pharmacist	26	12	12	40.79	0.197
Nurse	86	66	55		
health officer	20	16	11		
Midwife	40	22	26		
General practitioner	23	19	29		
Laboratory professional	15	11	7		
Anastasia	7	6	10		
Environmental health	7	2	4		
Gynecologist	4	3	4		
Internist	7	5	11		
IESPS	5	0	6		
Surgeon	5	2	10		
Neurologist	1	0	1		
Ophthalmologist	1	0	1		
Dentist	2	0	0		
Radiologist	2	0	1		
Ophthalmic nurse	1	0	3		
Others****	7	2	4		
Attitude					
Negative attitude	239	113	46	11.37	0.003
Positive attitude	122	72	28		

Note: other-** (health officer, midwife, Laboratory professional, Environmental health, pharmacist and Dentist), **Specialist*-** gynecologist, Internist, Surgeon, Neurologist, Ophthalmologist, Dentist, Radiologist. **Others*- Catholic, Jobha, etc.,** Others****- **Others***- psychiatric, nurse, neurology. **Physician-** GP and any specialist doctors.

HCWs confidence level in diagnosis and management of mpox

The overall proportion of HCWs who had high confidence level in diagnosis and management of mpox disease was found to be 31.5% [95% CI: 27.9%, 35.2%]. Similarly, 26.8% [95% CI: 23.2%, 30.3%] and 41.8% [95% CI: 38.1%, 45.4%] of HCWs expressed medium and low confidence level in their ability to diagnose and manage mpox disease, respectively. Aside from that, 22.1% [95% CI: 19.0%, 25.5%] of HCWs had higher confidence level in diagnosis and 20.2% [95% CI: 17.2%, 23.4%] of them had higher confidence level in management of mpox disease (Figure 2).

HCWs knowledge and attitude towards mpox

Although about 41.7% [95% CI: 37.9%, 45.8%] of HCWs were less knowledgeable, more than half 361(58.2%) of them responded that mpox virus is prevented by frequent hand washing for at least 20 s with soap and water or alcohol. Similarly, beyond half 328(52.9%) of them responded that antibiotics can be used to treat mpox disease. However, only 36.9% of HCWs had knowledge on contaminated environment-to-person transmissions of mpox and 34.3% of them responded that mpox is a bacterial disease. About 44.4% of physicians and only 27.6% of nurses and other professionals had higher knowledge about mpox (Figure 3).

Regarding the HCWs attitude towards mpox, only 35.8% [95% CI: 32.3, 39.6] of them had positive attitude leaving the majority 64.2 % [95% CI: 60.4, 67.7] of the HCWs with negative attitude. Higher percentage (42.3%) of physicians had positive attitude towards mpox virus compared to nurses and other professionals (33.9%) (Figure 3).

Factors associated with HCWs confidence level in diagnosing and managing mpox disease

In binary ordinal logistic regression analysis, variables such as working hospital standards, sex, work experience, occupational category, regular participation in morning sessions, exposure PHEM training, attitude, visiting WHO, CDC, and other websites, and age group, were selected as candidate for multivariable ordinal logistic regression analysis. During the multivariable ordinal logistic regression analysis, variables such as positive attitude, aged 30 – 35 years old, professional category and habit of visiting the WHO, CDC, and other amenable websites were found to be significantly associated with the outcome variable.

The HCWs with a cut of point value ≤ 13.97% were classified as having a low confidence level, given that they were working in a primary hospital, being female, having < 5 years of work experience, being a nurse and other health professionals, not participating in a morning session, not receiving PHEM training, having a negative attitude, not visiting the WHO, CDC, and other websites, and aged < 30 years old as opposed to between 30–35 years. Similarly, the HCWs with a cut of point value ≥ 2.083 were classified as having a higher confidence level, given that the above variables were kept similar with their reference. Additionally, participants with a cut of point value between 0.8603 and 2.083 were considered to have medium confidence level where the independent variables were kept similar with their reference.

The odds of higher confidence level vs. lower or medium confidence level in diagnosing and managing mpox disease was 1.59 times (AOR = 1.596, 95% CI: 1.158, 2.198) higher for the HCWs who regularly visit the WHO, CDC, and other potential websites than those who do not visit the websites when other variables were kept constant. The odds of higher confidence vs. lower or

medium confidence level was 1.9 times (AOR = 1.899, 95% CI: 1.318, 2.734) higher for physicians in comparison to being nurses and other professionals when the other variables are kept constant. Similarly, the odds of higher versus lower or medium confidence level in managing and diagnosing mpox disease was 1.6 (AOR = 1.637, 95% CI: 1.118, 2.397) times greater for HCWs if their age is 30–35 years compared to less than 30 years old when the other variables were kept constant.

Moreover, the odds of higher versus lower or medium confidence level in managing and diagnosing mpox disease was 2.8 times (AOR = 2.799, 95% CI: 1.942, 4.035) greater for HCWs who had exposure PHEM training than their counterparts. Lastly, the odds of higher confidence level vs. lower or medium confidence level in managing and diagnosing mpox disease was 1.72 times (AOR = 1.724, 95% CI: 1.258, 2.362) greater for HCWs who had positive attitudes than their counterparts when the other variables were kept constant (Table 2).

Table 2: Multivariable ordinal logistic regression of factors associated with HCWs Confidence level in diagnosis and management of mpox disease in hospitals in Amhara Region, Northwest Ethiopia, 2022.

Characteristics	**Confidence levels of HCW**			**Std. Error**	**AOR [95% conf. interval]**	**P-value**
	Low	**Medium**	**High**			
visiting (WHO, CDC and other websites)						
No	189	104	121	1	1	
Yes	70	62	74	0. 261	1.596[1.158, 2.198]	0.004
Occupational category						
nurse and others*	209	137	132	1	1	
Physician	50	29	63	1.353	1.899[1.318, 2.734]	0.001
Year of experience						
< 5 years	100	57	67	1	1	
>5 years	159	109	128	0.212	1.297[0.94, 1.789]	0.113

Working hospital						
Primary	82	58	63	1	1	
working CSHP	177	108	132	0.165	0.989[0.714, 1.372]	0.950
Sex						
Female	80	48	55	1	1	
Male	179	118	140	0.187	1.096(0.783, 1.532)	0.594
Participate morning session						
No	142	74	96	1	1	
Yes	117	92	99	0.194	1.253[0.925, 1.699]	0.145
PHEM training						
No	215	135	117	1	1	
Yes	44	31	78	0.522	2.799[1.942, 4.035]	0.001
Age of HCW						
<30 years	142	86	83	0.318	1	
30-35 years	49	38	59	0.221	1.637[1.118, 2.397]	0.011
> 35 years	68	42	53	1	1.202[0.834, 1.731]	0.322
Attitude						
Negative attitude	239	113	46	1	1	
Positive attitude	122	72	28	0.277	1.724[1.258, 2.362]	0.001
Cut1				0.274	0.860[0.324, 1.396]	
Cut2				0.284	2.084[1.527, 2.641]	

Discussions

The HCWs should be equipped with the required knowledge and confidence in clinically diagnosing and managing mpox disease in areas where there is scarce resources to install testing laboratories. However, this is a predominant challenge that the HCWs faced in the current mpox outbreak, which requires not only an intensive prevention strategy including vaccination but also early detection, quick response, and proper management of affected patients. This study was designed to assess the HCWs confidence level in diagnosing and management of mpox disease in hospitals in Amhara Region. The findings of this study is important to design interventions that strengthen HCWs' preparedness for mitigations and responses towards the outbreak [52].

The overall proportion of HCWs who had high confidence level in managing and diagnosing mpox disease was 31.5% [95% CI: 27.7%, 35.2%]. Even though the differences in the cut off points in determining the outcome and the study participants, similar proportion (34.9%) was reported by the study conducted in Indonesia [53].

Similarly, the proportion of HCWs who had higher confidence level in managing the mpox diseases was found to be 32.1% [95% CI: 28.2%, 35.7%]. However, higher proportions (P = 47.5%) [46] and (P = 38.9%) [18] was reported in studies conducted in Kuwait and Jordan, respectively. Likewise, the proportion of HCWs who had higher confidence level to diagnose the disease was also determined to be 35.0% [95% CI: 31.3%, 38.7%]. Similar proportions were reported by studies conducted in Kuwait (32.3%) and Jordan (38.0%) [18, 46].

In this study, those HCWs aged 30–35 years old had higher confidence level in diagnosing and management of mpox disease compared to those HCWs aged less than 30 years old. This finding may be due to the fact that HCWs in this age-range capitalized on their knowledge and prior clinical experiences such as with the COVID-19 pandemic to better manage the mpox outbreak. In addition, HCWs in this age category may have a habit of searching new facts and updates about emerging and re-emerging epidemics. This study also found that those HCWs with positive attitude had higher confidence in diagnosing and managing mpox diseases compared to those HCWs with negative attitude. This may be because having a positive attitude towards understanding mpox helps HCWs thrive in searching for new information regarding the diagnosis and management of the disease. The information seeking behavior might help the HCWs to develop higher level of confidence towards the management and diagnosis of the disease. This contemplation was also supported by the current study, which revealed that those HCWs who had visited different websites such as the WHO and CDC websites had higher odds of high level of

confidence in diagnosing and managing mpox diseases compared to those who had not. The mere reason behind this might be due to WHO and other partners like CDC might release accurate and updated information on daily basis regarding the signs and symptoms, transmission, prevention, and treatment the virus and the global strategies for the prevention and control of mpox outbreaks [54]. The importance of prior information about the mpox virus was mentioned to be an independent predictor of higher level of confidence among general practitioners as those general practitioners who had received information of mpox virus during their medical education had higher confidence than those who had never received such information[55]. Therefore, visiting different websites could improve HCWs' knowledge and attitude about mpox, leading to a high level of confidence in the diagnosis and management of re-emerging viruses.

Like another study conducted in Jordan[18], this study identified that physicians (GPs and Specialists) had higher confidence level in diagnosing and managing mpox disease compared to nurses and other professionals. The possible explanation might be due to the physicians' higher and intensive educational exposure during their medical education, which might help them understand the fundamental sciences of communicable diseases like mpox virus. In addition, the physicians might have an opportunity to attend regional and international conferences during such type of pandemics, which updates them with the current worldwide understanding about the diseases. This was explained by the study conducted in Indonesia, which suggested that, attending national conferences (at least one) helps general practitioners equip with better confidence [53]. Another possible reason might be because physicians such as specialists have practical experiences in the management and diagnosis of similar pandemics such as COVID 19, which help them to be sensitive to potentially threatening mpox virus pandemics across the globe. In contrast to our finding and these justifications, a study conducted in Kuwait[46] reported nurses displayed higher

self-reported confidence levels to diagnose and manage the disease. The possible reason might be the differences in the variable categorization, this study categorized the variable into dichotomous variable (GPs and specialists Vs Nurse and other professionals); however, the later study categorized the variable into four categories.

Those HCWs who had recieved training about public health epidemic-prone diseases had higher confidence level in diagnosis and management of mpox disease. Previous studies conducted in Indonesia [53], Australia [56] and Italy [57] agreed with our findings that receiving information during medical training was significantly associated with goods knowledge about mpox, which increases their confidence level. The level of HCWs' confidence increased with prolonged attachment and trainings in healthcare centers [56], as adequate training and continuing medical education are important to ensure the buildup of confidences in diagnosing and management of infectious diseases[58].

Conclusions

The overall HCWs' confidence level in diagnosing and managing mpox disease in Amhara region was low compared to what was recommended by WHO. Those modifiable variables such as positive attitude, professional category (being a GP and specialist doctor), age, and visiting the WHO, CDC, and other amenable websites were found to be significantly associated with higher HCWs' confidence level in diagnosing and managing mpox disease. Raising awareness and confidence level of HCWs in diagnosing and managing mpox disease can strengthens their preparedness for the mitigation and response of the emerging threat of mpox. For instance, training on the WHO's rapid interim guideline for the clinical management and infection prevention and control (IPC) of mpox should be given for all HCWs in the study area [59]. Additionally, those

physicians with higher confidence level in diagnosing and managing should share their knowledge and skills with nurses and other health professionals.

Ethics approval and consent to participate

Ethical approval was obtained from the Institutional Review Board (IRB) with protocol number: No./RCS/70024/26 of the Debretabor University, College of Medicine and Health Sciences. Before data collection, formal permission letters were obtained from each hospital. Similarly, facility heads were communicated through supporting letters and informed about the purpose of the study before actual data collection. Informed verbal consent were obtained from the sampled HCWs. The respondents were also informed that they have the full right to withdraw or refuse at any time during interviewing. Data confidentiality was maintained by avoiding possible identifiers, such as exchanging the names of study participants with identification numbers.

Abbreviation and Acronyms

AOR: Adjusted Odds Ratio; **CDC**: Center for Disease Control and Prevention; **CSPH**: Comprehensive Specialized Hospital; **GP**: General Practitioner; **HCWs**: Healthcare Workers; **IESPS**: Integrated Emergency Surgery Professional Specialty; **mpox**: Monkeypox; PHEM: Public Health Emergency Management; **WHO**: World Health Organization.

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author upon reasonable request.

Competing interests

The authors declare that they have no conflicts of interest regarding any aspect of this article.

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Authors' contributions

AGY- Conception, design, acquisition of data or analysis and interpretation of data and wrote the manuscript. **AT** - designed the study and analyzed, interpreted, and wrote the manuscript. **GM** - conceived the study and reviewed and wrote the manuscript. **TD-** reviewed and wrote the manuscript, **AM-** reviewed and wrote the manuscript, **HT-** reviewed and wrote the manuscript, **ASA**- reviewed and wrote the manuscript, **MA**- reviewed the manuscript, **AS-** edited the manuscript, **DT-** edited the manuscript, **EM-** edited the manuscript, **TDT-** edited the manuscript and **CY -** Design, acquisition of data or analysis and interpretation of data and wrote the manuscript.

Reference

1. Karagoz, A., et al., *Monkeypox (mpox) virus: Classification, origin, transmission, genome organization, antiviral drugs, and molecular diagnosis.* Journal of Infection and Public Health, 2023.
2. Hirani, R., et al., *A Review of the Past, Present, and Future of the Monkeypox Virus: Challenges, Opportunities, and Lessons from COVID-19 for Global Health Security.* Microorganisms, 2023. **11**(11): p. 2713.
3. Perramon, A., et al., *Analysis of the epidemiological dynamic of monkeypox from 15th May to 31st August 2022.* Disponible en: www. enfermedadesemergentes. com, 2022: p. 160.
4. Ilic, I., I. Zivanovic Macuzic, and M. Ilic, *Global outbreak of human Monkeypox in 2022: Update of epidemiology.* Tropical Medicine and Infectious Disease, 2022. **7**(10): p. 264.
5. Galassi, F.M., et al., *Monkeypox between dermatology and anthropology: A model for evolutionary medicine.* Clinics in Dermatology, 2023. **41**(3): p. 423-424.
6. Xiang, Y. and A. White, *Monkeypox virus emerges from the shadow of its more infamous cousin: family biology matters.* Emerging microbes & infections, 2022. **11**(1): p. 1768-1777.
7. Cheema, A., et al., *Monkeypox: A Review of Clinical Features, Diagnosis, and Treatment. Cureus 2022, 14, e26756*.
8. Ladnyj, I., P. Ziegler, and E. Kima, *A human infection caused by monkeypox virus in Basankusu Territory, Democratic Republic of the Congo.* Bulletin of the World Health Organization, 1972. **46**(5): p. 593.

9. Antunes, F., R. Cordeiro, and A. Virgolino, *Monkeypox: From A Neglected Tropical Disease to a Public Health Threat.* Infectious Disease Reports, 2022. **14**(5): p. 772-783.
10. Mande, G., et al., *Enhanced surveillance of monkeypox in Bas-Uélé, Democratic Republic of Congo: the limitations of symptom-based case definitions.* International Journal of Infectious Diseases, 2022. **122**: p. 647-655.
11. Kraemer, M.U., et al., *Tracking the 2022 monkeypox outbreak with epidemiological data in real-time.* The Lancet Infectious Diseases, 2022.
12. Update, E., *Monkeypox multi-country outbreak.* European Centre for Disease Prevention and Control, 2022.
13. WHO, *2022-23 Mpox (Monkeypox) Outbreak: Global Trends; Produced on 19 December 2023: https://worldhealthorg.shinyapps.io/mpx_global/.* 2023.
14. CDC, *2022-2023 Mpox Outbreak Global Map, Data as of 27 Dec 2023: https://www.cdc.gov/poxvirus/mpox/response/2022/world-map.html. 2023.* 2023.
15. Ilic, I. and M. Ilic, *Historical review: Towards the 50th anniversary of the last major smallpox outbreak (Yugoslavia, 1972).* Travel Medicine and Infectious Disease, 2022. **48**: p. 102327.
16. Yousaf, M., et al., *Immuno-informatics profiling of monkeypox virus cell surface binding protein for designing a next generation multi-valent peptide-based vaccine.* Frontiers in Immunology, 2022. **13**.
17. Titanji, B.K., et al. *Monkeypox: a contemporary review for healthcare professionals*. in *Open forum infectious diseases*. 2022. Oxford University Press.
18. Sallam, M., et al. *Assessing Healthcare Workers' Knowledge and Their Confidence in the Diagnosis and Management of Human Monkeypox: A Cross-Sectional Study in a Middle Eastern Country*. in *Healthcare*. 2022. MDPI.
19. Tarín-Vicente, E.J., et al., *Clinical presentation and virological assessment of confirmed human monkeypox virus cases in Spain: a prospective observational cohort study.* The Lancet, 2022. **400**(10353): p. 661-669.
20. Morgan, C.N., et al., *Environmental persistence of monkeypox virus on surfaces in household of person with travel-associated infection, Dallas, Texas, USA, 2021.* Emerging Infectious Diseases, 2022. **28**(10): p. 1982-1989.
21. Peiró-Mestres, A., et al., *Frequent detection of monkeypox virus DNA in saliva, semen, and other clinical samples from 12 patients, Barcelona, Spain, May to June 2022.* Eurosurveillance, 2022. **27**(28): p. 2200503.
22. Vaughan, A., et al., *Human-to-human transmission of monkeypox virus, United Kingdom, October 2018.* Emerging infectious diseases, 2020. **26**(4): p. 782.
23. Al-Tammemi, A.a.B., R. Albakri, and S. Alabsi, *The Outbreak of Human Monkeypox in 2022: A Changing Epidemiology or an Impending Aftereffect of Smallpox Eradication?* Frontiers in Tropical Diseases, 2022. **3**: p. 951380.
24. Mbala, P.K., et al., *Maternal and fetal outcomes among pregnant women with human monkeypox infection in the Democratic Republic of Congo.* The Journal of infectious diseases, 2017. **216**(7): p. 824-828.
25. Rodriguez-Morales, A.J. and G. Lopardo, *Monkeypox: another sexually transmitted infection?* Pathogens, 2022. **11**(7): p. 713.
26. Bunge, E.M., et al., *The changing epidemiology of human monkeypox—A potential threat? A systematic review| PLOS Neglected Tropical Diseases.* 2022.
27. Simpson, K., et al., *Human monkeypox–After 40 years, an unintended consequence of smallpox eradication.* Vaccine, 2020. **38**(33): p. 5077-5081.
28. Weinstein, R.A., et al., *Reemergence of monkeypox: prevalence, diagnostics, and countermeasures.* Clinical infectious diseases, 2005. **41**(12): p. 1765-1771.

29. Beer, E.M. and V.B. Rao, *A systematic review of the epidemiology of human monkeypox outbreaks and implications for outbreak strategy.* PLoS neglected tropical diseases, 2019. **13**(10): p. e0007791.
30. Rimoin, A.W., et al., *Major increase in human monkeypox incidence 30 years after smallpox vaccination campaigns cease in the Democratic Republic of Congo.* Proceedings of the National Academy of Sciences, 2010. **107**(37): p. 16262-16267.
31. Petersen, B.W., et al., *Vaccinating against monkeypox in the Democratic Republic of the Congo.* Antiviral research, 2019. **162**: p. 171-177.
32. Khodakevich, L., et al., *Monkeypox virus in relation to the ecological features surrounding human settlements in Bumba zone, Zaire.* Tropical and geographical medicine, 1987. **39**(1): p. 56-63.
33. Haider, N., et al., *Increased outbreaks of monkeypox highlight gaps in actual disease burden in Sub-Saharan Africa and in animal reservoirs.* International Journal of Infectious Diseases, 2022.
34. Ortiz-Martínez, Y., et al., *YouTube and 2022 Monkeypox outbreak: opportunities for awareness and infection control.* Journal of Hospital Infection, 2022.
35. ASSESSMENT, R.R., *Monkeypox multi-country outbreak.* 2022.
36. Sah, R., et al., *The Emergence of Monkeypox: A Global Health Threat.* Cureus, 2022. **14**(9).
37. Al-Musa, A., J. Chou, and B. LaBere, *The resurgence of a neglected orthopoxvirus: Immunologic and clinical aspects of monkeypox virus infections over the past six decades.* Clinical Immunology, 2022: p. 109108.
38. mondiale de la Santé, O. and W.H. Organization, *Epidemiology of human monkeypox (mpox)–worldwide, 2018–2021–Épidémiologie de la variole simienne chez l'humain–dans le monde, 2018-2021.* Weekly Epidemiological Record= Relevé épidémiologique hebdomadaire, 2023. **98**(03): p. 29-36.
39. Antunes, F. and A. Virgolino, *Monkeypox Mysteries of the New Outbreak in Non-Endemic Areas.* International Journal of Environmental Research and Public Health, 2022. **19**(22): p. 14881.
40. Shariq, A., Z. Rasheed, and W. Al Abdulmonem, *Human monkeypox: An update on knowledge and future implications.* International Journal of Health Sciences, 2022. **16**(4): p. 1-2.
41. Koenig, K.L., C.K. Beÿ, and A.M. Marty, *Monkeypox 2022: a primer and identify-isolate-inform (3I) tool for Emergency Medical Services professionals.* Prehospital and Disaster Medicine, 2022. **37**(5): p. 687-692.
42. Taherdoost, H., *Determining sample size; how to calculate survey sample size.* International Journal of Economics and Management Systems, 2017. **2**.
43. Sallam, M., et al., *Knowledge of human monkeypox and its relation to conspiracy beliefs among students in Jordanian health schools: filling the knowledge gap on emerging zoonotic viruses.* Medicina, 2022. **58**(7): p. 924.
44. Ramli, N., N.A.A. Rahman, and M. Haque, *Knowledge, Attitude, and Practice Regarding Osteoporosis Among Allied Health Sciences Students in a Public University in Malaysia.* Erciyes Medical Journal/Erciyes Tip Dergisi, 2018. **40**(4).
45. Rony, M.K.K., et al., *Knowledge and Attitude Regarding Human Monkeypox Virus Infection among Nurses: A Cross-Sectional Study.* SAGE Open Nursing, 2023. **9**: p. 23779608231216619.
46. Alsanafi, M., K. Al-Mahzoum, and M. Sallam, *Monkeypox Knowledge and Confidence in Diagnosis and Management with Evaluation of Emerging Virus Infection Conspiracies among Health Professionals in Kuwait.* Pathogens, 2022. **11**(9): p. 994.
47. Alshahrani, N.Z., et al., *Assessment of knowledge of monkeypox viral infection among the general population in Saudi Arabia.* Pathogens, 2022. **11**(8): p. 904.
48. Alshahrani, N.Z., et al., *Assessment of Knowledge of Monkeypox Viral Infection among the General Population in Saudi Arabia.* pathogens, 2022. **11**: p. 904.

49. Hasan, S. and S. Saeed, *Monkeypox disease: An emerging public health concern in the shadow of COVID-19 pandemic: An update.* Tropical Medicine and Infectious Disease, 2022. **7**(10): p. 283.
50. Hong, J., et al., *The willingness of Chinese healthcare workers to receive monkeypox vaccine and its independent predictors: A cross-sectional survey.* Journal of Medical Virology, 2023. **95**(1): p. e28294.
51. Huang, Y., L. Mu, and W. Wang, *Monkeypox: epidemiology, pathogenesis, treatment and prevention.* signal Transduction and Targeted Therapy 2022(7): p. 373.
52. Wenham, C. and M. Eccleston-Turner, *Monkeypox as a PHEIC: implications for global health governance.* The Lancet, 2022. **400**(10369): p. 2169-2171.
53. Harapan, H., et al., *Confidence in managing human monkeypox cases in Asia: A cross-sectional survey among general practitioners in Indonesia.* Acta tropica, 2020. **206**: p. 105450.
54. Organization, W.H., *Obesity: preventing and managing the global epidemic.* 2000.
55. Harapan, H., et al., *Acceptance and willingness to pay for a hypothetical vaccine against monkeypox viral infection among frontline physicians: A cross-sectional study in Indonesia.* Vaccine, 2020. **38**(43): p. 6800-6806.
56. McNair, R., et al., *Medical students developing confidence and patient centredness in diverse clinical settings: a longitudinal survey study.* BMC Medical Education, 2016. **16**(1): p. 1-8.
57. Gallè F, B.L., Da Molin G, Mancini R, Sciacchitano S, Ferracuti S et al,, *"Monkeypox: What Do You Know about That?" Italian Adults' Awareness of a New Epidemic. Pathogens 11:1285. doi:10.3390/pathogens11111285.* 2022.
58. Choudhry, N.K., Fletcher, R.H., Soumerai, S.B.,, *Systematic review: the relationship between clinical experience and quality of health care.* Ann. Intern. Med, 2005(142): p. 260–273.
59. WHO, *Clinical management and infection prevention and control guideline; https://iris.who.int/bitstream/handle/10665/355798/WHO-MPX-Clinical_and_IPC-2022.1-eng.pdf?sequence=1.* 2022.

Figure 1: Map of Amhara region and hospitals sample taken about confidence level of mpox disease at health care workers, Northwest Ethiopia, 2022.

Figure 1: HCWs confidence level in diagnosing and management of mpox disease in Hospitals in Amhara region, northwest Ethiopia, 2022.

Figure 3: HCWs knowledge on questions related to the diagnosing, management, prevention and control of mpox disease in Hospitals in Amhara region, northwest Ethiopia, 2022.

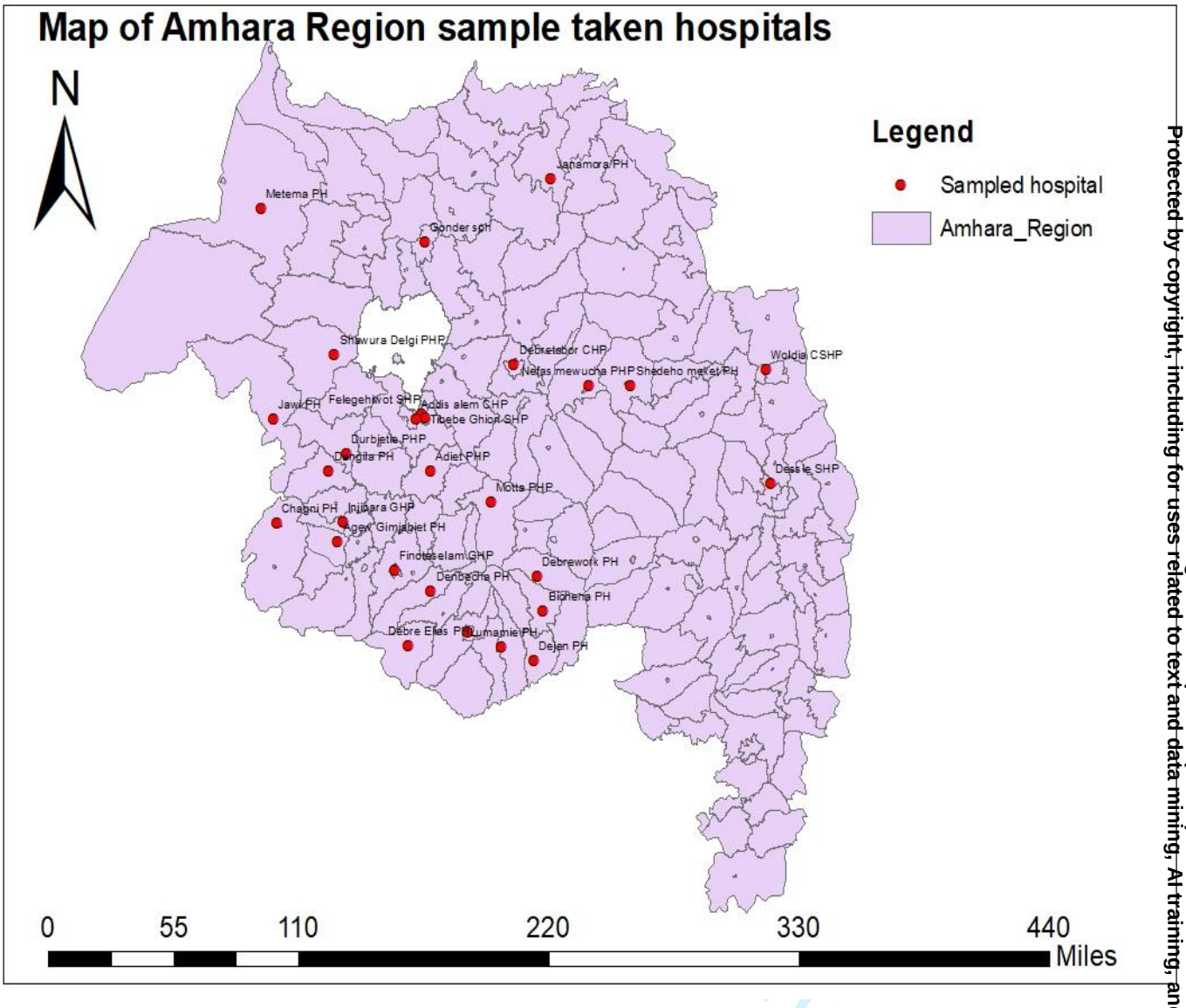
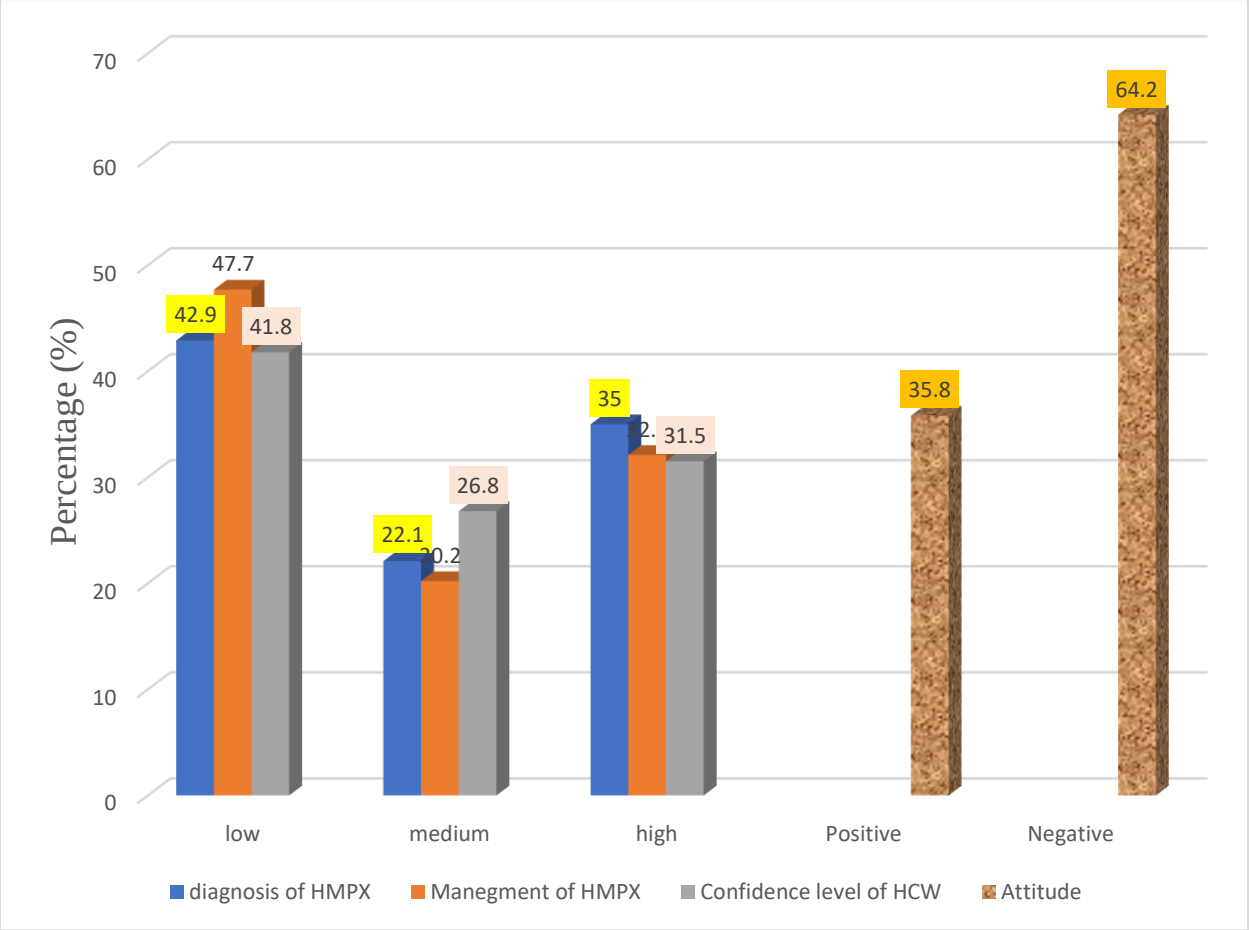


Figure 1: Map of Amhara region and hospitals sample taken about confidence level of mpox disease at health care workers, Northwest Ethiopia, 2022.



Note: HMPX- human monkeypox virus, HCW- health care worker

Figure 1: HCWs confidence level in diagnosing and management of mpox disease in Hospitals in Amhara region, northwest Ethiopia, 2022.

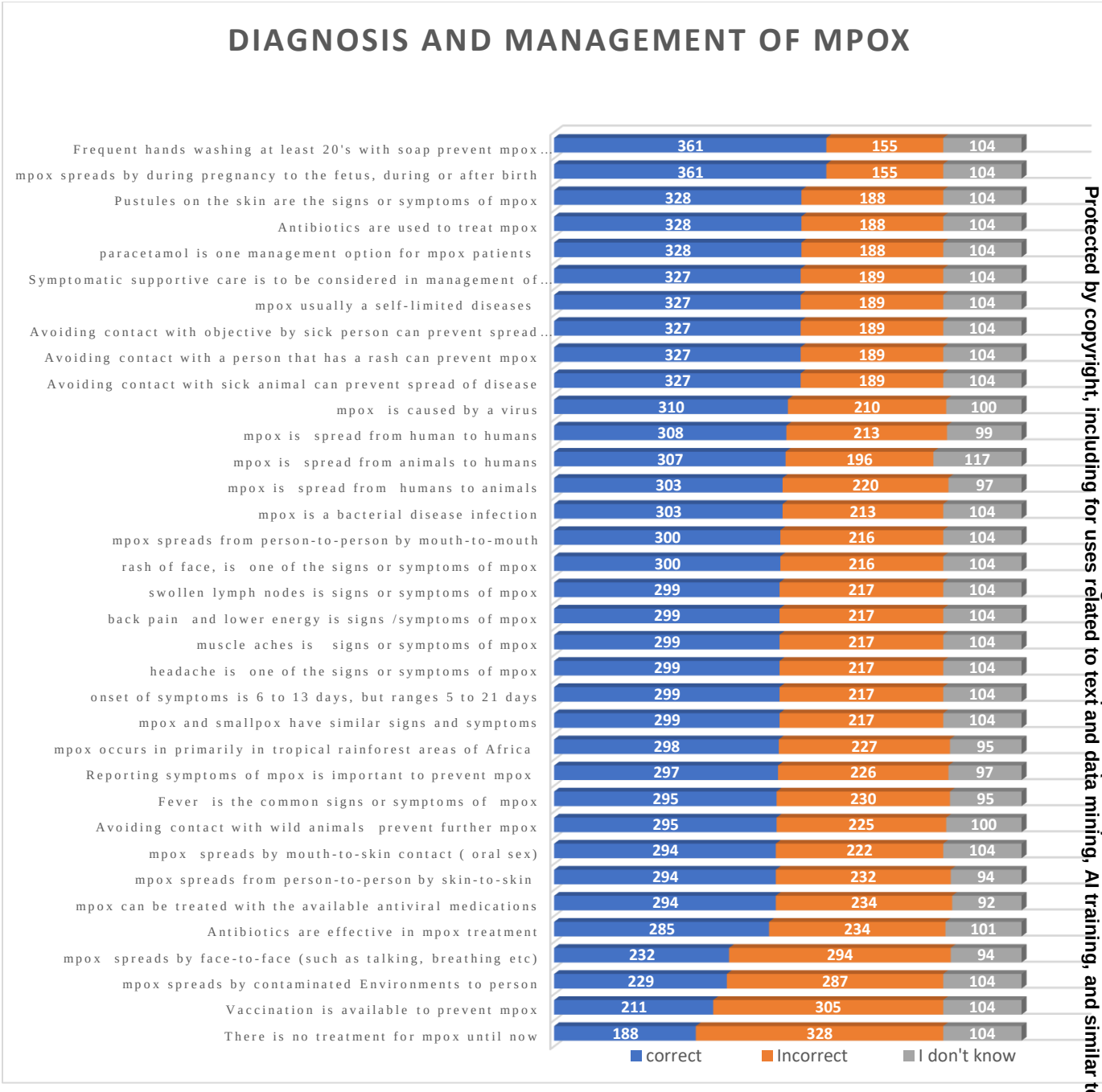


Figure 3: HCWs knowledge on questions related to the diagnosing, management, prevention and control of mpox disease in Hospitals in Amhara region, northwest Ethiopia, 2022.

Content validity format

Title of the tools validated: Assessing healthcare workers' confidence levels in diagnosis and management of emerging infectious virus of human monkeypox at Amhara Region.

Dear experts!!

We beseech your expert opinion and on the degree of relevance of each item being measured. This instrument will be used to our study entitled "Assessing healthcare workers' confidence levels in diagnosis and management of emerging infectious virus of human monkeypox at Amhara Region".

This instrument are provided below to guide you in your analysis. Please use the following rating scales and rate each item as objective as possible in your view.

Degree of relevance

1= the item is not relevant for measured outcome.

2= the item is somewhat relevant for measured outcome

3= the item is relevant for measured outcome

4= the item is highly relevant for measured outcome

C					
S.No	**Questionaries**	Not relevant (1)	Somewhat relevant (2)	Relevant (3)	Highly relevant (4)
	Diagnosis related questions of mpox				
1	Does Monkeypox is spread from animals to humans				
2	Does Monkeypox is caused by a virus				
3	Does Monkeypox is spread from human to humans				
4	Does Monkeypox is spread from humans to animals				

5	Monkeypox occurs in primarily in tropical rainforest areas of Africa and is occasionally exported to other region				
6	Does monkeypox spreads from person-to-person by skin-to-skin (such as touching or vaginal/anal sex)				
7	Does monkeypox spreads from person-to-person by Close contact or face-to-face (such as talking, breathing or singing close to one another which can generate droplets or short-range aerosols)				
8	Does monkeypox spreads from person-to-person by mouth-to-skin contact (such as oral sex or kissing the skin)				
9	Reporting symptoms of Monkeypox to local health authorities is important to prevent further disease transmission				
10	Avoiding contact with wild animals (alive or dead) essential to prevent further monkeypox transmission				
11	Fever is the common signs or symptoms of human monkeypox				
12	Does monkeypox spreads by contaminated environment from person-to-person with the monkeypox virus:				
13	Monkeypox is a bacterial disease infection				
14	Monkeypox and smallpox have similar signs and symptoms				
15	The interval from infection to onset of symptoms is usually from 6 to 13 days but can range from 5 to 21 days				

16	headache is one of the signs or symptoms of human monkeypox				
17	muscle aches is one of the signs or symptoms of human monkeypox				
18	back pain and lower energy is one of the signs or symptoms of human monkeypox				
19	swollen lymph nodes is one of the signs or symptoms of human monkeypox				
20	rash of face, palms of the hands, soles of the feet, groin, genital and/or anal regions is one of the signs or symptoms of human monkeypox				
21	Does monkeypox spreads from person-to-person by mouth-to-mouth (such as kissing)				
22	Does monkeypox spreads from person-to-person by the virus can also spread during pregnancy to the fetus, during or after birth				
23	Frequent hands washing for at least 20 s with soap and water or alcohol based hand sanitizers is essential to prevent further monkeypox transmission				
24	Pustules on the skin are one of the signs or symptoms of human Monkeypox				
25	Avoiding contact with any objectives that have been in contact with sick animal can prevent spread of disease				
26	Avoiding contact with any person that has a rash can prevent spread of disease				

27	Avoiding contact with any objective that has been in contact with sick person can prevent spread of disease				
28	Monkeypox usually a self-limited disease with the symptoms lasting from 2 to 4 weeks				
	Management related questions of mpox				
1	Monkeypox can be treated with the available antiviral medications				
2	Antibiotics are effective in monkeypox treatment				
3	Vaccination is available to prevent human monkeypox				
4	Symptomatic supportive care is to be considered in the management of Monkeypox disease				
5	One management option for monkeypox patients who are symptomatic is to use paracetamol				
6	Antibiotics are used to treat human monkeypox				
7	There is no treatment for monkeypox until now				
	Preparedness related questions of mpox				
1	Diagnose monkeypox virus based on your current status?				
2	Diagnoses monkeypox virus based your current facility diagnostic test?				
3	Do you manage monkey poxvirus cases, in this situation?				

4	Does rapid response team (RRT) ready to manage unusual events like monkeypox virus cases, in this situation?				
5	Do you participate rapid response team (RRT) activities to manage unusual events like monkeypox virus?				
6	Do you face public health threatening events like COVID-19 in the previous working time that helps to cope the current and future emerging events like manage monkeypox virus?				
7	is there any strong triage room in your health facility to diagnose unusual events				
8	Is there enough medical equipment to manage monkeypox cases?				
9	Do you manage monkeypox cases, based on your facility medication commodities				
	Attitude related questions of mpox				
1	Monkeypox spread worldwide due to the role of male homosexuals				
2	I am skeptical about the official explanation regarding the cause of virus emergence				
3	I do not trust the information about the viruses from scientific experts				
4	I do not trust the information about the viruses from scientific experts				
5	The spread of viruses is a deliberate attempt to reduce the size of the global population				

6	The spread of viruses is a deliberate attempt by governments to gain political control				
7	The spread of viruses is a deliberate attempt by global companies to take control				
8	Lockdowns in response to emerging infection are aimed for mass surveillance and to control every aspect of our lives				
9	Lockdowns in response to emerging infection are aimed for mass surveillance and to destabilize the economy for financial gain				
10	Lockdown is a way to terrify, isolate, and demoralize a society as a whole in order to reshape society to fit specific interests				
11	Viruses are biological weapons manufactured by the superpowers to take global control				
12	The mainstream media is deliberately feeding us misinformation about the virus and lockdown				
13	Monkeypox was a plot by globalists to destroy religion by banning gatherings				

Name and signature of experts---------- date----------

No	Questionaries	Exp1	Exp2	Exp3	Exp4	Exp5	Exp6	Number of agreements	Item content validity ratio (I-CVR)	UA
Part-1	**Diagnosis related questions**									
1	Does Monkeypox is spread from animals to humans	4	3	3	3	4	4	6	1	6
2	Does Monkeypox is caused by a virus	4	4	4	4	4	4	6	1	6
3	Does Monkeypox is spread from human to humans	4	4	3	3	4	4	6	1	6
4	Does Monkeypox is spread from humans to animals	4	3	2	4	4	4	5	0.8333333	5
5	Monkeypox occurs in primarily in tropical rainforest areas of Africa and is occasionally exported to another region	2	4	4	4	3	4	5	0.8333333	5
6	Does monkeypox spreads from person-to-person by skin-to-skin (such as touching or vaginal/anal sex)	4	4	4	3	4	4	6	1	6
7	Does monkeypox spreads from person-to-person by Close contact or face-to-face (such as talking, breathing or singing close to one another which can generate droplets or short-range aerosols)	3	4	3	4	4	4	6	1	6
8	Does monkeypox spreads from person-to-person by mouth-to-skin contact (such as oral sex or kissing the skin)	4	4	3	3	4	4	6	1	6

9	Reporting symptoms of Monkeypox to local health authorities is important to prevent further disease transmission	4	4	2	4	4	4	5	0.8333333	5
10	Avoiding contact with wild animals (alive or dead) essential to prevent further monkeypox transmission	4	2	4	4	4	4	5	0.8333333	5
11	Fever is the common signs or symptoms of human monkeypox	4	4	4	4	4	4	6	1	6
12	Does monkeypox spreads by contaminated environment from person-to-person with the monkeypox virus:	4	3	4	4	4	4	6	1	6
13	Monkeypox is a bacterial disease infection	4	2	4	4	4	3	5	0.8333333	5
14	Monkeypox and smallpox have similar signs and symptoms	4	4	4	4	4	4	6	1	6
15	The interval from infection to onset of symptoms is usually from 6 to 13 days but can range from 5 to 21 days	4	3	3	2	4	4	5	0.8333333	5
16	headache is one of the signs or symptoms of human monkeypox	4	4	4	4	3	4	6	1	6
17	muscle aches is one of the signs or symptoms of human monkeypox	4	4	4	4	4	4	6	1	6
18	back pain and lower energy is one of the signs or symptoms of human monkeypox	4	4	3	4	4	4	6	1	6
19	swollen lymph nodes is one of the signs or symptoms of human monkeypox	4	4	4	4	4	4	6	1	6

20	rash of face, palms of the hands, soles of the feet, groin, genital and/or anal regions is one of the signs or symptoms of human monkeypox	4	4	2	4	4	4	5	0.8333333	5
21	Does monkeypox spreads from person-to-person by mouth-to-mouth (such as kissing)	4	4	4	4	4	4	6	1	6
22	Does monkeypox spreads from person-to-person by the virus can also spread during pregnancy to the fetus, during or after birth	4	4	4	4	4	3	6	1	6
23	Frequent hands washing for at least 20 s with soap and water or alcohol-based hand sanitizers is essential to prevent further monkeypox transmission	4	4	4	4	4	4	6	1	6
24	Pustules on the skin are one of the signs or symptoms of human Monkeypox	4	2	4	4	3	4	5	0.8333333	5
25	Avoiding contact with any objectives that have been in contact with sick animal can prevent spread of disease	4	4	4	4	4	4	6	1	6
26	Avoiding contact with any person that has a rash can prevent spread of disease	4	4	3	4	4	4	6	1	6
27	Avoiding contact with any objective that has been in contact with sick person can prevent spread of disease	4	4	4	4	3	4	6	1	6

28	Monkeypox usually a self-limited disease with the symptoms lasting from 2 to 4 weeks	4	4	4	4	4	4	6	1	6
Part-2	**Management related question**									
1	Monkeypox can be treated with the available antiviral medications	4	4	4	4	4	4	6	1	6
2	Antibiotics are effective in monkeypox treatment	4	4	4	4	4	4	6	1	6
3	Vaccination is available to prevent human monkeypox	4	4	4	4	4	4	6	1	6
4	Symptomatic supportive care is to be considered in the management of Monkeypox disease	4	4	4	4	3	4	6	1	6
5	One management option for monkeypox patients who are symptomatic is to use paracetamol	4	4	4	4	4	4	6	1	6
6	Antibiotics are used to treat human monkeypox	4	4	4	3	4	3	6	1	6
7	There is no treatment for monkeypox until now	4	4	4	4	4	4	6	1	6
Part-3	**Preparedness related question**									
1	Diagnose monkeypox virus based on your current status?	4	4	4	4	3	4	6	1	6
2	Diagnoses monkeypox virus based your current facility diagnostic test?	4	4	4	4	2	4	5	0.8333333	5
3	Do you manage monkey poxvirus cases, in this situation?	4	4	4	4	4	4	6	1	6

4	Does rapid response team (RRT) ready to manage unusual events like monkeypox virus cases, in this situation?	4	4	4	4	2	4	5	0.8333333	5
5	Do you participate rapid response team (RRT) activities to manage unusual events like monkeypox virus?	4	4	4	4	4	4	6	1	6
6	Do you face public health threatening events like COVID-19 in the previous working time that helps to cope the current and future emerging events like manage monkeypox virus?	4	4	4	4	4	4	6	1	6
7	is there any strong triage room in your health facility to diagnose unusual events	4	4	4	4	4	3	6	1	6
8	Is there enough medical equipment to manage monkeypox cases?	4	4	4	4	3	4	6	1	6
9	Do you manage monkeypox cases, based on your facility medication commodities	4	4	4	4	4	4	6	1	6
Part-4	**Attitude related questions**									
1	Monkeypox spread worldwide due to the role of male homosexuals	4	4	4	4	4	4	6	1	6
2	I am skeptical about the official explanation regarding the cause of virus emergence	4	4	4	4	2	4	5	0.8333333	5

3	I do not trust the information about the viruses from scientific experts	4	4	4	4	4	4	6	1	6
4	I do not trust the information about the viruses from scientific experts	4	4	4	4	4	3	6	1	6
5	The spread of viruses is a deliberate attempt to reduce the size of the global population	4	4	4	4	3	4	6	1	6
6	The spread of viruses is a deliberate attempt by governments to gain political control	4	4	4	4	4	4	6	1	6
7	The spread of viruses is a deliberate attempt by global companies to take control	4	4	4	4	4	4	6	1	6
8	Lockdowns in response to emerging infection are aimed for mass surveillance and to control every aspect of our lives	4	4	4	2	4	4	5	0.8333333	6
9	Lockdowns in response to emerging infection are aimed for mass surveillance and to destabilize the economy for financial gain	4	4	3	4	4	4	6	1	6
10	Lockdown is a way to terrify, isolate, and demoralize a society as a whole in order to reshape society to fit specific interests	4	3	2	4	4	4	5	0.8333333	6
11	Viruses are biological weapons manufactured by the superpowers to take global control	4	4	4	4	4	3	6	1	6
12	The mainstream media is deliberately feeding us misinformation about				4	4	4	6	1	6

	the virus and lockdown	4	4	4						
13	Monkeypox was a plot by globalists to destroy religion by banning gatherings	4	4	4	4	3	4	6	1	
	Totall	**225**	**217**	**212**	**219**	**213**	**222**	**329**	**54.8333333**	**3**
	Proportion of relevance	0.99	1	0.9	1	0.93	1	0.962	0.96199	
	Average proportion of items judged as relevance across the 6 experts								0.9561	

Calculated content validity ratio part by part

Diagnosis related Questions	**Score**		**Management related Questions**	**Score**
SUM of (I-CVI)	26.66666667		SUM of (I-CVI)	7
S-CVI Average (sum of I-CVI/No of questions)	0.952380952		S-CVI Average (sum of I-CVI/No of questions)	1
Total universal agreement	160		Total universal agreement	42
UA = Total agreement/ No. Items	0.952380952		UA = Total agreement/ No. Items	1
S-CVI Relevance (sum of UA/ Number of questions	0.952380952		S-CVI Relevance (sum of UA/ Number of questions	1

For Knowledge	**Score**		**Preparedness related Questions**	**Score**
SUM of (I-CVI)	33.66667		SUM of (I-CVI)	8.6667
S-CVI Average (sum of I-CVI/No of questions)	0.961905		S-CVI Average (sum of I-CVI/No of questions)	0.963
Total universal agreement	202		Total universal agreement	52

UA = Total agreement/ No. Items	0.961905		UA = Total agreement/ No. Items	0.963
S-CVI Relevance (sum of UA/ Number of questions	0.961905		S-CVI Relevance (sum of UA/ Number of questions	0.963

For Confidence level	**Score**		**Attitude related Questions**	**Score**
SUM of (I-CVI)	42.33333333		SUM of (I-CVI)	11.5
S-CVI Average (sum of I-CVI/No of questions)	0.962121212		S-CVI Average (sum of I-CVI/No of questions)	0.884615
Total universal agreement	254		Total universal agreement	69
UA = Total agreement/ No. Items	0.962121212		UA = Total agreement/ No. Items	0.884615
S-CVI Relevance (sum of UA/ Number of questions	0.962121212		S-CVI Relevance (sum of UA/ Number of questions	0.884615

The overall the questionnaire CVR	
SUM of (I-CVI)	54.83333333
S-CVI Average (sum of I-CVI/No of questions)	0.961988304
Total universal agreement	329
UA = Total agreement/ No. Items	0.961988304
S-CVI Relevance (sum of UA/ Number of questions	0.961988304
Legends:	
CVI = content validity index	
I-CVI = Item- content validity index	
S-CVI = Scale - content validity index	
UA = universal agreement	
UA = Total agreement/ No. Items	
I-CV = Number of agreement (per item) / Number of experts	
S-CVI = I-CVI/Number of items	
recorded for at least six= 0.8333	

STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	Recommendation	Page No
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1, 3, &4
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	1, 3, &4
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	6, 7 & 8
Objectives	3	State specific objectives, including any prespecified hypotheses	
Methods			
Study design	4	Present key elements of study design early in the paper	9
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	9
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	9
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	11
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	*10*
Bias	9	Describe any efforts to address potential sources of bias	12
Study size	10	Explain how the study size was arrived at	10
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	10
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	13
		(*b*) Describe any methods used to examine subgroups and interactions	13
		(*c*) Explain how missing data were addressed	13
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	13
		(*e*) Describe any sensitivity analyses	
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	13
		(b) Give reasons for non-participation at each stage	13
		(c) Consider use of a flow diagram	
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	14 &15
		(b) Indicate number of participants with missing data for each variable of interest	14 & 15
Outcome data	15*	Report numbers of outcome events or summary measures	15,16,17 & 18

Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	15,16,17 & 18
		(*b*) Report category boundaries when continuous variables were categorized	15,16,17 & 18
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	15,16,17 & 18
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	
Discussion			
Key results	18	Summarise key results with reference to study objectives	19, 20 &21
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	19, 20 &21
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	19, 20 &21
Generalisability	21	Discuss the generalisability (external validity) of the study results	19, 20 &21
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	23

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.