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Individual and Organisational Factors Associated with Mpox Outbreak Preparedness Among Healthcare Workers in Zambia

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Abstract

Background

Responding to new infectious disease outbreaks requires healthcare workers to be well-prepared. The demands on health-system preparedness and epidemic response capability significantly rose during Zambia's 2024–2025 Mpox outbreak, which impacted six provinces. Despite this, there is little data on how organisational, structural, and cognitive factors affect healthcare personnel's preparedness strategies. This study examines the determinants of Mpox preparedness behaviours in Zambia and offers an empirical framework to direct future efforts to improve readiness.

Methods

A cross-sectional analytical study was conducted among 202 healthcare workers from public health facilities, training institutions, healthcare management offices, private health facilities, and supportive service units in Zambia. Composite measures were constructed to assess cognitive preparedness, structural preparedness, and preparedness practices. Internal consistency was evaluated using Cronbach's alpha. Descriptive statistics, correlation analysis, Kruskal-Wallis tests, and multivariable quasi-Poisson regression models were employed to identify determinants of preparedness practices.

Results

Preparedness practices and cognitive preparedness were positively correlated (IRR = 1.05; 95% CI: 1.02–1.08). The strongest correlation was found between preparedness behaviour and structural preparedness (IRR = 1.20; 95% CI: 1.13–1.28). Organisational settings differed greatly in terms of preparedness, with training facilities and healthcare management organisations showing lower readiness than medical facilities. There is a disconnect between readiness capacity and actual preparedness behaviour, as seen by the fact that healthcare personnel reported relatively high structural preparedness and moderate cognitive preparedness, but their preparedness practices remained lower. These findings lend credence to a multi-level conceptualisation of preparedness in which organisational environment, institutional readiness, and knowledge all work together to shape preparedness practices.

Conclusion

The interaction of organisational context, structural preparedness, and cognitive preparedness determines preparedness for Mpox. The importance of institutional readiness in enabling successful outbreak response is highlighted by the fact that structural preparedness has a greater impact on preparedness practices than cognitive preparedness. Integrated approaches incorporating workforce

training with investments in institutional and organisational capabilities are necessary to improve readiness for Mpox and other emerging infectious diseases.

Background

The Mpox virus, an Orthopovirus closely related to the variola virus that causes smallpox, is the source of the reemerging zoonotic illness Mpox. Despite being historically prevalent in Central and West Africa, Mpox has garnered international attention due to large outbreaks documented since 2022, underscoring the ongoing threat posed by emerging and re-emerging infectious diseases to health systems around the globe [1]. The resurgence of Mpox has highlighted the importance of preparedness and response capabilities at the health-system and healthcare facility levels, especially in resource-limited settings where workforce and infrastructure capacity may make outbreak control difficult [2, 3]. Effective outbreak preparedness continues to be a crucial element of global health security and resilience against new infectious disease threats, according to recent analyses [3].

Through case identification, clinical management, infection prevention and control, surveillance, and risk communication activities, healthcare professionals play a crucial part in outbreak preparedness and response [4, 5]. As a result, the success of outbreak detection, containment, and response initiatives is directly impacted by their readiness [6, 7]. Research from Cameroon, Vietnam, and Benin has shown that healthcare workers have varying degrees of Mpox-related knowledge, readiness, and response capability; deficiencies in training, case identification, and infection prevention practices present significant obstacles to outbreak control [5, 8, 9]. These findings underscore the importance of identifying and analysing factors that affect preparedness among healthcare workers, especially in environments confronting emerging outbreak threats.

Zambia entered a developing regional outbreak in October 2024 when the first verified Mpox case was identified. Concerns about outbreak preparedness, surveillance capacity, and health-system readiness were raised by subsequent reports documenting the spread of Mpox across several provinces [10, 11]. The National Incident Management System was activated, and response pillars such as surveillance, case management, points of entry control, infection prevention and control, and risk communication were put into place after six provinces reported instances by 2025. The findings of the UNICEF Zambia Qualitative Assessment Report underscore the need for increased preparedness activities across many levels of the health system by highlighting issues with risk perception, information dissemination, and community participation [12].

According to recent research, readiness for infectious disease epidemics is influenced by a variety of interconnected elements at the human, institutional, and organisational levels and goes beyond the understanding of healthcare workers. In order to facilitate an effective outbreak response, health-system preparedness frameworks emphasise the importance of workforce capacity, infection prevention infrastructure, governance systems, communication mechanisms, and organisational readiness [13–15]. In a similar vein, research on preparedness for COVID-19, Ebola, and other infectious disease outbreaks

has shown that institutional environments and healthcare workers' competencies both influence preparedness [7, 16, 17]. As a result, preparation is becoming more widely acknowledged as a multifaceted concept that represents the interplay between organisational structures, institutional resources, and individual capacities.

Although Mpox preparedness is becoming more and more important, there remains limited empirical evidence from Zambia. The combined impact of cognitive preparedness, institutional readiness, and organisational determinants on preparedness behaviours has received limited attention in previous research, which has mostly concentrated on knowledge and awareness among particular professional groups [18]. In order to improve outbreak preparedness and guide health-system response plans, it is critical to comprehend these factors. Thus, this study evaluated the organisational, structural, and cognitive factors that influence healthcare professionals' readiness for the Mpox outbreak in Zambia.

Methods

Participants and Study Design

202 healthcare professionals from medical facilities, training centres, healthcare management offices, private facilities, and supportive service units in Zambia participated in a cross-sectional survey.

Data Collection

A standardised questionnaire measuring Mpox knowledge, institutional preparedness, infection prevention and control (IPC) measures, preparedness behaviours, institutional preparedness resources, and perceived obstacles to outbreak response was used to gather data. The questionnaire was distributed electronically and had both single-response and multiple-response questions.

Measures of Preparedness

According to the definition used, preparedness is a multifaceted concept encompassing organisational, structural, and cognitive domains. Cognitive preparedness was evaluated using composite scores derived from accurate identification of Mpox symptoms and transmission routes. Structural preparedness was measured using indicators of institutional readiness, including the availability of personal protective equipment (PPE), guidelines, protocols, hand hygiene resources, isolation capacity, screening procedures, and waste management systems. Overall preparedness was quantified using a composite score reflecting self-reported infection prevention and control (IPC) and outbreak response practices. Organisational context was represented by facility type.

Statistical Analysis

Data were cleaned and analysed using R statistical software (Version 4.6.0). Descriptive statistics were used to summarise participant characteristics and preparedness indicators. Composite measures were

evaluated for internal consistency using Cronbach's alpha. Relationships among preparedness domains were examined using correlation analysis.

Differences in structural preparedness across facility types were assessed using the Kruskal-Walli's test, followed by Dunn's post-hoc comparisons where appropriate. Factors associated with preparedness practices were identified using multivariable generalised linear models with a quasi-Poisson distribution and log link. Adjusted incidence rate ratios (IRRs) and 95% CI confidence intervals (CIs) were reported. Model diagnostics included assessment of dispersion, multicollinearity, and residual behaviour. Statistical significance was determined at a 5% level ($p < 0.05$).

Development of the Preparedness Framework

According to the developed empirical framework, preparedness practices result from interactions between structural and cognitive preparedness within larger organisational contexts.

Ethical Approval and Consent to Participate

Ethical approval for this study was obtained from the National Health Research Authority and the Biomedical Research Ethics Committee of Lusaka Apex Medical University (LAMUBREC: Ref: LAMUBREC: No: 0561/21/07/2025). All respondents provided informed consent before data collection, and participation in the study was entirely voluntary. To maintain anonymity, the dataset was anonymised, and no personal identifiers were recorded. All procedures involving human participants were conducted in accordance with the ethical standards of the Biomedical Research Ethics Committee of Lusaka Apex Medical University, the National Health Research Authority, and the principles of the Declaration of Helsinki and its subsequent amendments. The study was carried out in accordance with all applicable institutional and national guidelines and regulations.

Results

The study comprised 202 healthcare professionals in total. 76.2% of the respondents worked in clinical departments. Administrative and training personnel accounted for less than 10% of the study, at 3.5% and 3.0%, respectively, whereas 17.3% of the workforce worked in community health (Table 1). Health facilities accounted for the largest share of participants (76.7%), followed by training facilities (14.9%). Private health facilities, supportive services, and healthcare management institutions accounted for smaller percentages.

Nearly a quarter (24.8%) had between one and three years of work experience, half of the respondents (50.0%) had more than six years of professional experience, and 9.9% had less than a year of experience in the health sector. The respondents' reports of Mpox-specific training varied widely: 23.3%, 20.8%, and 20.3% reported monthly, annual, and quarterly training exposure, respectively, while more than one-third (35.6%) reported never receiving Mpox-related training.

Significant shortcomings were evident in institutional preparedness indicators. 39.1% of respondents reported their institutions had no Mpox-specific criteria, compared to just 35.1% who said they did. Similarly, 22.8% of respondents reported having access to appropriate personal protective equipment (PPE), while 60.9% did not. Of the sites, 26.7% were unsure if Mpox-specific management protocols were available, 35.6% had them, and 37.6% had none.

Table 1
Sociodemographic and workplace characteristics of healthcare workers included in the study (N = 202).

Characteristic	Frequency (n)	Proportion (%)
Department		
Clinical	154	76.2
Community	35	17.3
Administrative	7	3.5
Training	6	3.0
Facility type		
Public Health Facility	155	76.7
Training Facility	30	14.9
Private Health facility	8	4.0
Supportive Services	5	2.5
Healthcare Management	4	2.0
Years of Experience		
Less than 1 year	20	9.9
1–3 years	50	24.8
4–6 years	31	15.3
More than 6 years	101	50.0
Frequency of Mpox-related training		
Never	72	35.6
Monthly	47	23.3
Annually	42	20.8
Quarterly	41	20.3
Availability of Mpox guidelines		
Yes	46	22.8
No	123	60.9
Not Sure	33	16.3
Availability of Mpox Protocols		

Characteristic	Frequency (n)	Proportion (%)
Yes	72	35.6
No	76	37.6
Unsure	54	26.7

Institutional Preparedness for Mpox Outbreak Response

Participating facilities differed greatly in their institutional preparedness for a Mpox outbreak (Table 2). There were few resources devoted to Mpox-specific readiness. Just 22.8% of respondents possessed sufficient personal protective equipment (PPE), and only 35.6% reported having access to Mpox-specific instructions. On the other hand, a number of infection prevention and control (IPC) capacities were more accessible: 86.1% of respondents had hand hygiene resources, 89.1% had isolation capacity, 76.2% had screening protocols, and 71.3% had waste processing systems. According to this data, generic IPC infrastructure was far more common than outbreak-specific preparedness resources. The distribution of resources for preparedness is shown in Fig. 1.

The structural preparation construct's good internal consistency (Cronbach's α = 0.74) demonstrated that the institutional preparedness indicators revealed a coherent underlying dimension of structural preparedness. Figure 2 shows how preparedness resources are distributed among facilities, emphasising the difference between relatively strong regular IPC capacities and restricted access to Mpox-specific tools and advice.

Table 2
Distribution of structural preparedness indicators for Mpox outbreak preparedness among healthcare workers in Zambia.

Preparedness Indicator	Available (n)	Available (%)
Isolation Capacity	180	89.1
Hand Hygiene Resources	174	86.1
Screening Procedures	154	76.2
Waste Management Systems	144	71.3
Mpox Protocols	72	35.6
Mpox Guidelines	71	35.1
Adequate PPE Availability	46	22.8

Percentages represent the proportion of participants reporting the availability of each preparedness indicator.

Preparedness Domains Among Healthcare Workers

The four Mpox outbreak readiness domains—symptom knowledge, preventative knowledge, structural preparedness, and preparedness practice—were used to gauge preparedness. With a mean score of 4.82 (SD = 1.56) out of a maximum possible score of 6, or 80.4% of the maximum, structural preparedness showed the best relative performance. The average score for symptom knowledge was 5.65 (SD = 1.89) out of 9 points (62.8%), but the average score for preventative knowledge was 2.95 (SD = 1.29) out of 5 points (59.0%). With a mean of 2.92 (SD = 1.16) out of 5 points (58.4%), preparedness practice scores were significantly lower.

Figure 2 shows the relative performance domains. Knowledge and practice domains had much lower scores, despite structural preparedness scores being generally high. This pattern implies that the existence of institutional resources might not be enough to guarantee healthcare staff' best preparedness practices.

Both the structural preparedness construct (Cronbach's α = 0.74) and the cognitive preparedness construct (acceptable internal consistency) supported their usage as composite indicators in further analyses.

Table 3
Summary statistics and internal consistency estimates for the cognitive, structural, and practice domains of Mpox outbreak preparedness.

Preparedness Domain	**Mean**	**SD**	**Maximum**	**% Maximum**
Symptom knowledge	5.65	1,89	9	62.8
Prevention Knowledge	2.95	1.29	5	59.0
Preparedness Practice	2.92	1.16	5	58.4
Structural preparedness	4.82	1.56	6	80.4
Reliability				
Construct			Cronbach’s α	
Cognitive Preparedness			~ 0.70	
Structural Preparedness			0.74	

SD = Standard Deviation; Cronbach’s α = Cronbach’s alpha coefficient. The percentage maximum was calculated as the observed mean divided by the maximum possible domain score.

Facility-Level Differences in Structural Preparedness

Structural preparedness scores differed significantly across facility types (Kruskal-Wallis $\chi^2 = 13.17$, df = -4, p = 0.010).

The principal distinction between training facilities and health facilities was found by post-hoc pairwise comparisons using Dunn's test (Z = 2.72, adjusted = 0.065), although this link was no longer statistically

significant after Bonferroni adjustment. There was no statistically significant difference between healthcare management organisations, private healthcare facilities, and complementary services. The results indicate that organisational context may affect the availability of outbreak preparedness resources and infection prevention infrastructure, albeit care should be taken when interpreting pairwise differences due to small sample sizes in some facility categories.

These results demonstrate that structural preparation differs among healthcare facilities and justify the inclusion of facility context as a component of the preparedness framework..

Determinants of Mpox Outbreak Preparedness

Factors linked to healthcare professionals' preparedness practice scores were found using a multivariable quasi-Poisson model (Table 3; Fig. 3). About 27% of the observed variation in preparedness practices was explained by the model (Nagelkerke $R^2 = 0.269$).

Among the cognitive determinants examined, knowledge of Mpox symptoms was significantly associated with preparedness practices (IRR = 1.05, 95% CI: 1.02–1.08, $p < 0.001$). Each additional symptom correctly identified was associated with an estimated 5% increase in preparedness practice scores.

Several structural and organisational determinants were also associated with preparedness practices. Respondents who were uncertain about the availability of personal protective equipment (PPE) reported significantly lower preparedness practices scores compared to those reporting no PPE availability (IRR = 0.79, 95% CI: 0.64–0.95, $p = 0.017$). The availability of Mpox-specific protocols was positively associated with preparedness practices, although the relationship did not reach conventional levels of statistical significance (IRR = 1.12, 95% CI: 0.98–1.29, $p = 0.097$).

The model also evaluated the role of facility context, and an association was discovered. Respondents working in healthcare administration institutions reported significantly lower preparedness practice ratings than those working in health facilities (IRR = 0.60, 95% CI: 0.37–0.91, $p = 0.027$). Similarly, respondents at training facilities had lower preparedness practice scores (IRR = 0.80, 95% CI: 0.67–0.95, $p = 0.015$). Figure 3 displays the updated incidence rate ratios and confidence ranges for the final model. The findings as a whole show that organisational, structural, and cognitive factors all affect preparedness practices, with institutional contexts having a particularly significant impact on readiness outcomes.

A Framework for Integrated Preparedness

An empirical framework summarising the elements linked to healthcare workers' preparedness activities is shown in Fig. 4. The results of facility-level investigations, multivariable regression modelling, and preparedness domain assessments were merged to create the framework.

Higher knowledge scores were associated with better readiness performance, and cognitive preparedness, as measured by Mpox symptom knowledge, showed a positive correlation with preparedness measures. In contrast to the impact of structural readiness, this association's magnitude was small.

The best indicator of preparedness practices was found to be structural preparedness. In terms of isolation, hand hygiene, screening, and waste management, facilities often reported high levels of regular infection prevention and control capabilities. However, there were still very few Mpox-specific resources available, including as protocols, recommendations, and sufficient PPE. These results imply that converting institutional readiness into efficient preparedness procedures may depend on the availability of outbreak-specific preparedness resources. The results also showed that preparedness was impacted by organisational context. Respondents who worked in training facilities and healthcare management institutions scored lower on structural preparedness than those who were situated in healthcare facilities. This pattern implies that organisational contexts may indirectly affect preparedness by affecting resource availability and structural readiness.

When taken as one, these results provide credence to a multi-level framework for preparedness, according to which cognitive and structural factors combine to produce preparedness practices. The degree to which these factors translate into an effective epidemic response capability is also influenced by the organisational setting. The approach emphasises structural readiness as the primary means by which healthcare facilities improve their readiness for Mpox response.

Discussion

Cognitive Preparedness and Preparedness Practices

The study discovered a positive correlation between healthcare personnel's readiness behaviours and cognitive preparedness, as determined by their understanding of Mpox symptoms. Participants with higher symptom knowledge scores demonstrated better practices, suggesting that disease-specific knowledge remains an important component of outbreak readiness. This finding is consistent with studies conducted among healthcare workers in Cameroon [5], Vietnam [8], Uganda [7], and Nigeria [19], which reported that greater knowledge of emerging infectious diseases was associated with improved preparedness, case identification, and infection prevention practices.

The observed association is biologically and operationally plausible. Early recognition of symptoms facilitates timely implementation of infection prevention and control measures, improves case detection and reduces opportunities for healthcare-associated transmission. Healthcare workers who are familiar with disease presentation are therefore more likely to identify suspected cases and initiate appropriate preventive actions.

However, the effect of cognitive preparedness was modest compared with that of structural preparedness. This finding suggests that knowledge alone may be insufficient to produce optimal

preparedness practices. Similar observations have been reported by Idowu et al. (2021) and Olum et al. (2024), who noted that healthcare worker readiness depends not only on knowledge acquisition but also on the institutional environments in which the preparedness activities occur [7, 20]. Consequently, educational interventions should be viewed as necessary but insufficient components of preparedness strengthening efforts.

These findings highlight the continued importance of training, capacity building, and professional development programmes while emphasising the need to complement knowledge-based interventions with investments in institutional preparedness and outbreak response capacity.

Structural Preparedness as a Determinant of Preparedness Practice

Structural preparedness emerged as the strongest determinant of preparedness practices in this study, exerting a greater influence than cognitive preparedness. Healthcare workers operating within environments characterised by higher structural preparedness demonstrated better preparedness practices. This finding is consistent with evidence from Uganda, where Kibuule et al. reported that outbreak response capacity depended heavily on the variability of institutional preparedness systems, including infection prevention infrastructure, surveillance mechanisms, and response resources [6]. The results also corroborate more general preparedness literature, indicating that operational resources and organisational support mechanisms are essential elements of disaster preparedness systems, according to Amaratunga et al. [21]Healthcare staff are better prepared when they have clear operational procedures, functional emergency planning mechanisms, and sufficient institutional resources. The significance of institutional protections, including isolation protocols, screening systems, and protective equipment, in lowering the likelihood of transmission was also highlighted in Kuehn et al.'s comprehensive assessment of Mpox infection prevention and control strategies [22].

This study's key finding was that, when assessed as a composite entity, structural preparation was linked to preparedness practices. Individual readiness metrics, on the other hand, did not exhibit meaningful effects on their own. This implies that readiness may not be driven by a single institutional resource. Instead, readiness seems to result from the coordinated action of several interconnected elements. This explanation aligns with models for health system readiness, which conceptualise preparedness as an emergent attribute of several interdependent system components. According to Palagyi et al., outbreak preparation should be viewed as a systems attribute that results from interactions between many health-system domains. Workforce capacity, infrastructure, communication systems, governance, and operational readiness were all recognised by Lee et al. as interrelated components of successful emergency preparedness [13, 14]. This viewpoint is supported by the current findings, which show that the whole readiness environment may have a greater impact than any one preparedness strategy taken separately.

The results also suggest that organisational setting influences structural readiness. Compared to health facilities, healthcare management organisations and training facilities showed lower levels of preparedness, suggesting that preparedness capacity may not be evenly dispersed throughout

healthcare settings. This observation is consistent with qualitative findings published by Ughasoro et al., who found that organisational coordination, resource allocation, and institutional communication systems were significant factors influencing facility preparedness during communicable disease outbreaks [17]. Similar variations in readiness across healthcare settings were also reported by Olum et al. among emergency healthcare workers in Uganda [7].

Collectively, these findings suggest that strengthening preparedness requires more than the provision of isolated resources or stand-alone interventions. Consistent with health-system preparedness frameworks proposed by Palagyi et al., Lee et al., and Meena et al., effective outbreak preparedness may require coordinated investments across multiple institutional domains, including infrastructure, workforce development, communication systems, and organisational support structures [13–15]. Such an approach is likely to generate greater improvements in preparedness practices than interventions targeting individual preparedness components alone.

Toward a Multi-Level Framework for Outbreak Preparedness

The findings of this study support a multi-level conceptualisation of outbreak preparedness in which preparedness practices are influenced by interactions among cognitive preparedness, structural preparedness, and organisational context. While symptom knowledge was positively associated with preparedness practices, structural preparedness practices showed a substantially stronger association with preparedness behaviour than cognitive preparedness practices. Additionally, preparedness varied among organisational settings, indicating that healthcare workers' circumstances and individual competencies both influence preparedness.

The study's key finding is that structural and cognitive preparation scores were higher than preparedness behaviours. Although institutional preparedness resources were relatively high and healthcare professionals indicated moderate levels of Mpox knowledge, preparatory practices did not rise correspondingly. These results imply that readiness habits are not always correlated with the availability of information and preparedness infrastructure. This finding is in line with a larger body of research on readiness, which contends that the availability of resources does not always imply their successful application in day-to-day operations [15]. According to the results, preparedness should be viewed and assessed as a multi-level phenomenon that includes institutional readiness, knowledge, and the conversion of these capacities into regular preparedness practices.

When considered collectively, these results imply that readiness should be seen as a multifaceted concept rather than a strictly personal one. Therefore, training for healthcare professionals should be combined with investments in institutional preparation and organisational ability in order to increase preparedness for Mpox and other emerging infectious illnesses. Such an approach may strengthen the translation of preparedness capacities into effective outbreak response practices.

Strengths, Limitations and Implications for Practice

This study contributes to the growing body of evidence on healthcare worker preparedness for emerging infectious diseases by providing one of the first empirical assessments of Mpox preparedness in Zambia. A key strength of the study was the adoption of the multi-domain approach that examined cognitive, structural, and organisational determinants of preparedness simultaneously. The use of composite preparedness measures, reliability assessment, and multivariable modelling enabled a more comprehensive evaluation of preparedness than would have been possible through isolated assessments of knowledge or institutional resources. Furthermore, the development of an empirical preparedness framework provided a practical synthesis of the factors associated with preparedness practices among healthcare workers.

Several limitations should be considered when interpreting the findings. First, the cross-sectional design limits the ability to establish causal relationships between preparedness determinants and preparedness practices. Also, preparedness practices were assessed through self-report measures and may therefore be subject to social desirability and reporting biases. The study captured preparedness at a single point in time and may not fully reflect changes in preparedness capacity that occur during evolving outbreak situations.

Despite these limitations, the findings have important implications for outbreak preparedness policy and practice. The findings imply that boosting healthcare personnel's knowledge alone is not enough to increase preparedness. Instead, in order to translate preparedness capacities into effective preparedness behaviours, investments in institutional readiness—such as infection prevention infrastructure, preparedness protocols, and organisational support systems—are equally crucial. Therefore, measures for boosting preparedness for Mpox and other emerging infectious disease risks may be more successful if they combine workforce development with institutional and organisational improvement.

Conclusion

Zambian healthcare personnel's readiness for Mpox was influenced by cognitive, structural, and organisational aspects. Improved preparedness behaviour was linked to increased symptom knowledge, underscoring the significance of institutional preparedness in facilitating successful outbreak response. Healthcare personnel stationed in training institutes and healthcare management contexts showed lower levels of preparedness than those in health facilities, indicating that organisational context also influenced preparedness. The results imply that preparation should be viewed as a multi-level construct shaped by interactions between healthcare worker knowledge, institutional resources, and organisational contexts rather than as a solely individual attribute. Crucially, the observed discrepancy between preparedness habits and capacity raises the possibility that knowledge and resources may not be adequate to guarantee the successful application of outbreak-response behaviours.

It will take encompassing strategies that combine workforce training with investments in institutional readiness, infection prevention and control systems, and organisational ability to strengthen

preparedness for Mpox and other emerging infectious diseases. These tactics could enhance the conversion of preparedness capabilities into efficient epidemic response procedures and strengthen health systems.

Declarations

Competing Interests

The authors declare that they have no competing interests.

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The study received no specific funding from any external organisation, agency, or sponsor.

Ethical Approval

Ethical approval was obtained from the Lusaka Apex Medical University Biomedical Research Ethics Committee (Ref; LAMUBREC: No: 0561/21/07/2025). Written informed consent was obtained from all the participants before any data collection activities. Participation was voluntary, and all data were anonymised to ensure confidentiality.

Data Availability

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

Consent for Publication

Not applicable. The manuscript does not contain any individual person’s identifiable data, images, or personal information.

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Author Contribution

JM conceptualised the study, coordinated fieldwork, led data entry and analysis, and drafted the manuscript. RA, CM, HL, and MN contributed to data collection, interpretation, and editing. NRS provided critical revisions. All the authors reviewed and approved the final version of the manuscript

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References

1. Rahi M, Joy S, Sharma A. Public Health Challenges in the Context of the Global Spread of Mpox Infections. Am J Trop Med Hyg. 2023;108:641–5. https://doi.org/10.4269/ajtmh.22-0596.
2. Alakunle E, Emmanuel F, Alakunle, Okeke MI, Malachy Ifeanyi Okeke. Monkeypox virus: a neglected zoonotic pathogen spreads globally. Nat Rev Microbiol. 2022. https://doi.org/10.1038/s41579-022-00776-z.
3. Mohamed Abdoul-Latif F, Ainane A, Mohamed H, Merito Ali A, Houmed Aboubaker I, Jutur PP, et al. Mpox Resurgence: A Multifaceted Analysis for Global Preparedness. Viruses. 2024;16:1737. https://doi.org/10.3390/v16111737.
4. Murray EJ, Mason M, Sparke V, Zimmerman P-AP. Factors Influencing Health Care Workers' Willingness to Respond to Duty during Infectious Disease Outbreaks and Bioterrorist Events: An Integrative Review. Prehospital Disaster Med. 2021;36:321–37. https://doi.org/10.1017/S1049023X21000248.
5. Nka A, Yagai Bouba J, Fokam A, Ka'e JE, Gabisa N, Mandeng, et al. Current knowledge of human Mpox viral infection among healthcare workers in Cameroon calls for capacity-strengthening for pandemic preparedness. Front Public Health. 2024. https://doi.org/10.3389/fpubh.2024.1288139.
6. Kibuule M, Sekimpi D, Agaba A, Halage AA, Jonga M, Manirakiza L, et al. Preparedness of health care systems for Ebola outbreak response in Kasese and Rubirizi districts, Western Uganda. BMC Public Health. 2021;21:236. https://doi.org/10.1186/s12889-021-10273-2.
7. Olum R, Ahaisibwe B, Atuhairwe I, Balizzakiwa T, Kizito PM, Apiyo M, et al. Readiness to manage Ebola Virus Disease among emergency healthcare workers in Uganda: a nationwide multicenter

survey. BMC Health Serv Res. 2024;24:1271. https://doi.org/10.1186/s12913-024-11741-2.

8. Nguyen HTN, Nguyen TV, Tran KV, Nguyen HV, Vo LY, An PL, et al. Healthcare Providers' Knowledge, Attitude, and Practices Regarding Prevention of Mpox in Vietnam. Sage Open. 2024;14:21582440241306827. https://doi.org/10.1177/21582440241306827.
9. Romeo P, Rose M, Colette A, Jennifer O, Badirou A. Assessment of Frontline Health Workers' Capacity for Mpox Case Identification in Emergency Departments of Benin. World J Public Health. 2025;10:580–5. https://doi.org/10.11648/j.wjph.20251004.25.
10. Ndabashinze R, Simiyu BW, Sah S, Mehta R, Bushi G, Balaraman AK, et al. Zambia's first Mpox case: An emerging challenge in Southern Africa amid a global health crisis. New Microbes New Infect. 2024;62:101536. https://doi.org/10.1016/j.nmni.2024.101536.
11. Chipoya M, Sialubanje C, Ngulube D, Kapin'a M, Chikuluma J, Mambo C, et al. The first Mpox case in Zambia: a case report. J Med Case Rep. 2025;19:571. https://doi.org/10.1186/s13256-025-05462-1.
12. UNICEF Zambia. Mpox Rapid Qualitative Assessment Report | UNICEF Zambia 2025. https://www.unicef.org/zambia/reports/mpox-rapid-qualitative-assessment-report (accessed August 4, 2025).
13. Palagyi A, Marais BJ, Abimbola S, Topp SM, McBryde ES, Negin J. Health system preparedness for emerging infectious diseases: A synthesis of the literature. Glob Public Health. 2019;14:1847–68. https://doi.org/10.1080/17441692.2019.1614645.
14. Lee JM, Jansen R, Sanderson KE, Guerra F, Keller-Olaman S, Murti M, et al. Public health emergency preparedness for infectious disease emergencies: a scoping review of recent evidence. BMC Public Health. 2023;23:420. https://doi.org/10.1186/s12889-023-15313-7.
15. Meena P, Abdellatif D, Tiwari V, Chatterjee S, Luyckx VA. Health Systems Preparedness for Infectious Disease Outbreaks: Relevance for Nephrology. Semin Nephrol. 2023;43:151465. https://doi.org/10.1016/j.semnephrol.2023.151465.
16. Lam SKK, Kwong EWY, Hung MSY, Pang SMC, Chiang VCL. Nurses' preparedness for infectious disease outbreaks: A literature review and narrative synthesis of qualitative evidence. J Clin Nurs. 2018;27. https://doi.org/10.1111/jocn.14210.
17. Ughasoro MD, Esangbedo DO, Udorah IM. Health-Care Workers' Perspectives on Preparedness of Health-Care Facilities for Outbreak of Communicable Diseases in Nigeria: A Qualitative Study. Am J Trop Med Hyg. 2019;100:1022–8. https://doi.org/10.4269/ajtmh.18-0404.
18. Chisompola D, Nzobokela J, Chinyante E, Chidima N, Chipipa A, Nyirenda C, et al. Knowledge, attitudes, and practices toward Mpox among laboratory professionals in Zambia: A cross-sectional study. PLoS ONE. 2025;20:e0335365. https://doi.org/10.1371/journal.pone.0335365.
19. Adebimpe WO, Adebimpe WO, Adebimpe W, Adebimpe WO, Adabanija K, Adabanija K et al. Knowledge and practice of preparedness for infectious disease prevention and control among healthcare workers in secondary health care facilities in Osogbo, Nigeria. 2020;2:67–77. https://doi.org/10.46912/jeson.25

20. Idowu OE, Adefolalu AO, Chetty D, Knowledge. Attitude and Preparedness of Healthcare Workers Toward an Outbreak of Ebola Viral Disease. Eur J Med Health Sci. 2021;3:122–7. https://doi.org/10.24018/ejmed.2021.3.3.911.
21. Amaratunga PDCA, O'Sullivan PDTL, Phillips PDKP, Lemyre, PhD L, O'Connor PDE, Dow, MSc D, et al. Ready, aye ready? Support mechanisms for healthcare workers in emergency planning: A critical gap analysis of three hospital emergency plans. Am J Disaster Med. 2007;2:195–210. https://doi.org/10.5055/ajdm.2007.0029.
22. Kuehn R, Fox T, Guyatt G, Lutje V, Gould S. Infection prevention and control measures to reduce the transmission of mpox: A systematic review. PLOS Glob Public Health. 2024. https://doi.org/10.1371/journal.pgph.0002731.

Figures

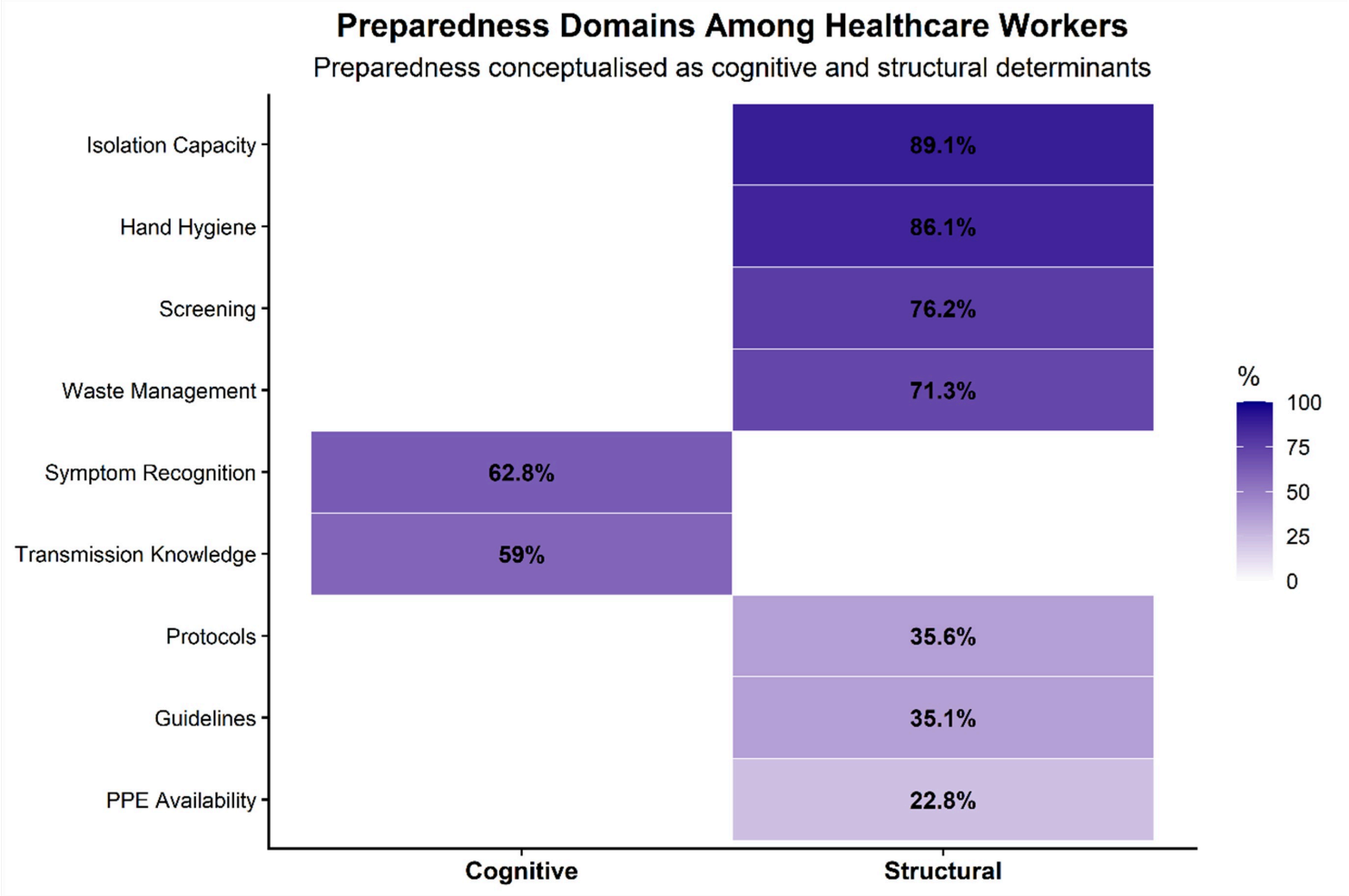


Figure 1

Distribution of Structural preparedness indicators for Mpox outbreak preparedness among healthcare workers in Zambia. Darker shades indicate greater availability of the respective preparedness indicators among study participants.

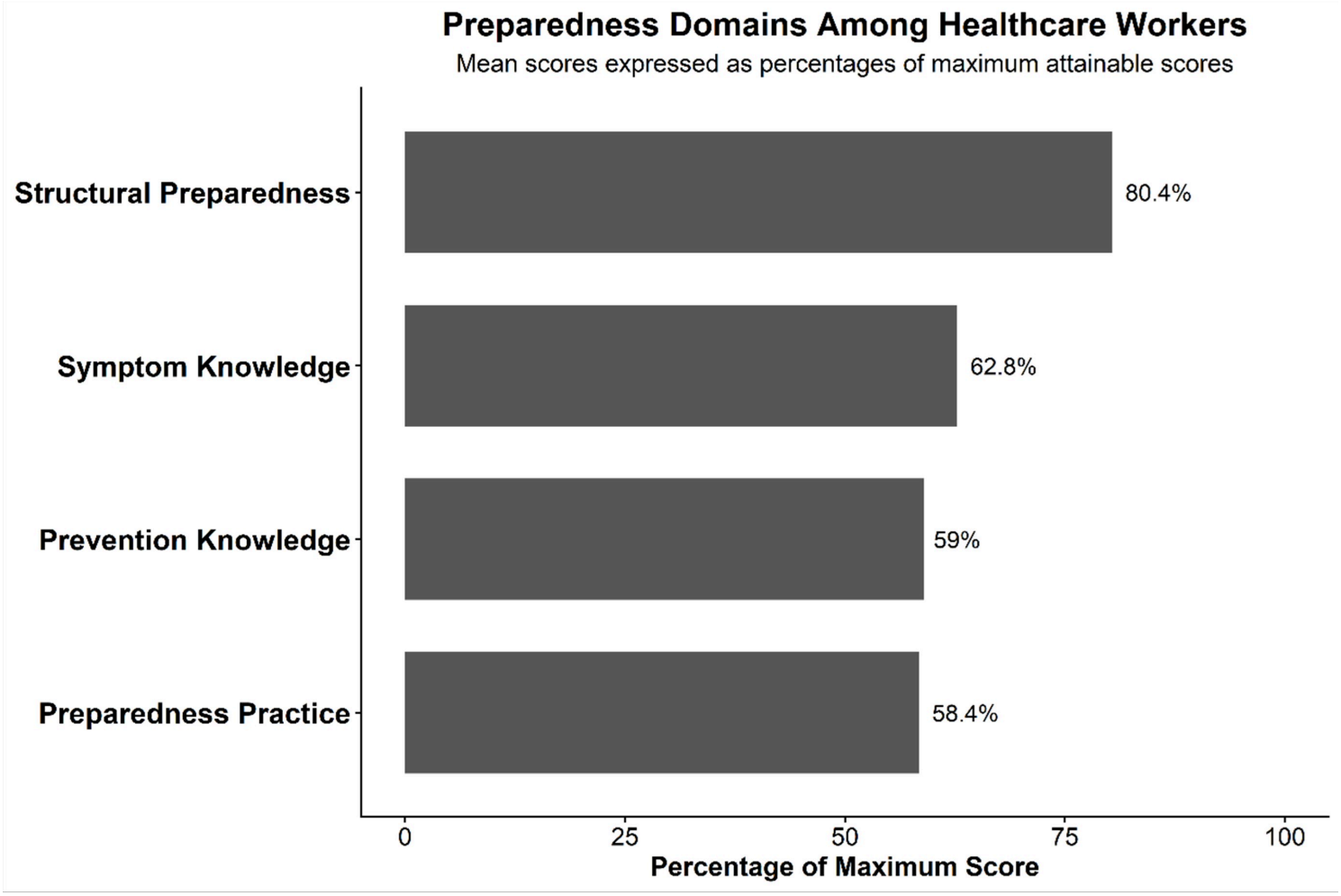


Figure 2

Comparative performance across cognitive, structural and practice domains of Mpox outbreak preparedness among healthcare workers in Zambia. Values are presented as percentages of the maximum possible domain score for each preparedness construct.

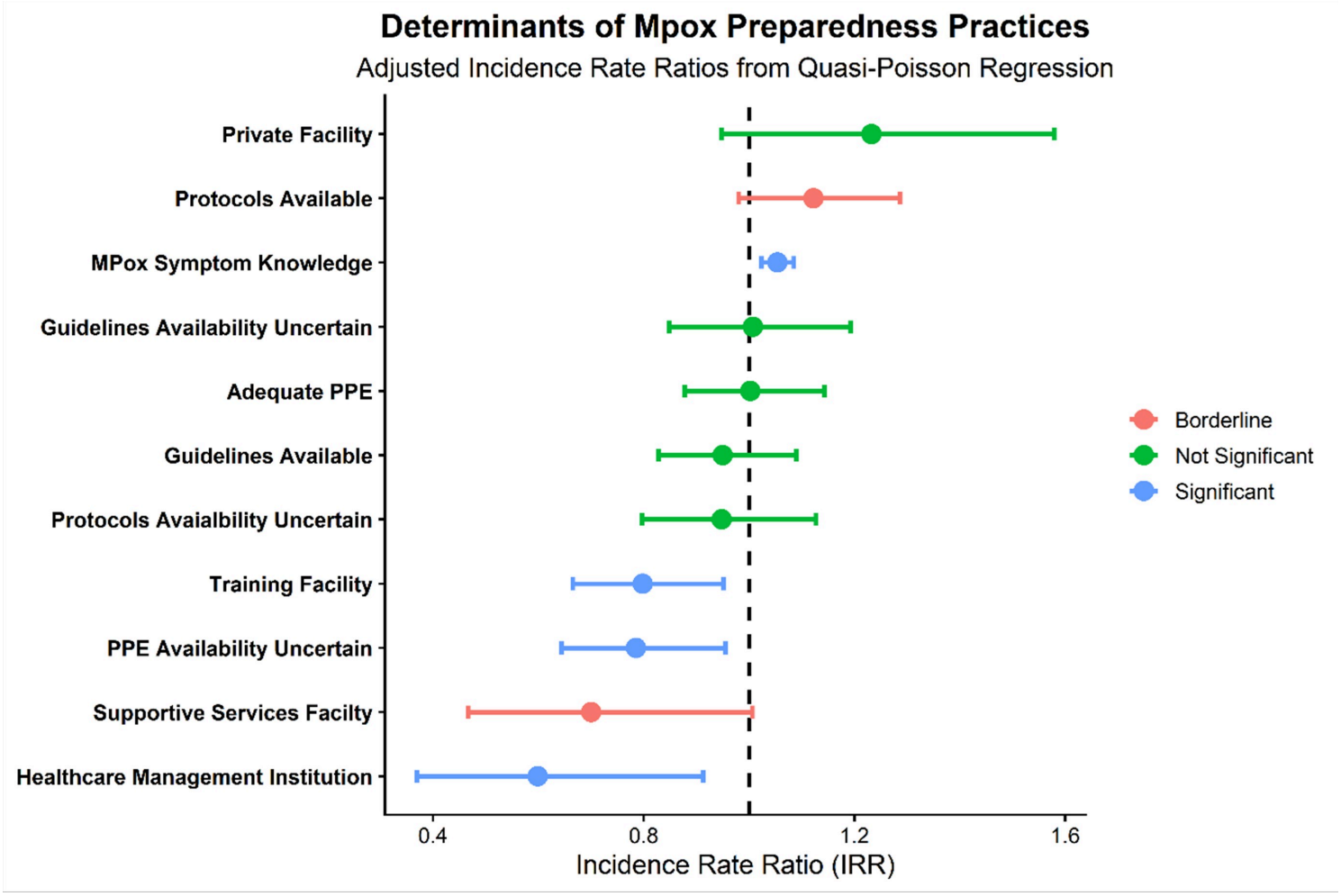


Figure 3

Incidence rate ratios and 95% confidence intervals for factors associated with Mpox outbreak preparedness practices among healthcare workers in Zambia. Incidence rate ratios greater that one indicate a positive association with preparedness practices, whereas values less than one indicate a negative association Horizontal bars represents 95% confidence intervals.

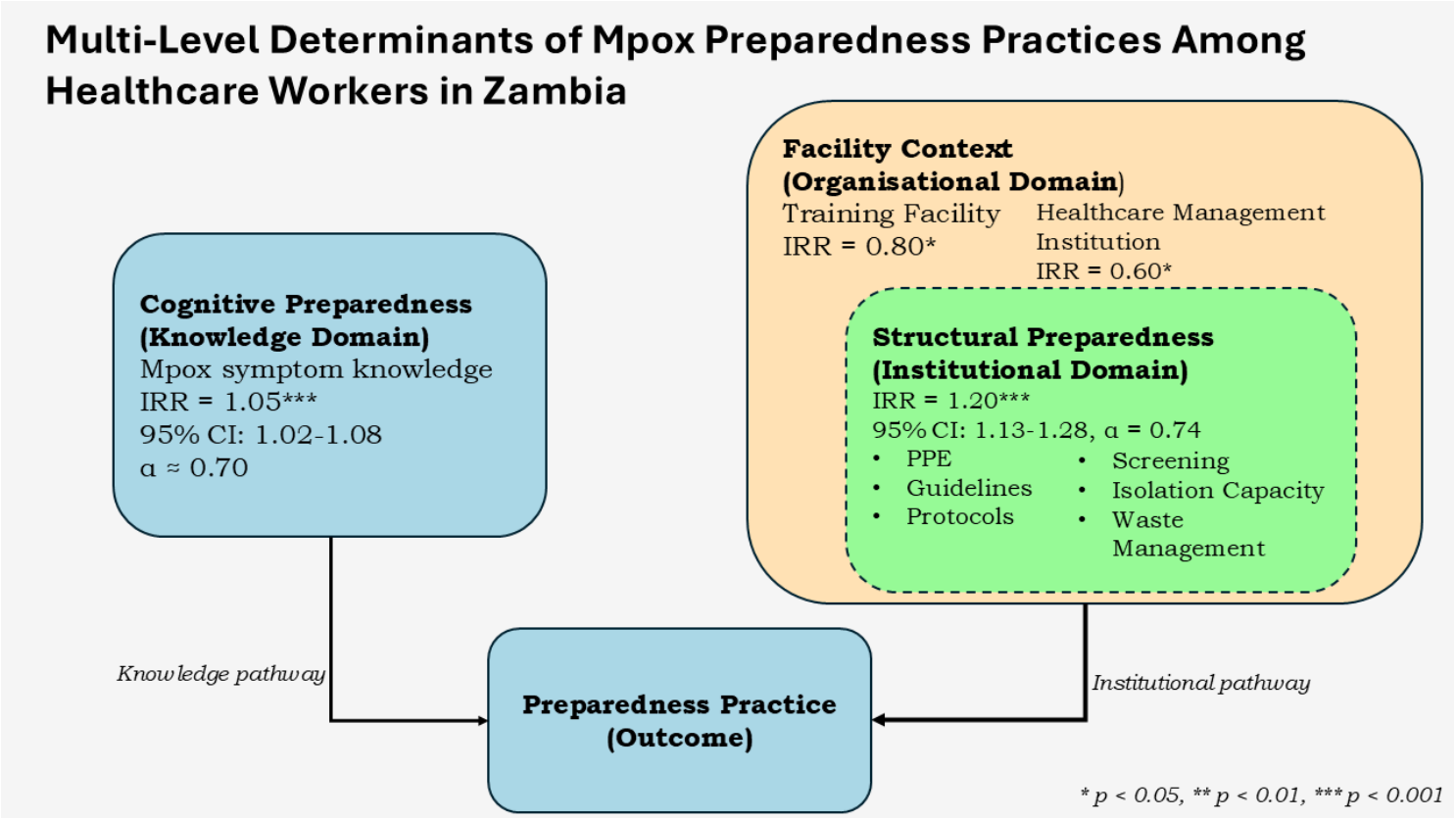


Figure 4

Empirically derived multi-level framework illustrating the relationships between cognitive, structural, and organisational determinants of Mpox outbreak preparedness among healthcare works in Zambia. The framework was developed from the study findings and illustrates the observed relationships between preparedness domains and preparedness practices.