ONLINE FIRST

ORIGINAL ARTICLE

Determinants of Monkeypox Awareness and Vaccination Willingness among Healthcare Workers in Pakistan

Rabbiya Ahmad[1], Sara Ahmad[2], Araj Hussain[3], Shaib Muhammad[4], Ali Qureshi[5], Azfar Athar Ishaqui[6], Narendar Kumar[7*]

[1]*Department of Pharmacy, University of Lahore, Pakistan*
[2]*Bahawal Victoria Hospital, Bahawalpur, Pakistan*
[3]*Bilawal Medical College, Jamshoro, Pakistan*
[4]*Department of Pharmaceutics, Faculty of Pharmacy, University of Sindh, Jamshoro, Pakistan*
[5]*Department of Clinical Pharmacy, School of Pharmaceutical Sciences, Universiti Sains Malaysia, Pulau Pinang, Malaysia*
[6]*Department of Clinical Pharmacy, College of Pharmacy, King Khalid University, Abha, Saudi Arabia*
[7]*Department of Pharmacy Practice, Faculty of Pharmacy, University of Sindh, Jamshoro, Pakistan*
Correspondence: *nkumar.bhojak@usindh.edu.pk*
doi: 10.22442/jlumhs.2025.01381

ABSTRACT

OBJECTIVE: This study assessed the healthcare workers' knowledge, attitudes, perceptions (KAP), and willingness to vaccinate against Monkeypox in Pakistan.

METHODOLOGY: A cross-sectional study was conducted among healthcare workers (HCWs) aged 22 years and older using a self-administered online survey. The participants were enrolled using a convenience sampling technique, a simplified snowball technique, while non-healthcare workers were excluded. Data were analyzed using IBM SPSS software version 26.

RESULTS: A total of 420 participants were included, with a predominance of females (57.1%). Most participants were single (61.4%), university graduates (72.1%), and pharmacists (69.3%) working in the private sector (61.4%) and urban areas (80.7%) of the Sindh region (49.3%). Good knowledge of Monkeypox (Mpox) was observed in 65.7% of participants, with high awareness of the association between Mpox and skin lesions (90.0%) and preventive measures (90.0%). However, only 28.6% were aware of its case-fatality ratio. Predictors of good knowledge included previous awareness of Mpox (aOR 2.24; p<0.001) and concern about Mpox (aOR 2.47; p<0.001), while poor knowledge was associated with being from Sindh (aOR 0.48; p=0.003) or KPK (aOR 0.29; p=0.004). Positive attitudes toward vaccination were associated with being male (aOR 1.91; p = 0.035), working in tertiary care hospitals (aOR 1.86; p = 0.036), and concern about Mpox (aOR 1.95; p = 0.020). Most participants (68.6%) favored free vaccination initiatives.

CONCLUSION: Promoting Monkeypox vaccination among populations may be improved with more deliberate transmission of common information about Mpox among HCWs.

KEYWORDS: Monkeypox, Vaccination, Pakistan, Knowledge, Attitude, Perception

INTRODUCTION

Monkeypox (Mpox) disease is not a newly emerging disease; it was first identified in 1970 in the Democratic Republic of the Congo (formerly Zaire) [1]. However, the Monkeypox virus (MPV) was first identified in 1958[2]. Mpox was endemic to Western and Central Africa and has now spread widely throughout the globe[3]. The virus had received little attention from the international community until the first case was reported in the USA on May 17, 2022 [4]. On July 23, 2022, the World Health Organization (WHO) declared the multinational outbreak of Mpox as a public health emergency of global concern[5]. As of March 20, 2024, over 94,000 cases and around 180 deaths have been reported around the globe [6].

Pakistan confirmed its first case of Mpox on April 21, 2023, in a traveler from Saudi Arabia [7]. Recently, in May 2023, various cases of Mpox have been reported from Karachi and Islamabad, raising concern among the masses [8]. Even though vaccinations and therapies are available, the WHO suggests that controlling Mpox transmission requires robust public health surveillance, prompt diagnosis, and effective clinical management [9]. However, this suggestion necessitates practitioners to possess the expertise to recognize and manage Mpox. The literacy rate in Pakistan is very low [10], which makes communicating public health information challenging. On the other hand, the country is currently facing a significant shortage of healthcare professionals and workers due to its growing population [11]. According to a survey study of over 459 general practitioners, it was found that only 34% had experienced more than 10 years of practice. It was revealed that a high workload among general practitioners hindered their ability to keep up-to-date knowledge [12]. According to another report, general practitioners in both government and private settings typically address the majority of primary healthcare needs. However, most practitioners have not even acquired postgraduate training [13]. Therefore, considering previous studies on knowledge-based research among healthcare providers [14], we are conducting this research to determine the updated knowledge among healthcare providers in Pakistan.

This study explored KAPs towards Mpox and vaccination willingness among HCWs in Pakistan to support the development of targeted educational programs and effective disease control measures during the ongoing outbreak.

METHODOLOGY

Study design and setting

This study employed a cross-sectional design, utilizing a self-administered online survey conducted via Google Forms. The research was conducted on diverse HCWs from various healthcare settings in Pakistan between 01-08-2023 and 30-10-2023. Participants from different professional backgrounds were invited, including general practioners, pharmacists, and other allied health workers.

Study instrument

The study instrument used in this research was adapted from previous studies [1, 15]. The online questionnaire was developed in English and administered through Google Forms. The instrument included relevant information about the background of the research study, confidentiality assurance statements, and a statement regarding voluntary participation. The survey comprised of 04 sections: 1) sociodemographic characteristics and two questions regarding the previous knowledge about Mpox before 2022, and sense of worry about Mpox, 2) a section for knowledge-based items 3) section for attitude-based items regarding vaccination against Mpox and 4) section for perception-based items toward Mpox.

Inclusion and exclusion criteria

The study targeted HCWs aged 22 years and older with English understanding and who had access to the Internet. Participants were instructed to access the online survey by clicking the provided link. After clicking the link, an informed consent statement appeared, outlining the requirements for voluntary participation. Only those individuals who agreed to participate were able to proceed to the following sections. Responses from individuals outside the healthcare field were excluded to focus on the intended population.

Data collection

The participants were invited to participate in data collection by being sent hyperlinks through communication platforms such as WhatsApp and Facebook Messenger. They were also sent occasional reminders to improve the response rate. Convenient sampling was employed, utilizing a simplified snowball sampling technique to enrol study participants. The survey was restricted to one response per participant, using their unique email address.

Measures

The knowledge section consisted of sixteen closed-ended components; participants could respond either "True", "False", or "Don't know". Every correct and wrong answer was allotted 1 and 0 points, respectively. The participants could get a total score between 0 to 16 points; a higher score (10 points or above) indicated good knowledge about Mpox.

The participants' attitude was measured using four statements based on their willingness to get vaccinated against Mpox. Each statement was rated on a 5-point Likert scale (1-point for strongly disagree to 5-points for strongly agree). The participants could get a total score between 0 to 20 points. The total attitude score was measured by summing all the values; a higher score (12 points or above) indicated a positive attitude toward getting a vaccination against Mpox.

Four statements assessed participants' perception. Each statement was rated on a scale of 5 points (1 point for "least likely" to 5 points for "most likely"). Participants could earn a total score between 0 and 20 points. A higher attitude score (12 points or above) indicated a positive perception towards Mpox.

Statistical Analysis

Data analysis was carried out using IBM SPSS software version 26. Categorical variables were summarised in terms of frequencies and percentages. Univariable and multivariable binary regression analyses were used to determine the factors associated with Mpox knowledge, vaccination attitudes, and perceptions regarding Mpox. A p-value of ≤0.05 was considered statistically significant.

RESULTS

Sociodemographic characteristics

A total of 420 participants were included in this study, with the majority being female (57.1%) and aged 21 to 30 years (72.1%). A significant number of participants were single (61.4%) and university graduates (72.1%). Regarding professional background, the most significant proportion of participants were pharmacists (69.3%), followed by physicians (19.3%) and nurses (7.1%), who worked in the private sector (61.4%) and were affiliated with tertiary care hospitals (42.1%) from urban (80.7%) and rural (19.3%) areas of Pakistan. A large proportion of all participants were residents of Sindh province (49.3%), followed by Punjab (35.0%), and so on. In terms of knowledge of Mpox, more than half of the participants (56.4%) were unaware of Mpox disease before 2022. Furthermore, most were worried about Mpox (70.0%), as shown in **Table I**.

Table I: Participants' sociodemographic characteristics (n=420)

Characteristics	Categories	N (%)
Gender	Female	240 (57.1)
	Male	180 (42.9)
Age in years (Mean±SD)	29.3 ± 6.6	
Age groups	22-30	303 (72.1)
	31-40	99 (23.6)
	41 and above	18 (4.3)
Marital Status	Single	258 (61.4)
	Married	159 (37.9)
	Separated/Widowed	3 (0.7)
Highest qualification	Graduate	303 (72.1)
	Postgraduate	117 (27.9)
Profession	Physician	81 (19.3)
	Pharmacist	291 (69.3)
	Nursing staff	30 (7.1)
	Other*	18 (4.3)
Workplace	Tertiary care	177 (42.1)
	Secondary care	63 (15.0)
	Primary care	147 (35.0)
	Pharmacy	33 (7.9)
Type of organization	Public sector	159 (37.9)
	Private sector	258 (61.4)
Experience	1-3 years	246 (58.6)
	4-6 years	78 (18.6)
	>6 years	96 (22.9)
Area	Rural	81 (19.3)
	Urban	339 (80.7)
Region	Sindh	207 (49.3)
	Punjab	147 (35.0)

	Khyber Pakhtunkhwa	30 (7.1)
	Azad Kashmir	6 (1.4)
	Baluchistan	21 (5.0)
	Gilgit	9 (2.1)
Aware of Mpox before 2022	No	237 (56.4)
	Yes	183 (43.6)
Worried of Mpox	No	126 (30.0)
	Yes	294 (70.0)

* Medical technologists, Laboratory technicians, Nutritionists, Physiotherapists;

Participants' Knowledge of Mpox

By assessing participants' overall knowledge regarding the Mpox virus, it was found that most participants exhibited good knowledge (65.7%). Specifically, a majority of participants were aware of the association between Mpox infection and typical skin lesions (90.0%). Similarly, a significant proportion of participants recognized that Mpox infection could be prevented by implementing standard measures (90.0%). However, it is worth mentioning that only a limited number of participants had accurate knowledge regarding the case-fatality ratio of Mpox (n = 120, 28.6%), as shown in **Table II**.

Table II: Knowledge of participants about Mpox (n=420)

Variables	Correct, N (%)
The Mpox virus was recently discovered.	318 (75.7)
It circulates only among primates, including humans.	279 (66.4)
It manifests with symptoms similar to influenza	207 (49.3)
Mpox infection appears with typical skin lesions.	378 (90.0)
Patients without symptoms may spread the Mpox virus to others.	129 (30.7)
In Europe, Mpox cases are mostly travel-associated.	303 (72.1)
There isn't any specific vaccine approved for Mpox.	288 (68.6)
There isn't any specific drug approved for Mpox.	300 (71.4)
Recipients of smallpox vaccine may further require vaccination shots to be protected from Mpox	282 (67.1)
Children infected with Mpox pose more severe illnesses than adults.	249 (59.3)
It is associated with a high rate of systemic complications	288 (68.6)
The Mpox virus causes synchronous skin rashes	276 (65.7)
Mpox infection can be prevented by the implementation of standard measures	378 (90.0)
It can survive on contaminated surfaces for several days	270 (64.3)
Mode of transmission	306 (72.9)
The case-fatality ratio of Mpox	120 (28.6)
Levels of knowledge	
Good knowledge	276 (65.7)
Poor knowledge	144 (34.3)

Mpox: Monkeypox

Participants' Attitudes Towards Vaccination against Mpox

A comprehensive snapshot of the participants' attitudes towards vaccination against Mpox determined that a substantial proportion of participants strongly agreed (30.7%) towards receiving the smallpox vaccine to prevent Mpox infection. Furthermore, around two-fifths of participants (42.9%) demonstrated a strong agreement to receive the Mpox vaccine when it becomes available. Regarding the payment for vaccination, a relatively small number of participants (20.0%) expressed a strong willingness to cover the vaccination cost. In contrast, the majority of participants (68.6%) strongly agreed or agreed with vaccination if it were made free by the government.

Participants' Perception Towards Mpox

Regarding participants' perception towards Mpox, a substantial proportion (37.1%) believed that Mpox is a severe infection. In contrast, fewer participants (12.1%) thought it was a frequently occurring infection. On the other hand, a notable proportion of participants (n = 126, 30.0%) expressed a strong sense of concern about the status of Mpox as a public health threat. Regarding the impact of Mpox on routine activities, a modest proportion of participants (18.6%) strongly agreed that Mpox could have a significant impact on their routine activities.

Predictors of good knowledge

After controlling for confounders through multivariable regression, the factors linked with good Mpox knowledge were being a pharmacist (aOR, 0.56; 95% CI, 0.33-0.92; p=0.024), working at a tertiary care hospital (aOR, 0.52; 95% CI, 0.32-0.85; p=0.009), previous knowledge about Mpox (aOR, 2.24; 95% CI 1.41-4.05, p<0.001) and worried about Mpox (aOR, 2.47; 95% CI 1.51-4.05; p<0.001). Conversely, we also found factors linked with poor knowledge were working in pharmacy (aOR, 0.24; 95% CI, 0.10-0.65; p=0.001), from Sindh (aOR, 0.48; 95% CI, 0.30-0.78; p=0.003), and Khyber Pakhtunkhwa (KPK) (aOR, 0.29; 95% CI, 0.13-0.68; p=0.004), as shown in **Table III**.

Table III: Predictors of good knowledge using binary logistic regression (n=420)

Variables	Univariable 95% CI	p-value	Multivariable 95% CI	p-value
Gender				
Female	1			
Male	0.73 (0.39-1.09)	0.131	----	----
Academic				
Graduate	1			
Postgraduate	0.91 (0.58-1.42)	0.665	----	----
Profession				
Physician	2.07 (1.17-3.65)	0.012	----	----
Pharmacist	0.66 (0.42-1.03)	0.068	0.56 (0.33-0.92)	**0.024**
Nurse	0.77 (0.36-1.64)	0.490	----	----
Others*	1.04 (0.38-2.85)	0.931	----	----
Place of Work				
Primary care/ Clinic	2.02 (1.29-3.16)	0.002	----	----
Secondary care	1.36 (0.76-2.45)	0.301	----	----
Tertiary care	0.69 (0.46-1.05)	0.084	0.52 (0.322-0.85)	**0.009**
Pharmacy	0.27 (0.13-0.56)	**<0.001**	0.24 (0.10-0.56)	**0.001**
Sector				
Public	1			
Private	0.77 (0.50-1.17)	0.220	----	----
Region				
Sindh	0.65 (0.44-0.98)	**0.040**	0.48 (0.30-0.78)	**0.003**
Punjab	1.29 (0.84-1.98)	0.245	----	----
KPK	0.49 (0.23-1.04)	0.064	0.29 (0.13-0.68)	**0.004**
Baluchistan	0.52 (0.11-2.59)	0.422	----	----
Aware of Mpox before 2022				
No	1			
Yes	2.20 (1.44-3.36)	**<0.001**	2.24 (1.41-4.05)	**<0.001**
Worried about Mpox				
No	1			
Yes	2.27 (1.47-3.49)	**<0.001**	2.47 (1.51-4.05)	**<0.001**

**Medical technologists, Laboratory technicians, Nutritionists, Physiotherapists;*

Predictors of positive attitudes

After controlling for confounders through multivariable regression, the factors linked with positive attitudes towards vaccination against Mpox were being male (aOR, 1.91; 95% CI, 1.05-3.51; p=0.035), working in tertiary care hospital (aOR, 1.86; 95% CI, 1.04-3.31; p=0.036), who were worried about Mpox (aOR, 1.95; 95% CI, 1.11-3.43; p=0.020). However, being allied HCW (aOR, 0.17; 95% CI, 0.05-0.50; p=0.001), from KPK (aOR, 0.36; 95% CI, 0.14-0.92; p=0.032) were linked with a negative attitude towards vaccination against Mpox, as shown in **Table IV**.

Table IV: Predictors of positive attitude using binary logistic regression (n=420)

Variables	Univariable	p-value	Multivariable	p-value
	95% CI		95% CI	
Gender				
Female	1			
Male	1.48 (0.92-2.39)	0.105	1.91 (1.05-3.51)	**0.035**
Academic				
Graduate	1			
Postgraduate	0.76 (0.46-1.25)	0.284	----	----
Profession				
Physician	1.80 (0.93-3.49)	0.080	1.90 (0.92-3.94)	0.084
Pharmacist	1.32 (0.81-2.15)	0.259	----	----
Nurse	0.64 (0.28-1.45)	0.285	----	----
Others*	0.12 (0.05-0.35)	**<0.001**	0.17 (0.05-0.50)	**0.001**
Place of work				
Primary care/ Clinic	0.11 (0.43-1.09)	0.113	----	----
Secondary care	1.25 (0.63-2.45)	0.522	----	----
Tertiary care	1.43 (0.89-2.31)	0.142	1.86 (1.04-3.31)	**0.036**
Pharmacy	0.74 (0.33-1.65)	0.461	----	----
Sector				
Public	1			
Private	1.46 (0.91-2.32)	0.114	1.72 (0.97-3.03)	0.060
Region				
Sindh	0.88 (0.56-1.41)	0.611	----	----
Punjab	1.42 (0.86-2.34)	0.173	----	----
KPK**	0.39 (0.18-0.85)	**0.018**	0.36 (0.14-0.92)	**0.032**
Baluchistan	-----		----	----
Aware of Monkeypox before 2022				
No	1			
Yes	1.85 (1.14-3.00)	**0.013**	1.58 (0.95-2.649)	0.076
Worried about Mpox				
No	1			
Yes	1.66 (1.03-2.69)	**0.039**	1.95 (1.11-3.43)	**0.020**

**Medical techno logistics, Laboratory technicians, Nutritionists, Physiotherapists*

DISCUSSION

Mpox is the talk of the town nowadays due to its global spread. However, it is crucial to acknowledge that Mpox remains unfamiliar to a large population around the globe, including individuals from developing countries, HCWs, and policymakers [16]. Consequently, it becomes imperative to promptly spread the knowledge about the disease and leverage the scientific community and media to establish a positive attitude among HCWs.

This study provides crucial sociodemographic information among HCWs. Our study provides a comprehensive overview of the participants' knowledge regarding various aspects of Mpox. A majority of participants were aware that Mpox is a recently discovered virus and that it circulates among primates, including humans. In comparison with other studies, our study reveals a high level of knowledge regarding the disease and its symptoms. A study conducted in Italy showed that physicians had knowledge gaps regarding the disease and were uncertain about the diagnosis of Mpox[17]. According to another study conducted in Indonesia, out of 432 general practitioners, 10.0% knew Mpox [18]. According to a cross-sectional survey, only 119 (30.59%) of 389 active medical professionals in Bangladesh were found to have a good understanding of monkeypox [19]. The lack of knowledge stems from the fact that most physicians are young and have not encountered cases of Mpox or received basic training. They lack basic education regarding the virus. However, the participants displayed relatively weaker knowledge in some areas. For instance, a limited number of participants were aware that asymptomatic individuals can still transmit the Mpox virus to others. The results of this report are in line with the study conducted by Benjamin R. Bates in Ohio, USA, according to which nothing is known about the fact that children are just as likely as adults to have systemic issues from Mpox. Clinicians should be aware that Mpox can spread through direct contact with lesions or bodily fluids, respiratory droplets, exposure to contaminated surfaces, and on contaminated surfaces[1].

Since endemic Mpox cases are relatively new to countries outside Central Africa, studies are required in various areas, including the disease's treatment and prevention, as well as the development of vaccinations against this virus[21]. In our study, the findings reveal a range of perspectives regarding the acceptance and accessibility of vaccines for Mpox prevention. Participants most often strongly agreed (44.3%) to receive the smallpox vaccine. This suggests that a sizable portion of people support the use of the smallpox vaccination as a tool for Mpox prevention. The affirmative response indicates that utilizing an existing vaccination to combat this infectious disease is considered valuable.

Additionally, nearly half of the respondents (42.9%) showed significant interest in receiving the vaccination when it becomes available. Such a mindset is consistent with a prior study on the KAP of HCWs regarding vaccination, which found that a generally favorable attitude toward a particular vaccine or a collection of vaccines is typically associated with a higher level of acceptance of new interventions (in this case, Mpox) [22, 23]. In contrast to these studies, some studies differ from this. HCWs may not always have a favorable attitude about vaccinations [24, 25]. Despite possessing a scientific background and medical expertise, they often have significant knowledge gaps and misconceptions, particularly regarding vaccination and infectious diseases. There is some evidence to suggest that even HCWs may be more strongly impacted by emotional and personal reasons than by their logical comprehension of a given subject in their views regarding vaccination [22, 26]. According to the findings, only a small percentage of individuals (20.0%) indicated that they would be extremely eager to pay for the immunization. This implies that there may be financial obstacles preventing specific individuals from receiving the Mpox

vaccine. This suggests that removing financial restrictions could greatly enhance public acceptance and vaccination rates. Policymakers, healthcare professionals, and other relevant authorities can use these findings to establish initiatives that will encourage vaccination, handle budgetary issues, and guarantee that the Mpox vaccine is available to the public.

In the multivariable regression analysis that controlled for confounders, several variables were still shown to be strongly correlated with opinions on Mpox vaccination. First, it was found that having a positive attitude towards Mpox vaccination was significantly associated with being male (aOR, 1.91; 95% CI, 1.05-3.51; p = 0.035). This suggests that, given men's more positive views, gender may play a role in shaping perceptions and attitudes toward vaccination.

Second, having a good attitude was associated with working in a tertiary care hospital (aOR, 1.86; 95% CI, 1.04-3.31; p = 0.036). This finding suggests that individuals working in tertiary care settings may be more likely to be exposed to knowledge or networks of professionals that influence their favourable opinions toward Mpox immunization. Further highlighting the importance of worries or anxieties in forming favorable attitudes toward vaccination, participants who indicated worry about Mpox (aOR, 1.95; 95% CI, 1.11-3.43; p = 0.020) were more likely to have a positive attitude.

Contrarily, even after controlling for covariates, being an allied HCW (aOR, 0.17; 95% CI, 0.05-0.50; p=0.001) and being from the KPK region (aOR, 0.36; 95% CI, 0.14-0.92; p=0.032) continued to be significantly associated with a negative attitude towards vaccination against Mpox. These results are consistent with a study from Nepal [27]. This implies that, despite taking into account any confounding variables, people in these groups still have doubts or worries about immunization.

In Pakistan, no comprehensive study has been conducted among HCWs regarding the evaluation of knowledge, attitudes, perceptions, and willingness to vaccinate against Mpox to date. Our study is the first of its kind, giving deep information regarding KAP and vaccination status against Mpox.

CONCLUSION

These conclusions emphasize that perception (37.1%) and knowledge of Mpox (67.5%) among HCWs were favorable. The willingness to get vaccinated was high among HCWs (42.9%). The findings highlight the importance of strengthening awareness about Mpox and its prevention. Organizing practical training and knowledge-sharing sessions for doctors may serve as a pragmatic approach to enhance current preparedness and improve the response to potential future outbreaks.

ACKNOWLEDGMENT

We thank all the participants who generously donated their time to participate in this research.

Ethical permission: University of Sindh, Jamshoro, Pakistan, Institutional Bioethics Committee, IRB letter No. ORIC/SU/1509.
Conflicts of interest: The Authors reported no conflicts of interest.
Funding: No funding was received for this work.
Data Sharing Statement: The corresponding author can provide the data proving the findings of this study on request. Privacy or ethical restrictions bound us from sharing the data publicly.

AUTHOR CONTRIBUTION

Ahmad R: Study concept, drafting and revising for important intellectual content
Ahmad S: Data collection, and revise the initial draft for important intellectual content
Hussain A: Data collection, revisions of the initial idea
Muhammad S: Data collection and drafting
Qureshi A: Statistical analysis and interpretation of data
Ishaqui AA: Methodology and statistical analysis
Kumar N: Study concept and design, critical analysis, expert opinion

REFERENCES

1. Bates BR, Grijalva MJ. Knowledge, attitudes, and practices towards monkeypox during the 2022 outbreak: An online cross-sectional survey among clinicians in Ohio, USA. J Infect Public Health. 2022;15(12):1459-1465.
2. Peng X, Wang B, Li Y. Perceptions and worries about monkeypox, and attitudes towards monkeypox vaccination among medical workers in China: A cross-sectional survey. J Infect Public Health. 2023;16(3):346-353.
3. Sardana K, Sachdeva S, Thole A. A Need to Focus on the Atypical Features and Pronounced STD Transmission of Monkey Pox and the Emergent Role of Dermatologists in Breaking its Transmission. Indian J Dermatol. Sep-Oct 2022; 67(5):556-559. doi:10.4103/ijd.ijd_611_22
4. Hraib M, Jouni S, Albitar MM, Alaidi S, Alshehabi Z. The outbreak of monkeypox 2022: An overview. Ann Med Surg. 2022;79:104069.
5. Sallam M. A-MK, Al-Tammemi AB, Alkurtas M, Mirzaei F, Kareem N, Al-Naimat H 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. Healthcare. 2022; 10: 1722.
6. Organization WH. 2022-23 Mpox (Monkeypox) Outbreak: Global Trends. Accessed March 31, 2024. Available from: https://worldhealthorg.shinyapps.io/mpx_global/#section-fns2.
7. Abdullah, AS, Cancado FA, de Oliveira CA. The emergence of Monkeypox virus, new challenges to the healthcare settings in Pakistan. J Med Virology. 2023; 95(1):e27899.
8. Ata I, Riaz N, Mallhi TH. Monkeypox: A Rising Health Concern in Pakistan and Wake-Up Call for the Government. Disaster Medicine and Public Health Preparedness. 2023;17:e376.
9. Rabaan AA, Al-Shwaikh SA, Alfouzan WA. A Comprehensive Review on Monkeypox Viral Disease with Potential Diagnostics and Therapeutic Options. Biomedicines. 2023;11(7):1826.
10. Rehman Au, Bin Naeem S, Faiola A. The prevalence of low health literacy in undergraduate students in Pakistan. Health Inform Libraries J. 2023;40(1):103-108.
11. Abdullah MA, Wazir S, Gilani I, Gorar Z, Shaikh BT. The health workforce crisis in Pakistan: a critical review and the way forward. World Health Popul. 2014; 15(3):4-12.
12. Elnaga HHA, Ahmed MB, Fathi MS, Eissa S. Virtual versus paper-based PBL in a pulmonology course for medical undergraduates. BMC Med Educ. 2023; 23(1): 1-10.
13. SR. S. The case for family medicine in Pakistan. J Pak Med Assoc. 2015; 65:660–4.
14. Player E SA, Steel N, Rodrigues V. Massive open online courses for continuing professional development of GPs. InnovAiT. 2020; 13:522–7
15. Kumar N, Ahmed F, Raza MS. Monkeypox cross-sectional survey of knowledge, attitudes, practices, and willingness to vaccinate among university students in Pakistan. Vaccines. 2022;11(1):97.
16. Khan S, Akbar SMF, Yahiro T, Al Mahtab M, Kimitsuki K, Nishizono A. Unprecedented rise of monkeypox in Europe and America: Are Asian countries ready for a new outbreak during the ongoing COVID-19 pandemic? J Glob Health. 2022; 12
17. Riccò M, Ferraro P, Camisa V. When a neglected tropical disease goes global: Knowledge, attitudes and practices of Italian physicians towards monkeypox, preliminary results. Trop Med Infect Dis. 2022;7(7):135.

18. Harapan H, Setiawan AM, Yufika A. Confidence in managing human monkeypox cases in Asia: A cross-sectional survey among general practitioners in Indonesia. Acta tropica. 2020;206:105450.
19. Hasan M, Hossain MA, Chowdhury S. Human monkeypox and preparedness of Bangladesh: A knowledge and attitude assessment study among medical doctors. J Infect Public Health. 2023; 16(1):90-95.
20. Velavan TP, Meyer CG. Monkeypox 2022 outbreak: an update. Trop Med Int Health. 2022; 27(7): 604-605.
21. Gutiérrez A, Rodríguez-Morales A, ÁJ NM. Colombian consensus recommendations for diagnosis, management and treatment of the infection by SARS-COV-2/COVID-19 in health care facilities-Recommendations from expert' s group based and informed on evidence. 2020;
22. Betsch C, Wicker S. Personal attitudes and misconceptions, not official recommendations, guide occupational physicians' vaccination decisions. Vaccine. 2014;32(35):4478-4484.
23. Santos AJ, Kislaya I, Machado A, Nunes B. Beliefs and attitudes towards the influenza vaccine in high-risk individuals. Epidemiology & Infection. 2017;145(9):1786-1796.
24. Larson H. Vaccine hesitancy among healthcare workers and their patients in Europe: A Qualitative Study. ECDC; 2015.
25. MacDonald NE. Vaccine hesitancy: Definition, scope and determinants. Vaccine. 2015;33(34):4161-4164.
26. Riccò M, Ferraro P, Peruzzi S, Balzarini F, Ranzieri S. Mandate or not mandate: Knowledge, attitudes, and practices of Italian occupational physicians towards SARS-CoV-2 immunization at the beginning of vaccination campaign. Vaccines. 2021;9(8):889.
27. Das SK, Bhattarai A, KC S. Sociodemographic determinants of the knowledge and attitude of Nepalese healthcare workers toward human monkeypox: a cross-sectional study. Front Public Health. 2023; 11: 1161234.