



Elsevier has created a [Monkeypox Information Center](#) in response to the declared public health emergency of international concern, with free information in English on the monkeypox virus. The Monkeypox Information Center is hosted on Elsevier Connect, the company's public news and information website.

Elsevier hereby grants permission to make all its monkeypox related research that is available on the Monkeypox Information Center - including this research content - immediately available in publicly funded repositories, with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the Monkeypox Information Center remains active.



Vacunas

www.elsevier.es/vac



Letter to the Editor

The global reemergence of human Monkeypox; is mass vaccination essential?

Reemergencia global de la viruela del simio en humanos; ¿es esencial la vacunación masiva?

Monkeypox virus (MPXV) is a double-stranded DNA virus that belongs to the genus *Orthopoxvirus*, family *Poxviridae*; this virus was identified for the first time following an outbreak of pustular disease in a macaque colony in Denmark in 1959.¹ Monkeypox is considered as causative agent of the zoonotic disease monkeypox which was recognized as a human pathogen in the Democratic Republic of the Congo (DRC, formerly Zaire) during early 1970s. Outside of Africa, in 2003 an outbreak in the United States was associated with rodents imported from Ghana, and human-to-human transmission did not occur.² This virus is genetically classified in 2 distinct clades, the Congo Basin clade which is associated to higher virulence and mortality rate (10%), and the West African clade with a lower mortality rate (<3%) that was responsible for recent outbreaks in Nigeria.³ After 39 years without recognition of human monkeypox cases in Nigeria, an outbreak was reported with 118 confirmed MPXV cases in September 2017.⁴ Moreover, there were 183 confirmed cases throughout 18 states in Nigeria during November 2019.⁵ In recent years, the number of cases and geographic spread of monkeypox have been increasing, possibly because of waning immunity to smallpox and the recent monkeypox outbreak has gone global.^{6–8} There have been 920 confirmed and 70 suspected cases in at least 30 non-African countries as to June 5, 2022.⁴ The current epidemiological investigations showed recent MPXV outbreaks, mainly caused by the West Africa clade, occurred following travel and/or international exportations of animal carriers.^{4,5}

However, there is shifting in demographics of this outbreak that might shed light into reasons behind the reemergence of monkeypox in West Africa. Mauldin et al., 2022 suggested new MPXV cases with new variations in the Bayelsa, Delta, and Rivers states with unidentified source pool.^{9,10} Bunge et al. (2022) recently revealed changing epidemiology of human monkeypox; they found median age of MPXV increased from 4 to 21 years. In addition, the number of cases has increased 10-

fold especially in DRC.¹¹ The World Health Organization Research and Development Blueprint categorized monkeypox as an emerging zoonotic disease demanding high priority for further research, and public health action in 2018.¹²

There are 3 main reasons for the resurgence of monkeypox including: (1) the African residents have experienced increased exposure with rodents as well as forest animals; (2) waning immunity following discontinued global smallpox vaccination; (3) genetic evolution of the monkeypox virus during time.^{5,9} The previous documents showed that smallpox vaccination was approximately 85% protective against monkeypox.¹³ Bunge et al. (2022) revealed that unvaccinated individuals accounted for approximately 80–96% of monkeypox cases.¹¹ Nguyen et al. (2022) found that previous smallpox vaccination provides protection against MPXV by stimulation of IgG and memory B cells; they have declared decline in immunity among vaccinated individuals as well as population growth cause increase of MPXV outbreaks in the central Africa states.⁵ According to CDC reports, smallpox vaccination is recommended for prevention of secondary disease transmission from monkeypox-infected cases. Currently, there are 2 FDA approved vaccine for prophylaxis of monkeypox, i.e. JYNNEOS (pre exposure), and ACAM2000 (post exposure). In addition, Tecovirimat and Brincidofovir have been confirmed in clinical use as therapeutic regimen for monkeypox cases.¹⁴ The smallpox vaccination could benefit for induction of strong response against monkeypox. Unlike SARS-CoV-2, monkeypox can be spread from close contact via saliva or cough.⁹ However, Beer et al. (2019) proposed that risk of monkeypox transmission among household contacts who were unvaccinated was approximately 80%.¹⁵ Unfortunately, Adler et al., recently discovered that prolonged upper respiratory tract MPXV DNA shedding even after skin lesion.¹⁶ Several European countries as well as the United States have initiated pre-exposure vaccination of individuals with high risk of exposure to monkeypox, particularly healthcare

workers.^{17,18} According to the interim guidelines provided by WHO regarding vaccination and immunization against monkeypox: (1) Currently, global vaccination is not required nor recommended against monkeypox, (2) post-exposure prophylaxis is recommended using the second or third generation vaccine in case of contacts with monkeypox infected-cases, (3) pre-exposure prophylaxis is recommended for health workers at risk, (4) vaccination programmes must be applied using accurate surveillance system under the evaluation and supervision of professional experts with standardized protocols and appropriate data collection tools, and (5) the necessity of vaccination should be decided by a full assessment of risks and benefits on a case-by-case basis.¹⁹

In summary, monkeypox, which was previously considered as a rare zoonotic infection with low mortality rate, has resurged with a higher contagious form causing higher death rates during recent decades. It seems that genetic variation, continuous evolution of monkeypox virus, and waned immunity causes rapid dissemination of this disease in non-African territories. The implementation of protective appropriate strategies, e.g. screening and fast identification, quarantine of individuals contacting monkeypox cases, application of personal protective equipment, face masking, travel bans, post-exposure prophylaxis as well as vaccination of individuals who may be at high risk of contamination could be tools to abate monkeypox outbreaks.

Conflict of interest

Nil.

REFERENCES

- Magnus PV, Andersen EK, Petersen KB, Birch-Andersen A. A pox-like disease in cynomolgus monkeys. *Acta Pathol Microbiol Scand.* 1959;46(2):156–76.
- Centers for Disease Control and Prevention (CDC). Update: multistate outbreak of monkeypox—Illinois, Indiana, Kansas, Missouri, Ohio, and Wisconsin, 2003. *MMWR Morb Mortal Wkly Rep.* 2003;52:642–6.
- Adler H, Gould S, Hine P, Snell LB, Wong W, Houlihan CF, Osborne JC, Rampling T, Beadsworth MB, Duncan CJ, Dunning J, et al. Clinical features and management of human monkeypox: a retrospective observational study in the UK. *Lancet Infect Dis.* 2022.
- Rao AK, Schulte J, Chen TH, Hughes CM, Davidson W, Neff JM, Markarian M, Delea KC, Wada S, Liddell A, Alexander S, et al. Monkeypox in a traveler returning from Nigeria—Dallas, Texas, July 2021. *Morb Mortal Wkly Rep.* 2022;71(14):509.
- Nguyen PY, Ajisegiri WS, Costantino V, Chughtai AA, MacIntyre CR. Reemergence of human monkeypox and declining population immunity in the context of urbanization, Nigeria, 2017–2020. *Emerg Infect Dis.* 2021;27(4):1007.
- Durski KN, McCollum AM, Nakazawa Y, Petersen BW, Reynolds MG, Briand S, Djingarey MH, Olson V, Damon IK, Khalakdina A, et al. Emergence of monkeypox—west and central Africa, 1970–2017. *Morb Mortal Wkly Rep.* 2018;67(10):306.
- Sklenovska N, Van Ranst M. Emergence of monkeypox as the most important orthopoxvirus infection in humans. *Front Public Health.* 2018;6:241.
- Yinka-Ogunleye A, Aruna O, Dalhat M, Ogoina D, McCollum A, Disu Y, Mamadu I, Akinpelu A, Ahmad A, Burgu J, Ndoreraho A, et al. Outbreak of human monkeypox in Nigeria in 2017–18: a clinical and epidemiological report. *Lancet Infect Dis.* 2019;19(8):872–9.
- Kozlov M. Monkeypox goes global: why scientists are on alert. *Nature.* 2022;606(7912):15–6.
- Mauldin MR, McCollum AM, Nakazawa YJ, Mandra A, Whitehouse ER, Davidson W, Zhao H, Gao J, Li Y, Doty J, Yinka-Ogunleye A, et al. Exportation of monkeypox virus from the African continent. *J Infect Dis.* 2022;225(8):1367–76.
- Bunge EM, Hoet B, Chen L, Lienert F, Weidenthaler H, Baer LR, Steffen R, et al. The changing epidemiology of human monkeypox—a potential threat? A systematic review. *PLoS Negl Trop Dis.* 2022;16(2), e0010141.
- WHO. 2018 Annual review of diseases prioritized under the Research and Development Blueprint Informal consultation 6–7 February 2018 Geneva, Switzerland. Available at: 2018-annual-review-of-diseases-prioritized-under-the-research-and-development-blueprint.pdf(who.int).
- Fine PE, Jezek Z, Grab B, Dixon H. The transmission potential of monkeypox virus in human populations. *Int J Epidemiol.* 1988;17(3):643–50.
- Costello V, Sowash M, Gaur A, Cardis M, Pasięka H, Wortmann G, Ramdeen S, et al. Imported monkeypox from international traveler, Maryland, USA, 2021. *Emerg Infect Dis.* 2022;28(5):1002.
- Beer EM, Rao VB. A systematic review of the epidemiology of human monkeypox outbreaks and implications for outbreak strategy. *PLoS Negl Trop Dis.* 2019;13(10), e0007791.
- Adler H, Gould S, Hine P, Snell LB, Wong W, Houlihan CF, Osborne JC, Rampling T, Beadsworth MB, Duncan CJ, Dunning J, et al. Clinical features and management of human monkeypox: a retrospective observational study in the UK. *Lancet Infect Dis.* 2022.
- Mahase E. Monkeypox: healthcare workers will be offered smallpox vaccine as UK buys 20 000 doses. *BMJ.* 2022;377, o1379.
- Rao AK. Use of JYNNEOS (smallpox and monkeypox vaccine, live, nonreplicating) for preexposure vaccination of persons at risk for occupational exposure to orthopoxviruses: recommendations of the advisory committee on immunization practices—United States, 2022. *MMWR Morb Mortal Wkly Rep.* 2022;71.
- Available. at <https://www.who.int/publications/i/item/who-mpx-immunization-2022.1>.

Ali Beheshti Namdar^a y Masoud Keikha^{b,c,*}

^aGastroenterology and Hepatology Research Center, Mashhad University of Medical Sciences, Mashhad, Iran

^bAntimicrobial Resistance Research Center, Mashhad University of Medical Sciences, Mashhad, Iran

^cDepartment of Microbiology and Virology, Faculty of Medicine, Mashhad University of Medical Sciences, Mashhad, Iran

*Corresponding author.

E-mail address: Keikham971@mums.ac.ir (M. Keikha).

<https://doi.org/10.1016/j.vacun.2022.06.007>
1576-9887/

© 2022 Elsevier España, S.L.U. All rights reserved.