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Perspective

Monkeypox outbreak: a perspective on Africa's diagnostic and containment capacity

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ABSTRACT

Since the first monkeypox (MPX) case was reported in humans in 1970, there have been several outbreaks of the disease. MPX is endemic in central and western Africa. MPX virus infection is confirmed using the conventional polymerase chain reaction, which detects the viral DNA in samples from the rash. Of concern is that the current outbreak has affected five regions of the world. Although MPX confirmatory tests are available worldwide, there are concerns about Africa's capacity to diagnose and contain the disease. The challenges faced by Africa include a lack of adequate laboratory infrastructure and health care workers, weak disease surveillance systems, and a lack of MPX knowledge among health care workers and communities. These challenges can be addressed by mobilizing resources for MPX virus testing, strengthening surveillance systems, collaboration among countries, training health care workers, task shifting, and engaging communities.

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Introduction

Monkeypox (MPX) is a zoonotic disease caused by the MPX virus (MPXV), which is a member of the poxviridae family, chordopoxvirinae subfamily, and orthopoxvirus genus. It is endemic in central and western Africa. MPX was first discovered in laboratory monkeys at a research facility in Denmark in 1958. Although it was first discovered in monkeys, African rodents are believed to be the natural reservoir. MPX infections occur in squirrels, rats, mice, monkeys, prairie dogs, and human beings. The first reported case of MPX in human beings was reported in 1970, when the virus was isolated from a child in the Democratic Republic of Congo suspected of smallpox (Ligon, 2004). Two genetic clades of MPX that have been characterized include the more common West African clade and the Central African clade. The West African clade has no documented human-to-human transmission and has a case fatality

rate of less than 1%, whereas the Central African clade has reported human-to-human transmission and has a case fatality rate of up to 10%. Since the first MPX case was reported, several MPX outbreaks have occurred in Africa (Sklenovská and Van Ranst, 2018). African countries that have experienced MPX outbreaks include the Democratic Republic of Congo, Nigeria, Gabon, Cameroon, Central African Republic, Congo, South Sudan, Sierra Leone, and Liberia (Sklenovská and Van Ranst, 2018). Outside Africa, an outbreak occurred in the United States in 2003, where 53 cases were reported (Ligon, 2004). From January to June 22, 2022, 3413 laboratory-confirmed cases of MPX have been reported from 50 countries worldwide, covering five regions of the world, with one fatality (WHO, 2022a). The five regions are the Americas, Africa, Europe, eastern Mediterranean, and the western Pacific. About 86% of the confirmed cases are from Europe, 11% from the Americas, and 2% from Africa (WHO, 2022a).

Risk factors for MPX infection include living in heavily forested and rural areas of central and western Africa, handling and preparing bushmeat, and caring for someone infected with MPXV (Rimoin *et al.*, 2010). MPX transmission from animals to human beings occurs when human beings get bitten by an animal infected with the disease or have direct contact with the animal's lesions

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or body fluids. Human-to-human transmission occurs during direct contact with body fluids of an infected person or objects contaminated with the virus and through respiratory droplets. The incubation period ranges from 5 to 21 days (WHO, 2022a). The signs and symptoms are the same as those of smallpox, although they are usually milder. Patients typically present with fever, headache, muscle aches, backache, swollen lymph nodes, and a feeling of discomfort and exhaustion. Lymphadenopathy during the prodromal stage of the illness is a clinical feature that can be used to distinguish it from smallpox or chickenpox. A vesicular and pustular rash such as that of smallpox develops within 1–3 days after the onset of fever. Initially, the rash is papular; however, it then progresses to vesiculation, pustulation, and finally, crusting. These different rash stages are found simultaneously on the face, head, trunk, and extremities. The illness typically lasts 2–4 week (Ligon, 2004). Confirmation of the infection requires laboratory evidence (Osadebe et al., 2017). This review will discuss the available testing and diagnosis methods for MPX infection; Africa's capacity for testing, diagnosing, and containing the disease; and our recommendations for the continent.

Diagnosis

Confirmation of MPXV infection is based on nucleic acid amplification testing using real-time or conventional polymerase chain reaction (PCR) for the detection of unique sequences of the viral DNA. Samples should be from the skin lesions' roof, dry crusts, or fluid from vesicles and pustules. Lesion samples must be stored in dry, sterile tubes, refrigerated or frozen within an hour of collection, and transported as soon as possible after collection (WHO, 2022b). Although PCR is the preferred laboratory test for confirming MPX infection, other alternatives can be used for diagnosis. However, these alternatives have limitations. The alternatives include biopsy for culture, PCR blood tests, serum studies for antibody detection, visualization on electron microscopy, immunohistochemical staining for orthopoxvirus antigens, and case definition criteria. Serum antibodies are detectable by the time the lesions appear. However, by this time, the patient will already be contagious because infectivity starts when the fever starts. The fever starts within the first 5 days after infection; however, lesions appear up to 3 days after the onset of fever. PCR blood tests are usually inconclusive because of the short duration of viremia relative to the timing of specimen collection after symptoms begin. Antigen and antibody detection methods do not provide MPX-specific confirmation because orthopoxviruses are serologically cross-reactive. Trained clinicians will be required to collect the biopsy samples if a culture is to be performed, making this option less feasible (McCollum and Damon, 2014). Using case definitions may also not be feasible because the disease may need to be differentiated from other diseases such as smallpox, chickenpox, scabies, measles, generalized vaccinia, and eczema herpeticum (Osadebe et al., 2017).

Africa's capacity for diagnosing and containing the disease

As a result of the reinforced laboratory capacity in the wake of COVID-19, all African countries have PCR machines needed to test for MPXV. However, only seven countries in Africa can sequence the MPXV. Another challenge African countries face in diagnosing MPX is the lack of reagents and training in specimen collection, handling, and testing. In addition, some areas in Africa have health care facilities that do not have refrigerators or reliable power supply to keep the specimens viable until they are transported to centers where the tests will be performed. Moreover, there are remote areas in Africa that are not easily accessible by any means of transport (WHO, 2022c).

There is a shortage of health care workers in Africa, making it difficult for countries to collect specimens for laboratory confirmation. Although integrating common features of MPX into its case definition has been found to raise the definition specificity to 85%, 50% of actual MPX cases will still be missed (Mande et al., 2022). In addition, health care providers in many African countries lack the knowledge and experience to recognize and diagnose MPX. Furthermore, infection prevention and control techniques and supplies are usually lacking in African rural health facilities (Durski et al., 2018).

The tools required to contain the MPX outbreak, such as diagnostics, vaccines, therapeutics, and intense surveillance systems, are not readily available or accessible to most African countries (Africa Centers for Disease Control and Prevention, 2022). Although the smallpox vaccine can prevent MPXV, the vaccine has since been discontinued after the disease was declared eradicated in 1980. Even if manufacturers start producing the vaccine again, it will take time to reach African countries because they usually prioritize high-income countries, as they did with the COVID-19 vaccine (Tatar et al., 2021). In most countries in sub-Saharan Africa, routine data from health management information systems are rarely assessed for quality, analyzed, or used for decision making. Several studies in sub-Saharan Africa identified weaknesses in the identification and recording of cases at primary health centers. Other deficiencies affecting the quality of data collected for surveillance of infectious diseases include capturing incomplete data and the inconsistency of the data at different levels of the surveillance system. This has been attributed to low motivation, inadequate health management information systems-related resources, and lack of skills among health care workers owing to the lack of training. In addition, the data collected are sometimes not analyzed, and there is no feedback on the data. Delayed outbreak detection and reporting of cases affect the operationalization of prevention and control strategies, leading to the further spread of the disease (Mremi et al., 2021).

Recommendations

Based on lessons from previous outbreaks, including the COVID-19 pandemic and the previous Ebola viral disease outbreaks, we proposed several recommendations on how to improve Africa's capacity for diagnosing and containing the MPX disease. The lessons learned from the previous outbreaks were that surveillance and testing capacities in most African countries were weak, leading to delays in identifying the outbreaks. Furthermore, there was a failure to collect, analyze, and disseminate data. These issues delayed the mobilization of local and international support to institute effective public health responses (Afolabi et al., 2021).

Mobilizing resources for testing

African countries must come together and set up a task force to coordinate the mobilization of resources for MPXV testing. The task force should seek donations from international organizations and within African countries. They can also borrow capital from international lending organizations, such as the Africa Development Bank and the World Bank, to finance laboratory capacity building that will ensure that the continent can test for MPXV (Ahanhanzo et al., 2021). Regional reference laboratory systems should be established in the continent to support diagnostic assay quality assurance and confirmation (Durski et al., 2018). The task force should also request material and technical support from organizations, such as the World Health Organization, Centers for Disease Control and Prevention, and manufacturers. With enough support, the continent should rapidly expand national diagnostic capacity in all countries. There should also be laboratory network

integration, which can facilitate integrated electronic reporting systems to ensure that laboratory tests guide patient care (Ahanhanzo et al., 2021; Naidoo and Ihekweazu, 2020).

Strengthening surveillance systems

MPX surveillance systems strengthening in Africa can be achieved by ensuring that academic institutions are encouraged to conduct research that can be used for disease surveillance. Demographic surveillance sites can also be used to collect disease surveillance data during outbreaks. Within countries, information should be shared among departments with morbidity and mortality data to ensure that the disease is accurately characterized (Mremi et al., 2021). There should also be MPX mandatory reporting to improve systematic reporting of the disease. Contact tracing should also be implemented because it will allow for early diagnosis of cases (Durski et al., 2018). The continent should also use digital disease surveillance, which involves the use of data generated outside the health system for disease surveillance because there is high coverage of cellular phone services on the continent (Mremi et al., 2021). Apart from MPX surveillance on humans, there should also be active surveillance on animals (Eteng et al., 2018).

Collaboration

Coordination and communication between human and veterinary health services should be improved within and among countries to ensure that animal outbreaks are quickly communicated to health care personnel who will institute prevention measures needed to prevent the spread of the disease to human (Reynolds et al., 2019). There should also be a collaboration of ministries of health of different countries. African governments must establish an intercountry early warning system for infectious disease outbreaks. Multicountry collaboration must involve sharing experiences about the disease and alerting neighboring countries of cases of MPX in both animals and human beings (Durski et al., 2018).

Health care worker training and task shifting

Africa's capacity to deal with the MPX outbreak requires trained health care workers. Laboratory staff should be trained in MPXV testing procedures; the types of specimens; and safe sample collecting, storing, and transporting methods. Training clinicians is essential because it will allow them to diagnose and manage MPX cases. Furthermore, lower-level health cadres must be trained to identify suspected cases of MPX and refer them to health care facilities for further confirmatory tests and management (Durski et al., 2018).

Community engagement and education

Communities must be warned about impending outbreaks early so that they can prepare and take preventive measures to reduce morbidity and mortality (Mremi et al., 2021). There should be a communication of risk messages to communities at large and specific populations at high risk, such as sex workers, immunocompromised individuals, and children (Africa Centers for Disease Control and Prevention, 2022). Messages that should be emphasized include reducing human contact with suspect animals, avoiding physical contact with infected individuals, frequent handwashing, and early medical examination of suspected cases (Eteng et al., 2018). Measures to improve infection prevention and control include contact precautions, appropriate disinfection, and limited contact with patients (Durski et al., 2018).

Conclusion

MPX is endemic in central and western Africa. Several outbreaks have been reported in several African countries before 2022. The diagnosis of MPXV infection is confirmed using conventional PCR to detect the viral DNA in samples from the rash. There are concerns about Africa's ability to diagnose and contain MPX emanating from inadequate laboratory infrastructure and health care workers, weak disease surveillance systems, and a lack of MPX knowledge among health care workers and communities. These challenges can be addressed by implementing lessons learned from previous outbreaks, which include mobilizing resources, strengthening surveillance systems, collaboration among countries, training health care workers, task shifting, and engaging communities.

CRedit authorship contribution statement

Enos Moyo: Writing – original draft. **Godfrey Musuka:** Writing – original draft. **Grant Murewanhema:** Writing – review & editing. **Perseverance Moyo:** Writing – review & editing. **Tafadzwa Dzimarira:** Conceptualization, Writing – review & editing.

Conflict of interest

The authors have no known competing interests to declare.

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