



## Emergence of mpox in Oman: investigating the first cluster and its implications, October 2023

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### ABSTRACT

**Objectives:** The mpox virus, a member of the orthopoxvirus genus of the *Poxviridae* family, is the source of this newly recognized viral zoonotic illness. Before October 2023, no mpox cases were reported in Oman. This study describes the first confirmed case of mpox and a related family cluster from North Batinah Governorate. This study aimed to describe the clinical and epidemiologic investigations of the first mpox case and cluster in Oman, including the identification of infection sources; assessing the transmission prevention measures in place for health care settings and the community; and providing recommendations for improving public health measures for the prevention, detection, and response to the emerging threat of mpox.

**Methods:** An outbreak investigation study was conducted involving all three confirmed cases of mpox in October 2023 in North Batinah Governorate, using a previously prepared form for epidemiological investigation of the cases and another form for detailed contact tracing.

**Results:** The results showed that all three cases were from the same family from Sohar Willayat infected with mpox clade IIb. The possible source of infection for the index case was not declared but was potentially travel-related. Transmission to secondary cases occurs through droplets, direct contact, and bedding within households. All contacts were identified and followed up for 21 days, and no secondary cases occurred outside the household.

**Conclusions:** Travel-related exposure appeared to be a significant factor in the outbreak of clade IIb in Oman. This investigation serves as a practical exercise for public health preparedness, emphasizing the importance of an adaptive health system. Ensuring robust detection and response measures while accounting for patient privacy, cultural contexts, and available resources, such as institutional quarantine for contacts, is crucial for effectively managing emerging infectious diseases.

### Introduction

The mpox virus (MPV) is a zoonotic disease within the orthopoxvirus genus that primarily affects mammals, including rats, squirrels, and monkeys [1,2].

Mpox, previously known as monkey pox, is a viral disease caused by MPV. The virus has two distinct clades: clade I with subclades Ia and Ib and clade II (subclades IIa and IIb). The fatality rate of mpox

associated with clade I is about 10%, although it is rarely fatal, with over 99% of cases having a high survival rate with clade II [3]. The incubation period for MPV ranges from 7 to 21 days, with a prodromal stage lasting 2-4 days, with symptoms such as fever, chills, headache, and fatigue, followed by a characteristic rash [1,4-7]. Mpox typically resolves within 2-4 weeks. Transmission can occur during the prodromal phase, and infected individuals remain contagious for up to 4 weeks or until lesions heal. MPV can survive on surfaces for

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up to 2 weeks, especially in dry and high-temperature environments [5].

Human-to-human transmission of mpox occurs primarily through direct contact with infected skin lesions, body fluids, and respiratory droplets during prolonged face-to-face interactions, and through contact with contaminated surfaces or objects [5,6]. This includes intimate activities such as oral, anal, and vaginal sex, as well as touching contaminated materials such as bedding and towels. Health care workers, family members, and close contacts of infected individuals are at higher risk, particularly, in settings with prolonged exposure [8–12].

The World Health Organization has declared mpox a “Public Health Emergency of International Concern” in the last 2 years. In 2022, there was a global outbreak of a new clade IIb, primarily, among men who have sex, and an increase in the number of mpox cases. In 2024, there was a global response to the mpox outbreak caused by the clade I variant originating in the Democratic Republic of the Congo [2,13–15].

In October 2023, the first mpox cluster in Oman was confirmed in the North Batinah Governorate after the detection of a case in a 43-year-old male from Sohar. The Ministry of Health (MoH)’s Directorate of Disease Surveillance and Control coordinated a rapid response involving a multidisciplinary team to investigate and control the outbreak. The national rapid response team (RRT) played a key role in controlling the outbreak, preventing transmission, and enhancing the sensitivity of health care workers to potential cases. This study aimed to describe clinical and epidemiologic investigations of the first mpox cluster in Oman. In addition, it aims to provide recommendations for improving public health measures to prevent, detect, and respond to the emerging threats of mpox.

## Methods

An outbreak investigation was conducted in October 2023 in the North Batinah Governorate (NBG) of Oman, involving all three confirmed mpox cases. This study used a previously prepared epidemiologic investigation form for cases and a separate form for detailed contact tracing.

Upon receiving information from the MoH regarding a confirmed mpox case in Buraimi Governorate, an RRT was immediately activated. The team included the Director of Disease Surveillance and Control, the Heads of the Departments for Communicable Disease Control, Infection Prevention and Control, Surveillance, Occupational and Environmental Health, and an epidemiologist.

An urgent meeting was conducted with the Buraimi Governorate, and a plan for field investigation was prepared and discussed with the Centers of Disease Control and Prevention (CDC) of the MoH. Field visits to the patient’s house and workplace were arranged, as well as visits to all health institutions that the patient had visited since the onset of symptoms September 29, 2023. All contacts were traced, examined, and enlisted for follow-up of their symptoms for 21 days from the last contact with the patient. Health education for patients and contacts was provided, and high-risk contacts were isolated.

The Director General of Health Services in the governorates and the CDC in the MoH were informed and updated. The Directors of primary healthcare, Sohar Hospital, private health institutions, and nurses were advised to alert all health institutions about the case. Case definition was based on the Oman MoH guidelines. All items required for the field investigation, such as complete personal protective equipment (PPE), swabs, viral transport media culture, and triple packing, were obtained. The MoH guidelines for mpox were reviewed for clinical and epidemiologic details.

All detailed histories were obtained from the cases, and full physical examinations were performed for the cases and contacts. All suspected cases were investigated and followed up for 21 days. The reports were updated frequently and shared with the concerned health workers.

The mpox case definition of the MoH was used to suspect and confirm the cases according to the Oman MoH guidelines.

## Results

After epidemiological investigation and contact tracing, the results revealed three confirmed mpox cases within a single family, all Omani nationals from Sohar Willayat. Two of the three patients were adults, and two were males. All patients recovered fully. No symptoms developed among the high-risk contacts.

### Case 1 (primary case)

A 43-year-old male Omani, married and residing in Sohar and employed as a security guard at the Sohar court complex, was admitted to Buraimi Hospital on October 6, 2023. The patient presented with a 7-day history of intermittent fever, generalized body pain, and severe pain in the right wrist. Four days after admission, he developed widespread erythematous, papular, and pustular skin lesions that primarily affected the face, scalp, chest, oral cavity, and genital areas, some of which were filled with pus. These lesions render eating and drinking difficult.

### The sequence of events

On September 24, 2023, he traveled to the United Arab Emirates (UAE), visited the Sharjah industrial area alone to purchase spare vehicle parts and stayed there for several hours. The patient returned to Oman on the same day. He denied any sexual contact, contact with a suspected patient, or contact with any type of rash. The patient had no history of contact with animals. On September 29, 2023, the patient had generalized body pain and fatigue. On October 1, 2023, although he had a high-grade fever and severe right wrist pain, he attended duty for 1 hour, went to a private hospital for NBG, and was prescribed symptomatic treatment. On October 1, 2023 (evening), he developed mild rashes on his face, visited a private hospital in Buraimi Governorate and was given symptomatic treatment. From October 2 to 3, 2023, the rash spread over the face, palm, scalp, and chest, extending to the genital area, with severe itching and high-grade fever. On October 6, 2023, he was referred from a private hospital to a governmental hospital accident and emergency department in NBG, diagnosed with chickenpox, and discharged.

After that, the patient went to the previous private hospital in Buraimi, where he was referred to Buraimi Hospital in the evening. He was seen at the emergency department and isolated after highly suspecting the case of mpox by dermatologists and general medicine. Samples were taken for polymerase chain reaction (PCR) of mpox from the serum, throat, and lesions and sent to the Central Public Health Lab (CPHL). Therefore, he was transferred to an isolation room in the male ward. On October 9, 2023, the results were PCR mpox-positive.

### Laboratory results on admission

All investigations were within normal limits, except for inflammatory markers: C-reactive protein 64.70 mg/l and erythrocyte sedimentation rate 65 mm/h. A high lymphocyte count indicates viral infection.

### Source of infection

The source of infection was not determined. However, it can be transmitted through close contact with an infected person through bodily fluids, lesions, or respiratory droplets.

### Contacts tracing

On October 10, 2023, two teams were arranged to trace contacts, deliver health education, identify possible sources of infection, and identify active cases. One team visited the patient’s house and his place of work. The team identified eight household contacts and considered them high-risk contacts because they lived in the same house and had meals together. All contacts were examined thoroughly and found to be asymptomatic, except for the patient’s wife, who was symptomatic (H/O fever

for 2 days, sore throat, and myalgia). The team strictly advised the patient to isolate herself from other family members, and throat and nasopharyngeal swabs were collected with full infection control precautions using PPE. The specimens were packed in triplicate and sent to the CPHL through Sohar Hospital Laboratory.

The team visited the patient's workplace and identified seven contacts, none of whom were symptomatic. The team classified the contacts as low-risk because the patient did not go to work because he was on short leave and attended work for only 1 hour on October 1, 2023.

At the government hospital, the team identified two contacts, none of whom were symptomatic. The contacts were classified as low-risk because health care workers (HCWs) used full PPE. In addition, an alert was distributed to all health establishments with information on the case definition of mpox and instructions to contact the communicable disease hotline (24/7) for any inquiries.

In private hospitals, the team met the head of the hospital and the infection control staff. Information regarding patient visits was collected, five contacts were identified, and none were symptomatic. The contacts were considered low-risk because they were using full PPE.

All contacts underwent RRT monitoring for 21 days from the last date of exposure.

Health education

Health education and necessary preventive and control measures to prevent further cases were explained to the family, the health institutions, and workers in the workplace. The symptoms and nature of the disease were explained to all contacts and they were followed up for 21 days from the last exposure to the patient. The wife was counseled to report the symptoms immediately.

Case number 2 (secondary)

The second case is an Omani female, 36 years old, with a known case of diabetes mellitus, essential hypertension, and hypothyroidism. She had been in contact with the confirmed index case of mpox (her husband) since the onset of his symptoms on September 29, 2023 and a rash eruption on October 1, 2023 because she was taking care of him. She was doing well until October 8, 2023 when she started to develop body aches with a sore throat and lymphadenopathy. On October 11, 2023, she developed itchy, erythematous maculopapular rashes on her right hand, chest, and face.

Epidemiological investigations

The RRT team visited the patient's house on October 10, 2023, and enlisted all contacts in the households. Mpox case number two (the wife of the index case) complained of sore throat and body aches for 2 days, so a throat swab was collected at the house and sent to the CPHL. She was advised to isolate at home and reported no other symptoms to the RRT. On October 11, 2023, she developed itchy erythematous rashes (one rash each on the face, hand, and chest) and complained of fever. The patient was advised to isolate in the hospital for social reasons. Swabs from the lesions were collected on October 11, 2023 from the Sohar Hospital isolation room. The samples were sent to the CPHL, where the second case of mpox was confirmed. The patient denied any history of travel, contact with people other than her husband, or sexual contact outside her marriage.

Contacts tracing

The RRT visited the home again on October 12, 2023. These contacts were the same as the index case contacts (seven household contacts). All contacts at home were thoroughly examined (temperature, sore throat, rash, and lymphadenopathy). None of the patients were symptomatic. They were advised to minimize movement and report any symptoms of RRT.

All contacts of primary and secondary cases were followed up for 21 days from the last contact with the patients.

Table 1  
Summary results of cases with associated symptoms.

Cases	Fever	Lymphadenopathy	Sore throat	Typical rash
1	Yes	Yes	No	Yes
2	Yes	Yes	Yes	No
3	Yes	Yes	Yes	No

Source of infection

The patient (husband) was the source of infection. The infection was transmitted to the wife through different means, such as sexual contact, droplets, and direct contact with the lesions, because the wife was taking care of her husband.

Outcome

The patient recovered on November 1, 2023, but preferred to stay with her family until they finished the quarantine period.

Case number 3 (secondary to case 2)

The third case is an Omani male child, 10 years old (son of the index case), not known to have any medical illness, and was doing well until October 14, 2023, when he started to develop a fever of 38°C. On October 15, 2023, he developed three papular lesions: two on the face and one on the right forearm.

Physical examination showed a temperature of 37.7°C, and throat and lesion swabs were collected on October 15, 2023. The throat swab was tested for the mpox virus on October 16, 2023. The patient was in contact with his mother, who was diagnosed with mpox disease.

Epidemiological investigations

During the follow-up visits for the household contacts the team found one of them had a fever of 38°C on October 14, 2023, so, immediately, the patient was advised home isolation. During a home visit on October 15, 2023, the team found three skin lesions, and throat and lesion swabs were collected. All other contacts in the house were examined, and none had any signs or symptoms of mpox. The patient was advised to undergo home isolation and all other contacts were under strict follow-up.

Contacts tracing

The team visited the index case house to examine the contacts. All contacts were thoroughly examined (temperature, sore throat, rash, and lymphadenopathy). None of the patients were symptomatic. They were advised to minimize movement and report any symptoms to the RRT.

All contacts were followed up for 21 days from the last contact with patients.

Source of infection

The second case (mother) was the source of infection because they shared the same bedroom. The possible causes of transmission are respiratory droplets and/or close contact.

Outcome

The patient was discharged on November 5, 2023, with full recovery and skin healing.

Virological investigation

The two described cases were confirmed using the Liferiver Monkeypox Virus Real-Time PCR Kit (ZD-0076-02) designed for the qualitative detection of mpox virus DNA in serum or lesion exudate samples. DNA was manually extracted. The results are summarized in Table 1. Notably, vesicular fluid and skin swabs had the lowest cycle threshold values, indicating a substantial viral presence and an excellent site for sample collection. However, throat swabs can be valuable for detecting infections in their early stages.

**Table 2**  
Summary results of cases with polymerase chain reaction results, Ct value, and sample collection date in relation to onset.

Cases	Collection day after onset	Vesicular fluid /(Ct)	Skin	Serum	Throat
1	Day 4	+(Ct 22.5)	+(Ct 22.9)	+(Ct 33.6)	Not done
2	Day 2	Not done	+(Ct 30.2)	Not done	+(Ct: 33.5)
3	Day 1	No vesicles	Not done	Not done	+(Ct: 28.9)

Ct, cycle threshold.

Next-generation sequencing using the ONT GridION and Arctic mpox protocol was done for the index case using skin and vesicular fluid samples, achieving genome coverage of 93.01% and 94.96% ( $\geq 10$  reads), with both sequences assigned to clade I1b, subclade A.2.1 by Nexclade.

Summary of results

All patients developed fever and lymphadenopathy, and 66.6% developed sore throat. The index patient developed a typical mpox rash (Table 1).

The PCR results showed that case 1 had three positive samples, case 2 had two positive samples, and case 3 had one positive sample (Table 2).

There were eight household contacts in the index case: two developed mpox, whereas the other six remained asymptomatic.

Institutional isolation

After discussion with the CDC in the MoH, a decision of institutional isolation for the whole family was taken on October 27, 2023 to protect the family’s privacy while being visited by HCWs and protect surrounding neighbors and friends from getting infected if they visited the family house. The institutional isolation location was well-prepared for the family to isolate cases and high-risk contacts for 21 days from the last contact to third case. During isolation, the RRT visited them daily to examine cases and contacts. All vital signs were recorded. On October 25, 2023, while examining the family, some popular lesions on the back of one contact (the daughter of the index case) were noted, with no history of fever, and all other examinations were unremarkable. Although the lesions appeared to be old acne lesions, swabs were collected from the lesions and throat. The swabs tested negative for mpox. On November 5, 2023, the family was discharged from the quarantine. Therefore, all patients were examined and discharged.

Discussion

This study reports the first mpox outbreak in Oman, specifically, in NBG, likely triggered by close household gatherings, as observed in similar outbreaks [8]. The patient was in close contact with various workers of different nationalities in an industrial area in the UAE. He denied sexual contact or exposure to individuals with rashes or symptomatic relatives. Viral sequencing of the patient showed MPV clade I1b, which circulated worldwide from 2022 to 2023 [3,14]. The infection appears to be travel-related because the index case traveled to the UAE 5 days before symptom onset, consistent with the known incubation period for mpox [1,4–6]. The infection may be transmitted through close contact with an infected person via bodily fluids, lesions, or respiratory droplets [5,6]. Furthermore, modeling studies have demonstrated the importance of the number of sexual partners as the main predictor of basic reproductive number [14].

In the second case, the patient’s wife developed symptoms 8 days after direct skin-to-skin contact while caring for him and cleaning his lesions, with additional exposure to contaminated surfaces, clothing, and bedding [5,6,8–12]. Despite the RRT’s advice to isolate, cultural caregiving practices led her to maintain close contact with their child, who developed symptoms 6 days later. Infection control measures were

hindered by cultural norms such as the practice of visiting neighbors, children playing together, and the duty to care for sick families and community members. Given concerns that transmission and the contact list would continue to grow while respecting individual and family privacy, the decision was made to place all subsequent contacts in institutional quarantine.

The index case showed typical mpox symptoms, including fever, body aches, lymphadenopathy, and rash progressing from the macules to the crusts [7]. However, the second and third cases had atypical rashes in terms of type and distribution. To minimize transmission to HCWs, the index patient was isolated with strict infection control measures, and only a limited number of staff attended to the patient, with HCWs monitored for 21 days.

This outbreak highlighted several key learning points for the timely detection, prevention, and control of mpox. Early and accurate diagnosis is essential to prevent further transmission. In this case, delayed recognition of symptoms and isolation of the index patient led to exposure to multiple high-risk contacts, which contributed to the spread of the disease. Prompt identification and immediate isolation of suspected cases are critical to reduce secondary transmission, particularly, within households and health care settings [16,17]. Moreover, the implementation of institutional quarantine for contacts, especially children, proved effective in preventing the spread to the wider community, as demonstrated by the lack of further cases in schools and workplaces.

Another important aspect of this outbreak is balancing the need for effective disease control with respect to patient privacy and dignity. Managing a highly contagious disease such as mpox in a family setting requires careful attention to confidentiality and respect for individuals’ rights. In this study, family members were provided clear guidance on isolation and hygiene practices, and efforts were made to maintain their privacy throughout the process. This approach is vital for maintaining public trust and ensuring that individuals feel comfortable seeking care without the fear of stigma or discrimination [18,19].

In addition, history-taking in diseases such as mpox can be complicated by current social stigmas, particularly, within men who have sex with men. In this case, the index patient denied any sexual contact, which may have been influenced by a fear of judgment or stigmatization. Accurate and thorough history-taking is essential for understanding the true epidemiological context, but it requires creating a safe and non-judgmental environment in which individuals feel comfortable disclosing sensitive information. Health care providers should be trained to address stigma-related barriers and ensure that all patients, regardless of their backgrounds or behaviors, are treated with dignity and respect. This approach improves the quality of history and, consequently, the accuracy of outbreak investigations [20,21].

The secondary attack rate in this outbreak was 33%, which is higher than the 10% rate reported in other studies [22]. The large number of high-risk contacts among family members, HCWs, and coworkers can be attributed to delayed diagnosis and isolation, which contribute to the increased risk of transmission. The prompt isolation of children in institutional quarantine before they interacted with classmates helped prevent further community spread, underscoring the importance of early containment measures in similar outbreaks [23].

The index patient was infected with clade I1b, which circulated in Southeast Asia after a large global outbreak in 2022 [14,15].

Limitation

This study faced challenges in identifying the infection source with likely travel history and high-risk exposure; however, conclusive data are lacking. Balancing infection control measures with family privacy was difficult because the family was reluctant to adhere to quarantine measures because of inconvenience. The presence of a regional and/or global molecular epidemiologic capacity would have facilitated case origin tracing across borders and the identification of index cases and other contacts.



In addition, the children missed approximately a month of school because of the quarantine. Delays in coordination with the Ministry of Education highlighted the challenges faced when public health measures intersect with social needs such as education and family privacy.

# Conclusion

This study marks the first mpox outbreak in Oman, which was likely triggered by household gatherings in NBG. Early detection supported by a robust surveillance system is crucial for limiting transmission. The outbreak underscored the need to consider mpox in patients with unexplained rashes and highlighted the importance of prompt diagnosis. It also reinforced the value of refining guidelines, enhancing surveillance, and using control measures, such as institutional quarantine for close contacts, while balancing public health actions with social and cultural factors.

# Recommendation

Public health responses should prioritize timely detection, appropriate control measures, respect for privacy, cultural sensitivity, and local capacities, including quarantine protocols for close contacts. Investments in building capacities for regional and global molecular epidemiologic networks can further aid in cross-country outbreak investigations and source tracing.

# Declarations of competing interest

The authors have no competing interests to declare.

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# Ethical approval

The ethics review committee of the North Batinah Governorate approved this study (RERAC 36/2023).

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# Author contributions

**Fatma Al Hashmi:** Corresponding author, involved in all phases of writing the manuscript conceptualization, methodology, writing – original draft preparation, investigation, data collection, investigation, resource, reviewing and editing and publication. **Khalid Al Saadi:** Con-

ceptualization, Methodology, Writing – Original draft preparation, investigation. **Abir Al Moqbali, Ahmed Al Saadi, Amina Al Busaidi, Saif Al Jabri, Maryam Al Baloshi:** Data collection, investigation. **Hanan Al Kindi, Sabria Al Marshoudi:** investigation, Resource. **Ahmed Al Mashaykhi:** Investigation. **Khalid Al Saadi:** Supervision. **Esklid Peterson:** Reviewing and Editing, funding acquisition. **Amal Al Maani:** Supervision, Reviewing and Editing, funding acquisition.

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