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An Investigation of the First Non-sexual Household-transmitted Mpox Cluster with Rapid Situation Analysis of Mpox Epidemic in Thailand

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Abstract

On 22 May 2023, the mpox cluster was reported in a household in Nonthaburi Province, Thailand. We investigated to confirm the outbreak and diagnoses, describe its possible linkage and source, and identify potential fomite transmission. We interviewed all cases, traced their contacts, and swabbed household surfaces for mpox. We conducted a rapid situation analysis of mpox cases in Thailand until July 2023. Three cases were confirmed within the same household involving five individuals. The first case was a sexually active male and the second case was his intimate partner. The third case was the mother of the second case. The first two cases reported no sexual activity after symptoms appeared. They both attended a shaving ceremony and engaged in activities without wearing face masks. The third case had direct contact with her son's droplets and rash and then developed symptoms, without rash and fever. No additional case was detected among participants of the ceremony. One of two other household members tested negative after developing symptom while the other was asymptomatic. Despite house cleaning with 70%-ethanol, before investigation, 18 of 27 environmental swabs tested positive, with cycle threshold values ≥30. Since situation analysis revealed no previously reported non-sexual household mpox transmission, this investigation confirmed its existence. Risk communication should address the plausibility of non-sexual transmission. Mpox symptom may occur without rash and fever, emphasizing the importance of testing suspected individuals and revising mpox investigation guidelines accordingly. Surface cleaning with 70%-ethanol may reduce fomite transmissibility.

Keywords: mpox, Thailand, household transmission

Introduction

Mpox is caused by the monkeypox virus (MPVX). It belongs to the *Orthopoxvirus*, same genus as smallpox. Human-to-human transmission occurs via droplet contact, direct contact with lesions, and indirect contact with contaminated fomites.[1] The secondary attack rate within households is less than 10%.[2] However, household secondary infections can spread across three waves, emphasizing timely outbreak investigations.[3] Although there is immunological cross-protection between mpox and smallpox,[1] the new global generation lacks this immunity because of the cessation of smallpox vaccination after the success of its eradication since 1979.[4]

The incubation period of mpox ranges from 5 to 21 days and around 10% of infected people are asymptomatic.[5] Symptoms start from the prodromal phase, characterized by fever, headache, lethargy, myalgia, and lymphadenopathy. A vesiculopustular rash appears following prodromal symptoms and lasts for 2–4 weeks. The infectious period starts from the prodromal phase until a new layer of skin has formed. Mpox is self-limited within 2–4 weeks. Severe illness and complications such as, pneumonia, and encephalitis, are rare.[4]

In 2022, a global-wide mpox outbreak occurred across 75 countries. The World Health Organization announced mpox as a Public Health Emergency of

International Concern on 23 Jul 2022.[3] The major route of transmission was sexual contact, with the majority of cases involving men who have sex with men (MSM).[1,4,6–8]

In Thailand, mpox is a communicable disease under surveillance by the Department of Disease Control (DDC). Every mpox case must be reported to the event-based surveillance (EBS) system. The first documented case of mpox in Thailand was on 18 Jul 2022.[9] At the time, Thailand's risk communication effort was primarily directed towards the lesbian, gay, bisexual, transgender, and queer or questioning communities. Additionally, there have been no previous documented case of household transmission of mpox via non-sexual routes nor any published study examining the mpox situation in Thailand. On 22 May 2023, a joint investigation team was notified by the Office of Disease Prevention and Control Region 4 Saraburi about the mpox cluster within a household in Bang Kruai District, Nonthaburi Province. Therefore, the outbreak investigation was conducted to confirm the outbreak and diagnoses, describe the epidemiological linkage, identify the possible source(s) of the outbreak, and potential risk of fomite transmission in the household. Moreover, we reviewed the mpox situation in Thailand to offer additional key insights into the context of the outbreak across the country.

Methods

Epidemiological Investigation and Contact Tracing

During 22–26 May 2023 we interviewed all confirmed cases, discussing demographic characteristics, clinical presentation, treatment, symptom onset, relationships, and shared activities with other cases, using a semi-structured questionnaire. We conducted contact tracing by interviewing confirmed cases to determine their potential exposure history. We interviewed the organizer of a shaving ceremony that case 1 attended to gather the ceremony details and any participant's illness history. Moreover, we developed an online questionnaire for symptom screening among ceremony-participants (details in the results section).

Our case definitions were as follows: a suspected case was an individual who was either suspected by a physician or in close contact with a confirmed mpox case between 1 and 21 Feb 2023 and developed one of the following symptoms: rash (including macules, papules, vesicles, pustules, or crusts), or fever along with associated symptoms including sore throat, headache, myalgia, back pain, or lymphadenopathy. A confirmed case was a suspected case with positive MPVX confirmation via real-time polymerase chain reaction (real-time PCR). Close contacts were individuals who had contact with a confirmed case from the beginning of the symptoms until the development of a scab including direct contact with a case's skin (either with or without lesion), mucosa, secretion, and surfaces such as clothes; or lived in the same house, or stayed overnight with a case for at least one night; or traveled with a case in the same vehicle within a distance of 1 meter; or shared a toilet with a case; or was involved with a case when having aerosol-generating activities. A discarded case was a suspected case with a negative test result on real-time PCR.

To confirm the diagnosis, a total of eight samples of lesion swabs, nasopharyngeal and throat swabs, and whole blood from all three confirmed cases and one discarded case were tested for MPVX by real-time PCR at Chulalongkorn or Bang Kruai Hospitals.

Environmental Study

To assess the risk of fomite transmission, we surveyed the affected household. We interviewed the cases about common touchpoints in their daily activities. Surface swabs from these touchpoints (n=27) were collected on 24 May 2023 after the house underwent cleaning with 70%-ethanol (details in results section). Samples were sent to the Bamrasnaradura Infectious Disease Institute for MPVX testing using real-time PCR. Positive samples with a cycle threshold (CT) value below 30 underwent further culture to assess virus viability.

Mpox Situation Analysis

To understand the mpox situation in Thailand, we reviewed confirmed case reports from the EBS system, up to 31 Jul 2023. Extracted data encompassed demographic characteristics, symptoms onset, treatment initiation date, notification dates, clinical presentations, HIV status, and reported risk behaviors.

Ethics

Since this study was part of routine DDC outbreak investigation, ethics approval was unnecessary.

Results

Epidemiological Investigation

We confirmed the diagnosis of the three mpox cases in Bang Kruai District, Nonthaburi Province. The first and second cases were male sexual partners. The third case was the mother of the second case. All lived in the same household, except for case 1 who lived elsewhere but often visited this house. This household also included two additional family members: the father of the second case (the husband of the third case) and a cousin of the second case.

The first case was a 27-year-old Indonesian-male. He was a dancer and was HIV-positive with a CD4 count >200 cells/mm^3 with undetectable viral load. He denied having multiple sexual partners. He lived alone in a condominium in Bang Phlat District, Bangkok. On 20 April, he performed dancing at a hotel in Sathon District, Bangkok, and had no physical contact with others. Between 25 and 29 April, he and his partner (case 2) spent time together at his condominium. They engaged in protected sex, using a condom, on 28 April. At that time, they had no symptoms and confirmed that they had no other sexual encounters. On 1 May he visited case 2's house, met their family, and stayed overnight. The next day, he participated in a shaving ceremony with case 2. On 3 May, he danced at a theater, denying close contact with others. During 4–8 May, he stayed at case 2's house and participated in various activities such as having dinner, without wearing a face mask. On 6 May, he developed headache, fatigue, and myalgia. Later, he developed fever and flank pain. On 9 May vesicles emerged on both arms, ankles, and the trunk, along with ulcers on the scrotum, penis, and perianal area. He then isolated at his condominium. He visited Chulalongkorn Hospital on 12 May and tested positive for MPVX. He reported no sexual activity after symptoms occurred.

The second case was a 25-year-old Thai-male. He had no underlying disease and denied multiple sexual partners. He stayed at his house in Bang Kruai District from 20 to 24 April, as he was recuperating from COVID-19. He visited the condominium of his partner (case 1) between 25 and 29 April and had shared activities, including intimacy, on 28 April. He returned to his house on 30 April. He took part in the shaving ceremony with case 1 on 2 May. From 4 to 13 May he stayed at his house. From 6 to 11 May, he experienced symptoms, starting with fever and cough on 6 May followed by headache and sore throat on 9 May. The rashes on his arms, head, trunk, and buttocks occurred on 11 May. He then isolated in his bedroom on 12 May. The next day, he visited case 1's condominium. On 14 May, he attended a polling station while wearing a face mask, long-sleeved shirt, and long-legged pants. He maintained social distance and had no close contacts. He visited Chulalongkorn Hospital on 15 May and tested positive for MPVX. As with case 1, he reported no sexual activity after symptoms occurred.

The third case was a 62-year-old retired Thai-female. She was the mother of the second case and lived in the same house. She underwent a smallpox vaccination during childhood. On 1 May, she had dinner with her son (case 2) and case 1 at her house in Bang Kruai District. Between 4–13 May she engaged in various activities such as having dinner with case 1 and case 2. She did not wear a face mask during these activities. She reported that her son coughed near her, without a face mask. On 11 May, she examined her son's rashes with her bare hands. On 12 May, she isolated in her bedroom. On 13 May, she experienced discomfort in her neck, followed by left cervical lymphadenopathy on 17 May and headache on 18 May. Note that she presented with neither fever nor rash. She visited Bang Kruai Hospital on 19 May and tested positive for MPVX.

Figure 1 shows a timeline of the shared activity among all cases.

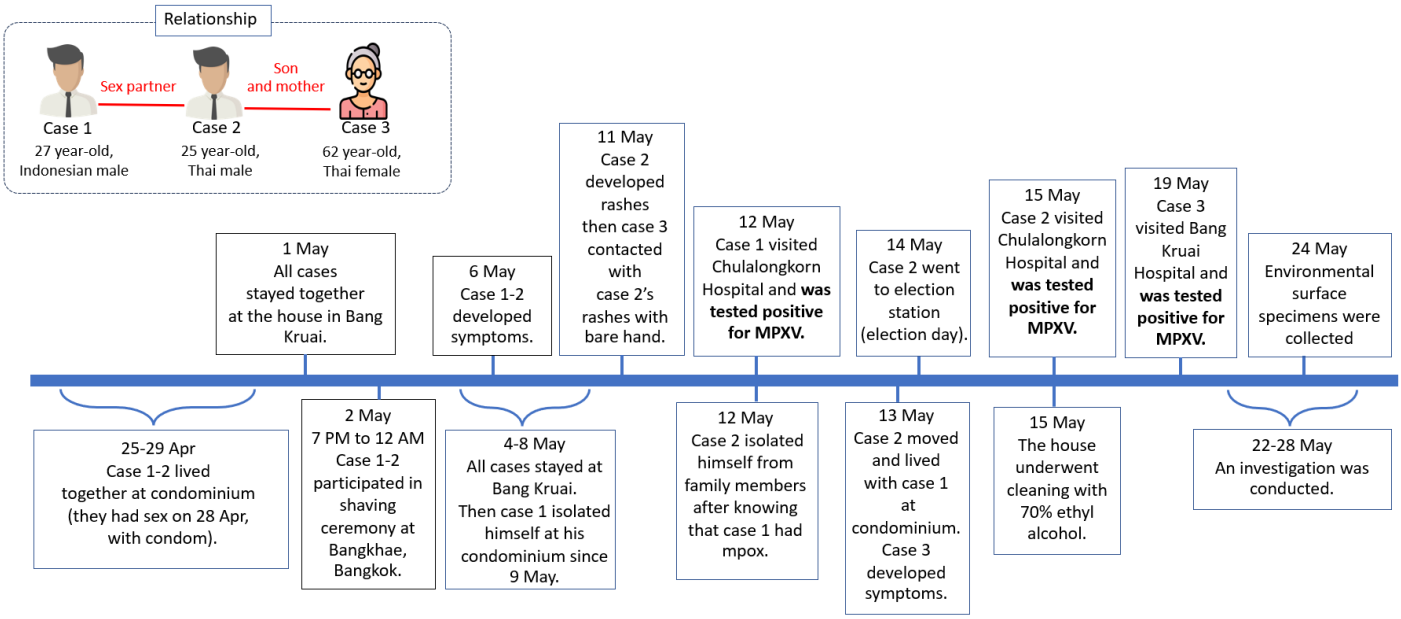

Figure 1. Summary of the shared activity and timeline among all mpox cases in Bang Kruai District, Nonthaburi Province, Thailand, 22–28 May 2023

Contact Tracing

The contact tracing revealed no additional case in case 1's condominium and the theater, where he performed on 3 May. We actively monitored the symptoms of the two other household contacts (the father and cousin of case 2) until 10 June. The father developed a nodule at the left index finger on 22 May, but his nasopharyngeal swab was negative for MPVX. The cousin was asymptomatic and was therefore not tested for MPVX.

The shaving ceremony is a tradition derived from Brahmanism to celebrate a boy's first haircut. This ceremony was held in Bang Khae District, Bangkok, on 2 May. There were about 100 participants who were primarily performers from several art institutions and reported to be from the LGBTQ+ community. The ceremony featured nine performances along with a self-serve dinner. Throughout the ceremony, there were close-contact behaviors such as handshakes and hugs among participants. Activities were conducted without face masks being worn. Shared toilet use was reported among participants. The ceremony-organizer stated that no additional mpox cases were reported by the participants. We developed an online questionnaire for ceremony-participants to record any symptoms and asked case 1 to help distribute the website address for this questionnaire on our behalf since we were not given the contact information of the ceremony-participants. However, only one individual responded, reporting no symptoms. Subsequent mpox cases reported to DDC after that were not linked to this ceremony.

Table 1 shows the laboratory findings for all cases. Case 3 had the highest CT value from nasopharyngeal and throat swab, still positive upon repeat testing seven days later.

Environmental Study

The affected household in Bang Kruai District is a three-storey-townhouse. The living room and kitchen are located on the first floor. Toilets are located on the second and third floors. There are various common touchpoints such as light switches, doorknobs, banisters, and faucets. Each family member occupies their own bedroom, with case 2 and case 3 residing on the third floor, the father on the second floor, and the cousin on the first floor. On 15 May, before our investigation, the house was cleaned with 70%-ethanol. Surface swabs yielded 18 positive samples out of 27, all with CT values exceeding 30. None were eligible for MPVX culture (Table 2).

Table 1. Laboratory results of all mpox cases in Bang Kruai District, Nonthaburi Province, 22–28 May 2023

	Case 1	Case 2	Case 3	
			1st test	2nd test
Onset date	6 May 23	6 May 23	13 May 23	
Test date	12 May 23	15 May 23	19 May 23	26 May 23
NPS & TS	Positive (CT 28.65)	Positive (CT 29.67)	Positive (CT 34.18)	Positive (CT 36.38)
Lesion swab	Positive (CT 14.34)	Positive (CT 18.31)	Not tested	Not tested
Whole blood	Weakly Positive (CT 35.28)	Negative	Not tested	Not tested

NPS & TS: nasopharyngeal swab and throat swab. CT: cycle threshold.

Table 2. Results of environmental surface swabs for testing the mpox virus at the household of mpox cases in Bang Kruai District, Nonthaburi Province, 24 May 2023

Floor	Touchpoint	Result	CT-value
First	Entrance doorknob	Positive (9/12)	37.75
	Toilet doorknob		36.96
	Light switches		35.52
	Toilet flush and seat cover		36.51
	Refrigerator door handle		36.13
	Table and stools		36.13
	Kitchenware		38.14
	Water filter machine		35.88
	Electric appliance switches		36.61
	Drainpipe	Negative	NA
	Faucet		
Second	Entrance door handle	Positive (2/7)	38.60
	Toilet doorknob		32.40
	Banister	Negative	NA
	Toilet flush and seat cover		
	Drainpipe		
	Shower		
	Light switch		
	Doorknob		
Third	Patient's room doorknob	Positive (7/8)	37.07
	Toilet doorknob		38.28
	Toilet flush and seat cover		35.80
	Drainpipe cover		38.16
	Light switches		34.38
	Electric appliance switches		33.75
	Banister		39.26
	Shower	Negative	NA

CT: cycle threshold. NA: not available.

Situation of Mpox in Thailand

As of 31 Jul 2023, there were 180 mpox confirmed cases (0.27 per 100,000 population). No death occurred. The median age of the cases was 35 years (interquartile range 29–40). About four-fifths of the cases (143/180) were identified as LGBTQ+ and approximately half (83/180) were HIV positive. Initial cases comprised individuals identifying as being male or female in approximately equal proportions. In March 2023 the number of LGBTQ+ cases started to increase. The number of mpox cases in Thailand reached its peak in mid-June 2023 (Figure 2). Of these 180 cases, 60% (108/180) provided a history of risk behaviors; 37% had multiple sex partners, and 33% had sexual intercourse with strangers (Figure 3). We did not find substantial evidence of mpox cases acquiring the disease within the household through non-sexual routes. The five most common mpox symptoms observed in Thailand were rash (97%), fever (73%), myalgia (44%), lymphadenopathy (42%), and sore throat (34%). Note that, we did not find any prior confirmed mpox cases without fever and rash simultaneously before this event. Mpox spanned 17 provinces, primarily concentrated within the Bangkok Metropolitan Area (Figure 4). The provinces with the five highest incidences were Bangkok, Phuket, Nonthaburi, Chonburi, and Nakhon Nayok (Table 3).

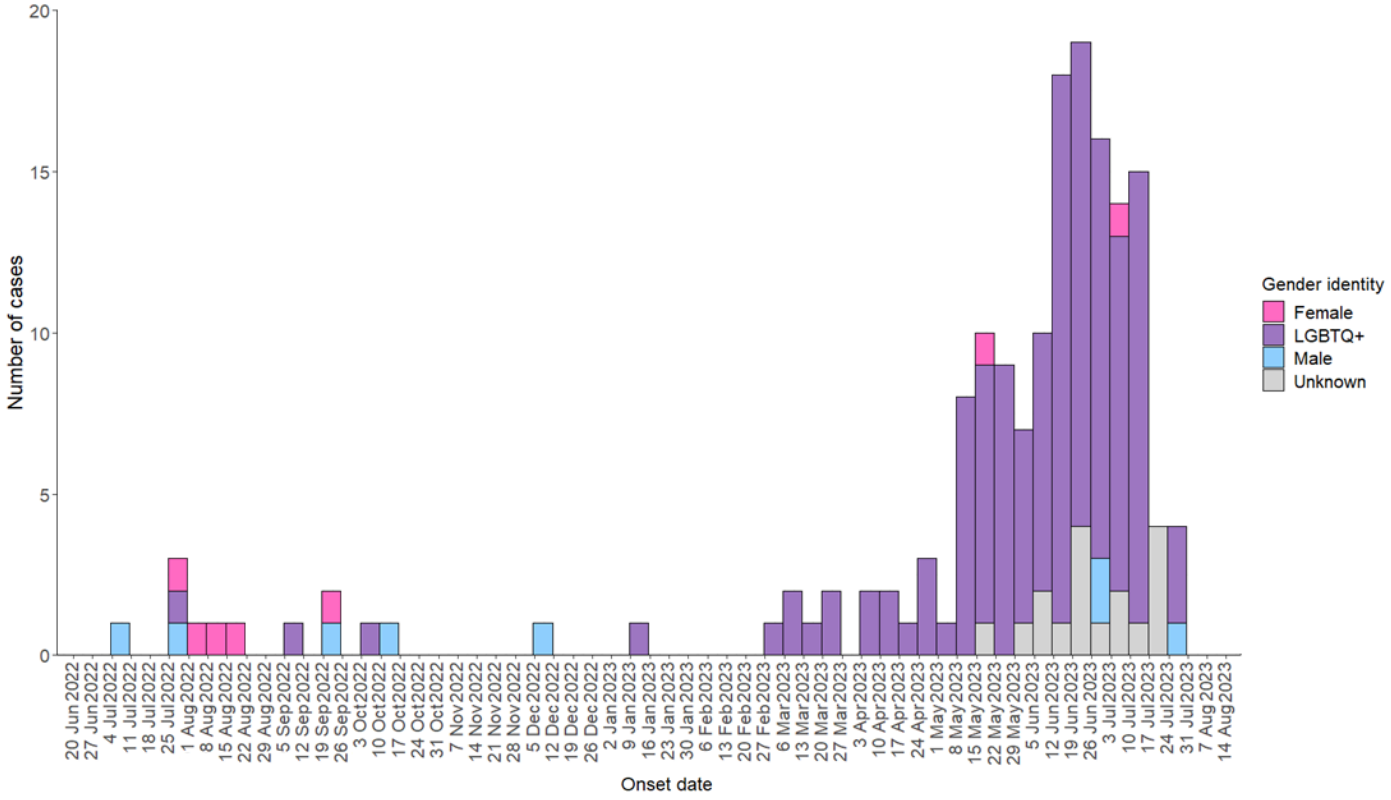

Figure 2. Number of weekly mpox cases in Thailand, 18 Jul 2022 to 31 Jul 2023, by gender identity (n=180)

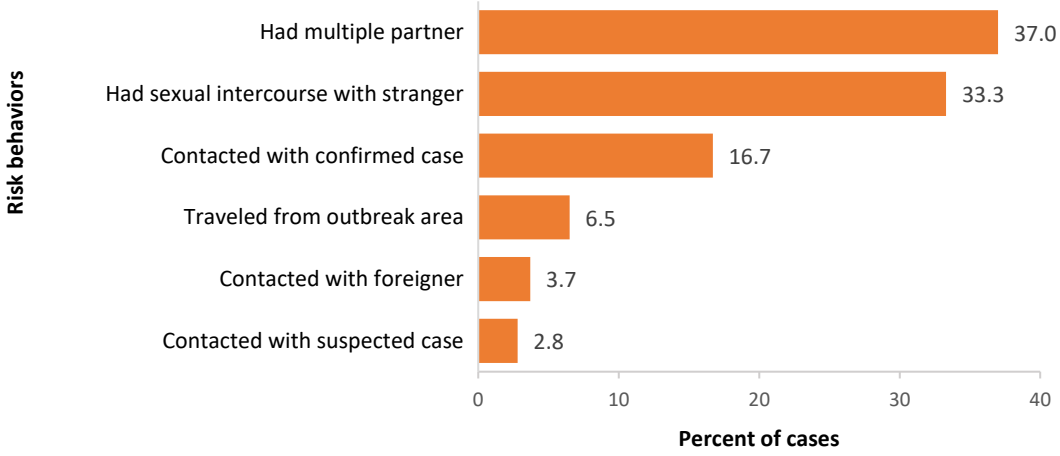

Figure 3. Risk behaviors among mpox cases (with availability of the information) in Thailand, 18 Jul 2022 to 31 Jul 2023 (n=108)

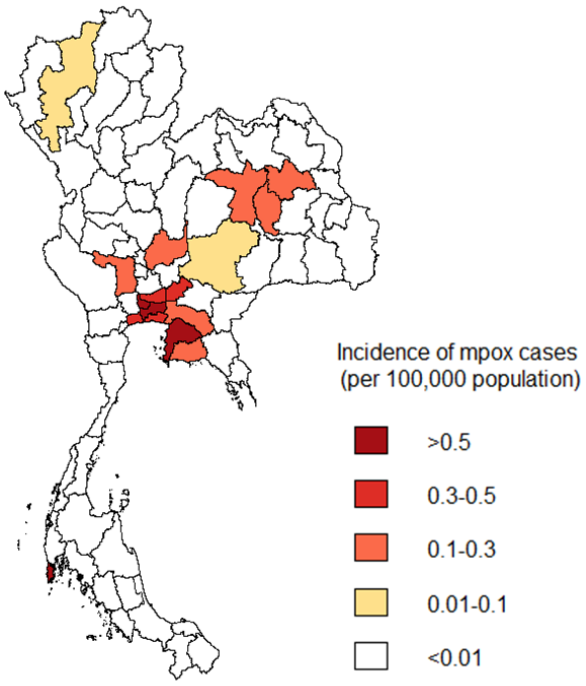

Figure 4. Incidence of mpox cases per 100,000 population in Thailand, 18 Jul 2022 to 31 Jul 2023, by province (n=180)

Table 3. Incidence of mpox cases per 100,000 population in Thailand, 18 Jul 2022 to 31 Jul 2023, by province (n=180)

Province	Number of cases	Incidence (per 100,000 population)
Bangkok	123	1.48
Phuket	7	1.33
Nonthaburi	13	0.97
Chon Buri	9	0.58
Nakhon Nayok	1	0.41
Samut Prakan	7	0.38
Samut Sakhon	3	0.34
Pathum Thani	4	0.30
Lop Buri	2	0.26
Kalasin	2	0.24
Maha Sarakham	2	0.24
Chachoengsao	1	0.14
Rayong	1	0.12
Suphan Buri	1	0.12
Khon Kaen	2	0.11
Chiang Mai	1	0.06
Nakhon Ratchasima	1	0.04

Action Taken

We provided health education on personal hygiene and environmental disinfection methods to all cases and household contacts. We monitored two household contacts for 21 days (until 10 Jun) from their last contact date with the cases. We conducted contact tracing and communicated the outbreak details to the organizer of the shaving ceremony. We urged him to disseminate outbreak information to the participants and encourage immediate reporting of any mpox symptoms.

Discussion

We confirmed the diagnosis of all cases through MPVX real-time PCR. The mpox outbreak was confirmed due to two reasons. First, this event was the first documented mpox cluster within Bang Kruai District. Second, a strong epidemiological linkage within a household was identified.

Case 3, had a history of close contact with her son's rashes and droplets. This observation confirmed the high plausibility of non-sexual transmission within a household beyond sexual transmission.[10] Our situational analysis did not reveal any evidence of this route of transmission within households before this investigation. So, this investigation was the first to document non-sexual transmission of mpox in Thailand, mirroring a similar occurrence in a hospital setting in the Republic of Congo.[11] Thailand risk communication should address the plausibility of non-sexual transmission. Even though, the likelihood of non-sexual transmission is low (4.6%).[2,12-14]

Case 3 exhibited no skin rash, consistent with our findings from the situation analysis, which indicated that approximately 3% of Thai-mpox cases had no rash. This aligns with a meta-analysis indicating that 5% of mpox cases manifest without rash.[2,15] Moreover, since case 3 did not exhibit any fever and rash, she does not meet the suspected case definition outlined in the mpox disease surveillance and investigation guidelines of the DDC.[16] And none of the previous mpox cases from our situation analysis lacked both rash and fever simultaneously. This might result in her not being tested, potentially increasing the risk of disease transmission to others. This observation emphasizes the importance for physicians to be vigilant towards nonspecific symptoms of suspected mpox patients and underscores the need for confirmed diagnoses by laboratory test. Additionally, the DDC should take this into account when revising the mpox disease surveillance and investigation guidelines regarding the criteria for diagnostic testing to ensure adequate sensitivity of case detection.

A significant portion (18/27) of the surface swabs from the household were positive for MPXV. Remarkably, these surfaces were cleaned with 70%-ethanol following the confirmation of mpox of case 2 who, together with the other affected cases, was isolated from the two non-affected family members. Despite these immediate measures, the persistence of MPXV on surfaces within the household was noteworthy.

However, all positive samples exhibited CT values that exceeded 30, which suggests that the virus was non-viable.[17] This aligns with previous studies indicating the ability of 70%-ethanol to mitigate the viability of the MPXV.[17,19–21] Thus, the fomite transmission in this household was unlikely during the investigation period. Hence, it is more likely that case 3 acquired the infection through direct contact with her son rather than through fomite transmission. Despite the low fomite transmissibility, case isolation is still recommended.[18] Additionally, the MPXV non-viability may not solely be attributed to the 70%-ethanol effect alone. The timing of our investigation, conducted two weeks after the onset of the first case, could have also influenced this finding.

Limitations

Limitations remain in this study. First, the cases appeared to be hesitant to reveal their exposure history, which led to difficulty in contact tracing. We tried to contact the shaving ceremony participants. However, we neither acquired full cooperation from the organizer nor received a full participant roster. This mirrors other mpox occurrences within LGBTQ+ communities and may be related to stigmatization.[22,23] Second, fomite transmission risk assessment relied on CT values obtained from specimens collected after the house was cleaned. So, caution must be taken when interpreting the fomite transmission risk. Third, the EBS contains unstructured data, leading to varying levels of detail provided by different reporters. Consequently, in our situation review, certain variables, such as gender identity were unavailable in some cases.

Recommendations

We recommend that direct contact with rash and droplet of mpox cases should be avoided. Risk communication in Thailand should address the plausibility of non-sexual transmission. Testing is recommended for symptomatic-contacts, even those presenting without rash. DDC should consider revising the mpox disease surveillance and investigation guideline to accommodate cases presenting without fever or rash concurrently. Moreover, it is crucial to promote rigorous hygiene and thorough environmental disinfection.

Conclusion

We confirmed the mpox outbreak within a household in Bang Kruai District. Disease transmission was observed through both sexual and non-sexual routes, emphasizing the importance of addressing the plausibility of non-sexual transmission in risk communication. Physicians should pay attention to nonspecific symptoms of mpox-contacts and confirm the diagnosis with laboratory tests. The mpox disease surveillance and investigation guideline should be revise to accommodate cases that present without fever or rash simultaneously. The environmental swabs revealed a large portion of specimens presenting with MPXV genetic, with CT values ≥30. This suggests a minimal risk of fomite transmission, potentially due to the effectiveness of 70%-ethanol.

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