A Review on Epidemiology of Monkeypox and Prevention in Thailand

Chalida Sompolwattana[a]*

[a] unna.chalida@gmail.com
*Chulalongkorn University Demonstration Secondary school, Bangkok 10330, Thailand

Abstract

Objective:
The purpose of study was to extend information prevention of monkeypox virus infection in Thailand.
Background:
Although monkeypox has been discovered and spread in particular areas, in 2022, monkeypox virus has immensely expanded to other continents and ultimately the global health crisis has occurred. Therefore, the monkeypox 2022 outbreak may negatively affect social contexts. To extend, there is the predisposition of increasing monkeypox infection cases and Thailand might encounter the monkeypox epidemic circumstance. Thus, this study endeavored to congregate monkeypox prevention may provide an initiative or idea regarding prevention in monkeypox outbreak for Thailand.
Result:
The research confirmed that there are 2 possible prevention methods to protect against infection including self-prevention and vaccination. 2 vaccines are recommended to use for prevention: JYNNEOS and ACAM2000. However, the conditions of JYNNEOS are that it is only recommended for people aged 18 or older with high risk, and must be vaccinated for 2 doses. Apart from that, ACAM2000, or smallpox vaccine, found no exact supporting evidence of effectiveness at current time. In extent, freeze-dry smallpox vaccines which were frozen for more than 4 decades are qualified to use in Thailand.
Conclusions:
Our data suggests that the JYNNEOS and ACAM2000 vaccines are able to be used, although the JYNNEOS vaccine may be prioritized first. Nonetheless, self-prevention might play a major role in coping with further monkeypox situations in Thailand.

Keywords: monkeypox; 2022 monkeypox outbreak; monkeypox vaccination; monkeypox prevention; smallpox vaccination

1. Introduction

Monkeypox is a rare contagious zoonosis that presents symptoms similar to smallpox in the past. It is less contagious than smallpox and is regularly nonfatal. Nevertheless, monkeypox has emerged as the most important orthopoxvirus for public health due to eradication of smallpox in 1980 with subsequent smallpox vaccination termination [1] [2].

Monkeypox is caused by infection with the monkeypox virus (MPXV) with double-stranded DNA which is a subset of poxviruses. It belongs to the Orthopoxvirus genus in the family Poxviridae, same as variola virus that causes smallpox, vaccinia virus used in the smallpox vaccine, and cowpox virus [1] [2]. MPXV can be segregated into 2 species: West African clade, which causes fatality at 1% and Central African (Congo Basin) clade causing fatality at 10% [3], which means that Congo Basin MPXV is more severe than West African MPXV [4]. West African clade is the species that spread in the monkeypox 2022 outbreak.

MPXV distributes by contact with infectious body fluid [5], intimate contact by inhaling, dermal lesions and scabs, or adulterate objects such as attires and bedcovers, which can transmit virus through individuals. Likewise, there is possibility of virus being spread by direct contact during sex activity. In other words, the virus does not pass on by casual contact [6].

Risk factors occurred in people if those have visited to the locations encountering outbreaks at the time, or being indicated as endemic countries. Besides, having sex, especially with anonymous sex partners, is considered as a high-risk factor [2] [5]. WHO also reveals the report that 98% patient with monkeypox infection had the record of man sexual with men. In addition, according to a study in Congo, a significant risk in a household primarily is sharing a place or equipment directly, including occupying the similar room or bed with monkeypox patients, or using the same cups or plates [7].

There is an identification toward susceptibility of infection in various wild mammals from areas where the monkeypox epidemic is reported. These contain rodents: dormice, Gambian pouched rats, rope squirrels, and tree squirrels. Non-human primates also included. Several species exhibit symptoms of rashes found in humans, such as great apes and monkeys. Meanwhile, asymptomatic infection is possible in some species. Nonetheless, there is no research nor evidence that proves the hypothesis of human-to-animal monkeypox transmission, besides effects on domestic animals or livestock by MPXV [1].

In this study, we extend information concerning monkeypox in order to understand the zoonosis outbreak and occurrence propensity in Thailand.

2. Transmission

Primarily monkeypox is found in central and west Africa, generally in proximity to tropical rainforests, and has sporadically expanded to other areas. There are 2 classifications of monkeypox transmission cycle, including animal-to-human transmission and human-to-human transmission.

Animal-to-human transmission, also known as zoonotic transmission, can be sent by consuming raw-infected animals or directly contacting infected animals through bodily fluids, blood, cutaneous or mucosal lesions. Evidence of monkeypox virus infection has been reported in Africa. It is found in primary hosts like rodents, incidental hosts i.e., monkeys from several species and others [1]. However, eating or processing wild animals are not significant risks [7].

Human-to-human transmission can occur by tarnished objects, skin lesions, or respiratory droplets from infected colonies with intimate contact. In the extent of how to spread, people who have face-to-face, skin-to-skin, mouth-to-mouth or mouth-to-skin contact, besides sex contact are required to be the risk group. Moreover, the virus can be transmitted from mother, who has close contact during pregnancy or after birth, to fetus which congenital monkeypox will occur. In addition, there is a report of the longest contagious human-to-human chain from 6 to 9 infections in sequence [1].

3. Risk areas with timeline of Monkeypox outbreak

The first discovery of monkeypox was found in cynomolgus monkeys shipped from Singapore to Copenhagen in 1958 [2] [8], although there was no precise information of the disease burden. Later, in 1970,

monkeypox was first identified in a human who was a boy aged 9-month-old in a region where smallpox used to scourge (however, smallpox eradication had done in 1968) of the Democratic Republic of the Congo [1] [9]. Rural and rainforest areas of the Congo Basin are the regions where primarily cases were recorded, and the number of human cases has increased significantly in central and west Africa. Since 1970 until before 2022 outbreak, there are 11 countries which monkeypox cases in human have been recorded, including Benin, Cameroon, the Central African Republic, the Democratic Republic of the Congo, the Republic of the Congo, Côte d'Ivoire, Gabon, Liberia, Nigeria, Sierra Leone and South Sudan. During 1996 to 1997, there was a vivid change found in monkeypox transmission in the Democratic Republic of the Congo. Number of cases which encounter fatality were reported lower compared to cases in previous years, nevertheless the range of health attacks became higher than normal. This can be extended for clarity by circumstance that meanwhile happened in the same region: chickenpox outbreak. Chickenpox is caused by varicella virus, which is not an orthopoxvirus like monkeypox, which could support the changes in transmission dynamics that has been mentioned above [1].

Besides, monkeypox disease started occurring out of Africa in 2003, in which the United States of America was, and over 70 cases were recorded. According to WHO information, infected pet prairie dogs contact was the factor of this outbreak, in which these pets had been provided living quarters amidst dormice and Gambian pouched rats brought from Ghana. Since 2017, Nigeria has experienced a huge epidemic, there were more than 200 confirmed cases along with over 500 suspicions and an approximate case fatality of 3% which report has been presented until today. Contagious travelers who departed from Nigeria to several regions were reported in several countries: Israel in September 2018, the United Kingdom in September 2018, December 2019, May 2021 and May 2022, Singapore in May 2019, and United States of America in July and November 2 [1].

From January 1 until 15 July 2022, data cases were confirmed from 68 countries, which the report has been secluded into 2 types: has been recorded in history and has none of record, which is indicated at 6 and 62 countries respectively. Consequently, the number of confirmed cases from a laboratory indicates that countries where monkeypox is not endemic in total over 12,000 cases. On 15 August 2022, the record demonstrated a total number of cases at over 31,000. This means that the amount of people with monkeypox infection has doubled by only 1 month. Both compartments are detailed in the graph [2] [10].

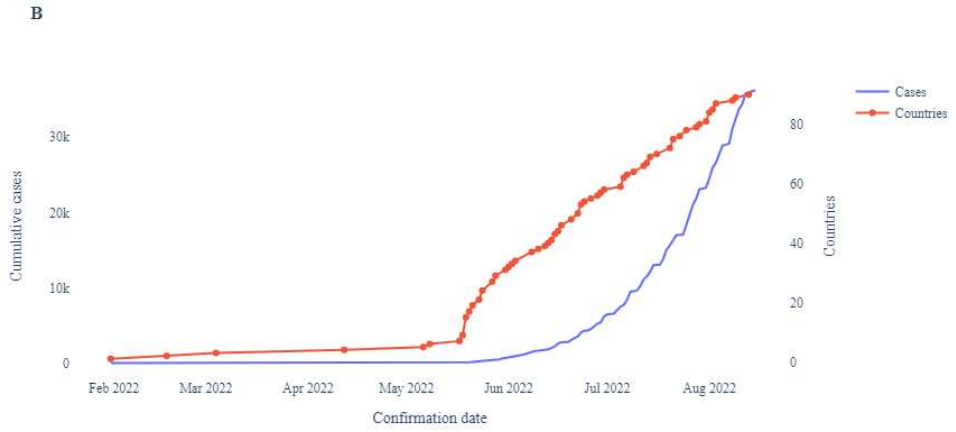

Fig. 1. Monkeypox 2022 global epidemiology; Report 2022-08-29 [10]

4. Monkeypox outbreak situation in Thailand

According to Thailand's health ministry, Monkeypox infection was first confirmed in Thailand on July 19 2022, which was found within 27-year-old Nigerian man in Phuket [11], becoming the 66th country where monkeypox infection was found. However, the significant issue occurred when the patient broke free from the hospital where had arranged transfer for medical treatments [12] [13]. Later, he was found already left Thailand and entered Cambodia. This caused 33 people: 19 people got high risks, and 14 people with low risks. However, later there was no report of being infected [14].

Besides, on July 28 2022, the second case was confirmed in a 47-year-old Thai man according to Wachira Phayaban Hospital in Bangkok. In addition, there was a report that the patient had close contact with a foreigner man, and found lesions full of liquid at genital area, which the information goes along with the WHO report. Furthermore, there were 10 people who had intimate contact with the patient [15]. In addition, according to his age, there is a possibility that he had received smallpox vaccination. Still, the patient is infected.

Later, the German male was reported being infected on August 3 2022 in Phuket after diagnosed symptoms including: Lymphadenopathy, lesions full by liquid at the trunk, arms legs and genital area. However, this patient is speculated to be infected before arrival to Thailand [16].

The fourth case was found in a 22-year-old Thai female who had suspect travel history regarding having a bar venue visit in Bangkok, in which foreigners commonly visit, and had intimate contact with a foreigner male. This monkeypox case has been confirmed on August 4 2022 [17].

On August 15 2022, the fifth patient was confirmed in a Thai female aged 25. With the travel history that she departed from Dubai, Arab Emirates and arrived in Thailand on August 14 at Suvarnabhumi airport. The report indicates that the patient got signs and symptoms before arrival. Consequently, there are only 2 foreigners with risks of monkeypox infection [18] [19].

According to records of travel history from 5 patients with monkeypox infection, Thailand may not be the center of the monkeypox virus source. The disease might be transported from other risk regions apart from Thailand. In extent, considering the amount of monkeypox cases and the number of people with high-risk of infection in Thailand, it may not occur in a significant cluster of the disease in common places except bar venues. Still, people should be cautious of monkeypox and have self-prevention in order to reduce risks of monkeypox infection.

There is no official announcement regarding prevention measures from the Department of Disease Control nor the Ministry of Public Health in Thailand. However, there is a report that Thailand has storage of the approximate 500,000 doses of smallpox vaccines in dry freeze form for 43 years ago (produced in 2004) [20] [21]. According to the official statement, if there was a monkeypox outbreak occurring in Thailand, these vaccines might be utilized in that circumstance.

4.1. Efficiency of 43-year vaccines

The study revealed the quality of immunity of individuals born between 1937 and 1982 who were vaccinated with smallpox vaccines, while passing generation has not been vaccinated [22]. The conclusion brought to the point that there still remains antiviral humoral immunity. However, the remaining immunity may afford less protection degree, and exceedingly probable to provide partial protection at least. The aforementioned second case in Thailand conforms to this explanation. Thus, the immunity level of the Thai patient after receiving it for a long period may decline [23].

Research regarding extending the virus lifetime demonstrates that long-time-maintaining Ebola vaccines, Avian influenza vaccines, and Rabies vaccines are efficient and able to be used for development. The stabilizing efficiency is controlled by 2 factors: 1. concentration of sugars and 2. cool temperature level that freezes germs

[24]. Also, there is a method of Freeze-Drying which increases stability of the Adenovirus and Poxvirus vaccine storage times [25] [26]. Still, financial and technological resources are the constraint of vaccine stability, particularly in underdeveloped regions [25]. In extent, public health knowledge can affect preparedness of prevention [27].

Additionally, the Government Pharmaceutical Organization of Thailand (GPO) collaborating with the Department of Medical Sciences Ministry of Public Health of Thailand tested the quality of smallpox vaccines from 13 versions by incubating germs. Ultimately, the result is vaccines are all physically qualified. Therefore, this may be used for vaccination in case there is an upsurge of monkeypox infection [20] [21]. Nonetheless, CDC indicates that there is uncertainty of quality that smallpox vaccines could strongly prevent monkeypox viruses according to supporting evidence [28].

In conclusion, although there are Thai people with monkeypox infection, Thailand has not yet occurred the monkeypox 2022 outbreak. However, following initial policies according to several countries may prevent epidemics that might occur in further circumstances.

5. Symptoms and complications

The incubation period is approximately 5-21 days before symptoms, but most of them show symptoms in the period 6-13 days [29]. People who contract the disease have different levels of severity, some people have mild symptoms, while others might need a health facility to look after. In addition, there are immunocompromised people who are at high risk for severe symptoms and complications including pregnant people, children and low-immune people [1].

Symptoms in monkeypox can appear through a wide range of signs, which the most common symptoms include fever, malaise, sweat [30], headache, chills, exhaustion, myalgia (muscle aches) and backache, lymphadenopathy (swollen lymph nodes) lesions and a rash. In extent, lesions will be full liquid before crust over, excessively dry and decrease respectively. The rash can appear on genital or anal regions of the body, the face, inside the mouth, throat, hand palms, feet, chest. The appearance can look like pimples or blisters, which primarily lasts 2-4 weeks and ultimately become well on their own or with medical care [1] [2]. This symptom can be found on the face, palms of the hands, soles of the feet, eyes, mouth, throat, groin, and genital or anal regions of the body [1].

6. Symptoms and complications

To give importance to monkeypox infection risk factors by educating and raising awareness of people can decrease susceptibility of exposure to MPXV.

6.1. Chain of Infection

In epidemiology, triad model is used to describe infectious disease spread resulting from the agent, host, and environment interaction. To extend, there are 6 links which connect as the chain including agent, reservoir, exit portal, modes of transmission, portal of entry, and host respectively. Policies in some countries are declared, or in process for announcement, to offer vaccines to people with risk of infection such as health workers and laboratorians [1].

In order to prevent germs or disease transmission, breaking the chain of infection at any link is the proper solution. For the monkeypox 2022 outbreak, transmission can be stopped by interrupting the link of hosts that can lead to increase of infectious agent; vaccination, and the portal of exit along with mode of transmission; for instance, hand hygiene or personal protective equipment such as masks [31] [32]. Additionally, aforementioned

strategies are detailed in the illustration.

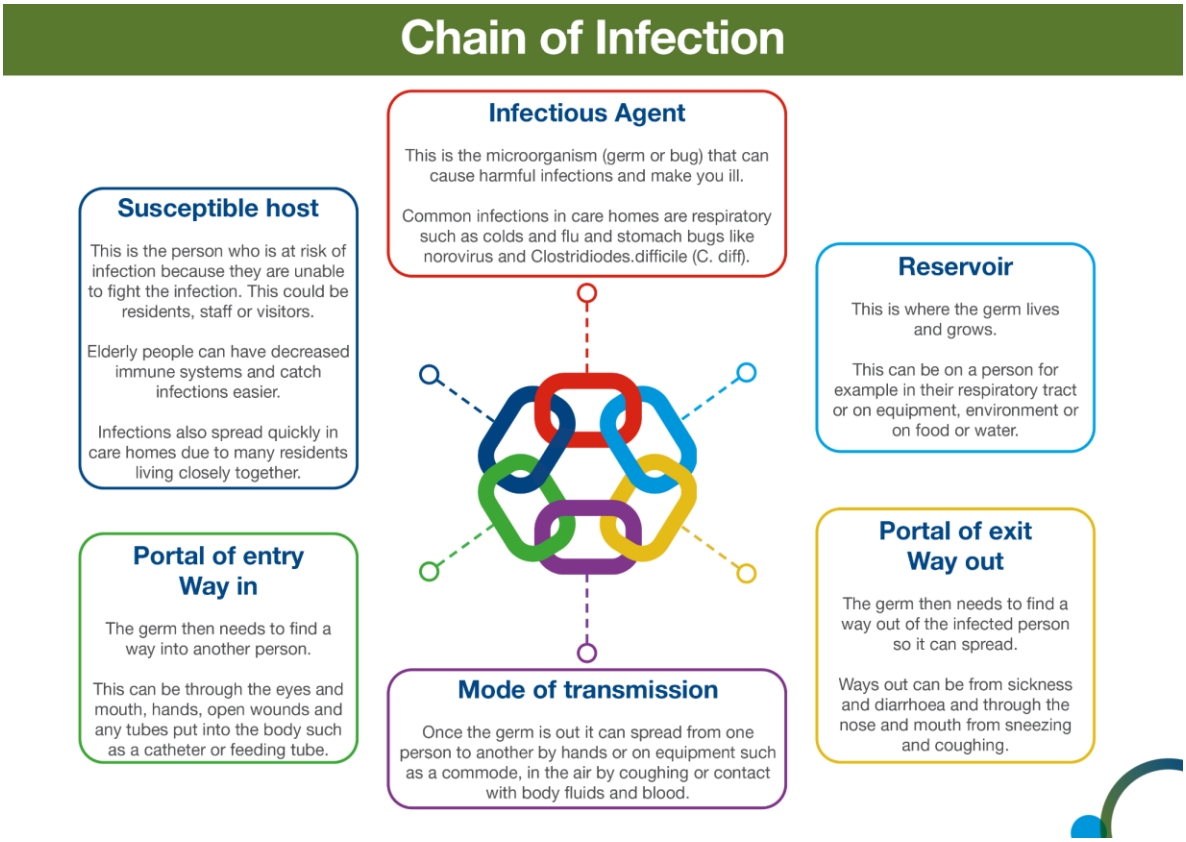

Fig. 2. Chain of Infection [33]

6.2. Self-Prevention

In order to prevent being infected by monkeypox virus, following 3 monkeypox prevention steps is recommended for people.

1. Avoid intimate contact with people who seemingly have monkeypox-like symptoms by not touching the rash, scabs or lesions. Skin-to-skin contact is also ought to be avoided e.g., cuddle, kiss, have sex.

2. Keep distance from suspicious objects or materials that have been used by infected people. For instance, not sharing household implements, bedding, towels or attires of a person with this infectious disease.

3.Wash hands regularly with soap and water. Use alcohol-based hand sanitizer before and after using the bathroom, touching your face or eating [2]. In necessary conditions, protective coverings are recommended to be worn [34].

Additionally, in regions in which found risks of being infected from animals (rodents and primates) that can spread the virus, contact through meat, blood or other parts, and bedding or materials they have touched must be avoided. Relatively, sick or dead animals must be distanced [2].

6.3. Vaccines

- JYNNEOS

JYNNEOS vaccine is recommended for people aged 18 or older with high risk in order to decrease propensity of infecting monkeypox and having illness directly. Its approval is supported by animal studies and clinical studies demonstrating an immune response which is comparable to ACAM2000.

The JYNNEOS has been divided into 3 following groups:

1. Monkeypox Vaccine Post-Exposure Prophylaxis (PEP)
   For this approach, PEP is important in the role of preventing monkeypox transmission. This strategy is regarded as standard PEP in the monkeypox 2022 outbreak. PEP can be used with people who have monkeypox exposure in order to prevent the following disease. In addition, it is essential to confirm monkeypox cases from states or other jurisdictions to access this vaccine. PEP should be administered in 4 days from exposure date. Nevertheless, if it is given between 4 to 14 days, the vaccination might decrease symptoms, but not prevent the disease. Besides, although vaccination is given after 14 days of exposure date, advantages from PEP may outweigh risks in some clinical circumstances.
2. Outbreak Response Monkeypox Vaccine Post-Exposure Prophylaxis (PEP)++
   PEP++, also can be considered as “individual-directed PEP” “expanded PEP” or “PEP plus-plus”, might reduce the speed of the disease spread in areas where monkeypox cases have been reported in large numbers and have higher levels of monkeypox virus transmission. This approach aims to reach someone with certain risk factors although those groups have not been reported exposure with confirmed monkeypox.
3. Monkeypox Vaccine Pre-Exposure Prophylaxis (PrEP)
   This approach aims to provide vaccines to people who are high-risk for monkeypox e.g., laboratorians or clinicians who have done Orthopoxvirus generic tests or handle specimens that may contain monkeypox virus. However, in the United States, most laboratory workers and clinicians who have no involvement with Orthopoxvirus experiment or diagnosis, including monkeypox virus, are not suggested to vaccinate PrEP.

People can receive the JYNNEOS by injection on the upper arm, which ought to be given 2 doses in total at approximately 4 weeks apart. People who are in moderate to virulent immunocompromised stage should be given the second dose after 4 weeks straight. Nevertheless, people who have no immunocompromised condition may receive the second dose at more than 28 days after (maximum at 35 days), in case there is a lack of vaccine supplies [35] [36].

- ACAM2000 (smallpox vaccine)

ACAM2000 is the vaccine of prevention against smallpox, which belongs to a similar genetical group of monkeypox. This vaccination strategy is considered to be recommended for high-risk people aged 1 year and older, and vaccinate it for 1 dose. There is no certain evidence regarding effectiveness and clinical efficiency of ACAM2000 against monkeypox. However, there is the only study of Dryvax, the first-generation smallpox vaccine, that provided effectiveness against MPXV through 338 patients in the Democratic Republic of the Congo [36].

6.4. Current antivirals

There are no specific medications for monkeypox disease. Nevertheless, due to genetic groups of monkeypox and smallpox that are the same, antivirals of smallpox may be able to be used for helping monkeypox prevention and infected patients. The antiviral that may be majorly recommended is tecovirimat or ST-246 (TPOXX). Additionally, there are other antivirals including: brincidofovir (Tembexa); cidofovir (Vistide), an antiviral used for treatment of cytomegalovirus retinitis with AIDS, and intravenous vaccinia immune globulin (VIGIV), which is verified for treatment of complications from smallpox [37].

7. Conclusion

In conclusion, monkeypox in the 2022 outbreak has risk factors that can be inhibited by self-prevention vaccination. MPXV has 2 species: West African clade and Central African (Congo Basin) clade, which West African clade is the species that spread in the current outbreak. The virus can be transmitted from animals to humans as zoonotic transmission by direct contact and consuming raw-infected animals, or spread to humans through intimate contacts and contaminated objects. Monkeypox was discovered and used to spread in particular regions such as central and west Africa. However, Later In 2022, the number of monkeypox cases in humans increased significantly and ultimately transmitted globally and has a tendency of case amount that will increase.

In order to prevent monkeypox disease, there are 2 ways to proceed including self-prevention and vaccination. Vaccines which are recommended to use for prevention are JYNNEOS, a monkeypox vaccine and ACAM2000, a smallpox vaccine. Nonetheless, the conditions of JYNNEOS are that it is only recommended for people 18 years old or older with high risk, and 2 doses vaccination is required. ACAM2000, or smallpox vaccine, currently found no exact supporting evidence of clinical effectiveness. Additionally, public health preparedness can have an effect on efficiency of prevention.

Thailand reported 5 infectious cases, of which 3 people were Thai and another 2 were foreigners. One of Thai patients with monkeypox infection is speculated to have received ACAM2000 (smallpox vaccine) vaccination several decades ago. Regarding this circumstance, the Department of Disease Control and the Ministry of Public Health in Thailand have yet no official declaration regarding prevention measures, but have tested 43-year dry freeze smallpox vaccine quality and it is proved to be efficient. Still, there is no certain official evidence with regard to efficiency of ACAM2000 against monkeypox virus. Besides, the treatment of this disease has no specific medications, but antivirals of smallpox may be able to be used due to the same genetic groups of monkeypox and smallpox.

Recommendation

Primarily, although vaccination is suggested as the main prevention method, self-prevention may be the strategy that should be used due to the situation in Thailand that has a low infection rate. However, health workers who look after monkeypox patients are at high risk. Therefore, the government may consider the regulation of strict self-prevention for risk workers. In the further situation, if there is an outbreak occurring in Thailand, ACAM2000 in the storage may be used. However, with limited doses and uncertain data of effectiveness of ACAM2000 against monkeypox, JYNNEOS vaccine could be an alternative choice.

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