Project Summarizing and Analyzing Research Paper

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Topic: Monkeypox

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Initial Prompt: I have used ChatGPT tools it is very useful for me yo summarize these article.

A STUDY TO KNOW ABOUT THE MONKEYPOX VIRUS

Monkeypox is a zoonotic disease caused by the monkeypox virus, which is part of the Orthopoxvirus genus, including variola (smallpox), vaccinia, and cowpox viruses. The disease was first identified in humans in 1970 in the Democratic Republic of the Congo and has historically been limited to parts of West and Central Africa.

Symptoms typically appear 7 to 10 days after exposure and include fever, muscle pain, and a distinctive rash. The rash evolves through stages from papules to vesicles, pustules, and eventually crusts, often affecting genital, anal, or oral areas. Complications, which may need medical treatment, occur in up to 40% of cases and can include severe pain and infections. Hospitalization is required for 1% to 13% of cases, with a case-fatality rate of less than 0.1%.

Diagnosis is confirmed through PCR testing for Orthopoxvirus DNA from lesion samples or body fluids. Severe cases or those at high risk may benefit from antiviral treatments like tecovirimat. For post-exposure or pre-exposure prophylaxis, the non-replicating modified vaccinia Ankara vaccine is recommended. However, access to antiviral treatments and vaccines remains limited in endemic regions in Africa.

Historically, monkeypox was first identified among monkeys in 1958 and later in humans in 1970. Previous smallpox vaccination was found to be about 85% effective in preventing monkeypox, although the long-term effectiveness of such vaccinations is uncertain.

Monkeypox is classified into two main clades: Clade 1, which has a higher fatality rate and is found primarily in Central Africa, and Clade 2, which is less virulent and found in West Africa. The discontinuation of smallpox vaccination, waning immunity, and changes in human behavior such as increased bushmeat hunting have contributed to the resurgence of monkeypox.

**Virology:**

Virologically, monkeypox is a large double-stranded DNA virus with about 190 proteins. Two main clades have been identified based on genomic differences, which correlate with clinical severity. The new B.1 lineage from the 2022 outbreak shows a higher mutation rate, possibly due to increased human-to-human transmission. This raises questions about its impact on virus transmissibility and virulence.

### Epidemiology Summary

Monkeypox, a zoonotic disease, was first identified in humans in 1970. Over the next decade, 59 cases were reported in West and Central Africa, with a high mortality rate of 17% among children under 10 years old. After the global eradication of smallpox and the discontinuation of routine smallpox vaccinations in 1980, there was increased concern about monkeypox due to reduced immunity in the population. This concern was compounded by several outbreaks from 2000 to 2015 in the Democratic Republic of the Congo, with a notable increase in cases.

The 2022 global outbreak saw a dramatic increase in cases, with the first reports to WHO in May. Many early cases were associated with an international LGBT+ Pride event in Gran Canaria, Spain, which led to transmission chains across Europe. By the end of May 2022, local and community transmission had become more prevalent in all affected regions.

### Pathogenesis of Monkeypox

**Virus Entry and Initial Infection:**

Monkeypox virus can enter the host through two main routes:

1. **Respiratory Route:** The virus infects airway epithelial cells in the respiratory tract.
2. **Dermal Route:** The virus targets skin cells such as keratinocytes, fibroblasts, and endothelial cells.

Once inside the body, the virus can also infect antigen-presenting cells like macrophages and dendritic cells. These cells carry the virus to draining lymph nodes, where initial replication occurs, leading to a low-grade primary viremia.

**Viral Spread and Replication:**

After initial replication in the lymph nodes, the virus spreads to other organs such as the spleen and liver. This leads to a second, more intense wave of viremia, which can then disseminate the virus to distant organs like the lungs, kidneys, intestines, and skin.

In non-human primate models:

* **Respiratory-Acquired Clade 1 Monkeypox:** The virus replicates in the respiratory epithelium and spreads to lymph nodes and lymphoid organs, such as the tonsils, spleen, liver, and colon. It is then detected in the blood and causes widespread skin and mucous membrane lesions.
* **Subcutaneous Inoculation:** The virus replicates primarily in the skin and lymphatic system, with mild, localized disease.

**Clinical Presentation and Transmission:**

The clinical presentation of monkeypox may vary based on the route of transmission and the specific clade of the virus:

* **Respiratory Transmission:** Leads to extensive systemic infection and widespread skin lesions.
* **Dermal Inoculation:** Often results in localized lesions and less extensive dissemination, with a lower concentration of viremia and less virus in respiratory secretions.

During the 2022 outbreak, the disease primarily spread through close or sexual contact, leading to localized lesions, particularly oral and anogenital, and fewer extensive skin lesions compared to previous outbreaks.

**Histopathological Findings:**

* **Vesicular Stage:** Characterized by ballooning degeneration of keratinocytes, spongiosis, dermal edema, and acute inflammation.
* **Pustule Stage:** Shows apoptotic keratinocyte debris, inflammatory cells, and cytopathic damage with eosinophilic inclusion bodies.

**Immune Response:**

Monkeypox infection triggers both humoral and cellular immune responses:

* **Humoral Response:** Produces orthopoxvirus-specific IgM and IgG antibodies, which provide long-term immunity and protection against severe disease.
* **Cellular Response:** Involves the activation and expansion of CD4+ and CD8+ T cells, which help control the infection. Memory T cells can persist for many years but may not always provide robust protection against monkeypox.

In people with HIV, a strong T-cell response is crucial for managing the infection. In non-human primates, B-cell responses are essential for protection, although depletion of T cells affects B-cell responses and protection.

Overall, the clinical and immunological responses to monkeypox are influenced by the route of infection, viral clade, and individual immune status, contributing to varying presentations of the disease.

### Transmission of Monkeypox

**Animal-to-Human Transmission:**

Monkeypox virus can be transmitted from animals to humans through various means:

* **Non-Invasive Exposures:** Contact with infected animals through activities like touching, cleaning their cages, or hunting/processing their meat. This type of exposure carries a lower risk of transmission compared to direct contact.
* **Bites or Scratches:** Direct exposure through bites or scratches from infected animals presents a higher risk of transmission.

Several animals in Africa, including rodents (e.g., Gambian rats, tree squirrels) and non-primate species, have been found to carry the virus. However, the specific animal reservoir remains unidentified. It is believed that monkeys and humans are incidental hosts rather than primary reservoirs.

**Human-to-Human Transmission:**

Transmission of monkeypox between humans can occur through:

* **Respiratory Secretions:** Large respiratory droplets from an infected individual can infect others when they come into contact with the mucous membranes of the mouth and nose. This typically requires extended face-to-face contact.
* **Direct Contact:** This involves direct contact with infectious skin lesions, bodily fluids, or contaminated materials.
* **Vertical Transmission:** The virus can be transmitted from a pregnant person to their fetus through the placenta.
* **Percutaneous Transmission:** This occurs through broken skin or mucous membranes coming into contact with infectious materials.
* **Indirect Contact (Fomites):** Transmission can occur via contaminated objects or surfaces, such as bedding or clothing.

**Infectious Period:**

The infectious period for monkeypox spans from the onset of clinical symptoms until all skin lesions have healed and the skin has re-epithelialized. Key points regarding viral shedding and detection include:

* **Viral DNA Detection:** In immunocompetent patients with mild disease:
  + **Skin:** Viral DNA is detectable for a median of 25 days.
  + **Pharynx and Rectum:** Viral DNA is detectable for approximately 16 days.
  + **Semen:** Viral DNA is detectable for about 13 days.
  + **Blood:** Viral DNA is detectable for about 1 day.

For 90% of cases, viral DNA in semen and skin lesions becomes undetectable by days 39 and 41, respectively. Although semen can contain viral DNA, it is unlikely to be a major source of transmission due to generally low viral loads and rapid viral clearance.

**Severe vs. Mild Cases:**

Severe cases of monkeypox are associated with:

* **Extended Viraemia and Shedding:** Longer periods of detectable viral DNA and extended viral shedding compared to mild cases.

Understanding these transmission dynamics is crucial for implementing effective public health measures and controlling outbreaks.

### Diagnostic Investigations for Monkeypox

**Clinical and Epidemiological Criteria:** Monkeypox diagnosis is based on a combination of clinical and epidemiological criteria:

* **Clinical Indicators:** The presence of an unexplained acute rash, which may include mucosal lesions in areas such as the conjunctiva, mouth, penis, vagina, or anorectal region. Symptoms may also include proctitis (inflammation of the rectum) and lymphadenopathy (swollen lymph nodes). Additionally, influenza-like symptoms following high-risk exposure raise suspicion.
* **Epidemiological Risk Factors:** Probable cases are those with a clinical suspicion of monkeypox and known epidemiological risk factors, such as:
  + Close or intimate contact with a confirmed monkeypox case.
  + Membership in a social network or community experiencing an outbreak.
  + Recent travel to areas with reported monkeypox outbreaks.

**Diagnostic Testing:**

* **Nucleic Acid Amplification Testing (NAAT):** The gold standard for confirming monkeypox infection is NAAT, including real-time or conventional PCR tests. These tests detect viral DNA specific to the monkeypox virus or generic to orthopoxviruses.
  + **Preferred Testing:** NAAT specific to the monkeypox virus is preferable for accuracy.
  + **Specimen Collection:** The recommended specimens for testing are from skin lesions. This includes:
    - **Swabs:** Swab the surface of the lesion or exudate.
    - **Crusts:** Collect lesion crusts, if present.
  + **Technique:** Swabbing should be done vigorously to ensure an adequate amount of viral DNA is collected.

**Testing Workflow:**

1. **Suspected Cases:** Patients presenting with relevant symptoms and risk factors should be promptly tested using NAAT.
2. **Sample Handling:** Proper collection and handling of specimens are critical for accurate test results.
3. **Interpretation:** Positive NAAT results confirm the presence of monkeypox virus, while negative results might require further investigation if clinical suspicion remains high.

Early and accurate diagnosis is crucial for managing monkeypox outbreaks and implementing appropriate public health measures.

### Treatment and Vaccination for Monkeypox

**Treatment:**

**Supportive Care:**

* 1. **Pain Management:** Many patients during the 2022 outbreak required medications for pain relief, especially for oral or anogenital lesions.
  2. **Symptom Relief:** For proctitis (inflammation of the rectum), stool softeners and topical lidocaine are used. Pruritus (itchiness) may be managed with warm baths and oral antihistamines.
  3. **Severe Cases:** Supportive care for severe cases includes catheterization for dehydration risk, intensive pain management, and treatment of complications. Extensive anogenital ulcers or abscesses may require drainage, debridement, and wound management. Secondary bacterial infections are managed with antibiotics.

**Antiviral Medications:**

* 1. **Tecovirimat:** This antiviral is the preferred treatment for severe monkeypox cases, such as infections of the eye, encephalitis, severe proctitis, or pharyngitis. It is also recommended for those at risk of severe illness, including immunocompromised patients, children under 8, pregnant people, and nursing mothers.

**Vaccination:**

**Types of Vaccines:**

* 1. **First-Generation Vaccines:** These include Dryvax, which consists of live unattenuated vaccinia virus. Though effective, these vaccines are outdated and not currently licensed due to the risk of serious side effects.
  2. **Second-Generation Vaccines:** ACAM2000 is a replication-competent vaccine derived from Dryvax with reduced neurovirulence. While it is effective, it poses risks to immunocompromised individuals and those with specific health conditions.
  3. **Third-Generation Vaccines:** IMVANEX (also known as JYNNEOS or IMVAMUNE) is a replication-deficient vaccine based on modified vaccinia Ankara (MVA). It has shown robust immune responses in animal models and is safer for immunocompromised individuals. It is administered in two doses subcutaneously, with a smaller intradermal dose being used in some countries due to supply constraints.

**Vaccination Strategy:**

* 1. **Pre-Exposure:** Vaccination is recommended for those at high risk of monkeypox, either before exposure or ideally within 4 days after exposure to improve infection outcomes.
  2. **Post-Exposure:** Vaccination within 4 days of exposure can mitigate the severity of infection and improve outcomes.

**Current Usage and Challenges:**

* 1. **Geographical Focus:** Vaccination programs are primarily active in North America and Europe, focusing on high-risk groups, such as men who have sex with men. However, African countries, where monkeypox is endemic, face challenges in vaccine access. Global health alliances like GAVI and The Global Fund are working to increase vaccine availability in these regions, but high-income countries currently dominate supply.

**Summary:** Treatment for monkeypox involves supportive care, pain management, and the use of antiviral medication such as tecovirimat for severe cases. Vaccination with smallpox vaccines, particularly the newer generation vaccines like IMVANEX, is effective in preventing monkeypox and mitigating severe disease. However, global vaccine distribution challenges persist, with significant disparities in access between high-income and lower-income countries.

**Keywords:** Disease, unusual, notably, symptoms, available, warning, associated, illness, primarly, remains, incubation period, monkey pox virus, symptoms, occurance, smallpox, vaccine, treatment, health, country, woman, men, children, medicine, skin, lesions, days, stages, clinical, virus, pox, immunity, rash, aches, regions, complications, pain, cases, novel, antiviral, raises, outbreak, reported, endemic, notable, mortality, discontinuation, identified, years etc.

**REFLECTION:** The prompts or the tool I have used is **ChatGPT**. The tool has been very helpful to simply the article and summarize it. By using these tool we can get the information in simplified form and words these app the tool are understandable by everyone. First I did not no how to use these tools but by lisining and doing exercises through the classes I have gained the knowledge and we can same our time to. Though it gives the information but some words might be different you need to analyse and use these tool.

**Reference:**

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