THE PREMED SCENE VIRTUAL RESEARCH COMPETITION

TB Pox (2085)

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INTRODUCTION

In the year 2085, a new pandemic has struck, caused by the most infectious virus to date. This report will investigate the cause of TB Pox and propose multiple solutions to target every aspect of the pandemic.

What is TB Pox?

TB Pox is a highly transmissible virus which spreads through droplets in the air, coughs, sneezes — all of which cause detrimental consequences in the respiratory and pulmonary systems. Symptoms of this virus usually appear within 7-14 days of infection. However, within 24 hours, individuals may develop a cough that escalates until they cough up blood and experience difficulty breathing. This virus is highly concerning and requires immediate action, especially given that the survival rate is 43% for people between the ages of 12 and 60.

Impacts

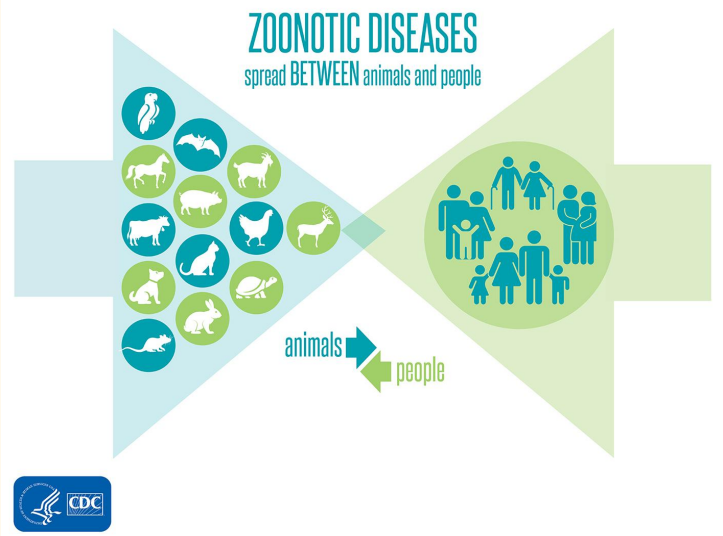
TB Pox primarily targets the respiratory system and skin. However, it can spread to the rest of the body, potentially affecting the pulmonary system, urinary system, and spinal cord. Ultimately, this can lead to blockage of fluid in the spinal cord, obstruction of arteries, a buildup of fluid in the lungs, and the formation of pus-filled blisters.

SOLUTIONS

STOPPING THE SPREAD/SOCIAL GUIDELINES

Viral Zoonosis

TB Pox is a zoonotic virus, spread from mammals. This means it spreads from infected animals to humans, through both direct and indirect contact. Because of this, one of the easiest ways to slow the virus' spread is preventing infection from reaching more humans. This can be done in a variety of ways, most simply through keeping hands clean after being near animals. People are additionally advised to avoid bites and scratches, and quickly disinfect any surfaces that may have touched a mammal.



Social Guidelines

TB Pox is an airborne disease, and can be spread through the inhalation of viral/bacterial droplets. However, this method of transmission can be mitigated by preventing inhalation. As with the SARS-CoV-2 pandemic beginning in 2020, it is highly recommended to social distance and wear face coverings — especially those with high filtration rates, such as N95 respirators. The disease also spreads through contact with high-use surfaces or objects used by an infected individual. Thus, it is recommended to sanitize your hands following contact with the surfaces listed below, and to sanitize objects brought home from outside. It is also advised to —

following contact with high-use surfaces — avoid making contact with any area of the body prone to infection.

- High contact surfaces include but are not limited to:
    - Subway poles
    - Doorknobs
    - Public restrooms
    - Railings

Individuals who experience *any* symptoms should immediately contact their health care provider. When in line with the recommendations of the healthcare provider, individuals should quarantine and separate any potentially infectious materials, listed below.

- Infectious materials may include:
    - Blankets, pillows, and other bed materials
    - Tissues
    - Containers of medication
    - Plates and cups
    - Food waste

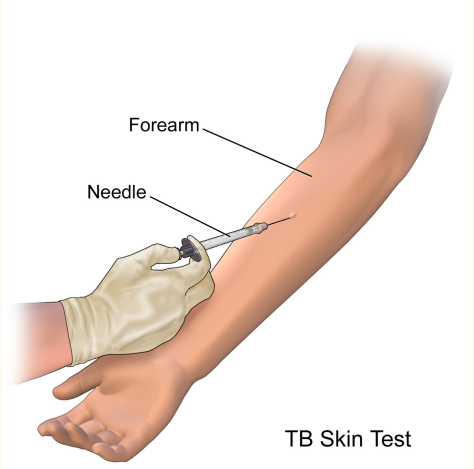
MEDICAL TREATMENTS + PREVENTION

Methods of Testing

If you suspect that you've been here are two possible methods to test for TB Pox.

1. ***SKIN TEST:***

→ The first method is the skin test, also known as Mantoux tuberculin skin test (TST). For children under the age of five, this test is typically preferred. Unlike the blood test, a skin test requires *two* visits to the patient's healthcare provider. On the first visit, the patient will have a small amount of the fluid tuberculin injected into their skin on the lower part of their arm (depicted to the right). Within 48-72 hours, the patient must return to have a medical professional look for any reaction of the arm.



If the test comes back positive, this indicates the presence of TB bacteria, although further testing is needed to confirm whether the person has latent TB infection or TB disease.

2. ***BLOOD TEST:***

→ The second method is the blood test, also known as interferon-gamma release assays or IGRAs. A medical professional will take a patient's blood sample and send it into a lab for evaluation.

A positive result indicates the same as the positive result of a skin test: the presence of TB bacteria, with additional tests needed to confirm the latency and stage of the virus.

3. ***SPECIMEN TESTING***

→ This test is primarily for testing lesions that are suspected to be due to TB Pox. A healthcare provider will use a swab to effectively collect a sample of the lesion of your rash.

Results of this test should be available within a few days, however the patient must continue taking precautions in order to prevent the spread.

Specific Symptom Treatments

1. ***Persistent Cough + Hemoptysis***

→ TB Pox heavily affects the respiratory system, resulting in a persistent cough and hemoptysis — the coughing up of blood typically from the respiratory tract. Although this symptom may be a sign of TB Pox, it can also be due to other health issues such as pneumonia or bronchitis. In order to determine the root cause, a doctor may perform a bronchoscopy, CT scan, or chest x-ray. These will enable the doctor to identify whether the patient's heart is receiving enough oxygen, as a symptom of TB Pox is the lack of oxygen and gradual build up of fluids in the lungs. Your doctor may prescribe antibiotics as a treatment, and it is crucial to take them as directed. Endovascular embolization is an alternative open surgery, which may also be an option based on your doctor's recommendation.

2. ***Chest pain + Difficulty Breathing***

→ Another symptom of TB Pox is chest pain and difficulty breathing. Again, there can be a plethora of reasons for these symptoms, however, when coupled with other symptoms, can be

highly detrimental if not acknowledged early. See a healthcare provider immediately if you suspect TB Pox in order to prevent the heart from experiencing a lack of oxygen.

3. ***Rash***

→ Those infected with TB Pox may experience a rash with pus-filled blisters. Depending on the individual, the rash might be the only symptom expressed. Some people may experience flu-like symptoms after the rash or prior to the rash, again depending on the case. These rashes may be accompanied by a fever, chills, swollen lymph nodes, muscle aches, and other respiratory symptoms. A skin test can prove to be beneficial for these types of cases, and should especially be done if the rash is progressively worsening.

Antibiotics

Similar to tuberculosis, the recommended treatment for TB Pox is a six month course of multiple antibiotics. The prescription calls for a two-month course of isoniazid, rifampicin, pyrazinamide, and ethambutol, with an additional four months of isoniazid and rifampicin. Taking the medication for the full six months is necessary, even if symptoms disappear, in order to ensure the bacterial infection is completely destroyed. Longer antibiotic courses may be necessary if the bacterial strain is very resistant, ranging up to 24 months of antibiotic treatment.

Antibiotic treatment may cause side effects, including:

- Illness
- Jaundice
- High temperature
- Numbness or tingling in hands or feet
- Rash
- Blurred vision

If experiencing any of these side effects, contact your doctor. Prior to treatment, liver function and vision will be tested, as some medications cause side effects in these areas.

TB Pox Vaccine

Vaccination, as shown with the COVID-19 pandemic, is vital to reducing infections and decreasing the death rate in any viral pandemic. In addition to the treatments outlined above, the solution for TB Pox involves vaccine development. Due to the time vaccine development

requires, as shown with the COVID-19 vaccine, it will take months before distribution can begin. The plan for vaccine testing is outlined below.

CLINICAL TRIALS

Clinical trials are essential to understanding TB Pox in order to observe patterns, trends, causes, and effects of the disease in specific groups. One clinical trial will be observing the change in symptoms such as the progression of the rashes and the hemoptysis, two of the major consequences of TB Pox. We are going to be collecting data on how many people tested negative for TB Pox at the end of the trial, and compare it to the amount of people who were positive at the start. The sample size will include a variety of individuals, inclusive of all regions and ages. This clinical trial will be executed over 4 weeks, as the physical symptoms such as rashes last at least 2-4 weeks.

PHASE I: (15-50 patients) Testing of new treatments, beginning with tecovirimat. It has previously been proven to be safe even when used by individuals without monkeypox. However, CRISPR, a novel gene editing technique, can be used to aid in adjusting tecovirimat in order to take into account the *Mycobacterium Tuberculosis*.

PHASE II: (<100 patients) Observing any side effects and any positive effects that the new treatment is having on the patients.

PHASE III: (>100 patients) Comparing the use of tecovirimat to other treatment options, and analyzing whether this treatment for TB Pox is more efficient than it was when being used solely for monkeypox.

PHASE IV: (~1000 patients) Observing the long-term benefits and consequences of tecovirimat and whether it is efficient for use at a wider scale.

TIMELINE

Timeline	**Solutions**
1-2 months	- Encouraging public safety measures such as washing hands consistently, encouraging mask wearing, socially distancing. - Collect data

3 months	- Mask mandates - Beginning of vaccine development and clinical trial
4 months	- Expand use of telehealth— decreasing the risk of exposure, especially for those who are most vulnerable. - Development of antivirals that could assist with the effects of TB Pox, based on research from monkeypox. - End of clinical trial
5 months	- Provide economic relief for hospitals and businesses that may have been negatively impacted by TB Pox. - Begin development of a take-home test so that everyone has immediate access if they have suspicions of being infected. - Analyze and publicize data from clinical trial
6 months	- Continue encouraging sanitation and also collecting data to see which regions are most vulnerable, in case there is a shortage of vaccines. - Distribute take-home tests to schools and pharmacies.
1 year	- Finalize vaccines and consider how they are going to be distributed, such that lack of vaccine equity will not be an issue as it was with the COVID-19 pandemic.
2 years	- Enforce a vaccine mandate once every region has equitable access. - Mask mandate can be less strict as long as the number of cases is decreasing in all regions.

POTENTIAL DRAWBACKS + CONSIDERATIONS

While the COVID-19 pandemic was, under the circumstances, managed relatively well, there are a number of mistakes made that need to be avoided in managing the TB Pox outbreak. Furthermore, there are a variety of other factors that must be considered in the TB Pox pandemic response.

Missteps with COVID-19

One of the most important things to note, and one of the biggest errs in the COVID response, is the management of public opinion. In the COVID-19 response, particularly in the US, leaders sent mixed signals on behavioral guidelines. Major leaders downplayed the risks, and dismissed the claims of medical officials. The public response to TB Pox should be much more organized. From the beginning, medical officials and organizations should be highlighted as sources of reliable information. Government officials should prioritize sending a transparent and organized message, as mixed information will cause confusion and potentially unrest.

Another major flaw with the US COVID response was the lack of federal control. While too much federal involvement may be dangerous for the democracy of the nation following the pandemic, the decentralization of the US response left many efforts weak. With TB Pox, it is important to outline clear federal guidelines for testing, tracing, and quarantining, to limit the virus' spread.

A third misstep with the COVID-19 response from the government was the lack of equity considering vaccine distribution. The main issue was not the lack of vaccines since the government and private companies were able to produce more than enough, but rather the distribution of them. In September 2021, the World Health Organization set a goal to have 70% of the global population vaccinated. At the time, however, only ~3% of people in low income countries had been vaccinated, in comparison to the 60.18% in higher income countries. This data depicts the disproportionate access to vaccines and the gap between countries that made resolving the pandemic even more difficult. The lost costs could have gone towards providing healthcare for developing countries, which also contributed to shortening the pandemic. With TB Pox, it's important to ensure the distribution of vaccines is equitable and not simply favoring the richer countries.

Social/Political Unrest (USA)

While lessons from the COVID-19 pandemic should mitigate major political issues, there are a few risks to consider with the TB Pox response. First, in some nations, heavy mandates and requirements could be seen as infringements on personal freedoms. Second, there is a risk that misinformation and/or disinformation will disseminate online or through the media. This may further decrease compliance with the above regulations/guidance. Finally, there is a risk that the pandemic may be used to polarize political groups during elections. Luckily, unlike with the COVID-19 pandemic, the TB Pox outbreak is not during a US election year, decreasing that risk. This issue may reemerge if the outbreak is not rapidly contained, and runs into an election period.

Economic Concerns

The COVID-19 pandemic has shown that widespread quarantine and isolation has the potential to seriously damage international economies. Isolation decreases profits and puts many people out of work. It can also damage the supply chain, potentially leading to a recession. Fortunately, the TB Pox response does *not* involve mass quarantine, and, if executed efficiently, should not require it to the extent that the economy is harmed.

The TB Pox response outlined above is very cost effective, primarily relying on existing treatments and easy to access goods, like hand sanitizer. To prevent a masking shortage, as seen with the COVID-19 pandemic, purchase of these materials should be limited by retailers, and production should be substantially increased immediately after the outbreak begins.

Mental Health in a Pandemic

In the COVID-19 pandemic, mental health became a major issue, with the prevalence of anxiety and depression increasing by 25%. This should not pose a problem of the same degree with the TB Pox response, which does not involve mass quarantine. However, to further prevent a mental health pandemic, nations should increase their investments in mental health. It is also vital to spread information and resources for mental health support, throughout the pandemic. On an individual level, people should attempt to support those in their communities in any way they can.

REFERENCES

Boyce, P. (2022, August 19). *Hemoptysis (coughing up blood): Causes, diagnosis, and treatment*. WebMD. Retrieved November 2, 2022, from https://www.webmd.com/lung/coughing-up-blood

Centers for Disease Control and Prevention. (2016, April 14). *Testing for TB infection*. Centers for Disease Control and Prevention. Retrieved November 2, 2022, from https://www.cdc.gov/tb/topic/testing/tbtesttypes.htm

Centers for Disease Control and Prevention. (2021, July 1). *Zoonotic Diseases*. Centers for Disease Control and Prevention. Retrieved November 2, 2022, from https://www.cdc.gov/onehealth/basics/zoonotic-diseases.html

Centers for Disease Control and Prevention. (2022, August 16). *CDC Museum Covid-19 Timeline*. Centers for Disease Control and Prevention. Retrieved November 2, 2022, from https://www.cdc.gov/museum/timeline/covid19.html

Centers for Disease Control and Prevention. (2022, August 23). *Monkeypox Testing Basics*. Centers for Disease Control and Prevention. Retrieved November 2, 2022, from https://www.cdc.gov/poxvirus/monkeypox/testing/testing-basics.html

Cordovilla, R., Bollo de Miguel, E., Ares, A. N., Povedano, F., Ortega, I., & Merchán, R. (2016, February 9). *Diagnosis and treatment of hemoptysis*. Archivos de bronconeumologia. Retrieved November 2, 2022, from https://pubmed.ncbi.nlm.nih.gov/26873518/#:~:text=Endovascular%20embolization%20is%20the%20safest,MDCT%20angiography%20shows%20artery%20disease.

Lewis, T. (2021, March 11). *How the U.S. pandemic response went wrong-and what went right-during a year of COVID*. Scientific American. Retrieved November 2, 2022, from https://www.scientificamerican.com/article/how-the-u-s-pandemic-response-went-wrong-and-what-went-right-during-a-year-of-covid/

NHS. (2019, November 12). *TB Treatment*. NHS choices. Retrieved November 2, 2022, from https://www.nhs.uk/conditions/tuberculosis-tb/treatment/#:~:text=The%20usual%20treatment%20is%3A,the%206%2Dmonth%20treatment%20period

United Nations. (2022, March 28). UN analysis shows link between lack of vaccine equity and widening poverty gap | | 1UN news. United Nations. Retrieved November 2, 2022, from https://news.un.org/en/story/2022/03/1114762

World Health Organization. (2022, March 2). *Covid-19 pandemic triggers 25% increase in prevalence of anxiety and depression worldwide*. World Health Organization. Retrieved November 2, 2022, from https://www.who.int/news/item/02-03-2022-covid-19-pandemic-triggers-25-increase-in-prevalence-of-anxiety-and-depression-worldwide#:~:text=Wake%2Dup%20call%20to%20all,mental%20health%20services%20and%20support&text=In%20the%20first%20year%20of,Health%20Organization%20(WHO)%20today.

CDC. (2022, September 19). *Patient's Guide to Monkeypox treatment with Tecovirimat (TPOXX)*. Centers for Disease Control and Prevention. Retrieved November 2, 2022, from https://www.cdc.gov/poxvirus/monkeypox/if-sick/treatment.html#:~:text=Tecovirimat%20is%20considered%20investigational%20for,showed%20the%20drug%20was%20safe.

Scott, A. (2018, March 7). *HOW CRISPR is Transforming Drug Discovery*. Nature News. Retrieved November 2, 2022, from https://www.nature.com/articles/d41586-018-02477-1