

Endemic plague in Madagascar: History and Solutions

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Introduction

Over the past two thousand years, Madagascar has been invaded and settled by various countries and cultures that contributed to the genetic and societal traits of its country's residents. However, the colonization of the French started in the mid-seventeenth century and has made the most profound impact. This colonization left a damaging impact on the local population in the form of governmental instability, corruption, and civil war. While these problems continue to affect the country, these issues are mostly a concern contained to its residents. However, another legacy remains from the time of the French conquest that afflicts not only the people of Madagascar but also the world. Madagascar is still harboring outbreaks of the bubonic plague (*Y. pestis*).

Though it ravaged the people of Europe in the Middle Ages, bubonic plague is now thought of as a mostly eradicated disease. Despite not being a concern for most modern civilization, bubonic plague remains problematic in Madagascar. In fact, for the past two decades, the country has had one of the world's worst rates of infection. "Plague was introduced to Madagascar in 1898 at the port of Toamasina," and the island has continued to be a hotspot of infection since it arrived on steamboats from India through this port city. (Pasteur, 2019) The inception of the disease happened two years after the French colonization and started in 1896. The French remained in power through the Berlin Conference of 1884–85, when they traded the British island of Madagascar for the island of Zanzibar.

Though the French left their position of power on the island, the disease continued to affect the local population. Despite efforts from the French government to continue fighting the last vestiges of this medieval disease with modern medicine, it persisted in its former colony. During this time, cases went unreported in rural areas, such as the Highlands, where it remains endemic today. (Andrianaivoarimanana *et al.*, 2019) (Keltie, 1895, p. 475)

The current government is unstable and suffers many of the same issues as the rest of sub-Saharan Africa. These issues include low economic development, problems with development in urban areas, such as lack of sanitation, and an innate lack of infrastructure in rural areas. The rural areas are often very isolated from the rest of the country and the government.

The rural Highlands, which are rarely accessed by outsiders and are dominated by small insular villages, continue to be where the disease exists. In this isolated area, there is a fundamental mistrust of Western

medicine and the government. Two fundamental issues that prevent public health efforts from being successful are the low reporting rates and undocumented plague deaths. Another significant issue is the local practice of "famadihana," where someone is buried after death in an individual grave and then moved later to a family vault. This possible transmission vector may explain the sporadic outbreaks and the disease's persistence. (Ripoll *et al.*, 2022) Following the 2017 outbreak, there was an effort to modify these cultural practices with public health measures, such as instituting a required seven-day waiting period before moving the body and a mandate to burn the deceased's clothes. Although not supported by epidemiological data, researchers see an improvement. (Ripoll *et al.*, 2022)

The introduction of these practices is significant because of the correlation of consistent plague cases in the Highlands, with more significant outbreaks spreading to urban areas. The virus continues to be at its highest during outbreaks in these regions. In these areas, it has become seasonal "between October and April," much like in the developed world. (Ripoll *et al.*, 2022)

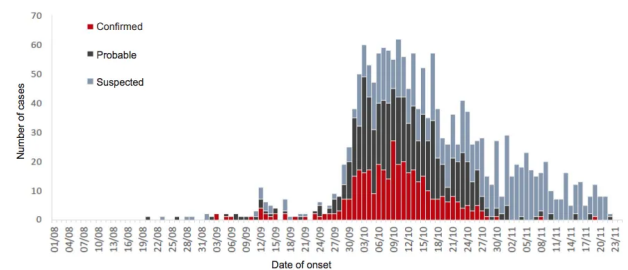


Figure 1: (WHO, plague outbreak Madagascar external situation report 12 2017)

Concerns

The main issue with fighting the plague and tropical diseases in Madagascar is access to modern healthcare. Most of the country is inaccessible by roads, therefore doctors and health care workers have difficulty accessing rural areas. "Only 60–70% of Madagascar's inhabitants have ready access to primary health care." (Razafison, 2008) This lack of basic infrastructure makes reporting and responding to outbreaks and endemic instances of the disease almost impossible. With these barriers and slow response times, local populations often turn to traditional cultural medicine for their ailments or ignore early symptoms of the disease.

The incredibly low accessibility to healthcare leads rural citizens to mistrust modern medicine and the disease. Without exposure to Western medicine,

convincing people of its benefits is often difficult. This mistrust in medical institutions results from a lack of education. Myths and folklore must be replaced with exposure to medicine and modern health care techniques.

Another primary concern is deforestation in the area, which has increased significantly in recent years. A sizable portion of this lumber harvest is illegal, with "at least 150,000 tonnes of logs illegally exported" over a five-year span. Much of this increase is driven by the exotic wood trade of ebony and rosewood. Mass deforestation can lead to many problems concerning zoological diseases. (Ratsimbazafy, Ringuet, & Newton, 2017) The harvesting of trees leads to large-scale rodent movements. The loss of habitat can force them into residential areas where they act as vectors of disease. The 2017 plague outbreak was "linked to uncontrolled deforestation." This is a genuine concern because it is a transparent vector of transmission and shows how endemic the disease is among the rodent population.

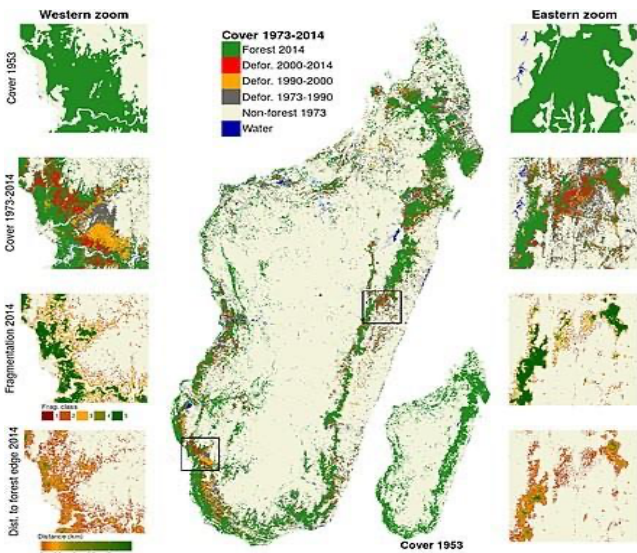


Figure 2: (Vieilledent et al.)

Given the endemic nature of *Y. pestis* (plague), the most worrying concern is antibiotic resistance. There have long been concerns over drug-resistant strains evolving on the island. Unfortunately, new evidence supports this theory.

In 2021, at least three independent cases of drug resistance had occurred, specifically with streptomycin. This antibiotic is one of the first-line drugs used to treat patients. (Andrianaivoarimanana et al., 2021) The *rpsL* mutation in the bacteria is the culprit for this drug resistance. (Andrianaivoarimanana et al., 2021) During a 22-person pneumonic plague outbreak, this mutation was detected on the island. It is hypothesized that traditional burial practices were to

blame for this event, with one original vector who died. Drug-resistant strains have been "isolated from 5 different locations in Madagascar." (Andrianaivoarimanana et al., 2021) These locations were widespread throughout the island and had the possibility of leading to a more significant trend of a drug-resistant virus. (Andrianaivoarimanana et al., 2021) Because so many of the cases are unreported, contact tracing is a challenging prospect. This leads to an increased concern of the spread of a resistant form over a large area.

Figure 2. Outbreak transmission. A, Timeline of events associated with this PP outbreak. B, Case interactions during ...

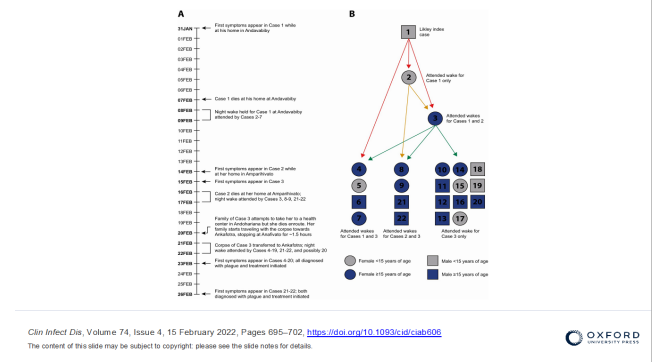


Figure 3: (Andrianaivoarimanana et al., 2021)

Not only is antibiotic resistance a threat to the population of Madagascar, but also to global public health. Although humans have been battling the plague for most of recorded history, thanks to modern medicine and increased hygiene, we were winning the war. However, with drug-resistant strains on the horizon, it can once again threaten large sections of the world. In many industrialized countries, including the US, cases are promptly reported and quickly treated with the use of antibiotics. (CDC, 2022)

Madagascar is an excellent case study of what could go wrong if long-forgotten diseases are ignored. Although plague is endemic to some other parts of the world, Madagascar has the highest case count, with frequent pneumonic and bubonic plague outbreaks. (WHO, Plague) An easily treatable disease has the potential to become one that is not. This disease has long shown its ability to spread rapidly throughout a population if left unchecked. With antibiotic resistance, it risks affecting the world.

A quick response time is crucial to the successful eradication or control of the disease. Unfortunately, disease response is impaired by many factors. One is infrastructure; most people get their information "from radio announcements and word of mouth" and other sources considered primitive in

some parts of the world. (Ripoll et al., 2022) This leads to a lack of accurate information and/ or information that is often corrupted in transit.

Another concern is government corruption which affects "local plague response, with inadequate antibiotic doses being provided to patients so that the remainder can be sold for profit." (Ripoll et al., 2022) If people view health authorities as corrupt, they are less likely to use them. The Madagascar government has long been accused of corruption to the highest levels, which is unsurprising given the region and its history. (Ripoll et al., 2022) When there are large outbreaks, such as in 2017 and 2014, international organizations assist but tend to scale back their operations after the outbreaks are contained.

Solutions

Does the international community, especially the French as former colonizers, have the responsibility to be more involved in controlling the plague on the island? Treatments are inexpensive and commonplace; antibiotics work well. After considering the matter of resources, education, and information gathering, the most significant problem is infrastructure, given the lack of roads and the ability to communicate with rural areas. To implement improved disease response, there needs to be an improvement in the state of infrastructure in the country. The entire issue at hand can be seen as a matter of organization, planning, and logistics, something NGOs and foreign aid are exceptionally equipped to handle.

In a survey, "96%" of people understood that the plague is a fatal disease without treatment; that statistic came from an urban area during the 2017 outbreak. (Ripoll et al., 2022) Education alone will not work, however. The distribution of antibiotics and other forms of treatment must be available to curtail the disease and help avoid widespread antibiotic resistance. However, first, the issue of early detection must be solved. This would lead to a decrease in the transmission rates and would stop outbreaks in non-endemic communities.

To significantly reduce outbreaks and deaths, an awareness of early symptoms must be raised, and testing was made available on a large scale. The most optimal course of action would be to implement a more comprehensive, consistent strategy of providing resources over a longer period instead of dealing with outbreaks as they happen. Given that antibiotics would be readily available along with education, it would not be surprising to see a significant drop in year-over-year death rates. It would also be simple to avoid the cycles of urban outbreaks by going to the source and treating it as an endemic problem and not just addressing hot spots as they flare up.

One thing that often allows plague to be ignored is the low death toll; for example, "only 25% of

confirmed cases died in the 2017 epidemic, a large urban outbreak in which normal plague response resources were overstretched." Nevertheless, for an easily treatable disease that rarely kills in developed nations, it is incredibly high in comparison. (Ripoll et al., 2022) There is a one-in-four chance of dying from the disease during an outbreak. The plague should not be a threat anywhere in the world, even if a low-level of transmission remains.

Conclusion

France should be committed to stopping the spread of this infection introduced by European trade in their former colony. Letting this easily treatable disease remain endemic poses potential threats to the broader world. The recent awareness towards the importance of public health during the COVID-19 pandemic confirms the need for public health measures. Moreover, it is a viable humanitarian effort to treat endemic diseases with higher severity.

The good news is that consistent efforts have been made to fight the plague. The Pasteur Institute provided over one million antibiotic doses during the 2017 outbreak, as well as testing kits, and other supplies. (Pasteur, 2019) However, the key to fighting and winning the war on this disease is consistency in funding and a decrease in losses due to corruption and other seepages. This battle can be won, but we must keep this disease in the public eye. It should not just be a footnote in history books, as it is prolific and still kills today.

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