Keeping Walt at Bay: How to Prevent Orlando Fever from Conquering the World

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Overview of Methods:

Mackenzie Sutton, patient zero, came into contact with *Arterivirus potestas* sp. nov. while working as a pet sitter in Orlando, Florida. She contracted the virus from ticks that fed on infected flying squirrels shipped from Uganda that she was watching. She spread the virus by walking her clients’ animals in parks and trails around Orlando. *Amblyomma maculatum* ticks fed on her and the animals and become infected. They then spread the pathogen to other individuals hiking the parks and trails . Infected ticks also managed to transmit the pathogen to Mackenzie’s other clients, likely via their pets.

To date, there have been 678 cases of *Arterivirus potestas,* with only one known survivor. Incidence is concentrated in the urban southeast. Orlando, Florida, and Pensacola, Florida, have seen the largest outbreaks, with the disease spreading to Georgia and South Carolina. Cases in Corpus Christi, Texas, and Salt Lake City, Utah, resulted from victims taking vacations to Florida parks and Disney World. Educating these communities on how to prevent tick bites is the best option for quenching this outbreak. This approach would include encouraging the community to wear protective clothing that covers as much skin as possible and checking for ticks after any outdoor activity.

*Arterivirus potestas* sp. nov. is in the order Nidovirales and family Arteriviridae. It has a genome size of 17.7 kb and is a small, enveloped virus with an icosahedral core. This species is a linear, single-stranded, positive-sense RNA virus that replicates in the cytoplasm of host cells. In all victims, *Arterivirus potestas* sp. nov. has presented as a viral polyarthritis accompanied by lower back pain, fever, rash, and tenosynovitis. Broad-spectrum antibiotics and antivirals have proven ineffective. Research to create a specific antiviral drug should aim at preventing the virus from uncoating and entering the host cell by targeting its envelope proteins gp2 and gp5, while increasing the victim’s type-I interferon response. Development of a live attenuated vaccine could prove effective in preventing further outbreaks of Orlando Fever.

The vector of *Arterivirus potestas* is *Amblyomma maculatum*. It has a three host, hemimetabolous life cycle. It thrives in areas with high humidity and abundant shade and shelter. The tick feeds on livestock, birds, small mammals, and humans. It is very commonly found on rodent hosts, and is able to very efficiently spread pathogens to both the rodents and other, larger hosts (Ferreri *et al.* 2014)

*Mus musculus* and *Rattus rattus* are reservoirs of *Arterivirus potestas*. These animals are often found in homes and around humans because they eat human food and trash (Courtney and Fenton 1976). Interactions occur between the reservoir, pathogen, and humans because they are attracted to trash and food brought in by visitors to the parks, which support a high population that can be exploited by ticks. Control measures will primarily be focused on the *Amblyomma* vector, but reducing populations of the rodent reservoirs and inhibiting contact between them and human hosts will also be an integral part of an effective control plan.

Implementation of Methods:

The first patients admitted to hospitals were treated with broad-spectrum antibiotics and supportive treatments. This is typically the first line of treatment with other zoonotic viral diseases. Antivirals have proven effective in treating some diseases such as influenza (CDC 2014), however, they are not a cure-all method of treatment. Supportive treatments are typically the first step in treating some viral diseases like West Nile virus, but in the care of *Arterivirus potestas,* they proved ineffective. This ineffectiveness makes this disease a particular challenge to treat. A human vaccine could take years to develop, so while this could be a feasible solution, it should not be the only priority, and should not take precedence over more immediately effective measures.

Nonetheless, the comprehensive plan to control Orlando Fever will include the development of a vaccine to be deployed both in human populations and in rodent reservoir populations, as this presents a powerful new tool in controlling tick-borne zoonotic disease (Richer *et al.* 2014). In addition to vaccine development, research should continue on how to best tailor supportive treatments and antiviral compounds for effect against *Arterivirus potestas*.

The primary human-related goal, however, is to prevent all possible contact with vector and reservoir. As such, we advise the following guidelines. All persons, but especially those residing in or traveling to the urban southeast are advised to follow some simple steps to prevent contracting the virus. Nature parks should be avoided at times of peak incidence, as the chances of contracting the virus increase greatly with exposure to ticks and their hosts. If it is not possible to avoid these areas, protective clothing that covers as much skin as possible should be worn, with permethrin-treated clothing being ideal, as it is known to be safe and effective (Banks *et al.* 2014). Upon leaving these areas, a thorough tick check should be conducted. Permethrin-treated clothing should be kept away from cats, as permethrin is highly toxic to them.

The most affected parks have already been treated with acaricides, specifically synthetic pyrethroids. This treatment resulted in a 24% drop in the number of captured adults. It was, however met with heavy resistance from various groups. 851 cases of “pesticide poisoning” were reported to local hospitals, but there is no evidence they were caused by the acaricides used. Environmental groups mounted protests and wrote to the CDC citing the documented harm this pesticide has on wildlife.

The Walt Disney company, owner of some sprayed areas, contacted government officials attempting to stop future spraying. They say their employees refuse to work in areas sprayed with pesticides. Neighborhood organizations and local fishermen have also organized to stop the use of pesticide. They state the pesticides can have a negative impact on local wildlife, cause water pollution, and have harmful effects on children. Lawyers of some groups are also demanding the removal of the educational signs the CDC posted outside affected parks, claiming it has a negative impact on tourism. The Governor of Florida, Rick Scott, is siding with all the groups opposed to the spraying of pesticides.

Although synthetic pyrethroid spraying is controversial, it has proven to be effective, both in the case of Orlando Fever and elsewhere (Stafford 2004). As such, it remains the best option to control and reduce the vector, and the public outcry to periodic spraying is well worth the lives saved. In continuing prevention efforts, areas of high abundance of *Amblyomma maculatum* should be targeted. In order to better avoid effects on the non-target species, high incidence parks will be closed during the duration of acaricide spraying, and for one week following. Spraying will continue every 6 months until the disease is no longer transmissible.

It is extremely important to prevent human contact with the vector. This end will be achieved through the use of educational signs and the temporary closure of parks and recreational areas with significant incidence (i.e. detectable through monitoring activities). In addition, spraying will be focused exclusively on areas of high tick abundance and high risk for disease transmission. Dense vegetation close to trail edge should be cleared, as a change in suitable habitat will likely have a substantial impact on tick numbers (Fleetwood 1985).

In the future, , a vaccine targeted at the reservoir (rodents) will be the best option to control the spread of this disease, as discussed in Richer *et al.* 2014. This process is likely to be slow-moving and long-term. In addition, a given vaccine may not confer total immunity. Nonetheless, even a small reduction in susceptible reservoir hosts will translate to a reduction in human incidence. In addition to vaccination, rodent reservoirs can be controlled by reducing their populations and by reducing their contact with humans.

Access to human food and trash should be limited to render the park habitats and homes around the parks less suitable for the mice and rats, such that they can not introduce ticks to areas of human habitation. Nesting materials and park grounds should be treated with permethrin to prevent ticks parasitizing the rodents. In addition, rodent numbers can be reduced via the introduction of predator species, such that their populations are insufficient to support a high disease incidence with potential to infect humans (Collinge and Ray 2006).

The final major element of control is ongoing monitoring, which allows for assessment and analysis of the threat posed by the disease. Existing CDC procedures for mandatory reporting will be extended to *Arterivirus potestas*, via the National Notifiable Diseases Surveillance System (NNDSS), wherein health professionals are required to report any cases of certain high-risk diseases. The biannual collection and testing of *Amblyomma maculatum* will continue until *Arterivirus potestas* is no longer detected at transmissible levels. Similarly, rodents will be trapped and tested biannually as well. Finally, citizen science will be employed as a proxy for having more boots on the ground. Citizen science, or the incorporation of non-science professionals in scientific research, has great potential for understanding broad ecological patterns (Weckel *et al.* 2010). As such, there will be a dedicated tip line for Orlando Fever, wherein citizens may call and report unusually high levels of *Amblyomma* ticks, unusually high numbers of dead rodents, or any other related concerns.

Expected Outcomes:

It is expected that the combination of these methods will bring about a significant decrease in disease incidence over the coming months and years. Incidence and mortality will likely remain high for a period while the control measures catch up to the disease, but we expect them to drop within a few months.

A vaccine will likely not be ready for around a decade, but once it is, it can be deployed to children and adults to reduce the susceptible population. Vaccination for the rodent reservoirs will likely develop faster, as there are fewer ethical and safety concerns in place for non-human, non-threatened wild animals.

It is possible that the disease will continue to have periodic peaks when ticks are most active, but the control measures outlined above should keep that incidence at an acceptable level. Though citizens will likely continue to be upset about the use of pesticides, we believe that this bad will toward public health agencies is well worth the lives saved.

Should either the ticks or the pathogen develop resistance to the methods outlined above, our ongoing monitoring will allow us to be aware of the new threats posed before they become a large problem. We fully expect that Orlando Fever can be brought under control in the next decade, and that it will significantly decrease as a threat within the next year.

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