

# Unusual Outbreak of Rift Valley Fever in Sudan

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[Sarah Gregory] Hello, I'm Sarah Gregory, and today I'm talking with Dr. Ayman Ahmed, a scientist at the University of Texas Medical Branch and a lecturer at the Institute of Endemic Diseases in Khartoum, Sudan. And, he's calling in from Sudan. We'll be discussing a unique outbreak of Rift Valley Fever in Sudan during 2019.

Welcome, Dr. Ahmed.

[Ayman Ahmed] Hi, Sarah. Thank you so much.

[Sarah Gregory] So, Rift Valley Fever is an arboviral disease. What's that mean and what is Rift Valley Fever?

[Ayman Ahmed] It means it's an arthropodborne virus that's transmitted either by ticks, sand flies, midges, or mosquitoes. And Rift Valley Fever, it is one of those viruses that has been previously discovered in 1931 in Kenya...the Rift Valley...the Rift Valley area.

[Sarah Gregory] How is it transmitted, and what does vertical transmission mean, which you mention in your study?

[Ayman Ahmed] It's mainly a vectorborne disease that is transmitted by arthropods, as I mentioned. However, it's...it's kind of a unique virus in that it's able to transmit through several other modes of transmission, including raw...the consumption of raw meat or uncooked meat, or any direct contact (close contact) with animals or animal products. It can also be transmitted vertically in both vector with host or the vector itself directly (the mosquito).

[Sarah Gregory] What does vertically mean? What does transmission vertically mean?

[Ayman Ahmed] Vertical transmission is referring to the virus capability to be transmitted from the mother to child in case of animal or human. And we have some cases in....that the virus was transmitted vertically from the mother to child in human in Khartoum. Also, it can transmit vertically in a vector and there it would be called transovarial...transovarial transmission, which means that the virus would be transmitted from the mosquito female to the egg through the ovarian. And then when the egg hatched it would be carrying....carrying the virus, where it can start infecting the host when it starts taking blood meals.

[Sarah Gregory] I see, okay. Alright, so what are the symptoms?

[Ayman Ahmed] It has a wide range of symptoms. Most of the people, they have mild or no symptoms at all. However, in about 10% of the patients they develop sort of severe symptoms. The mild symptoms include fever and weakness and back pain. However, the severe symptoms include ocular disease (one would have, like, lesions and bleeding in their eye), and that can lead to vision loss or blindness. Also, it has encephalitic manifestation when the virus invades and causes inflammation in the brain, and that leads to coma and seizures and neurological syndromes. And the third severe presentation of the disease includes hemorrhagic fever, would involve bleeding or a patient bleeding from their eyes, gums, or the other indication events or something like that. And we had a high mortality rate among...among patients, not like the other clinical presentations.

[Sarah Gregory] Is there a treatment or a vaccination for it?

[Ayman Ahmed] There is a vaccination (several types of vaccinations) only for animals (so far, approved for the animals). However, for humans there is no treatment nor vaccine. Some have vaccines under development. The treatment is mainly just giving some medication for the symptoms, like for the fever and headache, and supportive care for the severe cases.

[Sarah Gregory] So, nothing that stops the bleeding?

[Ayman Ahmed] Nothing specifically for Rift Valley Fever. It's giving coagulant factors to stop the bleeding and supportive care in the hospital. But nothing that can stop the virus itself, like Rift Valley Fever virus, or it is...the disease itself.

[Sarah Gregory] Is there an infrastructure for surveillance in Sudan?

[Ayman Ahmed] For some of the diseases like reported ones like malaria and other diseases, there is basic surveillance. It's not that good yet, but it's sort of working. However, for arboviral diseases including Rift Valley Fever, nothing is established yet. So, most of arboviral disease infection or outbreaks are accidentally discovered or tested and reported to the Ministry of Health, and that's only through laboratories. One remote health facility, they had undifferentiated febrile illness, like they were with fever and headache, and sometimes severe symptoms. But they tested negative for malaria. Most of the time, arboviral infection are treated after being diagnosed as malaria.

[Sarah Gregory] Why was this outbreak in your study unusual?

[Ayman Ahmed] That is a very interesting question, thank you. This outbreak...it was unusual for several factors. First one is...has been development had stopped then developed and actually ended before the transmission season. The transmission season for vectorborne disease in Sudan is mainly corresponding with heavy rain and flooding season between September to December. However, in this outbreak...had started in May and ended in July, which is during the dry season where...when the vector population density is relatively low. Other factors that make this outbreak unique is the place itself. The area didn't have that history of Rift Valley Fever and transmission...unusual. And this outbreak...also, it's kind of...the two...has the two arms of outbreaks, because there is an epidemic among human population almost simultaneously with epizootic among animals. Because about...almost 100% of the patients have reported either mortality or abortion among their animals. And this is the main indicator for Rift Valley Fever transmission in animals.

[Sarah Gregory] Help us to understand what this outbreak means for public health?

[Ayman Ahmed] For the public health, it means a health threat because Rift Valley Fever...it's one of the very devastating disease. It has a high mortality rate—a high mortality rate among people, and also it affects their animals. And when it also gets involved in animals that means it expands in lateral transmission more. So, people can get it even if they control the vector. At that point, there was still an ongoing transmission through the animal and their borders, particularly in low- and middle-income countries like Sudan where people...they rely heavily on and live closely with their animals and they have very...somehow low food safety and hygiene that protects them. That again is the other mode of transmission.

[Sarah Gregory] How did you go about doing the study? What kind of data did you use?

[Ayman Ahmed] We...we used surveillance data, mainly lab-generated data from after taking samples from suspected cases. We managed only to get about 50 samples (blood samples) and sent it to the lab where it got diagnosed as Rift Valley Fever as the exclusively causative agent of this outbreak. Additionally, demographic data and animal-related data like deaths or abortion among animals, also the age and sex. However, we didn't find any significant association with...with other factors to give higher risk to one of the groups more than others. Nevertheless, the emergence of this outbreak in this area...it could be attributed to climatic change in...in the area. Although we haven't collected meteorological data, but the one change that we have seen in the area, it is relatively lower temperature because this area is mainly desert area. However, due to establishment of a irrigated agricultural project in the area, they become a sort of microenvironment suitable for the breeding and testing and maintaining the environment for mosquito vectors. So, this microenvironment recently established might be one major factor in this outbreak.

[Sarah Gregory] Were there political factors that might have contributed to this large outbreak?

[Ayman Ahmed] Actually, indeed. These political events associated with the national revolution largely has played a major role in this outbreak because it's...in addition to driving many people and pushing people from endemic areas to this particular state, and because one of the major revolution events and governance for demonstration has been held in a near city called Atbarah. In addition to that, health workers and public health and healthcare providers...they were particularly under attack by secret forces from a religious regime dictatorship that were focusing on people who...who provide healthcare for injuries during demonstration. Therefore, health system was incapacitated and not functioning at all and that limited any vector control services or vector surveillance, and also delayed reporting of early cases of the outbreak which could have (if they were detected early) could have been contained or at least some response could have been implemented to reduce the...the development of the outbreak.

[Sarah Gregory] Why were healthcare workers, do you know, particularly targeted for violence?

[Ayman Ahmed] Health workers were particularly targeted because their crucial role in...in the success of demonstrations and the revolution, entirely. Because they were the first lines that provide support to the revolution leaders and...and people participating in these demonstrations in the field and in hospitals when they got seriously injured. So, security forces were targeting them so they'd...to impact or negatively impact and limit the capacity of leaders to recover quickly and participate in...in the field demonstration. And also it was because those healthcare providers had refused that security forces go into hospitals and healthcare facilities (including emergency rooms) to arrest the...some of these leaders. So, they became complicit to these forces to recoup the revolution leaders.

[Sarah Gregory] Give us a brief summary of your study.

[Ayman Ahmed] Well, mainly studying arbovirus disease we focus on their outbreaks and... including epidemics in human and epizootics in animals. This version of an arbovirus led me to...to join Dr. Weaver's lab in UTMB to get additional set of skills related to arbovirology. Because in Sudan, although all of these outbreaks and continued transmission of several arboviruses, we don't have a national expertise in arboviruses in the country. So during my visit there...there...I got in touch with...with my colleagues here and currently we are trying to establish and formulating like.... multidisciplinary team to investigate the transmission of

arbovirus disease in general. Regarding this specific study itself, it was triggered with a set of reported cases of Rift Valley Fever and I got to know of events from my colleagues in the River Nile State Ministry of Health. After that, we started formulating the...the investigation, and the investigation team had been derived by Ministry of Health, not supported by...by public leaders, however my colleagues have at one time supported the state Ministry of Health. Nevertheless, it was not declared or ruled one of the major prevention and control of Rift Valley Fever outbreak in health promotion, which required a legal declaration of Rift Valley Fever and transmission. Because as I mentioned earlier, several modes of transmission...they are playing a role in addition to the vectors. So people, they need to know about the ongoing transmission of risk, so they stop eating not...uncooked meat or raw meat and trying to...with their animal farm, not get in touch with them and become very cautious with dead animals and avoid dead animals at the same time. However, the Ministry of Health had a very rigid position regarding the declaration. Luckily, later the Ministry of Health after the revolution...there was another outbreak of Rift that was very, very small (not like this one) and had been immediately declared. I guess one of the things that made that outbreak belief grow and develop like this unique one, it is the immediate declaration by the formal Ministry of Health of Sudan.

[Sarah Gregory] And what did you find?

[Ayman Ahmed] We found that this...this outbreak is composed of two. We couldn't tell which had started before the other one—whether the epizootic of the disease or the outbreak among animals or the outbreak among humans. That is almost similarly in the number of cases, or it might be actually higher among animals because they will have....all of our patients had reported infection among their animals and without estimate...a clear estimate. In addition to that, we...we found that there was several vectors (mosquito vectors) circulating in the area. But because we...we became aware of this outbreak later and not as early as we wished, we couldn't identify the specific vector. And this is one of the weakness about...in our knowledge about Rift Valley Fever transmission in Sudan. It's not clear yet which is...which is the initial vector and which is the main vector during the outbreak, because Rift Valley Fever has several vectors and main vectors, and the contribution of each vector differs—their location, time, and season. So, this was a major gap in our study.

[Sarah Gregory] So given all that, do you have any idea why these arboviruses are increasing in Sudan?

[Ayman Ahmed] It's obviously, arboviral (arboviral disease) and their outbreak increased in Sudan mainly because of gaps...major gaps in health policy and control programs and surveillance systems. Because all of those are not for arbovirus disease in Sudan. This mainly because of the limited funds available and the support for mental health and the research institute in the area of arboviral disease. Because on the other hand, malaria (because it's supported by global funds), there is a well-established surveillance system for both vector and...and patients and cases. But this is not the case for arbovirus disease. So, many detected accidentally and always the response...it comes very late. And this is also due to lack of advanced diagnostic tools in the country. Most of the time, cases of arboviral disease... they have...some will have to be taken from them and sent out of the country, most of the time either to Pasteur Institute in Senegal (Dakar, namely) or to...from other partners in Germany to confirm the causative agent.

Nevertheless, there's still many cases during outbreaks that are left as undifferentiated febrile ailment because we couldn't identify the causative agent.

[Sarah Gregory] Is there a way to stop them from increasing?

[Ayman Ahmed] At the moment, we're sort of helpless. People trying to get in some grants. But luckily after the previous revolution, Sudan became more open to...politically, and healthwise and researchwise. We hope this might help us in establishing partnership in both research and healthcare services. And also we can also apply for international grants, which we...we were not allowed to apply before this political conflict of the previous regime. Because as I mentioned earlier, there tends to be lack the basic diagnostic services, like PCR is not available in most of the country, it's mainly centralized. And the country lacks in-country services for sequencing. There is no single commercial sequencer or one place that you can use sequencing to identify the unknown causative agent of severe outbreak of illness. So, global partnership and collaborations and new grant opportunities might help in building the local capacity for the early detection and response to this virus. Actually, my attachment with Dr. Weaver's lab and the World Reference Center for Emerging Viruses and Arboviruses is one step further for...for me and for my Institute of Endemic Disease and for the country to establish local activities and try to bring in some advanced skills to tackle this arboviral disease.

[Sarah Gregory] Obviously from what you said, there were many challenges and limitations in doing this study. Are there any others you'd like to mention?

[Ayman Ahmed] For this specific study, we...we lacked the resource...resources, and asked for gene sequencing so we can identify the circulating strain of Rift Valley Fever. Because Rift Valley Fever virus has several strains, and if we had the chance to do sequencing we could have at least developed a more clearer understanding about the dynamic of this virus and where it potentially came from. Because several strains have different locations and we could speculate the interpoint and improve our prevention control strategy.

[Sarah Gregory] Are there any other actions or further studies that you'd like to see?

[Ayman Ahmed] Yes, actually there is a huge gap in arboviral disease transmission in the country because although it is well-known that dengue, chikungunya, yellow fever, and Rift Valley Fever and CCHF are endemic in the country. But there must be many, many others we don't know about, particularly that other countries around us like Kenya and Uganda, they...several arboviruses have been discovered there, and continuously new arboviral diseases have been discovered there because they have a well-established viral unit. However, here in Sudan, we mainly focus on these few arboviral diseases when we run a diagnostic test or even for research because up to now, we don't have any evidence about what else is circulating around. Also, we have a huge gap in understanding the vector of several arboviral diseases. Like last year, we had a massive outbreak of chikungunya with more than 47,000 cases of chikungunya. But no one knows exactly what is the vector. The area has *Aedes aegypti*, but the *Aedes aegypti* have been there for decades, and no outbreak of chikungunya has been reported from this area. So, it's potentially that *Aedes albopictus*, an already efficient vector of chikungunya, is there. But no one...no one knows exactly whether there is *Aedes albopictus* or not. And the role of other vectors is also still unknown.

[Sarah Gregory] You mentioned One Health in your article. Tell us what that is, and how that would help with this Rift Valley Fever situation.

[Ayman Ahmed] One Health is a health strategy that considers the health among humans and animal health and environmental health. Because although it is a relatively old concept, but we have finally realized that we cannot achieve any improvement in human health without considering the health of animal and environmental health. So, the One Health strategy...it is a multidisciplinary approach that brings all related stakeholders to work on improving the health of human and animal and environmental health, including the vector. Because all these aspects of health are interconnected, and they are affecting each other. And Rift Valley Fever is one of the diseases that is particularly high ranking in the need for One Health, because we cannot stop or prevent the transmission of Rift Valley Fever in humans without considering animal health because there are several other hosts for Rift Valley Fever virus, and there are several vectors (mosquito vectors) contribute to...in the transmission of Rift Valley Fever virus.

[Sarah Gregory] Do you have any recommendations to help alleviate the spread of Rift Valley Fever?

[Ayman Ahmed] The major recommendation would be that we need to accept here is that Rift Valley Fever, it is endemic because it has been previously discovered in the country or detected in dwelling...forest-dwelling people and has been detected in Sudan since 1930. So...however, most of health policy leaders, they still deny that they had Rift Valley fever in the country. Mainly because they assume it will affect our animal exportation, which is a country need for...for economic growth. But denying will not improve anything. So, as soon as you admit that Rift Valley Fever...it is endemic and we need to work on it, it's controllable. And if all people collaborate together with the Ministry of Health, Ministry of Animal Resources, and other stakeholders following a One Health approach and strategy, we could limit the transmission of Rift Valley Fever into very, very low incidence. However, without that, even our capacity to educate and increase the awareness of local communities and people at risk is very limited because you cannot increase the awareness about something that does not exist or deniable.

[Sarah Gregory] You mentioned vaccination of animals as a strategy for controlling in your article. Given the violent political situation, how would vaccination be carried out?

[Ayman Ahmed] Animals...Sudan, in general, has a very dry weather with only maximum 3 months of wet season and when we have rain in most of the country and flooding in some areas. So during the dry season, all animals will be clustered in...in large animal farming areas. So, this would be the best time to deploy vaccinations for animals (when they are clustering) because once the rainy season...the rainy season starts, most of the animals will go in to open pastures throughout the country and would be (in some areas) very, very difficult to reach due to high flooding and...and some roads would be disconnected due to the rain and flooding.

[Sarah Gregory] Tell us about your work and what you enjoy most about it.

[Ayman Ahmed] I'm too passionate about research, I guess this is because I believe this is the only way to improving our life. As I have grown in a very poor community, and when I start seeing around, reading and TV and throughout the internet, I...I felt like other people are living much better because they...they use science for good, for studies. However, it is so difficult to establish a career in research in low- and middle-income countries in general, and in

Sudan in particular because of living costs itself and no one (in general) believe in research, and there is no governmental support for research. That's why we now looking for this improvement in our international relationships and political situations for another opportunity to collaborate with and publish further studies in my career (in science). I enjoy the studying, and what makes me super happy from time to time is making new findings that improve people's health and...and One Health in...in my country. Like for instance, this...this study about Rift Valley Fever would bring knowledge and awareness not...not only about the health risks for the community themselves and for healthcare providers, but to open the mind of our health policymakers to consider in...in investing....consider investing in people's health and animal's health as a way forward. Because Rift Valley Fever, for instance, is hugely affecting the productivity of...of local communities and the country because most of the communities here rely on the animals for food and for money, because they sell and export it to get money out of it. Nevertheless, Rift Valley Fever transmission affects animal productivity, reducing their milk production and meat production, and also it reduces the herd size because several animals die of Rift Valley Fever infection and massive numbers die during outbreak of what they call Rift Valley Fever. So, increasing the wellness of...of communities themselves and currently we are trying to establish this One Health in the country. Although this concept is known for a long time, but still people are not...not practically implementing One Health in Sudan. But hopefully this article and this report and my field study will contribute in building the stability and to all work on improving our health. Because arboviral disease is preventable. All vectorborne diseases are preventable and controllable if people invested enough in...in that area.

[Sarah Gregory] You're currently in Sudan. Is that your home?

[Ayman Ahmed] Yeah. I'm mainly from Sudan. I just got last year a placement with UTMB University. It was a privilege for me to join the World Reference Center for Emerging Viruses and Arboviruses. Particularly up to last year, Sudan has a negative relationship with the U.S. and other countries. But I guess with my perseverance and the use of funds I received from Dr. Scott Weaver helped me in starting and developing a career in arboviruses. But here in Sudan, it...it was difficult to...to pursue this line of research in particular, because everyone thinks there is no future or money or career (or establishing career in virology) in a country with such limited research and diagnostic capacity.

[Sarah Gregory] What do you enjoy doing in your personal time?

[Ayman Ahmed] In this stage of my career, I have so limited personal time. I spend most of my time either in the field doing sample collection and data collection, or in the lab doing some studies or reading and writing and analyzing data. Though I'm trying hard to find personal time so I can spend it with my little daughter, and in a few days just about to be 4 years old. I enjoy walking with my friends and going out, but whenever I got time to spare.

[Sarah Gregory] Well thank you so much for taking your precious time to talk with me today, Dr. Ahmed.

[Ayman Ahmed] Thank you so much, Sarah for recognizing me to discuss our study and to present the situation of arboviral disease study in Sudan. Thank you so much.

[Sarah Gregory] And thanks for joining me out there. You can read the December 2020 article, Unusual Outbreak of Rift Valley Fever in Sudan, 2019, online at [cdc.gov/eid](https://www.cdc.gov/eid).

I'm Sarah Gregory for *Emerging Infectious Diseases*.

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