

# Deadly Respiratory Disease in Wild Chimpanzees

*[Announcer] This program is presented by the Centers for Disease Control and Prevention.*

[Sarah Gregory] Today, I have with me Dr. Tony Goldberg, Professor of Epidemiology at the School of Veterinary Medicine and Associate Director for Research at the University of Wisconsin, Madison, Global Health Institute. We'll be talking about a deadly respiratory disease in wild chimpanzees. Welcome, Dr. Goldberg.

[Tony Goldberg] Thank you. It's a pleasure to be here with you today.

[Sarah Gregory] Let's start with some basics. What are rhinoviruses?

[Tony Goldberg] Well, rhinoviruses are among the most common infectious agents of people worldwide and they're probably the most common cause of the common cold in people. So, they're a group of viruses that causes sniffles in children, maybe fevers, sore throats, cold-like symptoms, and usually don't cause that much harm in people, except under rare circumstances. Rhinoviruses are very small viruses. They're related, distantly, to polio virus, but they're viruses of the airways. And they're the most common cause of the common cold in people worldwide.

[Sarah Gregory] And how is rhinovirus C unique?

[Tony Goldberg] So, rhinovirus C is the most severe form of the human rhinoviruses. There are three versions—A, B, and C. And we didn't even know about rhinovirus C until about 2006. And we discovered it and realized that it's actually a mutant rhinovirus. So, it's unlike A and B in the way it attaches on to host cells. And because of that unique biochemistry, it has a tendency to cause more severe disease than its relatives.

[Sarah Gregory] Why did you decide to do this study?

[Tony Goldberg] Well, this was an interesting scenario. We did this study, which was a study of rhinovirus C in chimpanzees, because we found ourselves in the middle of a severe outbreak of respiratory disease in a wild chimpanzee population in Uganda. This was not a subtle thing. We were there, my collaborators and I who studied these animals in the wild, we're in the field and the chimpanzees started to get very sick, very quickly. And, in fact, a number of them died—about 10 percent of the population we were studying died. So, it wasn't the sort of thing you could ignore. We really felt like this was a crisis and we had to get to the bottom of it.

So, we deployed some fairly fancy virus hunting methods to try to figure out what the cause of this outbreak was, and the answer was really surprising. The answer was rhinovirus C, this virus I mentioned that's a severe form of the common cold. That was noteworthy because rhinovirus C had never before been found outside of humans. So, we had no idea that it could infect chimps, let alone cause a deadly disease. So, really, this is an example of how the study of epidemiology sometimes leads you to systems that are unexpected. We were not planning this study, but the virus sort of found us.

[Sarah Gregory] So, tell us about the study, how you conducted it, that sort of thing.

[Tony Goldberg] As I mentioned, we—my collaborators at various universities and I—are involved in a long-term research project on the wild primates of a beautiful national park in Uganda, called Kibale. And Kibale National Park is famous for its biodiversity and density of primates, including chimps. So, we have a long-term presence there. And when this outbreak occurred, we fortunately had the laboratory and personnel resources available to address it.

So, in practice, what happened is, when we realized that we were in the middle of a deadly respiratory outbreak, we put out a high alert for people to watch out for chimpanzees who might have succumbed to the illness. And one of the chimpanzees who died, a young female named Betty, was found very quickly after she died. And that's unusual. These are remote locations and animals, when they feel sick, tend to sort of slink off into the underbrush and you rarely find them in time. But in this case, we did. And it was that finding that allowed us to get samples that led to the discovery of this virus. So, we managed to retrieve Betty's body and do a thorough postmortem examination and collect samples from a number of different tissues, including her respiratory tract. And we knew that there was probably something respiratory going on, because the chimps were all coughing and sneezing. And with those samples, we were able to use next-generation DNA sequencing methodologies to identify the virus, which, again, turned out to be this very common human virus that had never been seen in chimps before.

[Sarah Gregory] This is all really fascinating and, I think, potentially frightening.

[Tony Goldberg] Yes.

[Sarah Gregory] What are the public health implications of this?

[Tony Goldberg] Well, you know, there are public health implications for chimps and there are public health implications for people. For chimps, the public health implications are pretty dire. It's not unheard of, by any means, for chimpanzees to suffer deadly infections from human pediatric respiratory viruses. There have been a number of instances across Africa where other respiratory pediatric viruses, for example metapneumovirus is a common one, or respiratory syncytial virus, which are also causes of common cold symptoms in people, have been found in chimps and have been found to cause deadly disease.

What's different about this case is that we just happen to know quite a bit about the way that rhinovirus C attaches to cells in the human airway. And thanks to my collaborators here at University of Wisconsin, Madison, we know that biochemistry in such intricate detail that we were able to go back to the chimps at our field site and across Africa, and ask, using genetics, if they have the proper biochemical receptor, the attachment protein, on the surface of their cells, to allow attachment and infection by rhinovirus C, in general. And the answer is that, yes, every chimp we examined in our study population and across Africa, has the receptor that will allow this virus to attach and enter the cell.

So, what it means is that, from a chimp public health perspective, all chimps throughout the continent of Africa, which is the only place where chimps live, are genetically susceptible to this virus. And to put that in context, not every person is genetically susceptible to this virus, or not equally so. There are a good proportion of people who have a variant of that receptor that makes

them resistant. It's an allyl, a variant of a receptor that seems to have popped up maybe around 8000 years ago or so, so recently in human evolution. But the interpretation is that we've had a chance to sort of evolve and adapt to this virus, such that a lot of people are now resistant. Well, chimps haven't. So, from a chimp public health perspective, it means that they're universally susceptible. And what's even more interesting, and this gets back to the question of human public health, is that the, that same receptor in humans that makes a person resistant to the virus, also makes a person resistant to asthma.

So, there's some sort of strong link between infection with this virus and asthma in people. And in fact, that's what we see clinically. People who are susceptible to rhinovirus C infection, are also highly susceptible to asthma, and suffer usually lifetimes of coughing and wheezing illness. So, what we see here, sort of, if it weren't so tragic for the chimp, it's actually very interesting. Chimpanzees, when they're infected by this virus, look a lot like humans who are asthmatic and prone to rhinovirus C infection. And again, the genetics of this are really well known. This, this particular genetic marker, is one of the earliest and most informative markers that you would get genotyped if you've ever submitted a sample to 23andMe. People who are asthmatic, more often than not, will have this susceptibility allyl, which is the same that we find in chimps all over Africa.

The results of the study have major implications for chimpanzee public health because we know they're all susceptible, but there also are implications for human health. It's a question now whether chimpanzees and maybe other primates could serve as a wildlife reservoir for human rhinoviruses. We've never thought about that before. We've treated them, from a public health perspective, as human diseases. And maybe we have to rethink that a little bit. I mean, we all know that, the old saying "a cure for the common cold." We've been looking for that for years and have focused on vaccines and antivirals, but we've never even considered that other species may be able to serve as reservoirs for these viruses. If that's the case, it really changes our approach from sort of a more standard medical approach to a one health approach that considers not only people, but the animals and the environments with which they interact.

[Sarah Gregory] So, from what you're saying, is it possible that these chimps can be treated for this, at all, or...?

[Tony Goldberg] It's possible, in theory. So, an interesting tidbit... There was work done on vaccines and there is work being done on vaccines for people against rhinoviruses. And, in the early days, a lot of that work was done on chimpanzees. So, this was in the day when experimental work on chimpanzees was permissible, it no longer is. But back in those days, there were some vaccines and some antivirals tested that showed promise. So, wouldn't it be ironic if those unwitting chimpanzee volunteers of the past, if the results derived from them might actually help their wild relatives today.

So there, one could envision a strategy, in which in an emergency situation, for example, there could be vaccination of wild apes. This is controversial. People have talked about this in the context of influenza, even Ebola. There are pros and cons. You know, clearly, there would be risks to the animals in terms of delivering the vaccines, how you do it, and in terms of potential

adverse effects. But, we now know that, in several cases, human viruses can kill these animals, and they're endangered. So, it's an interesting ethical debate. Are we obligated to sort of just leave them alone and let nature run its course or, because these viruses are coming from people, are we obligated to intervene and try to do the best we can to prevent the damage that we've done?

[Sarah Gregory] I imagine that debate will take a while.

[Tony Goldberg] It will take a while. It's been going on for a number of years, and there are people who feel very strongly on both sides of it. My, my own, my own feeling is that we should give a lot of consideration to vaccination of apes because there really are no apes that live anymore in the primordial state that we wish they did live in. They're all impacted by people, and that's likely to continue into the future.

[Sarah Gregory] So, based on this study, and sort of along with what you were saying, do [you] recommend any next steps for people?

[Tony Goldberg] Yes. There's a very nice set of rules, that's been published by the IUCN, on how people should interact with wild apes in Africa. And they have suggestions, such as the distance one should keep from wild apes, practices one should and shouldn't do, wearing face masks, using hand sanitizer, personal hygiene methods, things like that. Those are not universally followed, so I think our study, in combination with all the other good ones that have been done, are just, you know, putting more and more pressure on people who do interact with apes in the wild to pay serious attention to these guidelines. Prevention is our best weapon against these viruses. We really want to make sure that they don't get transmitted from people to these wild apes who are very susceptible. Beyond that, I think, we can improve those recommendations and we can explore some of these strategies that have been promising in the past, like vaccines and antivirals. For vaccines, there's still groups working on rhinovirus vaccines. In fact, recently there've been some promising developments in that arena. If we could find a vaccination strategy that worked well in people, chimpanzees are awfully similar to people genetically and physiologically, so we would expect it to work in chimps, too, with of course, appropriate testing. So, I think, you know, even though it's tempting to cite gloom and doom when you find a new virus that's coming from people and wreaking havoc in wildlife, knowing what's going on does offer some avenues for intervention.

[Sarah Gregory] There's episodic plague in Uganda and West Nile virus also originates there. Are their ecologic or environmental reasons this region is prone to infectious diseases?

[Tony Goldberg] It's a good question. Not only plague and West Nile virus, but Zika is named after a forest in Uganda. So, Uganda does have a long history of being the place of discovery of medically important viruses. Now, it's tempting to think that's all because it's a, you know, sort of a seething hotbed of viruses. That may not be true. Uganda is also a very progressive and visionary country when it comes to biomedical research. There's been a long history of research, going back to the 1920s, on vector-borne disease in Uganda. And there is an organization in Uganda, the Uganda Virus Research Institute, that works very closely with the CDC to identify and understand new viral threats. So, it's a bit of a, you know, "looking where the light is"

phenomenon. Uganda is well set up to discover these new viruses, so they do, and it appears that there is a high density of these viruses in Uganda. Now, there may be some truth to that. We, from what we know about the distribution of emerging infectious diseases across the world, they do tend to come from places with a lot of biodiversity, with a lot of human population growth, tropical areas, areas where people and wildlife are coming into certain types of close contact—all that fits in Uganda. But, you know, I always remind myself and my students that I'm a professor at the University of Wisconsin in the Upper Midwestern United States, and we have a terrible problem here with vector-borne diseases, namely Lyme disease. We're an epicenter for Lyme disease. There's also a worrisome virus in our ticks up here called Powassan virus that can cause febrile illness in people. So, it's not entirely clear that places like Uganda are truly more at risk for these types of emerging infectious disease events. Part of it is just where we've been looking and where our biases are.

[Sarah Gregory] So, would care to tell us about your job and how it relates to this study? I know you've talked a little bit about it earlier, but any more you'd like to say?

[Tony Goldberg] Sure. Yeah, so this study landed in my lap, not by coincidence, but because this is what I do for a living. I'm an epidemiologist and a veterinarian, and my specialty is emerging infectious diseases that cross species barriers. We hear a lot about zoonotic diseases—diseases like West Nile virus, diseases like Lyme disease, and plague, and SARS—all these diseases that make the news. But, the truth is, there's an awful lot of diseases that go the other way, too—diseases from people that go into animals and cause big problems there, or even diseases that go from one animal species to another, these are, we don't even have a good name for that last one. So, you know, these diseases that are emerging because they're crossing species boundaries, but aren't necessarily zoonotic, but may be a threat to conservation and animal health, that's a lot of what I do. So, when we realized that we had a reverse zoonotic disease, or an anthroponotic disease, a disease that was coming from people to animals and causing problems in the animals, that's, you know, that's what an epidemiologist at a veterinary school does, a lot of the time. So, I felt, you know, dismayed by the course of events, but lucky that I was in a position to be able to help. And I should mention that, you know, it doesn't end here. We are working very closely with the Uganda Wildlife Authority and other organizations throughout Africa to improve the public health measures for people and chimps so that we can prevent this sort of thing from happening again.

[Sarah Gregory] Thank you so very much, Dr. Goldberg, for taking the time to talk with me today.

[Tony Goldberg] You're very welcome.

[Sarah Gregory] Listeners can read the February 2018 article, *Lethal Respiratory Disease Associated with Human Rhinovirus C in Wild Chimpanzees, Uganda, 2013*, online at [CDC.gov/EID](http://CDC.gov/EID).

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

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