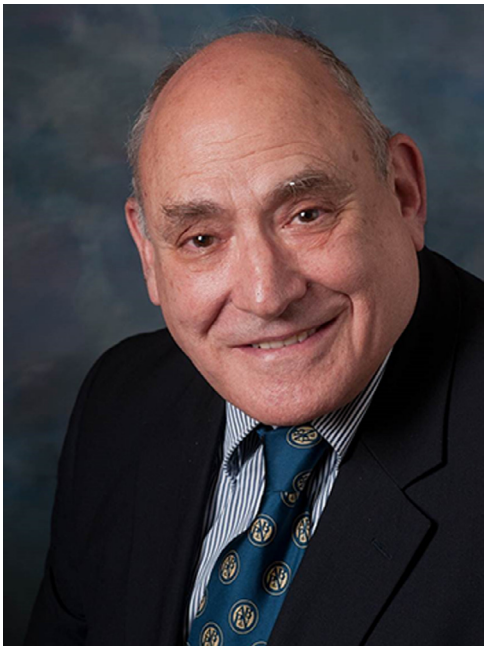
Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Editor-in-Chief's Note

Zoonotic Viruses: The Mysterious Leap From Animals to Man



Richard I. Shader, MD

As readers who follow my Editor-in-Chief's Notes know, I grew up in Florida, where during the 1940s and 1950s polio scares were common every summer. Public health officials periodically closed many lakes and swimming pools much to the dismay of those of us who sought refuge from the heat by going swimming. We also thought that this awful paralytic disease was caused by some unknown creature(s) in the water. Little did we know then that we were the creatures—poliovirus spreads through human fecal/oral transmission via stool or contaminated food, nor did we know what a virus was.

There are many pathways for viral spread among humans and from other species to humans. As an example of the former, consider wild type 2 poliovirus, an enterovirus in the Picornaviridae family. In many but not all countries, its contagion has largely been eliminated through vaccination. Wherever low vaccination rates exist, however, poliomyelitis can still emerge. North and South America were declared polio free by the World Health Organization in 1994.[1] In early June 2018, Cable News Network reported that a child was diagnosed with polio in Delta Amacuro, a very impoverished region in Venezuela. I followed this up on the internet. Several days later, I learned that polio had been ruled out as the cause of this child's flaccid paralysis.[2] Although vaccinations are not always completed in this area, this child's stool revealed Sabin type 3 poliovirus, indicating that she had been vaccinated. No causative agent has been identified by the time I started writing this Note, but other enteroviruses in the Picornaviridae family are known to cause acute flaccid paralysis. For example, EV-D68 was established as the cause of an outbreak of acute flaccid paralysis in the United States in 2014.[3] EV-D68 also causes respiratory symptoms.

As far as we know, these enteroviruses are not zoonotic viruses, that is, they do not leap from animals to humans. Nevertheless, there are other poliovirus strains that do infect animals. An example is the simian poliovirus, which stays within apes and monkeys.[4] By contrast, the origin of the human immunodeficiency viruses (HIVs) appears to be an example of successful host switching. Sharp and Hahn argue that the two lentiviruses that cause AIDS in humans (HIV-1 and HIV-2) arose from "multiple cross-species transmissions of simian immunodeficiency viruses (SIVs) naturally infecting African primates."[5] They believe their findings demonstrate SIV transmission from monkeys to apes and from apes to humans.

Chickenpox virus (*Varicella zoster*), contrary to its name, is not spread from chickens to humans. Like poliovirus type 2, it is spread among humans. Unlike enteroviruses, it spreads through contact with its blistery lesions, a diseased person's oral secretions, or secretions expelled by sneezing or coughing. Cowpox virus (*Vaccinia*) is closely related to chickenpox virus. It is a true zoonotic virus because it can be transmitted through touch from infected cows to humans and other animals. Vaccination with live *Vaccinia* confers immunity to smallpox virus (*Variola*). This property made cowpox vaccination central to the eradication of smallpox.

Another form of spread involves viruses that are transmitted from a nondiseased host to humans. Mosquito-borne viruses exemplify this type of spread. Mosquito-borne viruses cause yellow, Zika, dengue, West Nile, Rift

Valley, chikungunya, and Ross River fevers and Western equine, Eastern equine, Japanese, La Crosse, and St Louis encephalitis. Mosquito-borne viruses are often labeled as arboviruses, a category that also includes tick-borne viruses.

Another virus carrier is the fruit bat. I remember walking through a beautiful park in Melbourne Australia on the way to Captain Cook's cottage. I was startled by the sight of huge black creatures hanging from trees that arched over the walkway. The racket they made when they all flew away was memorable. They were Australian fruit bats. From a park guide, I learned that there are 13 varieties of Australian fruit bats, popularly known as flying foxes because their ears and faces are foxlike. Fruit bats belong to the family Pteropodidae. They are hosts for both Nipah and Hendra viruses, which can cause disease in various animals and humans. Nipah and Hendra viruses are both members of the Paramyxoviridae family; neither virus is known to cause disease in their host bats. Nipah also infects pigs. Fruit bats inhabit many other regions and countries, including Africa, China, India, and Malaysia.

Coronaviruses infect humans, other mammals, and birds.[6] Certain human coronaviruses are involved in the human to human transmission of some cases of the common cold. Some coronaviruses are zoonotic, infecting both their hosts and humans and other mammals. Examples include severe acute respiratory syndrome (SARS) and Middle East respiratory syndrome (MERS). The latter infections have been recognized only for the last several decades; it is possible that they have been around much longer but not identified as such. SARS is now definitively linked to bats.[7]

Certain influenza viruses (H5N1, H7N9) can infect birds, chickens, ducks, and other wild and domesticated birds. Called bird flu, these viruses can be transmitted to humans who come in contact with the droppings and saliva of infected birds. In rare instances, human disease has resulted from eating undercooked eggs or poultry. Similarly, although infrequent, the H1N1 influenza virus can be transmitted from infected pigs to humans, hence its common name of swine flu. Questions remain about these cases because some infected persons with SARS and MERS never came into contact with pigs.[8] Even more uncommon is for a virus to be transmitted from an infected human to an animal. Two reports I read suggest that humans infected their pets (cats, dogs, ferrets) with the H1N1 virus.[9,10] From what I could learn, however, the possibility that the animals and humans were independently infected from common sources has not been ruled out. In theory, infected humans could transmit the rabies virus to animals; no cases have been documented.[11]

A NEW ANTIVIRAL AGENT

Sheahan and colleagues[12] have reported that a novel antiviral, previously shown to be active against the acellular Ebola virus (*Zaire ebolavirus*), is also active against the coronaviruses SARS and MERS. Developed and named Remdesivir (GS-5734) by Gilead Sciences, it is a nucleotide analog prodrug. Gilead also studied it for Marburg virus. Ebola and Marburg are filoviruses. Results from other investigations suggest it may be effective against bat viruses and other viruses, such as respiratory syncytial virus and Lassa fever virus.[12-14] Remdesivir is not currently approved by the US Food and Drug Administration; however, some countries have authorized premarketing compassionate use.

THIS MONTH'S UPDATE

For this issue of *Clinical Therapeutics,* our Infectious Diseases Topic Editor Dr Ravi Jhaveri has assembled a collection of articles entitled "Hot Topics in Viral Diseases." The collection highlights recent controversies in vaccine licensure and recommendation, as well as advances in antiviral therapies for herpesvirus, hepatitis B and C, respiratory syncytial virus, and influenza, with an emphasis on pediatric patients.[15-22]

In closing, I wish to congratulate Ravi on his promotion and change of venue. He is moving from the University of North Carolina to Northwestern University's Feinberg School of Medicine, where he will become professor of pediatrics and associate chief of infectious diseases at Lurie Children's Hospital.

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This month's Infectious Diseases Update on Hot Topics in Viral Diseases is a special feature which is available as FREE ACCESS content on the journal's website. One of the previous Infectious Diseases Updates, entitled "**Vaccines**," was published in Volume 39, Number 8 of Clinical Therapeutics. To view the previous Update, see the articles below:

Jhaveri R. Vaccines

Collins MH, Metz SW. Progress and Works in Progress: Update on Flavivirus Vaccine Development

Cortes-Penfield NW, Ramani S, Estes MK, Atmar RL. Prospects and Challenges in the Development of a Norovirus Vaccine

McClure CC, Cataldi JR, O'Leary ST. Vaccine Hesitancy: Where We Are and Where We Are Going

Drozd EM, Miller L, Johnsrud M. Impact of Pharmacist Immunization Authority on Seasonal Influenza Immunization Rates Across States

Chong PP, Avery RK. A Comprehensive Review of Immunization Practices in Solid Organ Transplant and Hematopoietic Stem Cell Transplant Recipients