DEPARTMENT OF HEALTH AND HUMAN SERVICES

NATIONAL INSTITUTES OF HEALTH

Measles: The Continued Re-emergence of a Vaccine-Preventable Disease

Testimony before the

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Madam Chair, Ranking Member Guthrie, and Members of the Subcommittee:

Thank you for the opportunity to discuss the role of the National Institutes of Health (NIH) in addressing the re-emergence of measles. I direct the National Institute of Allergy and Infectious Diseases (NIAID), the lead NIH institute for conducting and supporting research on emerging and re-emerging infectious diseases, including measles. Measles was once a common childhood infection in the United States. However, the disease was declared eliminated in this country in 2000 thanks to the deployment of a highly effective vaccine in the 1960s. We are now seeing a resurgence of measles, primarily due to gaps in vaccine coverage that allow sporadic outbreaks to occur. Unfortunately, many of these gaps in the United States result from an anti-vaccine movement that continues to gain momentum.

The Centers for Disease Control and Prevention report that in 2018 there were more than 370 cases of measles in the United States and in 2019 there have been 159 cases of measles confirmed in ten states as of February 21, 2019. Six outbreaks have been reported in 2019 throughout the United States: three in New York State, one in Illinois, one in Texas, and one in Oregon and Washington State. Recent outbreaks have been sparked by individuals infected with measles virus in areas of the world with large measles outbreaks, such as the Philippines, Israel, and Ukraine. Fortunately, unlike with many other infectious disease threats, we already have the means to control measles virus: a safe and highly effective vaccine. However, failure to fully utilize this important intervention can have potentially serious individual and public health consequences.

OVERVIEW OF MEASLES

Measles is one of the most contagious viral infections known to man. The disease is caused by the measles virus, an RNA virus of the genus *Morbillivirus* in the family Paramyxoviridae. The measles virus was isolated in 1954 and is composed of eight proteins, two of which – the hemagglutinin and fusion proteins – are essential to its ability to cause disease. Full genome sequences of multiple measles virus strains are available, allowing for comparison to newly emerging strains. These genetic tools have been successfully utilized to detect the origin of measles cases imported to the United States from abroad. Measles is still common in many parts of the world where vaccine coverage is incomplete or insufficient to limit spread of the disease. There were approximately 110,000 measles deaths globally in 2017, mostly in children younger than five years of age.

Despite the continued spread of measles, there is the real potential to eradicate the disease entirely with a concerted global public health effort to increase measles vaccination. A cattle virus closely related to measles called rinderpest was eliminated in 2011 after a sustained worldwide vaccination campaign. There is no reason why the same cannot be accomplished for measles.

Measles is spread from person to person primarily by coughing and sneezing. Infectious droplets can remain airborne and transmit measles for up to two hours. This means that the disease can spread long after an infected person has left a room. If a person with active measles infection is in a closed space and is coughing and sneezing, 90 percent of the people in that space who are not immune will likely become infected. Individuals infected with the measles virus typically experience a 10- to 14-day incubation period before the development of a fever (as high as 105°F), runny nose, cough, red eyes, and sore throat lasting two to four days. These

symptoms usually are followed by the appearance of a rash that spreads from the head to the body to the lower extremities. Patients with measles can remain contagious from four days before through four days after the appearance of the rash.

Since most children who contract measles recover uneventfully, measles often is incorrectly portrayed as a disease of limited consequence; however, measles-associated complications can result in severe, lifelong disability or even death. Prior to the availability of a vaccine, three to four million measles cases occurred each year in the United States, resulting in approximately 48,000 hospitalizations and 500 deaths. Today, even in industrialized countries and settings with access to optimal care, measles infections still result in serious health consequences. One in ten patients experience ear infections, and one in twenty develop pneumonia. One in a thousand are affected by encephalitis, or inflammation of the brain, that can cause seizures and result in deafness or intellectual disability. Two or three in a thousand will die from the measles. In rare cases, a persistent central nervous system infection occurs, causing a fatal degenerative neurological disease called subacute sclerosing panencephalitis (SSPE). SSPE generally develops seven to ten years after measles infection and is characterized by behavioral changes, mental and motor deterioration, seizures, blindness, and ultimately death within one to three years.

The risks of serious complications or death from measles are higher in children younger than five years and adults older than 20 years. Fortunately, the widespread availability of a measles vaccine beginning in 1963 has led to a 99 percent reduction in measles cases and a corresponding reduction in measles-related complications in this country. Mass vaccination campaigns and increased routine immunization coverage in recent years have helped to reduce

the death toll from measles. The World Health Organization estimates that between 2000 and 2017, measles vaccination prevented an estimated 21.1 million deaths worldwide.

THE IMPORTANCE OF VACCINATION

The goals of vaccination are two-fold: to prevent illness and death in the vaccinated individual and to decrease viral transmission in the community. Prior to the availability of the measles vaccine, measles occurred in epidemic cycles. The introduction of a vaccination program for measles led to a reduction in the number of cases as well as the frequency and the size of epidemics. The measles vaccine when given in the recommended regimen of one dose at 11 to 12 months of age and an additional dose at 4 to 6 years of age is 97 percent effective in protecting against measles infection, making it one of the most effective vaccines available against any virus. This fact together with its excellent safety record, the highly contagious nature of the infection, and its potentially serious consequences underscore the importance of not withholding measles vaccination from those for whom it is indicated.

Immunization programs that achieve sufficiently high vaccination rates reduce the number of individuals in the community who are susceptible to infection, thereby limiting the spread of a contagious disease. This is called herd immunity. For herd immunity to be effective with measles, from 92 to 95 percent of the community must be immune, either by prior infection or by vaccination. Herd immunity protects unvaccinated individuals, including children who are too young for certain vaccinations or have other health conditions that preclude them from being immunized. For example, children younger than one year are too young to receive the measles vaccine. Nonetheless, they receive indirect protection when older individuals are vaccinated and become less likely to transmit measles. This indirect protection also is important for certain

individuals, such as those with immunodeficiency disorders or certain cancers, for whom the vaccine is medically contraindicated. Thus, the benefits of immunization against measles extend beyond just the vaccinated individual to the entire community.

NIH MEASLES RESEARCH

NIAID has a longstanding commitment to research on vaccine-preventable diseases, including those caused by morbilliviruses such as measles. This research has informed our understanding of measles virus biology and pathogenesis as well as the host immune response to measles infection and vaccination. NIAID has responded to the re-emergence of measles in the United States by expanding our portfolio of research on measles virus. This NIAID measles research includes efforts to understand why the disease spreads so efficiently from person to person by using an animal model to study measles virus replication within the airway. NIAID also is supporting several studies of vaccine-induced immunity, including using a third dose of vaccine to further boost the immune response; exploring potential differences in immune responses between sexes; and elucidating the mechanisms underlying the "waning immunity" that is observed in vaccine recipients compared to the life-long immunity observed in people naturally infected with measles virus.

No antiviral therapies are currently available to treat measles. NIAID is working to address this unmet need by facilitating collaborations among antiviral researchers through a scientific workshop to accelerate the development of measles antivirals. NIAID also funds efforts to screen antiviral compounds for activity against measles. In addition, NIAID supports basic research to improve our understanding of the host immune response to measles infection

and the mechanisms used by the virus to evade that response. This knowledge will provide the foundation for developing novel therapeutic strategies.

CONCLUSION

NIH is committed to continued collaboration with U.S. Department of Health and Human Services agencies and other partners across the U.S. government to address the re-emergence of vaccine-preventable diseases, including measles. NIAID efforts to elucidate the biology of measles virus and develop therapies to treat measles will help to limit the severity of measles-associated complications. NIAID also will continue to support efforts to improve our understanding of the host immune response to measles vaccines. Vaccines are among the 20th century's safest, most successful, and cost-effective public health tools for preventing disease, disability, and death. In addition to preventing a vaccinated individual from developing a potentially serious disease, vaccines help protect the entire community by reducing the overall transmission of infectious agents such as measles. Confidence in the safety and efficacy of vaccines is essential, and we will continue to work with our partners to stress the public health benefit of vaccination for measles and other vaccine-preventable diseases.