

National Center for Emerging  
and Zoonotic Infectious Diseases

# NCEZID ACCOMPLISHMENTS 2018



CDC works 24/7 to protect America from **health, safety, and security threats**, both foreign and in the United States. This report describes the work of CDC's **National Center for Emerging and Zoonotic Infectious Diseases (NCEZID)** in 2018. Our expert scientists, laboratories, and emergency responders work around the clock to protect people from a multitude of health threats, including **antibiotic-resistant infections, foodborne outbreaks, bioterrorism**, deadly diseases like **Ebola** and **rabies, diseases that cross borders**, and illnesses spread from **mosquitoes, ticks, and fleas**.





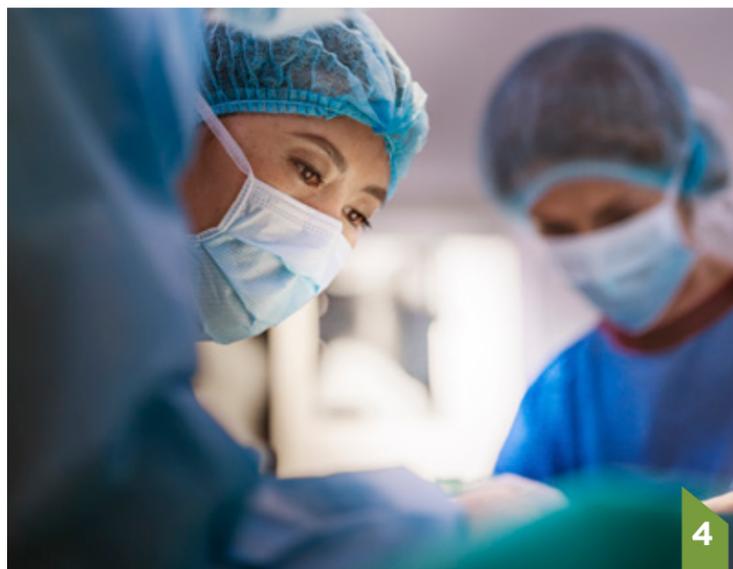
## Protecting Patients from Infections

### PARTNERING GLOBALLY TO COMBAT ANTIBIOTIC RESISTANCE

During the 2018 United Nations General Assembly (UNGA), more than 300 influential leaders from around the world joined CDC in showing their commitment to fight one of today's greatest global public health threats: **antibiotic resistance**. Each year, at least **2 million people are infected** with antibiotic-resistant bacteria in the United States alone, resulting in at least **23,000 deaths**. The Antimicrobial Resistance (AMR) Challenge was unveiled at an UNGA event co-hosted by the Bill & Melinda Gates Foundation, the Pew Charitable Trusts, the United Nations Foundation, Wellcome Trust, and the CDC Foundation. The AMR Challenge, spearheaded by the US Department of Health and Human Services (HHS) and CDC, engages pharmaceutical and health insurance companies, food animal producers and purchasers, medical professionals, government health officials, and other global leaders to make actionable commitments to make progress in the fight against antibiotic resistance. HHS Secretary Alex Azar unveiled the first commitments from more than 100 organizations at the event and more than 400 attendees joined virtually via livestream from around the world. The AMR Challenge encourages a One Health approach, which recognizes that the health of people is connected to the health of animals and the environment. As the AMR Challenge continues through 2019, CDC remains committed to collaborating with leaders worldwide to combat antibiotic resistance.

### PREVENTING INFECTIONS THAT CAUSE SEPSIS

Each year, more than **1.7 million adults in America develop sepsis** and nearly **270,000 Americans die** as a result. NCEZID worked with partners throughout 2018 to raise awareness about sepsis and share scientific expertise that healthcare professionals can use to prevent and treat infections that can lead to sepsis. CDC's **Get Ahead of Sepsis** educational effort provided new information to healthcare professionals and consumers via seven public service announcements (PSAs). The PSAs had a potential reach of more than 61 million people with messages emphasizing the importance of early recognition and timely treatment of sepsis, and preventing infections that can lead to sepsis. CDC also published the Hospital Toolkit for Adult Sepsis Surveillance, which provides healthcare facilities with tools to assess adult sepsis incidence and monitor progress in their facilities.



### MAKING PROGRESS IN PREVENTING INFECTIONS IN HEALTHCARE FACILITIES

Tracking the prevention of **healthcare-associated infections (HAIs)** provides data that CDC and partners can use to **improve patient outcomes, save lives, and reduce unnecessary healthcare costs**. In 2018, two CDC reports with important data from previous years were published – the 2016 HAI Progress Report and the 2015 HAI Prevalence Survey. These reports show that focused infection prevention efforts across the nation have successfully reduced infections in healthcare facilities. However, even with these successes, hundreds of thousands of patients are still being harmed by HAIs each year, and more action is needed. Although these data focus on hospitals and other acute care settings, CDC also works to prevent infections from occurring in other settings such as nursing homes, dialysis facilities, outpatient surgery centers, and communities. CDC continues to invest in and provide technical assistance to state and local health departments, healthcare systems, and other partners to prevent HAIs and support innovation for continued progress.

How does CDC get and use data on healthcare-associated infections?

**CDC's National Healthcare Safety Network (NHSN) receives secure data from more than 21,000 healthcare facilities to track and report information on healthcare-associated infections.**

**CDC, states, healthcare facilities, and other patient safety organizations use the data to identify areas where action is needed, measure progress of prevention efforts, and ultimately eliminate HAIs.**

### STOPPING ANTIBIOTIC RESISTANCE IN ITS TRACKS

In April 2018, CDC unveiled a powerful approach to stopping new and unusual forms of antibiotic resistance (AR). The **Containment Strategy** calls for public health and healthcare facilities nationwide to **take action at the first signs** of any new or rare type of AR. By quickly identifying emerging AR pathogens and initiating aggressive infection control and screening measures, the Containment Strategy seeks to **stop the spread of new or novel AR** in its tracks. This strategy requires a coordinated response among health care facilities, labs, health departments, and CDC, including the AR Lab Network. CDC's resources support containment nationwide, including seven AR Lab Network regional labs; 56 AR Lab Network state and local labs; and more than 500 local staff. Between January 2017 and August 2018, the AR Lab Network tested almost 24,000 isolates (pure samples of germs) and CDC supported more than 250 containment responses in partnership with state and local health departments.

### ADVANCING DOMESTIC AND INTERNATIONAL ANTIBIOTIC STEWARDSHIP STRATEGIES

Improving the way antibiotics are used around the world helps fight antibiotic resistance and ensures that these life-saving drugs will work when they are needed most. CDC's **Core Elements of Hospital Antibiotic Stewardship Programs** outline essential components for hospital-based programs to improve antibiotic use, commonly referred to as antibiotic stewardship programs. Hospitals across the United States have used these core elements to fight antibiotic resistance—for example, by training staff how to improve their antibiotic prescribing practices. CDC used these facilities' successes and lessons learned in the United States to work with international partners to identify and implement practical and sustainable strategies for international healthcare settings with limited resources and weakened health systems.

In its **Core Elements of Human Antibiotic Stewardship Programs in Resource-Limited Settings: National and Hospital Levels**, CDC provides guidance for national policies that can improve antibiotic use across the spectrum of care, including guidance specifically for acute care facilities. Such strategies must ensure access to antibiotics and reduce their inappropriate use. CDC is collaborating with countries, such as India and Kenya, to implement these core elements and improve antibiotic use.

## TRACKING DRUG-RESISTANT SKIN INFECTIONS IN INJECTION DRUG USERS

Recent CDC studies show that people who inject drugs are at high risk for dangerous, costly infections from skin bacteria and fungi. The CDC-funded Emerging Infections Program's Healthcare-Associated Infections/Community Interface found that people who inject drugs are at 16-times higher risk of invasive methicillin-resistant *Staphylococcus aureus* (MRSA) infections. Moreover, the proportion of **invasive MRSA infections among people who inject drugs more than doubled** from 2011 through 2016. Additional field investigations conducted by CDC staff in New York, New Mexico, and Colorado identified drug preparation or injection practices that greatly increase infection risk. This information is giving CDC and partners insights into how these dangerous infections can be prevented—for example, by educating people about wound care and early warning signs of serious infections associated with injection drug use.

CDC also teams up with partners to track emergency department (ED) visits and hospitalizations due to medication misuse. CDC's Medication Safety Program leads the National Electronic Injury Surveillance System – Cooperative Adverse Drug Event Surveillance (NEISS-CADES) project, a collaboration between the United States Consumer Product Safety Commission, FDA, and CDC, to track adverse drug events nationally. NEISS-CADES also tracks and analyzes ED visits and emergency hospitalizations due to medication misuse or abuse. These data show there were an estimated 130,000 ED visits for harm from prescription opioid misuse or abuse, out of 358,000 ED visits for nonmedical use of all prescription drugs.



*Candida auris*, plated on Candida CHROMagar

## FIGHTING THE GROWING THREAT OF *C. auris*, A DRUG-RESISTANT FUNGUS

*Candida auris* is a multidrug-resistant yeast that emerged in recent years causing serious and often fatal infections in patients in the United States and around the world. *C. auris* is a particular threat in healthcare facilities because the fungus can last on skin and healthcare surfaces, like bedrails and chairs, for weeks. In fact, *C. auris* can spread from person to person, even by a patient who carries the germ and does not show symptoms.

NCEZID rolled out a **rapid, sensitive, and accurate test** to detect *C. auris*. In 2018, this test was shared with regional labs in CDC's AR Lab Network to provide this testing to healthcare facilities nationwide. As of October 2018, the regional labs performed nearly 5,000 screenings, which helped identify hidden pockets of *C. auris* infection and informed actions to prevent its spread and, ultimately, protect patients.

## Why *C. auris* is a major public health concern worldwide

*Candida auris* is a drug-resistant fungus that causes severe infections and deaths in patients around the world. Most strains detected so far are resistant to at least one drug, and more than one-third are resistant to two of the three major drug classes used to treat fungal infections. CDC experts are working hard to respond to this emerging threat.

CDC worked with high-priority countries to develop recommendations to help hospitals control the spread of drug-resistant pathogens like *C. auris* and provide screening

guidance to help hospitals identify patients who might be carrying *C. auris* on their body but do not have symptoms.

Finding these patients is critical because it allows hospitals to take immediate steps to control the spread of infection to other patients.

CDC is also helping countries be able to conduct laboratory tests and surveillance for *C. auris* and take appropriate steps to respond when patients become infected.

## Protecting People from Domestic Health Threats



CDC scientists are learning more about the Asian longhorned tick and the health threats it may pose in the United States.

# Protecting People from Domestic Health Threats

Laboratory scientists at NCEZID study mosquitoes as well as fleas and ticks to stop the spread of deadly vector-borne diseases.

## DISEASES FROM MOSQUITO, TICK, AND FLEA BITES INCREASE

The number of people in the United States who got ill from mosquito, tick, and flea bites tripled between 2004 and 2016, according to a CDC Vital Signs report released in May 2018. Just over **27,000 illnesses were reported in 2004**, and that number rose to more than **96,000 in 2016**. Better control of mosquitoes and ticks is needed to protect people from these costly and sometimes deadly diseases. CDC is helping by funding states, territories, industry, and other groups to detect and respond to these infections and report cases to CDC.

## INVASIVE TICK DISCOVERED IN THE UNITED STATES

The **first Asian longhorned tick found** in the United States was discovered on a sheep in New Jersey in August 2017. Since then, experts have found the tick on pets, livestock, wildlife, and people. As of October 2018, scientists had not identified any harmful germs in the ticks collected in the United States; however, in other parts of the world, diseases spread by this tick can make people and animals seriously ill.

CDC scientists are learning more about the Asian longhorned tick and the threats it may pose in the United States by establishing a tick colony to determine what germs it could spread in the United States. CDC also is working with partners nationwide to find and track these ticks and conduct tests to determine how susceptible they are to pesticides. The presence of this tick in the United States presents an opportunity for collaboration between public health, agriculture, and other sectors to prevent diseases before people and animals get sick.

## TRAINING HEALTHCARE PROVIDERS TO RECOGNIZE A DEADLY TICKBORNE DISEASE

Rocky Mountain spotted fever (RMSF) is **one of the deadliest diseases spread by ticks**. Recognizing and treating RMSF within the first few days after a person gets sick is crucial. In 2018, CDC developed a toolkit and continuing education opportunities for healthcare providers that highlight key **ways to recognize, diagnose, and treat RMSF** and other tickborne diseases in the United States. The toolkit includes a training video, a pocket card with quick facts about RMSF diagnosis and treatment, a graphic that shows the clinical progression of RMSF, and a manual that highlights tickborne diseases in the United States. Through awareness and early recognition promoted by the toolkit, frontline healthcare providers can reduce the serious health consequences of RMSF and other tickborne diseases.

## Getting social with tick bite prevention

CDC captured national interest when it asked Twitter users if they could spot the difference between ticks and poppy seeds on a muffin. The tweet created a sensation, with more than 2,150 retweets and more than 2,930 likes on CDC's Twitter handle. With more than 1,100 comments

## CONTROLLING MOSQUITOES IN PUERTO RICO

The number of people getting sick from mosquito-borne diseases has significantly increased in Puerto Rico over the past few years. Local officials, CDC, and partners continually search for better ways to prevent mosquito bites and stop diseases like **dengue, chikungunya, and Zika**. To find out if mosquito control measures can reduce these infections in a community, CDC established the Communities Organized to Prevent Arboviruses (COPA) project in Ponce, Puerto Rico. Experts will use mosquito control strategies in the area and then track mosquito-borne infections in 3,000 people. In 2018, workers installed **over 350 mosquito traps** in the community and enrolled **more than 1,600 people** from over 1,100 households in the project. The results will inform decision makers about which strategies are most effective in reducing mosquito populations and the germs they spread.

## INVESTIGATING RARE BRAIN-EATING AMEBA IN TEXAS

*Naegleria fowleri* is an amoeba that can cause a **devastating infection of the brain** called primary amebic meningoencephalitis (PAM). CDC has received reports of 145 people in the United States who have been diagnosed with PAM since 1962. Only four of them survived. The amoeba usually infects people when contaminated water enters through their nose. In 2018, a person developed PAM and died after returning from a trip to a Texas surf park. CDC deployed a team of experts to collect water and other environmental samples that could be tested for the brain-eating amoeba. The team worked with local and state health officials and provided them with best practices guidance, based on CDC's Model Aquatic Health Code, to reduce the risk for further infections.



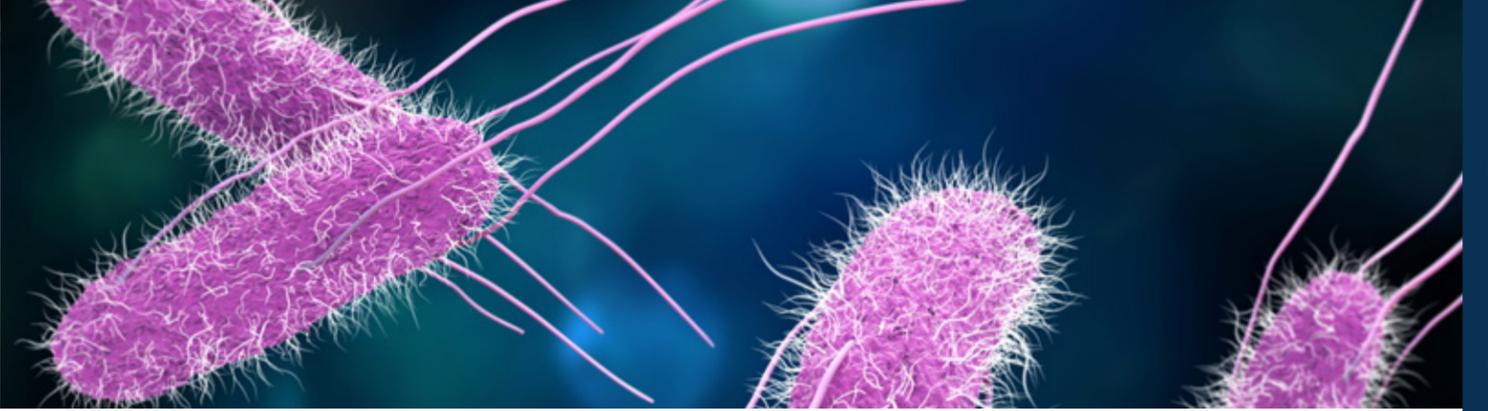
on @CDCgov, the popularity of the tweet increased engagement with CDC's Lyme disease prevention resources and started nationwide conversations about ticks and tickborne diseases. One Twitter user reported that after seeing the tweet, she found and safely removed a tiny tick on her body.





## RESPONDING TO HEALTH THREATS FOLLOWING DEVASTATING HURRICANES

When Hurricanes Irma and Maria ripped through Puerto Rico and the US Virgin Islands in 2017, the destruction was catastrophic: an estimated **\$90 billion in damage**, the **disrupted ability to fight infectious diseases**, and an **increased risk of infections** caused by fungi and contaminated food and water. CDC responders were still helping those areas recover in 2018. Experts from across CDC traveled to the affected areas and worked in the face of destruction to monitor and test for diseases, investigate disease outbreaks, and educate people how to stay healthy and safe when they had no water or power. The ability to quickly diagnose and treat infections is crucial to saving lives, especially in the aftermath of a disaster. When floods hit Puerto Rico and the US Virgin Islands after the hurricanes, health officials saw an increase in people sick with leptospirosis, a potentially deadly disease spread when infected animals urinate and contaminate the water. With public health laboratories on the islands severely disrupted, CDC and partners established a system to funnel samples to CDC for leptospirosis testing, with the goal of **helping laboratories recover their capacity** to conduct diagnostic tests for this and other infections so they can be quickly identified and treated.



## COLLABORATING WITH PARTNERS TO PROTECT PEOPLE DURING SALMONELLA OUTBREAKS CAUSED BY FOOD

In 2018, CDC, state public health and regulatory officials, and other federal agencies such as the US Food and Drug Administration (FDA) and the US Department of Agriculture's Food Safety and Inspection Service investigated several outbreaks of *Salmonella* infection, a foodborne disease that can cause diarrhea and lead to hospitalizations and deaths. Public health investigators used PulseNet to find people who were sick. Experts performed DNA fingerprinting on *Salmonella* bacteria isolated from ill people to help CDC precisely identify the germs responsible for these outbreaks.



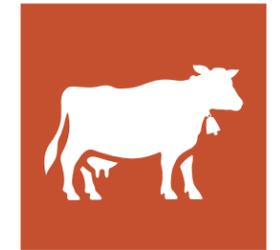
In a *Salmonella* outbreak that started in 2017 and continued through 2018, **199 people in 41 states** got sick, and 50 of them were hospitalized. Kratom, a plant consumed for its stimulant effects and as an opioid substitute, was the source of the outbreak. A multidisciplinary team from CDC worked closely with FDA on this complex investigation. Most ill people reported consuming kratom in pills, powder, or tea. The investigation uncovered a complicated importation and distribution network for kratom and identified multiple strains of *Salmonella* in products containing kratom. CDC and partners used news media, social media, and the web to make people aware that kratom could be contaminated with *Salmonella* and could make them sick.



An outbreak that began in March linked to Kellogg's Honey Smacks cereal resulted in **135 people from 36 states** getting sick, with 34 of them hospitalized. Health officials collected samples of the cereal in retail stores and from homes of those who became ill and confirmed *Salmonella* contamination in unopened Kellogg's Honey Smacks cereal from a retail store. As a result, Kellogg Company recalled all Honey Smacks cereal that were on the market within the cereal's 1-year shelf life.



In a July investigation, **77 people across 9 states** were infected with *Salmonella*, with 36 of them hospitalized. Investigators traced the source of this outbreak to pre-cut melons from Caito Foods, LLC of Indianapolis, Indiana. Caito Foods recalled fresh-cut watermelon, honeydew melon, cantaloupe, and fresh-cut fruit medley products that had potentially contaminated melons.



In an outbreak that started in August, **333 people from 28 states** were infected with *Salmonella* and 91 were hospitalized. JBS Tolleson, Inc., of Tolleson, Arizona, recalled approximately 12.1 million pounds of beef products, including ground beef, which may have been contaminated with *Salmonella*. The recalled products had been produced and packaged between July and September and were shipped to retailers nationwide.



### WARNING CONSUMERS ABOUT CONTAMINATED ROMAINE LETTUCE

Beginning in April 2018, CDC investigated the first of two multistate outbreaks of Shiga toxin-producing *E. coli* O157:H7 infections linked to romaine lettuce. During this investigation, CDC, working with FDA and state and local partners, rapidly identified romaine lettuce from the Yuma growing region in the Southwest as the likely source of the outbreak and issued a warning to consumers, restaurants, and retailers. CDC laboratory testing, including the use of whole genome sequencing, was critical in characterizing the outbreak as well as identifying the same pathogen in water samples taken from the Yuma growing region. A total of **210 people from 36 states** were infected, with 96 hospitalizations and five deaths. The spring outbreak was the largest multistate *E. coli* O157 outbreak since 2006.

Just when people were getting used to having their romaine salads back, another *E. coli* O157:H7 outbreak began, this one linked to romaine lettuce from the central coastal growing regions in northern and central California. A total of **62 cases and 25 hospitalizations** were reported from 16 states, with no deaths. Laboratory testing was critical in connecting this fall 2018 outbreak to another outbreak linked to leafy greens in fall 2017. CDC's fast action and collaboration with partners helped identify the source of the outbreak quickly, letting us warn the public and prevent more illnesses.

### PROTECTING A SMALL ALASKAN VILLAGE FROM A RARE AND DEADLY BACTERIA

Scientists from CDC's Arctic Investigations Program traveled to a small village (population 600) in southwest Alaska during the summer of 2018 after finding that one child had died and three others had been hospitalized for an infection with *Haemophilus influenzae type A (Hia)*. Hia is a type of bacteria (not to be confused with influenza) that can cause **serious illness** and **usually affects babies and children** under age 5. Scientists were concerned because the number of people who had gotten sick in such a small village was unusually high.

CDC and its **state and tribal partners** feared more children would become seriously ill. They **worked together** to follow new recommendations from the American Academy of Pediatrics **to stop the outbreak**. While team members collected throat swabs to examine how the disease was spreading throughout the community, pharmacists and nurses gave antibiotics to people at the highest risk of getting the infection, including nearly 130 children and the adults who were in close contact with the sick children. Since then, no other children in the village have become sick with this potentially deadly bacterial infection.

*NCEZID's Leisha Nolen, MD, takes a throat swab from a child in the small Alaskan village where an outbreak of a rare and deadly infection sickened young children during the summer of 2018.*





## Fighting Global Outbreaks

### STOPPING EBOLA'S SPREAD IN DEMOCRATIC REPUBLIC OF THE CONGO

On May 8, 2018, the Ministry of Health of the Democratic Republic of the Congo (DRC) reported two people infected with **Ebola virus** in the Equateur Province. CDC assisted the DRC government and local and international partners as they launched a response to the outbreak. CDC and partners used lessons learned from previous response efforts to quickly bring the outbreak under control. On July 25, the World Health Organization declared an end to the outbreak, which had **sickened 54 people, 33 of whom died**.

Just a week later, the DRC Ministry of Health reported **another Ebola outbreak** in North Kivu province. Serious security concerns in the area make this second outbreak response particularly challenging. The outbreak has continued to spread and, in December 2018, became the **second largest Ebola outbreak in history**. CDC is working closely with the DRC government, the World Health Organization, and other partners to bring the outbreak under control by supporting epidemiology, laboratory diagnostics, infection prevention and control, border protection, emergency operations, risk communication, and vaccination strategy activities. In 2018, CDC deployed more than 90 subject matter experts to DRC and neighboring countries to coordinate activities and provide technical guidance to help the region strengthen its preparedness to respond to Ebola.

### PREVENTING YELLOW FEVER AROUND THE WORLD

Yellow fever is spread by infected mosquitoes and can cause serious illness or death in people who have not been vaccinated. With continual outbreaks in Africa and South America, vaccination campaigns are critical to educate the public on yellow fever and the importance of the vaccine.

In Brazil, more than **1,370 yellow fever infections** and over **480 deaths** were reported from July 2017 through June 2018. In response, CDC issued a travel health notice in March 2018 to alert travelers and recommend that those who have never been vaccinated against yellow fever avoid traveling to the areas of Brazil where yellow fever is a risk. CDC conducted a coordinated multi-media effort to inform and encourage healthcare providers and travelers to plan ahead because of the limited availability of yellow fever vaccine in the United States.

Accurate diagnosis is also important, and in 2018, CDC launched an international study of a yellow fever diagnostic kit. Nine countries across Africa and South America are testing the kit to see how it performs and how it can be improved.

*NCEZID scientists outside Uganda's Python Cave, where they trapped and tagged bats to learn more about what areas may be at risk for Marburg virus, a close relative to Ebola virus.*



NCEZID experts worked with the Somali Regional Water Bureau to ensure that water at these tap stands in Ethiopia was chlorinated and monitored regularly (above).

### WORKING WITH MINISTRIES OF HEALTH IN AFRICA TO END CHOLERA

Cholera is a deadly disease spread by drinking water or eating food contaminated with cholera bacteria that can cause watery diarrhea. CDC helped Ministries of Health in Malawi, Zambia, and Zimbabwe respond to outbreaks of cholera, including in-country technical support for surveillance and laboratory diagnostics, case management, evaluation and monitoring of water quality, investigations of cholera mortality, and cholera vaccination. As part of the **Ending Cholera** initiative by the Global Task Force for Cholera Control, CDC has helped Kenya, Tanzania, and Zambia to develop and launch their plans to end cholera by 2030. To prevent cholera outbreaks, CDC is committed to identifying cholera hotspots, rapidly responding to outbreaks, providing targeted training for cholera surveillance and detection, and identifying unsafe water, sanitation and hygiene conditions.



### GLOBAL PARTNERSHIPS IMPROVE WATER, SANITATION, AND HYGIENE IN RURAL HEALTHCARE FACILITIES

In many countries, rural healthcare facilities with unsafe water and poor sanitation can be a deadly reality. The 2014-2015 Ebola outbreak in West Africa highlighted the crisis faced by healthcare workers and patients, when a lack of safe water and sanitation became a major hurdle in treating Ebola and saving lives. Since then, public health workers around the world have stepped up efforts to assess their water and sanitation infrastructures and develop national action plans. They are also working to make improvements needed to provide rural healthcare facilities with **access to safe water, adequate sanitation, and education about hygiene** to prevent infectious diseases.

In 2018, CDC experts worked with partners and ministries of health in **more than 300 rural healthcare facilities in five countries**—Mali, Uganda, Tanzania, Ghana, and Ethiopia—to improve water, sanitation and hygiene (WASH) conditions. Experts assessed facilities' water, sanitation, hygiene, and waste management infrastructures; evaluated healthcare workers' knowledge about WASH; studied their handwashing hygiene practices; and learned what providers and patients thought about existing WASH conditions. CDC and partners then helped put into place a plan to improve healthcare conditions by developing materials to strengthen healthcare workers' knowledge of how to improve WASH practices and deliver WASH messages.

### HELPING PAKISTAN FIGHT DRUG-RESISTANT TYPHOID FEVER

Without treatment, 30% of people infected with typhoid fever (*Salmonella Typhi*) will die. But when the infectious strain is drug-resistant, the percentage of people who die is much higher. Such was the case in late 2016, when health officials in the city of Hyderabad, Pakistan, reported an **outbreak of typhoid fever** that was **resistant to most antibiotics**—also known as extensively drug-resistant, or XDR typhoid fever. By 2017, the XDR outbreak had spread to Pakistan's largest city, Karachi. Public health authorities in Pakistan asked CDC to help with surveillance, laboratory testing, and control of the XDR outbreak. CDC's typhoid experts consulted with the National Institute of Health in Pakistan, Aga Khan University investigators, the CDC Country Office, and the USAID mission. In October 2018, they met with authorities in Islamabad and Karachi and together they were able to take steps to **improve surveillance, diagnosis, and control of XDR typhoid fever** in Pakistan.





## Safeguarding Travelers & Border Health



*CDC's meticulous planning and around-the-clock work behind the scenes protect people in the United States, including incoming airline passengers.*

### PROTECTING AIRLINE PASSENGERS

CDC's long-standing coordination with federal, state, and local partners to safeguard US ports of entry from contagious diseases was put to the test in September 2018, when a commercial airline from Dubai alerted JFK Airport about **100 sick passengers** on board. CDC's quarantine officers worked with the US Customs and Border Protection officers to rapidly isolate the plane and screen passengers for illness. Local partners transported ill passengers to the hospital for further evaluation, where several passengers tested positive for flu. The remaining passengers were screened and released. The next day, two more flights into the United States reported ill passengers, with one traveler testing positive for flu. These events show how CDC's **meticulous planning** and **around-the-clock work** behind the scenes **protect people in the United States**, including recent arrivals.

### IMPROVING THE QUALITY OF IMMIGRANT APPLICANTS' MEDICAL RECORDS

In 2018, the United States launched an electronic system, eMedical USA, to improve the quality of immigrant applicants' records and help physicians trained and licensed to practice overseas (panel physicians) to detect health-related conditions such as tuberculosis. The system improves the transfer of important medical information and improves CDC's ability to review the quality of medical exams, reducing the risk that panel physicians miss patients with tuberculosis immigrating into the United States. CDC staff, in partnership with the US Department of State, developed, tested, and established the eMedical system; trained US panel physicians and their staff in its use; and developed the partnership agreements necessary for eMedical's use. The system will eventually be used by **nearly 700 US panel physicians in 150 countries**.

## PROVIDING CRITICAL GUIDANCE IN THE FIGHT TO END TUBERCULOSIS

Because tuberculosis is a challenging disease to diagnose, treat, and control, CDC published new Tuberculosis Technical Instructions to help panel physicians overseas and civil surgeons in the United States to **detect and treat infectious forms of tuberculosis** (TB). These instructions help to ensure that people diagnosed with TB are treated and the risk of spreading TB among the US population is reduced. It is crucial that medical professionals have the most up-to-date materials to screen and treat patients for TB. These instructions are another tool experts can use in the fight to end TB.



## RESPONDING RAPIDLY TO THE FIRST KNOWN IMPORTED CASE OF ANDES VIRUS IN THE UNITED STATES

Hantaviruses are found around the world in rodents and can cause severe or deadly illnesses in people. Andes virus is a type of hantavirus found in South America, and it is the only hantavirus strain that can also spread between people. CDC collaborated with several states in 2018 to investigate the **first known imported case of Andes virus infection in the United States**. The ill person was a traveler who was infected while visiting South America and who could have exposed others when flying back to the United States. CDC and local and state health departments responded quickly and conducted investigations to identify and notify those who were exposed to the sick passenger on the plane. No one else was infected.

## FINDING FOREIGN TRAVELERS EXPOSED TO RABIES IN FLORIDA

While vacationing in Florida in January 2018, two European tourists found a sick bat and dropped it off at a veterinary clinic. The clinic tested the bat, and by the time the results were in—a **positive test for rabies virus**—the couple had left. They had not given any contact information but had mentioned they were from Switzerland. When notified about this potential rabies exposure, the Florida Department of Health investigated and contacted CDC staff, who then reached out to Swiss health officials to update the Swiss government about the situation. Swiss health officials identified the couple within 5 hours after releasing a national health alert. The couple started **rabies post-exposure prophylaxis** that same day, and it **may have saved their lives**.



*NCEZID experts in the WIRED video demonstrated the gear they use while fighting deadly diseases like rabies, monkeypox and (shown here) Ebola virus.*

## Gearing up to fight the world's deadliest diseases

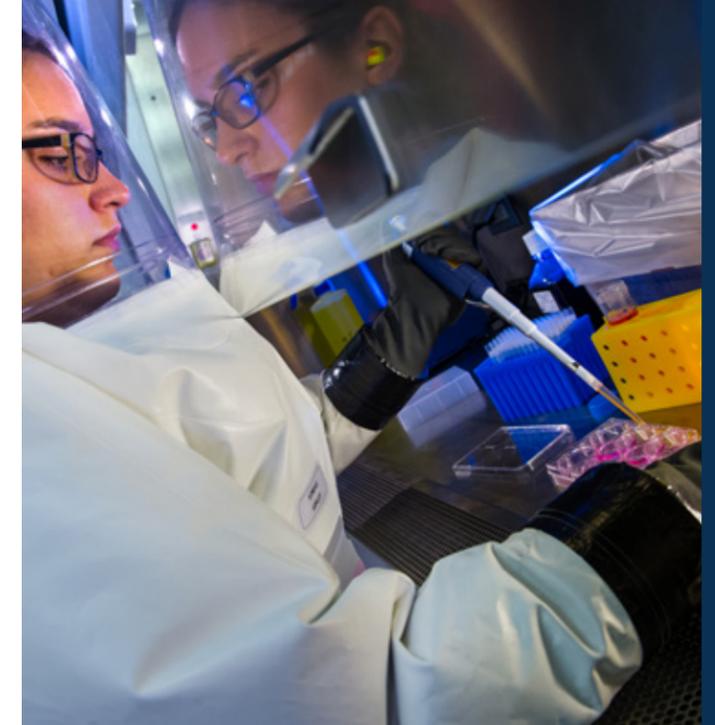
CDC disease detectives regularly go off the beaten path to crawl with snakes, trap bats, and vaccinate stray dogs so they can study dangerous pathogens, prevent illnesses and stop outbreaks. In 2018, WIRED magazine published a video detailing the gear that NCEZID experts use while on the front lines fighting deadly diseases like rabies, monkeypox, and Ebola.

A close-up photograph of a petri dish containing several bacterial colonies. The colonies are circular, with some showing a white, fuzzy appearance and others appearing more solid and dark. The background is dark, making the colonies stand out.

## Building Lab and Epi Capacity

### SUPPORTING US HEALTH DEPARTMENTS IN THE BATTLE AGAINST INFECTIOUS DISEASES

Across the United States, public health departments are on the front lines of fighting infectious diseases, but they cannot do it alone. For nearly a quarter century, CDC's **Epidemiology and Laboratory Capacity for Prevention and Control of Emerging Infectious Diseases** (ELC) has provided direct support to state and local health departments to modernize their laboratory resources, improve their health data systems, and strengthen their disease surveillance systems. In 2018, ELC awarded more than \$200 million to 64 public health departments. ELC-supported staff investigate more than 70% of all infectious disease outbreaks nationwide (not including HIV, STD, and hepatitis outbreaks). This crucial investment is one of CDC's key, nationwide funded programs that supports capacity building for the detection, prevention, and control of infectious diseases.



*NCEZID scientists conducted laboratory tests to evaluate the effectiveness of a new drug to treat smallpox and paved the way for its approved use in the United States.*

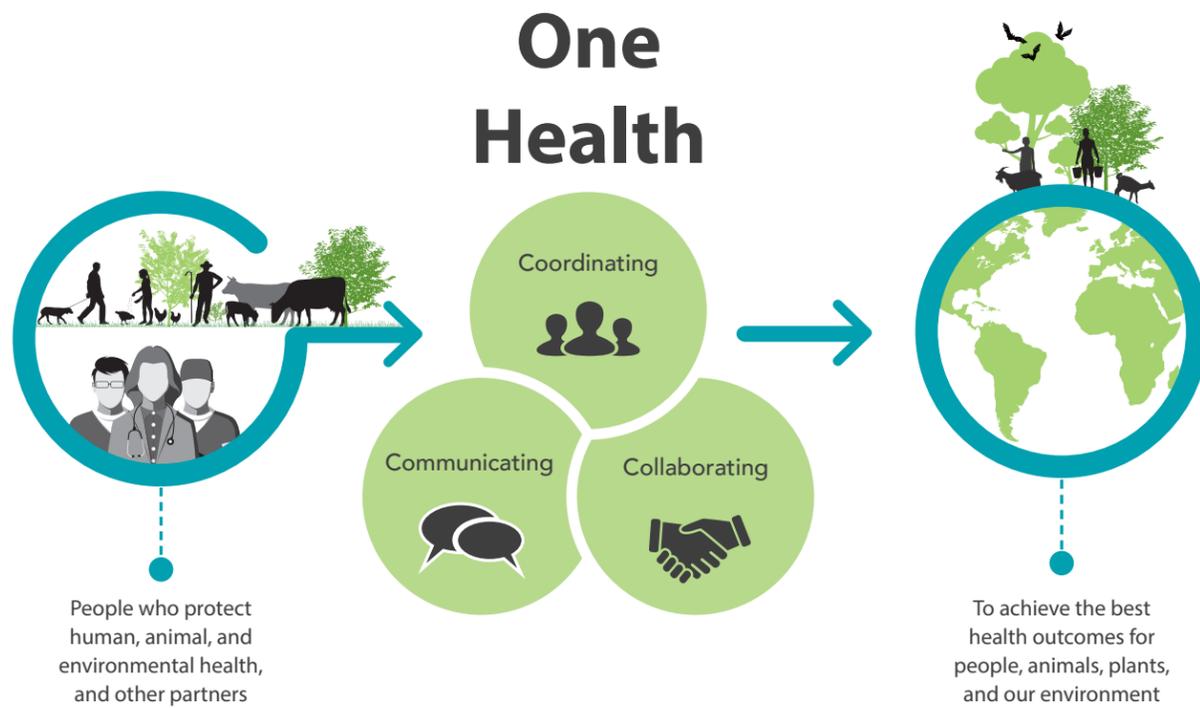
### PAVING THE WAY FOR FIRST SMALLPOX DRUG APPROVED FOR USE IN THE UNITED STATES

**Smallpox** was eradicated in the 1980s, but there are still concerns it **could be used in a bioterrorist attack**. Since many people today have never had smallpox or been vaccinated against it, having a **drug** available to treat this deadly disease would be **critical to saving lives** if smallpox ever were used in a bioterrorist attack. NCEZID scientists conducted laboratory tests to evaluate the effectiveness of a new drug called Tecovirimat (TPOXX) against the virus that causes smallpox. They confirmed that Tecovirimat halted virus multiplication, which prevents the virus from leaving an infected cell and spreading to the rest of the body. These data were used when the US Food and Drug Administration (FDA) considered approving the drug. In July 2018, the FDA approved the use of Tecovirimat as the **first treatment for smallpox**. Tecovirimat is now stored in the Strategic National Stockpile and could be used during a smallpox emergency to save lives.

### STRENGTHENING CDC LABS' CAPACITY TO TEST WATER DURING EMERGENCIES

In 2018, CDC laboratory scientists updated the methods they use to **test water contaminated with germs** that could cause serious infections or even death if they are inhaled (also known as Biosafety Level 3 agents). These updated methods strengthened CDC laboratories' capacity to process incoming surges of water samples during future public health emergencies, like hurricanes, and help **prepare CDC to respond to a broader range of potential threats** posed by contaminated water.





## Using a **One Health** approach to protect health for all

CDC experts are working to change the way we approach public health. Specifically, CDC wants people to know that human health isn't just about humans—it's **closely related to the health of animals** (including pets, wildlife, and livestock) **and the environment** that we share—an approach known as One Health. In 2018, experts from CDC's One Health Office helped **strengthen global health security** and capacity to prevent zoonotic diseases by collaborating with partners to conduct One Health Zoonotic Disease Prioritization Workshops in multiple countries and, for the first time, regions.

The **first regional workshops** were held for the Economic Community of West African States, which includes 15 member countries, and for US southern land border states. These regional workshops reflect the increased interest among partners to work together at the regional level **to prepare for shared threats** to people, animals, and the environment. CDC's One Health experts also facilitated national workshops in Mozambique, Ghana, and Uzbekistan. In Uzbekistan, they pilot tested a new toolkit to help the country develop a One Health strategy to prevent the diseases identified as being high priorities.

Commonly prioritized diseases worldwide include rabies, brucellosis, anthrax, and viral hemorrhagic fevers like Ebola and Marburg. By prioritizing the **zoonotic diseases that pose the biggest health threats**, countries can more efficiently build their laboratory capacity, conduct disease surveillance, plan outbreak response and preparedness activities, and create disease prevention strategies to reduce illness and death in people and animals.

## Advanced Molecular Detection: the first **five** years at CDC



Five years ago, CDC had fallen behind in a critical technology: DNA sequencing. A revolution in the field was under way—**next-generation sequencing (NGS)**—that promised **more finely detailed and precise data** to guide public health actions, such as detecting and responding to outbreaks. Since the Advanced Molecular Detection (AMD) Program began in 2014, CDC has become a leader in applying NGS to public health challenges.

In just five years, CDC has built a **workforce capable of applying NGS** and related technologies to over 50 infectious diseases. To make use of this enormous flow of genomic data, the agency has increased its **high-performance computing** capacity and is making increasing use of cloud services. CDC's infectious disease laboratories now lead the way in **using NGS to improve health**.

Moreover, state and local public health laboratories across the United States now have NGS capacity and the systems needed to support it. These advancements are helping public health agencies **discover** new trends in drug resistance, **detect** emerging outbreaks faster, and **stop** outbreaks more effectively. For example, one CDC partner supported by the Advanced Molecular Detection Program was able to confirm that a hotel hot tub in Hampton Beach, New Hampshire, was the likely source of a Legionnaires' disease outbreak that sickened 19 people, one of whom died.

## How **AMD** efforts help us prepare for infectious disease threats

- ▶ Better understanding of influenza viruses to improve vaccine developments
- ▶ Faster detection of emerging outbreaks for early intervention and control
- ▶ More effective interventions in outbreaks
- ▶ Improved insights into preventing foodborne outbreaks
- ▶ Discovery of new trends in drug resistance

# Looking Ahead to 2019

## Preparedness

Preparedness to fight infectious diseases is one of NCEZID's top priorities in 2019. NCEZID experts continue to strengthen preparedness efforts on many fronts:

- ▶ In 2019, the **Laboratory Response Network (LRN)** will mark its **20th anniversary** of working with partners to ensure that the United States can detect and respond to dangerous and emerging infectious diseases like H1N1 influenza, MERS, Ebola, and Zika. Moving forward, NCEZID experts will continue to provide leadership and support to make sure that the LRN stays well ahead of new health threats and demands.
- ▶ Design will begin of a **new, much-needed high-containment laboratory**, which will allow CDC scientists to continue conducting leading-edge work on some of the world's deadliest pathogens.
- ▶ As infectious disease threats grow in the United States, the way NCEZID supports states also needs to grow. The **Epidemiology and Laboratory Capacity for Prevention and Control of Emerging Infectious Diseases (ELC) Program** has engaged partners across the country to make strategic improvements to ensure that its new 5-year Cooperative Agreement (2019–2024) **gives support to prevent and control the spread** of infectious disease threats in the United States.

## Global Health

In 2019 and beyond, NCEZID experts know that international **outbreaks like Ebola will continue**, especially in insecure settings like the Democratic Republic of the Congo, and they will continue working vigilantly with many partners to **protect people abroad and in the United States from these deadly outbreaks**.

Also on the horizon are efforts to prevent deaths from infectious diseases like cholera and rabies. For example, NCEZID will continue to collaborate with global partners to **reduce cholera deaths by 90%** and **eliminate human deaths from dog-transmitted rabies** by 2030.

## Vector-borne Diseases

NCEZID and nine other federal agencies will continue working together to tackle the rising threat posed by diseases from mosquitoes, ticks and fleas. The partners will put into place a **National Strategy for Vector-borne Diseases** to prioritize resources, including new technologies and funds **to help states combat these diseases**. By working in concert, they can start solving problems the nation faces as vector-borne diseases continue to rise.

## Advanced Molecular Detection

Advanced Molecular Detection efforts at CDC are poised to take public health infectious disease work into the future through continued innovation and new opportunities, including plans to:

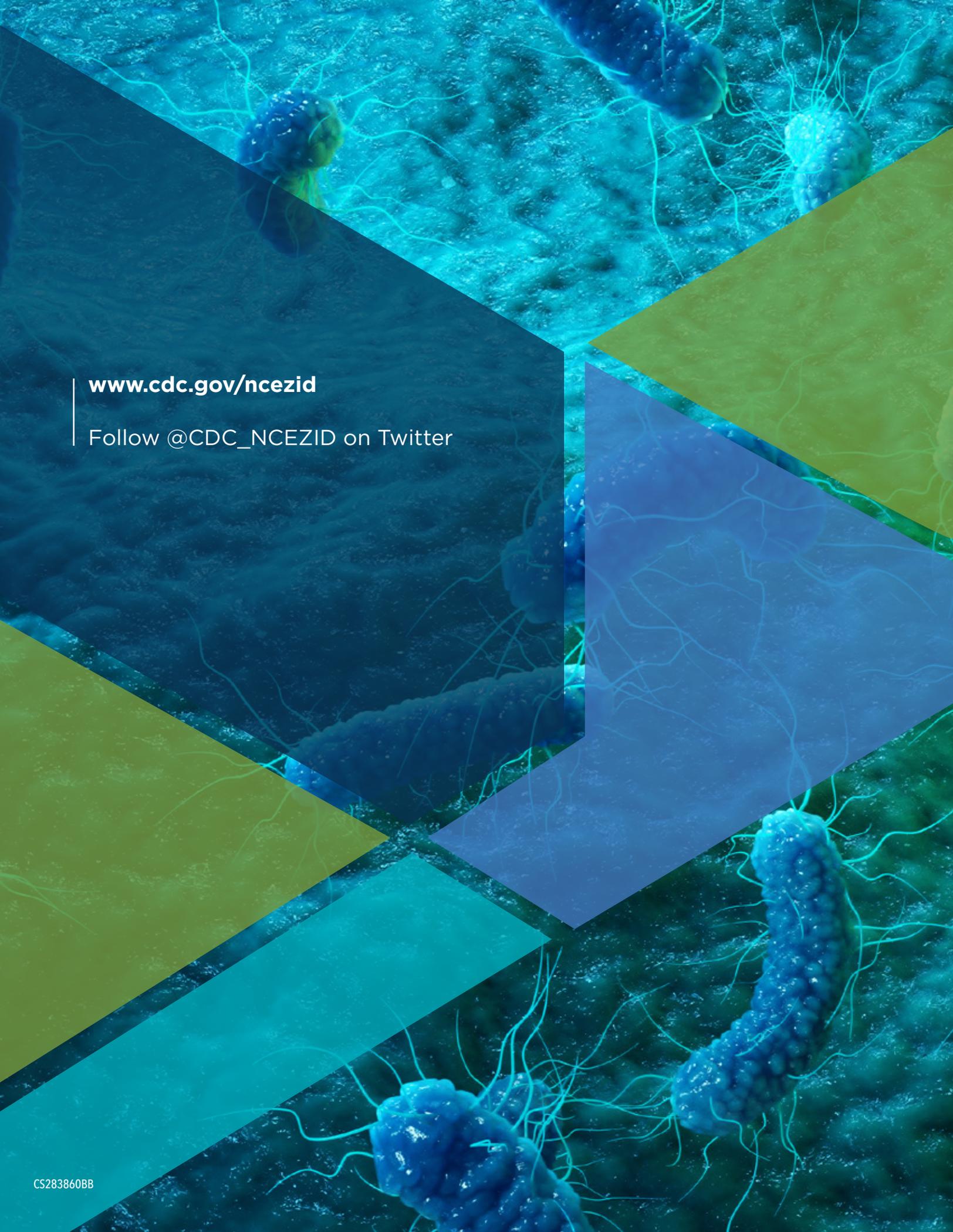
- ▶ **Develop and adapt tools** that combine genomic data with epidemiologic data to better support detection and investigation of infectious disease outbreaks.
- ▶ **Build a public health workforce** adept in pathogen genomics and molecular epidemiology.
- ▶ **Create a sustainable DNA sequencing technology infrastructure** across the United States.
- ▶ **Keep up with rapid advances** in sequencing technologies, adapting relevant technologies for use in public health.
- ▶ **Develop new tests** that can identify and characterize foodborne bacteria directly from patient specimens without the need for a culture (without needing to grow the bacteria in the lab). This potentially means getting lab results in hours rather than days.

## Antibiotic Resistance

During the 2018 United Nations General Assembly, NCEZID was joined by hundreds of leaders worldwide who made commitments to tackle antibiotic resistance (AR) in five areas:

- ▶ **Tracking and data:** Share AR data and improve data collection
- ▶ **Infection prevention and control:** Reduce the spread of resistant germs
- ▶ **Antibiotic use:** Improve appropriate antibiotic use while ensuring access to these drugs
- ▶ **Environment and sanitation:** Decrease antibiotics and resistance in the environment while improving sanitation
- ▶ **Vaccines, therapeutics, and diagnostics:** Invest in their development and improve access

These commitments will have a major impact over the coming years, as NCEZID expands its activities to meet the increasing need to **reduce AR** not just in the United States, but **globally as well**.

A microscopic view of several blue, rod-shaped bacteria with numerous thin, hair-like flagella. The bacteria are set against a dark, textured background. Overlaid on the image are several large, semi-transparent geometric shapes in shades of blue, green, and purple, creating a modern, abstract design.

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