

National Center for Emerging and Zoonotic Infectious Diseases

TOP 10

ACCOMPLISHMENTS 2016



Leading the response to the outbreak of Zika

Before Zika, no one knew that a bite from a mosquito could result in a devastating birth defect. [Zika virus](#) emerged in the Americas during 2015–16, and was unprecedented in more ways than one. The virus was spread both by mosquito bites and through sex. Zika was the first major infectious disease linked to birth defects to be discovered in more than 50 years. And the emergency response to Zika has been the most complex in CDC's history. Experts from multiple centers, in addition to NCEZID, were engaged in responding to the outbreak and at the forefront of protecting pregnant women and their fetuses.

As the lead center for CDC's response, NCEZID has had primary responsibility for activities on Zika-related epidemiology; onsite emergency response; monitoring and reporting of Zika cases; vector control; laboratory diagnostics, including distribution of assay reagents to US and international laboratories; pathology and pathogenesis; travel risk assessment and [advisories](#); and communication to international travelers and their clinicians.

In collaboration with other centers and external partners, NCEZID also provided leadership on public health guidance covering a broad range of clinical, personal protection, laboratory, preparedness, and related topics; emergency risk and health communication; policy and budget management; partnerships and outreach; emergency incident management; and overall response strategy. With \$350 million in [supplemental funds](#) approved in late 2016, CDC will continue this important work in the coming months.



A few examples of our work include:

Detecting and tracking Zika

CDC disease detectives worked closely with international partners to learn more about Zika as it swept across Brazil and other countries in 2015–16. In mid-January 2016, CDC issued an [advisory](#) to alert US healthcare providers and the public about the threat of Zika and its likely spread throughout the Americas. Although there was no known local spread of Zika in the United States at that time, infections were being detected in US-bound travelers from countries with Zika. The CDC alert described the then-suspected link between Zika and microcephaly (where a baby's head is much smaller than expected), and advised pregnant women to postpone travel to areas with Zika.

US healthcare providers were encouraged to report suspected Zika cases to public health departments, which were asked to report confirmed Zika cases to CDC. This early guidance served as the beginning of a comprehensive Zika surveillance effort that evolved during 2016 to include up-to-date information about pregnant women with any lab evidence of Zika and total numbers of Zika cases in the United States. By acting early and decisively, CDC and other public health officials likely prevented many additional cases of Zika and birth defects.



NCEZID staff developed a variety of communication materials for Olympic athletes.



Coordinating the emergency response

On January 22, 2016, CDC activated its Emergency Operations Center to manage the agency's Zika response, with NCEZID serving as the lead center in collaboration with multiple other centers. Teams were formed to focus their expertise on different areas of the complex response, including, among others, epidemiology/surveillance, pregnancy and birth defects, laboratory, blood safety, medical investigations, vector control, state coordination, global migration/travelers' health, international, risk communication, and policy. CDC worked with state and local officials to prepare for the possibility of mosquito-borne transmission of the Zika virus in [parts of the continental United States and Hawaii](#). In addition to awarding funds to support local responses to protect Americans from Zika, CDC deployed teams of experts to assist in public health responses in Puerto Rico, American Samoa, the US Virgin Islands, Utah, and Florida.



Diagnosing Zika

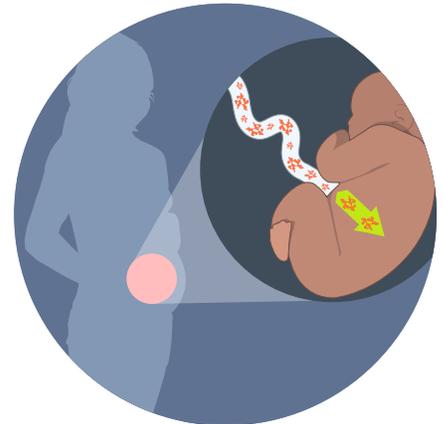
Before Zika, there was [chikungunya](#), and before that was [dengue](#). All three viruses are primarily caused by the bite of an infected *Aedes aegypti* (*Ae. aegypti*) mosquito. When Zika began spreading in Brazil in late 2015, NCEZID scientists knew that they would need one test (rather than three) that could quickly and accurately determine the exact type of infection. The team worked nonstop and created in 3 months what normally would have taken 1 or 2 years—the [Trioplex Real-time RT-PCR Assay](#), an unprecedented diagnostic test that allows laboratories to test for all three viruses at once. The test saves resources and time, especially critical for pregnant women, and to date has been used to diagnose 85% of cases of Zika in patients in Puerto Rico.

Controlling mosquitoes

Early on, NCEZID experts anticipated the virus would eventually spread to the continental United States. Prevention and control measures were focused on avoiding mosquito bites, reducing the risk of sexual transmission, and controlling the mosquitoes that spread Zika. In August, the [first cases of locally acquired Zika virus infection](#) were confirmed in the Wynwood section of Miami-Dade County, Florida, and NCEZID helped distribute traps that collected a large number of *Ae. aegypti* mosquitoes. CDC supported Florida officials as they intensified mosquito control efforts, including eliminating standing water, larviciding, and applying insecticides (larvicides and adulticides) by backpack and truck-mounted spraying, and later, aerial spraying. Within about 1 week, the number of *Ae. aegypti* mosquitoes found in traps already had significantly decreased, and no new cases of symptomatic Zika virus infection were identified more than 2 weeks after initial aerial spraying and applying larvicides. By mid-September [no new locally transmitted Zika cases in Wynwood](#) had been reported.

Connecting the dots

Nearing the end of 2015, local transmission of Zika virus was increasing in Brazil, and the link between Zika virus infection and microcephaly was growing stronger. During 2016, staff in NCEZID's Infectious Diseases Pathology Branch helped cement the [connection between Zika virus infection during pregnancy and microcephaly](#) and other birth defects. The team found Zika virus in tissues from pregnant women and their fetuses. They [also discovered](#) that the virus could make thousands of copies of itself in fetuses' brains and women's placentas and can persist in the tissues, which may help explain how the virus causes devastating birth defects and pregnancy losses even if a woman had only a minor illness from Zika.



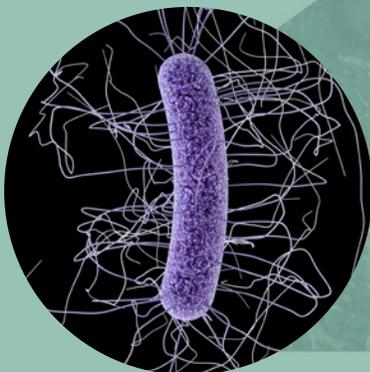
Keeping travelers and athletes healthy and safe at the Olympics

In addition to issuing dozens of travel notices over the course of the outbreak, NCEZID coordinated many activities with the US Olympic Committee to help travelers—and athletes—take steps to protect their health during their trips to the Olympic and Paralympic Games in Rio de Janeiro, Brazil. NCEZID [provided guidance and information for all travelers](#) about the status of Zika in the region. NCEZID staff also traveled to Houston, Texas, where athletes gathered before heading to Brazil. They distributed Zika prevention information, answered athletes' specific questions about staying healthy while in Rio, and reminded athletes of precautions to take after returning home. NCEZID also partnered with the US Department of State in Brazil to provide Zika information to travelers as they arrived for the Games.

Transforming the nation's fight against **antibiotic resistance**

Since throwing down the gauntlet with the landmark report [Antibiotic Resistance Threats in the United States 2013](#), NCEZID has led the agency's charge against what is considered by many the most concerning challenge to our country's health—a post-antibiotic world where bacteria no longer respond to the drugs designed to kill them. In 2016, NCEZID made significant inroads in the fight to contain antibiotic resistance.

Congressional funding of \$160 million in late 2015 for the [Antibiotic Resistance \(AR\) Solutions Initiative](#) has transformed how CDC and public health partners tackle antibiotic resistance at all levels. This funding propelled projects involving many centers at CDC and private and public healthcare and academic partners. Key investments are included in a new online tool, the [AR Investment Map](#), which uses an interactive map to show CDC's work to combat antibiotic resistance. A few examples of the work done in 2016 include:



Clostridium difficile (*C. difficile*) causes life-threatening diarrhea. These infections mostly occur in people who have had both recent medical care and antibiotics.

Establishing the Antibiotic Resistance Laboratory Network (ARLN)

In an effort to better combat resistance threats, a [new lab network](#) was established to enhance local lab capacity and strengthen regional and national coordination. The network is made up of 4 CDC labs, 7 new regional labs, and expanded capacity in state and local health department labs in all 50 states and 6 major cities and counties. Working together, the ARLN will conduct nationwide testing to fill data gaps and inform prevention and response for several urgent and serious pathogen threats including the nightmare bacteria (CRE), gonorrhea, *Salmonella*, *Streptococcus pneumoniae*, and *Clostridium difficile*.

This ambitious approach transforms much of the current laboratory landscape. It will increase local testing of hard-to-treat pathogens to more rapidly detect changes in antibiotic resistance and create the infrastructure needed to quickly ramp up special surveillance efforts when new threats emerge.

Supporting other AR priorities

DETECTION & RESPONSE

- Rapid detection, faster response to outbreaks and emerging resistance to contain and control spread
- Expanded overseas tuberculosis (TB) screenings and a national drug stockpile to prevent shortages of medicine needed to treat TB

PREVENTION OF INFECTIONS

- Improve prevention of healthcare-associated infections (HAIs), foodborne illness, and gonorrhea
- Empower networks for preventing AR threats across healthcare and communities
- Insights for research innovation and better patient care

IMPROVING ANTIBIOTIC USE

- Ensure antibiotics work to protect patients from life-threatening infections or sepsis
- Protect patients from unintended consequences associated with antibiotic use, including adverse drug events

Spurring innovation to protect modern medicine

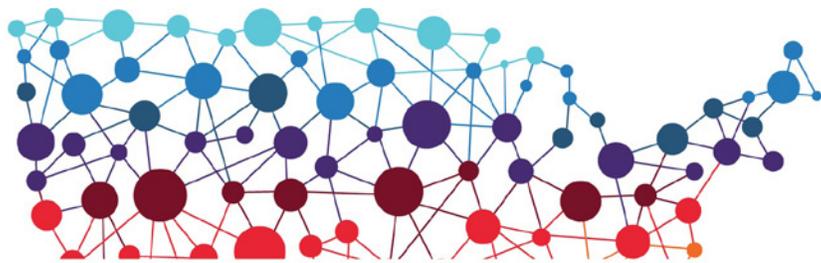
Just as wildfires decimate old-growth forests and their ecosystems, so do antibiotics destroy or compromise the microbiome, the community of naturally occurring microbes in and on our bodies. It is often the body's first line of defense against infections. Antibiotics can disrupt the microbiome by changing the balance of good and bad bacteria, putting people at risk for potentially untreatable illnesses.

In October, CDC awarded more than \$14 million through a broad agency announcement to [fund 34 projects](#) that will discover and develop new ways to prevent antibiotic-resistant infections and their spread, as well as unlock the mysteries of the microbiome. As part of the investigations, some research projects will study how antibiotics disrupt a healthy microbiome, how a disrupted microbiome puts people at risk, and how antibiotic stewardship protects the microbiome.

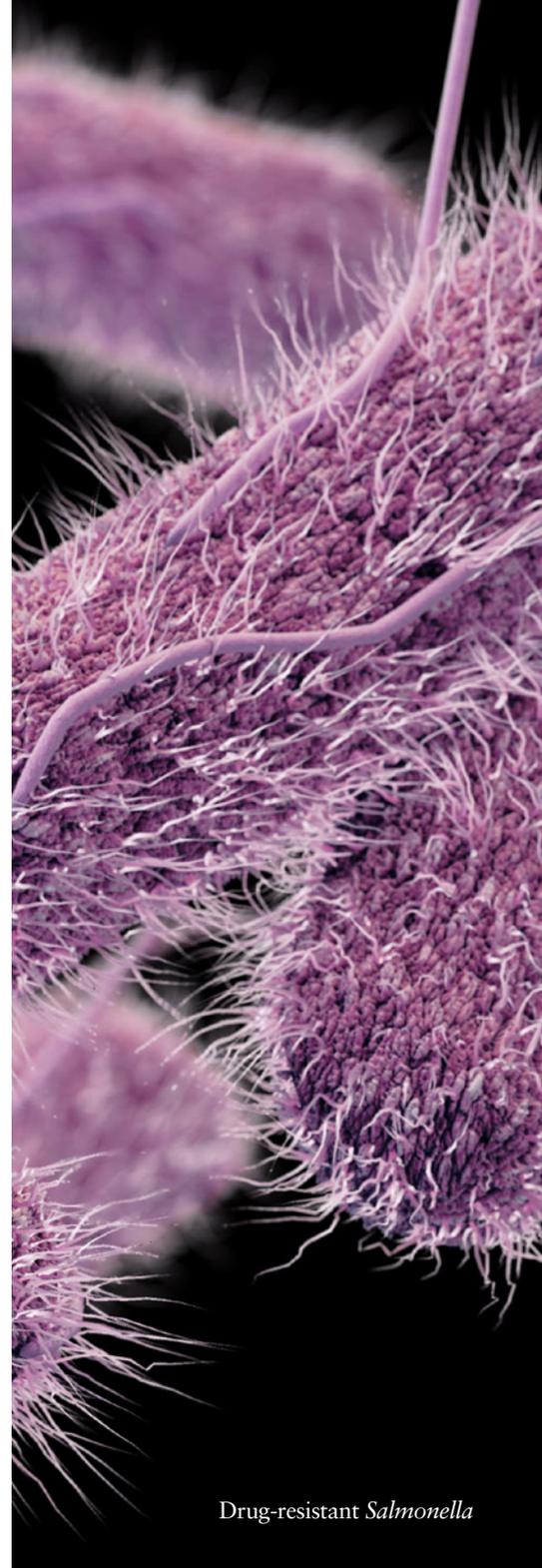
New data resources to drive change

The most important factor contributing to antibiotic resistance that we can change is inappropriate antibiotic use. In May, NCEZID, in collaboration with The Pew Charitable Trusts, released disturbing findings in the [Journal of the American Medical Association](#) on the inappropriate use of antibiotics in doctor's offices and emergency departments. At least 30% of antibiotics prescribed in the United States are unnecessary, which is about 47 million excess prescriptions that put people at unnecessary risk for allergic reactions or infection with the sometimes deadly diarrhea-causing bacteria *Clostridium difficile*.

NCEZID experts also developed the [Patient Safety Atlas](#), a new web app with interactive data about antibiotic resistance. The tool includes three datasets showing the number of healthcare-associated infections reported to CDC that are caused by resistant bacteria, antibiotic prescriptions dispensed to outpatients in US community pharmacies, and inpatient stewardship practices in US acute care hospitals.



ARLABnetwork



Drug-resistant *Salmonella*

BOTTOMLINE

Antibiotic resistance is an active threat to modern medicine for American patients and communities. Some resistant infections are already untreatable.

To protect today's life-saving drugs and the future of medical innovation, we must continue to improve national infrastructure to detect, respond, and contain AR infections and discover innovative ways to protect patients from this threat.

3

Hunting for—and finding—emerging and **dangerous** infectious threats

In 2016, three new or rarely seen emerging infectious threats caused heightened concern among public health professionals nationwide.

mcr -1

A new gene known as *mcr -1*—which can make bacteria resistant to colistin, a last-resort antibiotic for some multidrug-resistant infections—was first reported in China in November 2015. The *mcr -1* gene is on a plasmid, a small piece of DNA that is able to move from one bacterium to another. This “jumping” gene has the potential to quickly spread to other bacteria.

After China reported finding this new gene, CDC and federal partners began searching for *mcr -1* in bacterial samples from human, retail meat, and food animal sources. The gene was identified in the United States in a special study by the National Antimicrobial Resistance Monitoring Systems for Enteric Bacteria (NARMS) in intestinal samples of two pigs, one in South Carolina and the other in Illinois. It was also identified by the US Department of Defense in bacteria cultured from a Pennsylvania patient. CDC is working with state and local health departments to respond to and contain new *mcr -1* cases when they are identified.

CDC acted quickly to prevent *mcr -1* from becoming widespread in the United States and further threatening antibiotics of last resort. [They notified states, hospitals, and clinical laboratories](#) about the discovery of *mcr -1* and developed and deployed a rapid laboratory test to help clinical labs find bacteria with the *mcr -1* gene. With FDA, CDC is testing other new diagnostics that can rapidly detect bacteria with the gene.

E. coli bacteria carrying the *mcr -1* gene was found in a urine sample from a patient in Pennsylvania in May 2016.



Drug-resistant *Candida auris*

Candida auris

As of January 5, 2017, CDC reported 24 cases of infection with *Candida auris*, a globally emerging drug-resistant fungus, in the United States. *C. auris* is often resistant to multiple antifungal drugs, and, because it can colonize on the skin and stay in the environment longer than other *Candida* species, seems to spread easily in healthcare settings. *C. auris* has caused invasive healthcare-associated infections with high mortality. A [report](#) by NCEZID fungal experts detailed the first 7 US cases from May 2013 through August 2016. The same group of experts published another [article](#) in which they characterized the worldwide emergence of *C. auris* through whole-genome sequencing and clinical investigation.

Why is CDC concerned about *C. auris* infections? *C. auris* can cause serious and sometimes deadly bloodstream infections, have limited treatment options if resistant to antifungal drugs, be difficult to identify with standard laboratory methods, and has caused outbreaks in healthcare settings.

Who's at risk? Generally, people who have had recent surgery, diabetes, broad-spectrum antibiotic and antifungal use, and those who have been in an intensive care unit for a long time or have a central line (central venous catheter) placed in a large vein.

CDC is providing [guidance for clinicians and infection control personnel](#) to control the spread. CDC also is working with state and local health agencies, healthcare facilities, and clinical microbiology laboratories to ensure that laboratories are using proper methods to detect *C. auris* and know the limitations of certain tests for detecting *C. auris*. CDC continues to work with domestic and international partners to conduct epidemiologic studies to further understand the emergence of this organism, risk factors for infection, transmission mechanisms, and to evaluate the effectiveness of current infection control guidance.

Elizabethkingia

What's in a name...as in the rare bacteria called *Elizabethkingia*?

Well, actually more than you'd think, but first the facts. In late December 2015, six cases of rarely seen *Elizabethkingia* (*Elizabethkingia anophelis*) infection were reported in Wisconsin residents. These were the first signs of an [outbreak](#) that would sicken almost 60 people and cause 20 deaths. *Elizabethkingia* bacteria are usually found in water and are not a particular threat for healthy people, but could cause life-threatening bloodstream infections for those with weakened immune systems.

NCEZID scientists assisted Wisconsin and Michigan state health laboratories' investigation and were able to identify and characterize the outbreak strain as a newly recognized species of the rare genus of bacteria *Elizabethkingia*. In the summer, NCEZID helped Wisconsin conduct group interviews with a small sample of recovering patients who became ill with an infection from *Elizabethkingia*. Through those interviews, they discovered that many of the patients had some association with bulk-purchased fruits and nuts, but as of late 2016, the source of the infection had not been identified.

Most of the illnesses in this outbreak were in people over the age of 65 with serious underlying health conditions, and most were from Wisconsin, although 2 of the 20 people who died were from Michigan and Illinois.

And the story behind the bacteria's unusual name? In 2005, CDC microbiologist Elizabeth King (1912–1966), who had devoted her life to the study of unusual bacteria, was honored when the new genus of bacteria she had discovered many years prior was renamed *Elizabethkingia*.



BOTTOMLINE

The discovery of the mobile *mcr-1* gene means that resistance to last-resort drugs can be shared with other resistant bacteria, raising the possibility of completely untreatable infections.

Candida auris can spread throughout healthcare settings and is often resistant to treatment with antifungal drugs.

Thanks to CDC's new innovative online tool MicrobeNet, outbreaks of rare bacteria like *Elizabethkingia* can now be studied in record time, with isolates being matched with more precision than ever before.

The NCEZID Director's Recognition Award was presented in June 2016 to the *Elizabethkingia* Response Team for their work responding to the *Elizabethkingia anophelis* outbreak.



Elizabeth King

4

Applying new technologies to advance disease detection

In 2016, CDC's [Advanced Molecular Detection \(AMD\)](#) program made significant contributions to high-profile outbreak responses like [Zika](#), while continuing to expand and strengthen networks to ensure that AMD methods and innovation reached laboratories throughout the country.

When mosquito-borne Zika virus spread to the Western Hemisphere in 2015, NCEZID scientists sequenced genomes of the viral strains and rapidly developed, validated, and distributed a molecular diagnostic test protocol to laboratories within 3 weeks of receiving virus samples—a process that would have taken 3–4 months with older methods.

In 2016, the AMD program has been working with state and local health departments to:

- Identify gene mutations that are responsible for the increasing problem of antibiotic-resistant gonorrhea.
- Solve foodborne outbreaks faster. AMD is supporting the infrastructure at CDC and in state and local health departments to move from a 30-year-old technology (PFGE) to state-of-the-art whole-genome sequencing (WGS). Experience so far with [Listeria](#) has shown that this technology detects clusters of illness sooner, links more outbreaks to specific foods, and finds clusters of illnesses that would not have been detected by the older methods. The system is now rapidly expanding to include all states and all foodborne bacterial pathogens.
- Implement genomic surveillance of TB, which can help scientists more accurately pinpoint outbreaks of TB that may otherwise be hidden. Genotyping helps identify people with similar TB strains, a warning sign that the infection may have been acquired locally in the recent—rather than the distant—past. These cases of potentially local transmission are of particular interest to health departments.

The Office of AMD recognizes that workforce development is critical to the future expansion of AMD and has spent the year funding states to form regional networks and collaborations with academic partners. CDC is partnering with the Food Safety Centers for Excellence to develop online trainings on AMD for epidemiologists.

BOTTOMLINE

AMD has reduced the time needed to identify the source of disease outbreaks, increased the ability of public health professionals to track outbreaks, and improved outbreak response.



DURING THE ZIKA OUTBREAK IN BRAZIL, CDC SCIENTISTS USED GENOMIC DATA TO **RAPIDLY DEVELOP A TEST** TO DETECT EMERGING ZIKA VIRUS STRAINS. THEY DEVELOPED, VALIDATED, AND DISTRIBUTED THIS TEST PROTOCOL TO LABS THROUGHOUT THE HEMISPHERE **WITHIN THREE WEEKS** OF RECEIVING THE FIRST POSITIVE SAMPLE OF ZIKA VIRUS. OLDER METHODS WOULD HAVE REQUIRED THREE TO FOUR MONTHS.



ZIKA

number

5

Giving more assistance and resources to states than ever before

ELC

Responding to the urgent threats of Zika and antibiotic resistance have challenged resource-strapped state and local public health departments. In response, CDC awarded more than \$300 million this year to help states detect, prevent, and respond to these and other emerging and re-emerging infectious diseases. The funding is being distributed through the [Epidemiology and Laboratory Capacity for Infectious Diseases \(ELC\) Cooperative Agreement](#), one of CDC's key nationwide cooperative agreements, which oversees an array of cross-cutting epidemiology, laboratory, and health information systems activities that help domestic public health departments respond to complex infectious disease threats.

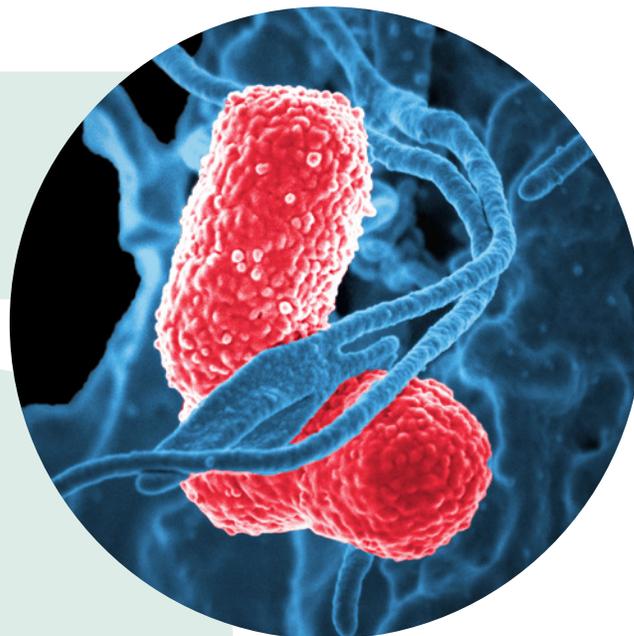
The [Zika-related funding](#) will be used to protect the health of Americans, especially pregnant women, from adverse health outcomes that can result from Zika infection, including the serious birth defect microcephaly. The funding will also provide for epidemiologic surveillance and investigation, improve mosquito control and monitoring, strengthen laboratory capacity, and support participation in the [US Zika Pregnancy Registry](#) to monitor pregnant women with Zika and their infants.

The ELC funding for antibiotic resistance will support activities related to CDC's [Antibiotic Resistance Solutions Initiative](#), including seven new regional laboratories with specialized capabilities allowing rapid detection and identification of emerging antibiotic resistant threats. These funds will be distributed to all 50 state health departments, 6 local health departments, and Puerto Rico. The funding also means that every state health department lab will be able to test for carbapenem-resistant Enterobacteriaceae ("nightmare bacteria") and work towards performing whole genome sequencing on resistant intestinal bacteria, including *Salmonella*, *Shigella* and *Campylobacter*.



MicrobeNet

Rare germs that doctors and labs haven't seen before can be mistakenly identified for more common ones. Sometimes that misidentification can lead to costly yet ineffective treatments, and even tragically at times, to death. That's why NCEZID's innovative online tool, [MicrobeNet](#), is so vital, because it gives laboratorians in all 50 states along with the world unprecedented—and free—access to CDC's virtual microbe library of more than 2,400 rare and emerging infectious bacteria and fungi. In 2016, [a new module added to MicrobeNet](#) has now made it possible for labs to search the protein signatures of the bacteria and compare them to the rare pathogens in CDC's MicrobeNet library.



The MicrobeNet database contains complete information on more than 2,400 pathogens like *Klebsiella pneumoniae* (pictured above).

BOTTOMLINE

The 2016 ELC award is the largest amount dispersed since the ELC cooperative agreement started in 1995.

MicrobeNet can dramatically reduce the time for testing from about a week to a few hours.

number

6

Improving healthcare

Increasing awareness of sepsis

When it comes to [sepsis](#), time matters. Sepsis is deadly when it's not quickly recognized and treated. Sepsis is a complication caused by the body's overwhelming and life-threatening response to infection, which can cause tissue damage, organ failure, and death. This year, NCEZID has been getting the word out about [sepsis prevention](#), especially to healthcare providers—the critical link to preventing, recognizing, and treating sepsis. In addition to working to prevent infections that could lead to sepsis, NCEZID is also defining epidemiology by including prevention opportunities that are missed pre-infection, developing surveillance definitions, and identifying hospital and patient-level factors (like early stroke recognition) that might account for differences in sepsis mortality between hospitals.

New guidance about endoscopes

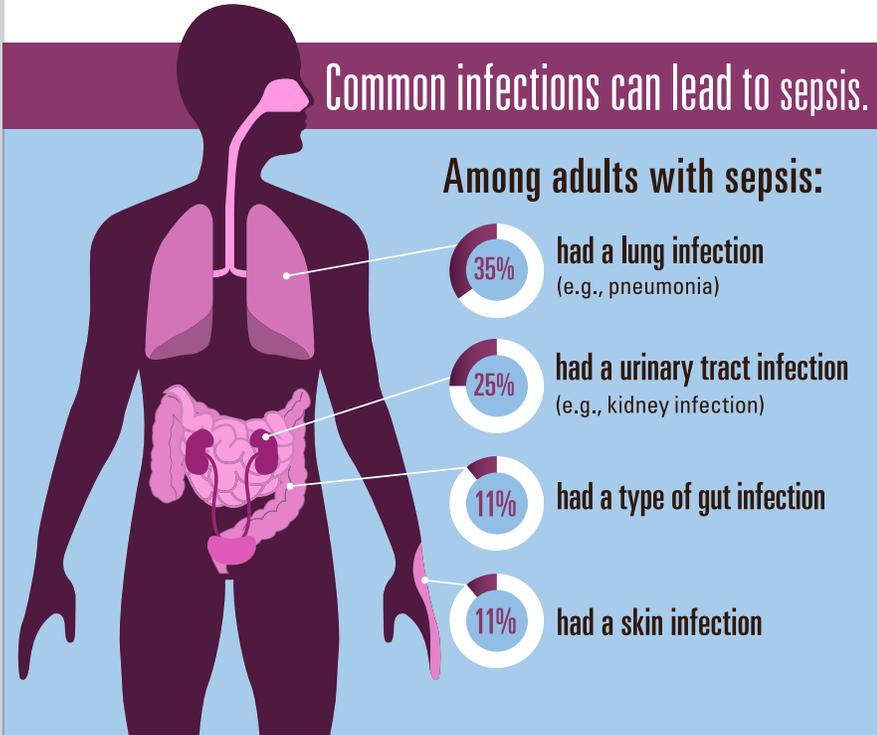
During 2016, CDC worked with the [Healthcare Infection Control Practices Advisory Committee](#) (HICPAC) to finalize [recommendations to assist healthcare facilities](#) in ensuring that flexible endoscopes are safe for patient use. In 2015, [outbreaks of CRE](#) (carbapenem-resistant *Enterobacteriaceae*) infections related to a type of endoscope called a duodenoscope highlighted the need for healthcare facilities to have a reliable, high-quality reprocessing (cleaning) program for these instruments.

The guidance approved at HICPAC's July 2016 meeting recommends that staff involved in reprocessing this equipment must understand and consistently follow seven essential steps. Ensuring adherence to these steps requires a complete and effective reprocessing program.



Expanding capacity of Prevention Epicenters

This year, CDC awarded \$26 million to support applied research at five medical centers that are part of the [Prevention Epicenters Program](#). The institutions are the Chicago Prevention and Intervention Epicenter at Rush University Medical Center and Cook County Health and Hospitals System; Duke University and the University of North Carolina; the Harvard Pilgrim Health Care and University of California, Irvine; the University of Pennsylvania; and Washington University School of Medicine in St. Louis, and BJC Healthcare. Together with CDC, these Prevention Epicenters develop and test innovative approaches for preventing infections, slowing antibiotic resistance, and improving patient safety in healthcare settings. The [new funding more than doubles previous awards](#) and extends to 2020, expanding the total number of Prevention Epicenters to 11.



BOTTOMLINE

NCEZID is collaborating with patient representatives and clinical partners to promote sepsis prevention and early recognition among healthcare providers, patients, and their families.

New recommendations will assist staff in all healthcare settings where endoscopic procedures are performed and where endoscopes are cleaned (reprocessed).

The new Epicenters will advance the goal of reducing healthcare-associated infections by helping doctors and nurses better protect the health and safety of their patients.

number

7

Making food safer to eat



CDC estimates that *Listeria*, a rare but deadly germ, is the third leading cause of death from food poisoning in the United States.

PulseNet

A [study](#) published this year confirmed what we already knew—CDC’s [PulseNet](#) system, which turned 20 in 2016, has been an extremely effective tool for detecting foodborne disease outbreaks. PulseNet is a national network of public health laboratories that compares DNA fingerprints of bacteria to identify foodborne disease outbreaks. It’s estimated to have prevented 270,000 foodborne illnesses annually. As next-generation PulseNet continues to apply [advanced molecular detection](#) methods, as it has done so successfully with the [Listeria project](#), it is transforming foodborne disease detection.

NARMS

Antibiotic use in people and food animals can lead to the development of antibiotic-resistant bacterial infections. The [National Antimicrobial Resistance Monitoring System for Enteric Bacteria](#) (NARMS), which also turned 20 in 2016, measures antibiotic resistance in bacteria isolated from people, retail meats, and food animals. For the first time, the [2014 NARMS Integrated Report](#) included [whole genome sequencing](#) (WGS) data of [Salmonella](#) from people, retail meats, and food animals. Using WGS, health officials can more rapidly detect resistance to some of the antibiotics that are critically important to treat foodborne infections.

PulseNet has made these foods safer to eat:



Peanut butter, Sprouts, Eggs, Tree nuts, Poultry products, Leafy greens, Tomatoes, Frozen entrees, Lunch meat, Spices Melons



BOTTOMLINE

PulseNet offers a solid return on investment: The study showed that for every \$1 spent running PulseNet, \$70 is saved in medical costs and lost productivity.

Data provided by the NARMS program inform public health actions and policies that will better protect people from the threat of resistant infections.

number

8

Responding to outbreaks

Foodborne outbreaks

Flour, long suspected as an outbreak source, now confirmed

After exposure to raw flour, [more than 60 people in 24 states got sick](#) with strains of *E. coli* and almost a third were hospitalized. Some of those who got sick reported eating raw dough or raw batter, and several children had played with raw dough at restaurants. The complex outbreak investigation revealed the flour was produced at a single US facility. As a result, the flour producer recalled more than 45 million pounds of flour, resulting in other recalls of flour-containing products like bread, cake, and muffin mixes.

What **NCEZID** did:

For the first time, conclusively showed that flour was the source of an *E. coli* outbreak.

Used whole genome sequencing to confirm that flour was the culprit.



Responding to
outbreaks**Cross-border effort helps identify new listeriosis outbreak source**

More than 30 people in the United States and Canada were hospitalized for listeriosis after eating packaged salads, including at least one person who died. Investigators connected the Listeria infections to the salads through interviews of sick people, food testing, and whole genome sequencing. The company that produced the packaged salads recalled all brands and varieties produced at a single US facility. The same day, NCEZID warned consumers not to eat the recalled salads, resulting in over 180,000 web page views on the CDC website and numerous inquiries to CDC-INFO, CDC's contact center. This investigation was the first to identify packaged salad as the source of a listeriosis outbreak.

**What NCEZID did:**

Collaborated with partners in Canada to share whole genome sequence data.

Identified packaged lettuce as a new source for listeriosis outbreaks.



Outbreaks caused by contact with animals

Backyard flocks cause record number of illnesses

What caused *Salmonella* infection in almost 900 people, 200 of whom were hospitalized? Not eating chicken, but *keeping* live chickens and ducks in backyard flocks. This year, 8 [multistate outbreaks](#) resulted in the largest number of illnesses linked to contact with live poultry ever recorded in the United States, affecting people in 48 states. Regardless of where they are purchased, [live poultry](#) may have *Salmonella* germs in their droppings and on their bodies (feathers, feet, and beaks), even when they appear healthy and clean. People, especially children, can be exposed to *Salmonella* by holding, cuddling, or kissing the birds and by touching things where birds live, such as cages or feed and water bowls, or by bringing birds into the house.

What NCEZID did:

Worked with mail-order hatcheries and retailers to encourage practices to reduce *Salmonella* in birds.

Increased education for flock owners and industry about staying healthy while keeping backyard flocks.

Outbreaks related to healthcare

Potential contamination of device used in open heart surgery

There have been recent—and troubling—alerts about potential [contamination of heater-cooler units](#) used in open heart surgery. Heater-cooler units are an essential part of life-saving surgeries, because they help keep a patient's circulating blood and organs at a specific temperature during open-heart procedures. Approximately 60% of the 250,000 heart bypass procedures performed in the United States every year use a brand of heater-cooler that [NCEZID investigators showed](#) could have been contaminated before being sent to hospitals worldwide. The fear is that some bypass patients could be at risk of serious, and occasionally fatal, infections (caused by the bacterium *Mycobacterium chimaera*). Fortunately, the risk is thought to be very low. In hospitals where at least one infection has been identified, the risk of infection was between about 1 in 100 and 1 in 1,000 patients.

What NCEZID did:

Alerted hospitals and clinicians about the threat, and offered guidance for informing patients at risk.

Cardiac arrest during dialysis

Disturbing news was reported in early January about 6 patients in Connecticut who had sudden cardiac arrest while they were undergoing routine dialysis; 3 of the patients died. Connecticut Department of Public Health requested help from NCEZID to help with the investigation. After a thorough review of patient charts, and extensive interviews, no single factor (like common medications, instruments, or staff) was identified.

What NCEZID did:

Made recommendations about how to detect adverse events during dialysis.

Targeting infectious disease work across the globe

Since 2014, NCEZID has been leading the agency's response to global outbreaks of [Ebola](#) and then [Zika](#), in addition to responding to more localized outbreaks of infectious disease in different parts of the world. NCEZID contributes vital expertise about pathogens and outbreak interventions. During the year, NCEZID has been involved in many global health projects aimed at reducing illnesses and deaths caused by infectious disease.

Supporting the response to a yellow fever outbreak in Angola and DRC

In 2016, NCEZID provided support for an outbreak of [yellow fever](#) that began in Angola and spread to the Democratic Republic of Congo (DRC). The outbreak that was threatening to spread into other countries was complicated by a worldwide shortage of yellow fever vaccine. In addition to sending disease experts to provide technical support, NCEZID also sent a new yellow fever diagnostic test kit that scientists had just developed. The new kit produced results in less than 4 hours, rather than the 2 days required by the standard lab testing. The NCEZID-developed kit also had the advantage of using components that could be stored without freezing, a benefit in resource-poor countries.



NCEZID microbiologist Jane Basile shows how to use the new yellow fever test kit that in less than 4 hours yields results that are as accurate as the 2-day test.



Child in India waiting with mom in Mumbai TB clinic

Looking for antimicrobial resistance in India

High levels of [antimicrobial resistance](#) (AMR) have been found in all regions of the world and threaten our ability to treat common infections. In 2016, NCEZID helped strengthen national AMR surveillance at 13 laboratories in India. Additionally, NCEZID's work included enhancing laboratory detection of dangerous pathogens, strengthening infection prevention programs in healthcare facilities, conducting surveillance of healthcare-associated infections, and promoting antimicrobial stewardship. The data collected will help inform India's national treatment guidelines, a critical step for preventing AMR.

Strengthening systems for recognizing and treating cholera in Cameroon

Cholera can be fatal, but it is easily prevented and treated. In Cameroon, NCEZID has successfully trained and is in the process of equipping the regional laboratory with capacity to isolate and identify [Vibrio cholerae](#) by stool culture and rapid diagnostic tests. The project also continues to strengthen epidemiologic, laboratory, and clinical capacity for cholera detection, diagnosis, and treatment. In early 2016, Cameroon activated its Emergency Operations Center (EOC) for the first time in response to a cholera outbreak. It took more than 8 weeks to get organized and respond. Officials worked diligently to improve coordination and, months later, activated the EOC again in only 24 hours—a dramatic improvement.





Neil Gupta teaches infection control at a training in Liberia.

Responding to an outbreak of Rift Valley fever in Niger

NCEZID supported the international response to an outbreak of [Rift Valley fever](#) (RVF) in Niger. RVF is a mosquito-borne viral disease that mainly affects livestock, causing disease and abortion in domesticated animals. The RVF virus can also infect and cause disease in people. As of December 5, 2016, the World Health Organization reported a total of 348 cases of RVF in people (17 of which were laboratory confirmed; the others are awaiting test results) and 33 deaths. NCEZID provided expert guidance and communications materials to the US Embassy and other partners in country, including French-language audio and video educational materials. In addition, four NCEZID experts traveled to the neighboring country of Burkina Faso to strengthen laboratory diagnostic capacity to support the laboratory diagnostic work in Niger.

Post-Ebola infection control work in Africa

CDC continues to be the central partner providing technical assistance to ministries of health in the three Ebola-affected countries—Guinea, Liberia, and Sierra Leone—to implement infection control safeguards in healthcare facilities. NCEZID is actively engaged with WHO and other partners to share our scientific expertise to help develop policy frameworks, inform infrastructure, and develop implementation tools to improve infection control and [WASH](#) (global water, sanitation, and hygiene) policies in health facilities in low- and middle-income countries.

BOTTOMLINE

NCEZID is using proven strategies and technical expertise to assist in outbreak response and strengthening infection control around the world.
Any vulnerability in another country is a vulnerability in our country.

Ebola

Since late March, when the WHO declared that the [Ebola](#) situation in West Africa no longer constituted a Public Health Emergency of International Concern and CDC deactivated the Ebola Emergency Operations Center, the public health world has breathed a sigh of relief. But NCEZID's experts have continued to drill down on Ebola.

[Follow-up studies](#) in male Ebola survivors in Liberia found a troubling persistence of the viral fragments in semen, still detectable in one of the survivors up to 500 days after being disease-free. These results highlight the need for continued research, education, and support for the survivors and their communities. [Another study](#) looked at biomarkers collected from the 7 US Ebola survivors to further understand how some people are able to survive the disease. The results suggest some new treatment avenues.

Based on data analysis from the 2014–2015 Ebola outbreak, NCEZID experts [published new guidelines](#) for US healthcare settings about screening and providing care for Ebola patients. The updated guidelines emphasize the importance of taking detailed travel histories from patients with febrile disease, and specify the types of care that require standard versus extra infection control precautions, like recommended personal protective equipment and quarantine measures.

Ebolavirus



Rabies

Although [rabies](#) is a vaccine-preventable disease, thousands of people die from the disease around the world each year. The [NCEZID Rabies Team](#) has traveled throughout the world to reduce rabies in some of the countries where it's most common—Ethiopia, Vietnam, and Haiti. In Ethiopia, the team trained human and animal health officers to assess whether an animal is rabid, to enact quarantine procedures, and to safely capture rabid animals. Another team worked with counterparts in Vietnam to ensure that the National Public Health laboratory retains proficiency in rabies diagnostic testing. In Haiti, where canine rabies kills an estimated 2 people each week, the team found that only 45% of dogs were vaccinated, far short of the 70% needed to stop rabies from spreading in the dog population. CDC and its partners worked to determine the most effective community-based approach for mass vaccination of dogs to achieve the target vaccination coverage.



NCEZID's Craig Manning (left) fields a question about hantavirus from KTNN-AM radio host Navajo Bob during the live call-in program.

Hantavirus

[Hantavirus](#) is spread by deer mice and contact with their droppings and causes a serious, sometimes lethal, respiratory infection. Since hantavirus was first identified in the western US in 1993, CDC led the public health response by studying the host animal and developing diagnostic tests. After a young woman from Navajo Nation died following hantavirus infection in early 2016, NCEZID's experts stepped in to assist with a response. To support the Nation's at-risk rural populations, NCEZID staff in collaboration with the Navajo Department of Health created messages on hantavirus prevention that were broadcasted daily via Navajo language radio. The team also coordinated a 2-hour community call-in radio program featuring both the Nation's president and vice president. To extract additional useful information about the hantavirus problem in the area, NCEZID coordinated sharing of state, tribal, and Indian Health Service health records of earlier hantavirus cases. Future efforts will focus on improving rodent control in affected Navajo Nation communities.



Children in Haiti bringing their dogs to be vaccinated.

BOTTOMLINE

NCEZID scientists continue to study Ebola and have issued updated guidelines for US healthcare settings.

CDC and Navajo Nation leaders collaborated to create and disseminate radio-based Navajo language hantavirus messages for the Nation's at-risk rural residents.

In Haiti, the Rabies Team and partners vaccinated 3,000 dogs in just 4 days this summer and plan to vaccinate a total of 8,000 dogs as part of this campaign.

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