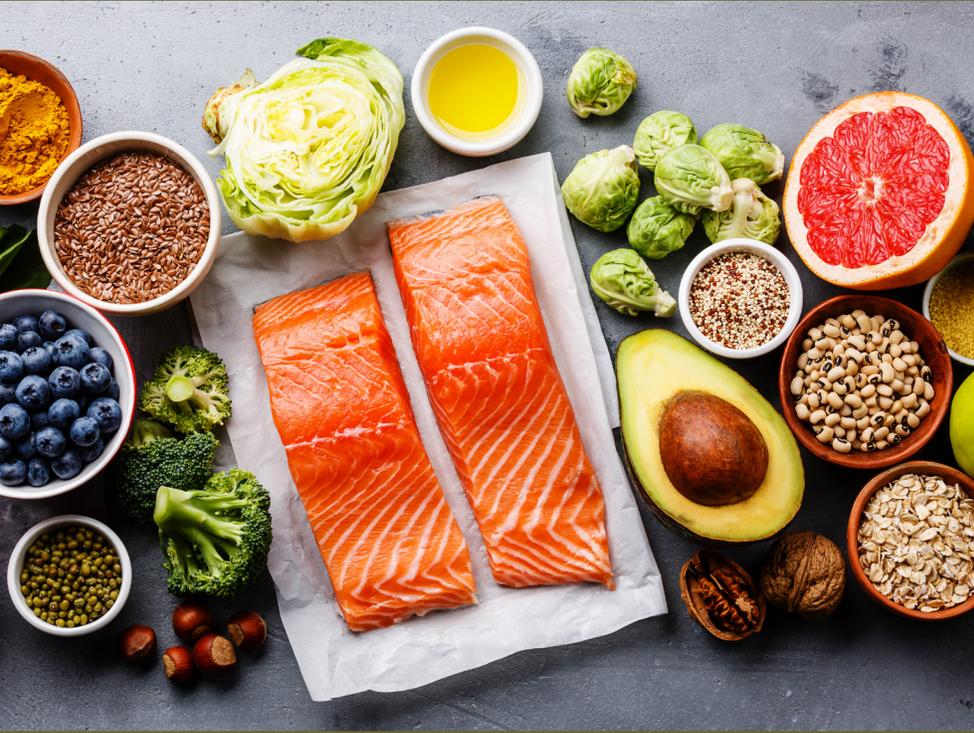


National Center for Emerging and Zoonotic Infectious Diseases



NCEZID 2017 accomplishments



OUR YEAR in NUMBERS

CDC has been described as the eyes and ears for our country when it comes to public health. This report describes the work of the National Center for Emerging and Zoonotic Infectious Diseases (NCEZID)—the part of CDC charged with focusing on emerging diseases and diseases that are spread between animals and people.

3 

Major hurricanes needing NCEZID response to health issues associated with mold, unclean water, and infection control in hospitals

~44,900

DNA samples sequenced in 2017 using Advanced Molecular Detection technologies



>200

Cases of fungal superbug *Candida auris* responded to since first US cases were found in 2016

11

One Health Zoonotic Disease Prioritization Workshops conducted in 2017 to help countries focus resources on diseases of greatest concern



23

Epi Aids in FY 2017 (NCEZID disease detectives sent to help with domestic and global outbreaks or other urgent health crises)

50th



Anniversary of CDC's quarantine program; NCEZID personnel support 20 Quarantine stations at ports of entry and land-border crossings where international travelers arrive

>2,400

Rare and emerging infectious diseases cataloged in MicrobeNet database and accessible to labs around the world

>1,100



Illnesses (*Salmonella* infections) associated with backyard flocks, the most ever recorded by CDC in one year

\$300M

Amount CDC awarded to states and US territories to combat antibiotic resistance, Zika, and other infectious diseases

270K



Deaths caused by sepsis in US each year; in 2017, CDC launched a new national initiative to identify and treat sepsis early

12,000+

Antibiotic Resistance Lab Network tests guided efforts to contain resistant infections and their spread

~205K

Zika tests performed

ANTIBIOTIC RESISTANCE



The strategy is an aggressive response to new and emerging threats, and it focuses on rapidly detecting resistance.

Containment: Aggressive strategy slows spread of drug-resistant diseases

In May 2017, an Oklahoma hospital identified a patient with an infection from *Candida auris*, a multidrug-resistant fungus. CDC worked with the Oklahoma State Department of Health and the hospital staff to aggressively search for additional cases to protect other patients and stop its spread. This is one example of CDC's containment strategy, which CDC rolled out in 2017.

The strategy is a systematic approach aimed at healthcare settings to slow the spread of multidrug-resistant pathogens—beginning with a single case. The strategy is an aggressive response to new and emerging threats, and it focuses on rapidly detecting infections in patients and those who may be silent carriers, determining how the pathogen is being spread, and controlling transmission. Since the containment strategy was used in Oklahoma, the hospital has not found further cases of *C. auris* infection in its facility. CDC has engaged state health officials about the containment approach and provided hands-on training to state programs nationwide.

Public communication: New efforts inform healthcare workers and patients

Public communication is critical to save lives, and in 2017 CDC launched two national efforts to improve patient outcomes and antibiotic use. CDC's *Get Ahead of Sepsis* is a new educational initiative that emphasizes the importance of early recognition and timely treatment of sepsis—the

body's extreme and potentially deadly response to an infection—as well as preventing infections that could lead to sepsis. In addition, CDC's *Be Antibiotics Aware: Smart Use, Best Care* effort helps healthcare professionals improve antibiotic prescribing and educates patients about when antibiotics should be used. This initiative aims to help ensure antibiotics remain effective when we need them for sepsis and other life-threatening infections. In 2017, CDC engaged more than 500 partners to help promote and launch these two initiatives. CDC hopes that together these national efforts will improve healthcare, decrease health consequences, and ultimately save lives.

Innovations: CDC pilots projects to combat antibiotic resistance

At least 23,000 people die each year as a direct result of infections with antibiotic-resistant bacteria. Preventing antibiotic-resistant infections is critical for the health of Americans, and CDC is piloting innovations that will uncover new ways to prevent these infections and stop their spread. CDC supports innovations and research to combat antibiotic resistance and has provided \$76.5 million for 84 projects since 2016.

In 2017, CDC supported 25 innovators to explore gaps in knowledge about antibiotic resistance and develop solutions to the antibiotic resistance crises in healthcare, veterinary, and agriculture industries. For example, CDC is working with these innovators to investigate the relationship between antibiotic use during pregnancy and its potential impact on child health.



Prescribing and use: New resource helps rural hospitals address challenges

In the fight against antibiotic resistance, small and critical access hospitals face special challenges. Many of these facilities have limitations in staffing, infrastructure, and resources, which create obstacles when trying to address antibiotic prescribing among doctors and antibiotic use among patients. In 2017, CDC released a new resource to help these hospitals implement programs to improve antibiotic use and prescribing.



**BE
ANTIBIOTICS
AWARE**

SMART USE, BEST CARE

To develop a resource that would be tailored to these hospitals and the patients they serve, CDC and partners met with hospital representatives from rural areas to gain a more in-depth understanding of the challenges they face. *Implementation of Antimicrobial Stewardship Core Elements at Small and Critical Access Hospitals* provides

guidance on first steps for starting programs to help these hospitals improve antibiotic prescribing and use, and protect their patients from preventable health consequences like *C. difficile* infections.



Rocky Mountain spotted fever: New test rapidly detects disease

Rocky Mountain spotted fever (RMSF) is considered the world's deadliest tickborne disease and, in 2017 an important diagnostic milestone was met. The US Food and Drug Administration (FDA) granted clearance for a test for a family of bacteria called *Rickettsia*, which causes RMSF and other diseases. The real-time polymerase chain reaction test (PCR) will be offered nationwide through CDC's Laboratory Response Network. This clearance is the culmination of nearly 20 years and countless hours of work. It is the first FDA-cleared PCR test for detection of rickettsial DNA in clinical diagnostic specimens.

Lyme disease: Researchers work toward improved tests

Properly diagnosing early Lyme disease can be challenging because current tests do not detect infections well during the first few weeks of infection. CDC and Colorado State University researchers are exploring a novel method to look for unique metabolic "fingerprints" found in patients with early Lyme disease. The new method—called metabolomics—can be used to identify and measure molecules the body produces during

illness. By identifying these fingerprints, researchers hope to develop improved early Lyme diagnostic tests. Preliminary research has successfully differentiated early Lyme disease from southern tick-associated rash illness.

Yellow fever: CDC helps respond to epidemics and a domestic vaccine shortage

In 2016-2017 large outbreaks of yellow fever affected Angola, the Democratic Republic of Congo, and Brazil. CDC played a central role in providing technical assistance in response to these epidemics. Yellow fever is caused by a virus spread through bites of infected mosquitoes. It is one of the few vaccine-preventable mosquito-borne diseases. Though once common in parts of the United States, the last major outbreak occurred in 1905. It is now a very rare cause of illness in US travelers. When manufacturing delays led to a depletion of the only US Food and Drug Administration-licensed yellow fever vaccine in the United States in 2017, CDC worked in advance with federal partners and the manufacturer to prepare and ensure that US travelers would have continued access to yellow fever vaccine.

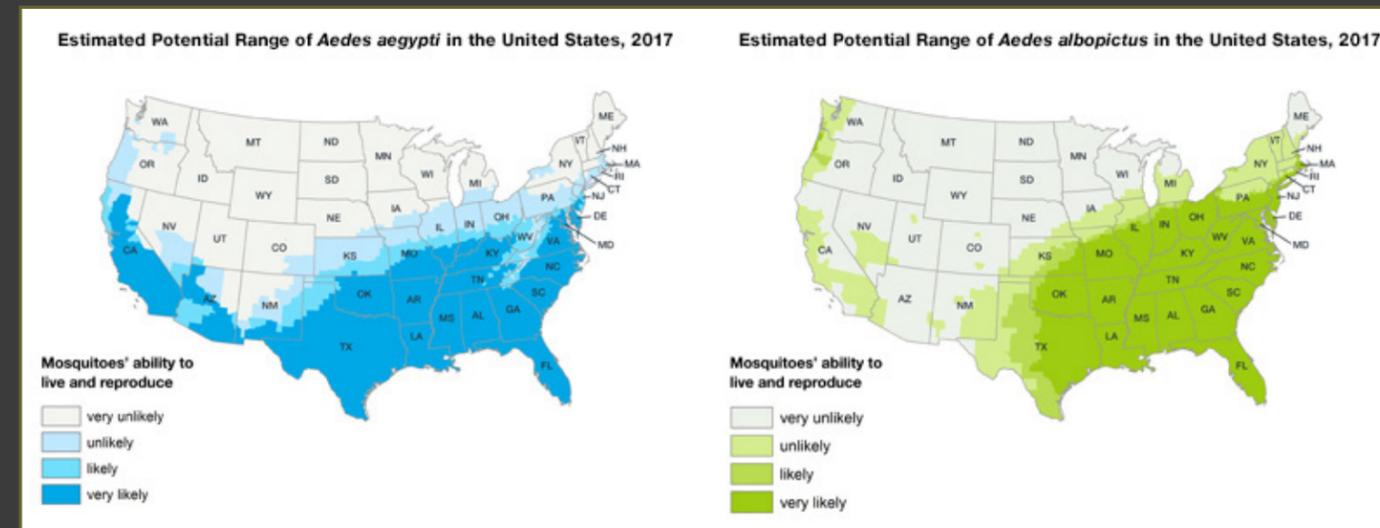
Guillain-Barré syndrome: Study sheds light on link with Zika

Guillain-Barré syndrome (GBS) is an uncommon illness of the nervous system that causes muscle weakness, and in severe cases, respiratory failure. Most patients fully recover from GBS, although some may have permanent damage. Outbreaks of GBS are extremely rare, so when one occurred in French Polynesia during a large outbreak of Zika virus infection in 2013, experts investigated a link between Zika virus infection and GBS. In 2015 and 2016, CDC collaborated with the ministries of health in Brazil and Colombia to perform case-

control studies and to gather evidence to explore the possible link between the outbreaks of Zika and GBS. In 2017, CDC, along with the Puerto Rico Department of Health and other partners, conducted the first case-control study in the Americas that showed both laboratory and epidemiologic evidence linking Zika virus infection and GBS. These studies have provided crucial information on the clinical features, risk factors, and outcomes of Zika outbreak-associated GBS.



Researchers hope to develop improved early Lyme diagnostic tests.



In 2017, CDC updated these maps to represent CDC's best estimate of the potential range of *Aedes aegypti* and *Aedes albopictus*, two mosquitoes that can spread Zika in the United States. The maps show where these two mosquitoes could survive and reproduce in the contiguous United States if introduced to an area during the months when mosquitoes are locally active. They do not represent risk for spread of disease.

Photos: The American dog tick (above) is one of several species of ticks that can spread the bacteria that causes Rocky Mountain spotted fever. Opposite page: The *Aedes aegypti* mosquito is one type of mosquito that can spread Zika virus.



A CDC scientist examines a bat during an investigation into cases of monkeypox in Africa. CDC scientists are studying a vaccine that could help prevent monkeypox outbreaks.

CDC launched a study that focuses on preventing infections from monkeypox virus.

Monkeypox: Study evaluates vaccine to prevent infections

In the Democratic Republic of Congo (DRC), a rare disease called monkeypox is a growing threat. In 2017, CDC launched a study that focuses on preventing infections from monkeypox virus in at-risk healthcare workers and laboratorians in DRC. Monkeypox virus is related to smallpox virus and, as part of the study, scientists are evaluating the use of Imvamune, a vaccine against smallpox. After smallpox was declared eradicated in 1980, countries around the world stopped regular vaccinations against the disease. Waning immunity to smallpox is thought to have contributed to increased reports of monkeypox in Central and West Africa. Until this study, Imvamune had never been tested in a population regularly exposed to monkeypox, so scientists hope to learn how effective it is in preventing monkeypox virus infection in people. The study aims to help experts learn more about its effectiveness by early 2019.

One Health: Global workshops help countries prioritize zoonotic diseases

The spread of diseases between animals and people is a global health issue. Prioritizing zoonotic diseases of greatest national concern enables countries to focus limited resources on activities such as strengthening surveillance, building laboratory capacity, and developing preparedness and response plans. CDC's One Health Office conducts One Health Zoonotic Disease Prioritization Workshops

to help countries develop a prioritized list with equal input from all relevant sectors, including human, animal, and environmental health ministries.

In 2017, the One Health Office coordinated workshops in Côte d'Ivoire, Uganda, Tanzania, Rwanda, Senegal, Bangladesh, Burkina Faso, Pakistan, Mali, Sierra Leone, and the United States. Country representatives prioritized endemic and emerging zoonoses using a multisectoral, One Health approach. In September, CDC staff also conducted a training on the use of CDC's prioritization tool at the Food and Agriculture Organization of the United Nations, expanding the number of countries able to benefit from the One Health Zoonotic Disease Prioritization process in the future.

Cholera: Campaign delivers vaccine to Cameroon

Cholera outbreaks are not new to Cameroon. From 2011 to 2014, Cameroon reported 26,621 cases of the waterborne disease, leading to 1,031 deaths. In 2017, CDC worked with global partners to deliver oral cholera vaccine to people in Cameroon's at-risk northeastern border villages. CDC staff traveled to Cameroon for 5 weeks to help the country distribute more than 278,000 doses of vaccine. The goal was to reduce the burden of cholera in Cameroon and prevent another epidemic of the severe diarrheal disease. The project targeted cholera "hotspots" with vaccine, and experts reinforced messages about safe drinking water, hygiene, and sanitation.



A young boy takes a dose of the oral cholera vaccine distributed in his village in Cameroon.

When a large cholera outbreak occurred across the border in Nigeria four months later, no cholera cases were detected in nearby Cameroon.

Quarantine regulations: Significant update accomplished

In response to recent global outbreaks, CDC updated the domestic (interstate) and foreign quarantine regulations. The updates went into effect on March 21, 2017, and improve CDC's ability to protect against the spread of communicable disease while also protecting individual civil liberties. This is the first time in decades that significant updates have been made to these regulations, which provide CDC with the tools to respond to 21st century public health threats.

Candida auris: Tracking and controlling a new superbug threat in the US

As of early 2016, the fungal superbug called *Candida auris* (*C. auris*) had caused outbreaks of bloodstream infections in healthcare facilities on multiple continents. However, at that time it was unknown whether *C. auris* was in the United States, and there was no national surveillance to identify it. CDC, along with state and local health departments, responded rapidly to the challenge of identifying and controlling *C. auris* in the US. To create awareness, the team informed the public health community—including clinicians and laboratorians—about *C. auris* and issued a call for cases. This resulted in the first cases of *C. auris* being reported in the US. Since 2016, CDC and partners have tracked more than 200 cases of *C. auris* and worked in several states to implement infection control measures and stop transmission.

Antibiotic resistance: Program helps Vietnam establish reporting systems

Antibiotic resistance (AR) is a global threat. CDC's International Infection Control Program is helping Vietnam establish a national AR reporting system. The reporting system will help determine the scope of the threat that AR presents to Vietnamese healthcare facilities, and it will help their leaders develop strategies to prevent the spread of AR. In 2017, Vietnam launched a national standardized healthcare and infections reporting system for bloodstream infections and urinary infections.



DOMESTIC

***E. coli* in the US: CDC helped identify, stop outbreak from soy nut butter**

In early 2017, CDC worked with partners to quickly investigate and stop a fast-moving outbreak of Shiga toxin-producing *E. coli* infections, which sickened 32 people—mostly children—in 12 states. The source was a brand of soy nut butter, which had never before been linked to an outbreak.

***Salmonella* in the US: CDC investigates infections linked to contaminated papayas**

In summer 2017, CDC and partners investigated four separate multistate outbreaks of *Salmonella* infections linked to Maradol papayas imported from Mexico. Investigators used CDC's PulseNet system to identify 251 illnesses from 26 states, including 79 hospitalizations and two deaths.

***Brucella* RB51 in NJ and TX: CDC investigates rare illnesses from raw milk**

Investigations in Texas and New Jersey identified people infected with a dangerous germ called *Brucella* RB51. If not treated with antibiotics, *Brucella* RB51 infection can lead to serious chronic infections and complications. These illnesses occurred among people who drank raw (unpasteurized) milk from a dairy farm in Texas and a milk delivery service in the Northeast. CDC and state health officials warned customers not to drink raw milk from these dairies and advised those who consumed the raw milk to seek antibiotic treatment.

Norovirus outbreak at festivals: CDC helps prevent illnesses tied to drinking water

In June 2017, CDC's waterborne disease and norovirus experts and state partners investigated an outbreak of norovirus infections in Pennsylvania after the disease was reported in attendees of three consecutive outdoor festivals. The suspected culprit was the venue's septic system, which contaminated a drinking water well and creek water. CDC supported efforts to prevent illness at the venue, including handwashing promotion, boil water advisories, and disease surveillance.

Multidrug-resistant *Salmonella* in the US: CDC traces illnesses to contact with dairy calves

In 2017, CDC worked with partners to investigate an outbreak of multidrug-resistant *Salmonella* Heidelberg infections linked to contact with dairy calves. Testing conducted by CDC showed that isolates from ill people were resistant to multiple antibiotics, including first-line treatment. By the end of 2017, a total of 54 people from 15 states had been infected.

Seoul virus in the US: CDC shows outbreak linked to pet rats

Before 2017, Seoul virus had been found in pockets of wild rats in the United States, but never in pet rats. However, when pet rat breeders got sick, CDC investigated and determined that they were infected with Seoul virus, a type of hantavirus found in Norway rats. CDC provided epidemiologic and laboratory support along with guidance for preventing infection. Over 5 months, 17 people in 7 states were infected, and 3 were hospitalized.

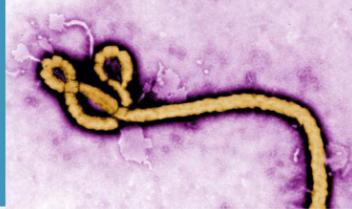
Dengue virus in American Samoa: Epidemiologists respond to ongoing outbreak

Dengue virus is a leading cause of illness and death in the tropics and subtropics. In 2017, CDC experts traveled to American Samoa to help investigate an ongoing outbreak of the mosquito-borne disease. Epidemiologists conducted surveys at households and took hundreds of samples to determine where and to what extent dengue virus was being spread, leading to targeted prevention measures.

CDC experts helped investigate an ongoing outbreak of dengue in American Samoa.



CDC worked with partners to investigate an outbreak of multidrug-resistant Salmonella Heidelberg linked to dairy calves.



GLOBAL

Ebola in the Democratic Republic of Congo: CDC provides support in country

When an outbreak of Ebola virus disease was reported in April 2017 in the Democratic Republic of Congo, CDC experts helped control the spread by providing support, including the distribution of educational and prevention materials about Ebola. The outbreak, which ended July 2, caused a total of 8 cases (including 5 laboratory-confirmed cases) and 4 deaths.

Monkeypox in the Republic of Congo and Nigeria: Experts help control outbreaks

CDC experts traveled to two countries in 2017 to help investigate and control outbreaks of monkeypox. Experts traveled to the Republic of Congo in March and Nigeria in November. CDC provided technical assistance, infection control expertise, and help with community education.

Typhoid fever in Zimbabwe: CDC works with partners to help control outbreak

In October 2016, sewage contaminating underground water likely contributed to a typhoid fever outbreak in Harare, Zimbabwe. CDC collaborated with partners to investigate and control the outbreak, which spanned nearly 5 months and caused 867 suspected cases and 4 deaths. CDC has returned to provide support in another typhoid fever outbreak that started in late 2017.

Anthrax in Namibia: CDC helps investigate outbreak in animals

When animals began dying of anthrax infection in Bwabwata National Park in Namibia, posing a threat to human health, CDC experts traveled to the country to help investigate the outbreak. By the end of 2017, 155 hippos, 86 Cape buffalo, and 2 impalas that were suspected of contracting anthrax had been buried. CDC also helped investigate and control anthrax exposure to people, collecting samples and performing diagnostic tests.



When animals began dying of anthrax infection in Namibia, CDC experts traveled to the country to help.

Photos:

- A team of scientists (above left) studied the ecology of the monkeypox outbreaks in Africa to help track and control cases of the disease.
- Scientists (above) perform tests during a monkeypox outbreak in the Republic of Congo.
- CDC trained veterinary technicians to collect samples and perform field tests during an anthrax outbreak in Namibia. A technician (right) explains the results of a positive test to park field workers.
- A CDC disease detective (opposite page, upper corner) examines a deceased buffalo during an anthrax outbreak in Namibia.

SUPPORT TO STATES



CDC awarded nearly \$50 million to 5 universities to help address emerging and exotic vector-borne diseases.

Vector-borne diseases: CDC funds university centers to confront threats

Some of the world's most dangerous diseases are spread by mosquitoes, ticks and fleas, and it is crucial that we work to stay a step ahead of these diseases. It isn't an easy task. In 2017, CDC awarded nearly \$50 million to 5 universities to establish regional centers of excellence that will help address emerging and exotic vector-borne diseases in the United States, like Zika. These centers will strengthen our nation's ability to mitigate the threat from vector-borne diseases by generating necessary research, knowledge, and capacity. CDC awarded funds to the University of Florida, the University of Texas Medical Branch at Galveston, the University of Wisconsin in Madison, Cornell University, and the University of California, Davis.

DNA sequencing: CDC brings new technology to public health labs

CDC's Advanced Molecular Detection (AMD) program has continued to bring state-of-the-art technology, such as DNA sequencing, into the United States public health system. CDC's AMD program works with other experts at CDC to ensure the US has the technology needed to protect Americans from infectious disease threats. The CDC AMD program develops and pilots next-generation diagnostics and protocols at CDC and state and local public health labs. These tools are then brought to scale in public health labs nationwide. By the end of

2017, almost every state public health lab had DNA sequencing capacity, and most had incorporated sequencing into their routine activities. State public health laboratories are now using sequencing to understand and control outbreaks of diseases that range from foodborne illnesses to tuberculosis. For example, in the case of foodborne illnesses, DNA sequencing is leading to faster detection of outbreaks and stopping them when they are smaller.

AR Lab Network: Enhancements help labs detect threats

The Antibiotic Resistance Lab Network (AR Lab Network) supports nationwide lab capacity to track changes in antibiotic resistance and to rapidly detect and respond to outbreaks of resistant pathogens in healthcare facilities, food, and the community. The network includes seven regional labs, the National Tuberculosis Molecular Surveillance Center (National TB Center), and labs in 50 states, five cities, and Puerto Rico. In 2017, CDC made several enhancements to the AR Lab Network's capabilities. The network has increased testing nationwide for the fungal threat *Candida*, including the multidrug-resistant threat *Candida auris*, and has strengthened infrastructure and surveillance for TB by adding the new national laboratory. The new center can perform whole genome sequencing, which can help identify new antibiotic-resistant TB strains as they emerge.

SHARING LAB EXPERTISE



CDC scientists using whole genome sequencing technology for outbreak detection and investigation.

CDC has amassed a collection of 450,000 antibiotic-resistant isolates.

Smallpox: New test to provide better results in less time

Before it was declared eradicated in 1980, smallpox was a dangerous infectious disease, and it continues to be a serious threat today. It is now theoretically possible that variola virus, which causes smallpox, could be recreated in a lab and used for a bioterror attack. Therefore, it is important that we have tools ready to protect people should the disease reemerge. In 2017, CDC received US Food and Drug Administration (FDA) clearance for a diagnostic test to detect variola virus. The new test was designed to provide reliable results in less time and will replace the smallpox test previously sent to laboratories through CDC's Laboratory Response Network. Even though the risk of a bioterror event involving smallpox is believed to be low, the new test could sound an early alarm in the event of such an attack.

MicrobeNet: CDC holds first international bacterial identification workshop

In 2017, CDC held its first international training for MicrobeNet, an online database that can help laboratory scientists identify more than 2,400 bacteria and fungi. CDC MicrobeNet experts partnered with India's National Centre for Disease Control and



biotechnology product manufacturer Thermo Fisher to train Indian scientists on bacterial identification, using DNA sequencing and MicrobeNet. Twenty-four scientists from a variety of organizations attended the workshop in New Delhi. MicrobeNet is used by more than 1,500 scientists from 838 worldwide organizations, which range from state public health labs to international clinical diagnostic laboratories. Pathogens were identified 12,921 times using MicrobeNet in 2017.

AR Isolate Bank: Growing number of experts use CDC's collection

As antibiotic resistance continues to be among the most concerning challenges to our country's health, a growing number of microbiologists, drug and diagnostic manufacturers, and researchers are using CDC's collections of resistant organisms—called isolates—to validate diagnostics in their labs. The CDC and FDA Antibiotic Resistance Isolate Bank provides a unique solution for experts who are looking for the latest samples of drug-resistant organisms. CDC experts gather isolates through outbreak responses and surveillance activities, and they have amassed a collection of 450,000 isolates. This collection is used to create curated panels for distribution to researchers. More than 570 customers have used the isolate bank since its launch in July 2015, and a 2017 survey showed that nearly 70 percent of customers use isolates to validate diagnostics in their labs.



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