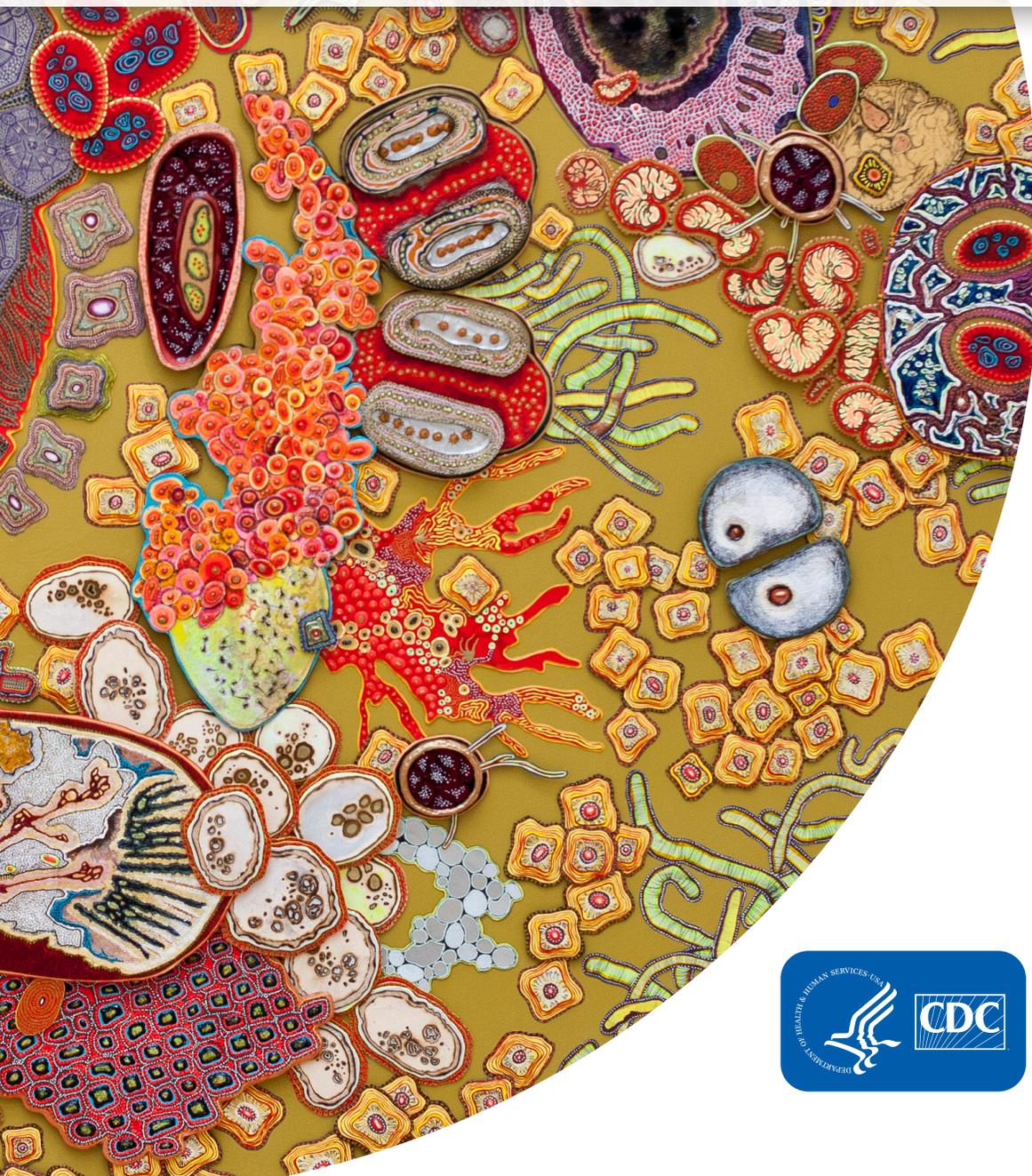


NCEZID ACCOMPLISHMENTS 2019

National Center for Emerging and Zoonotic Infectious Diseases



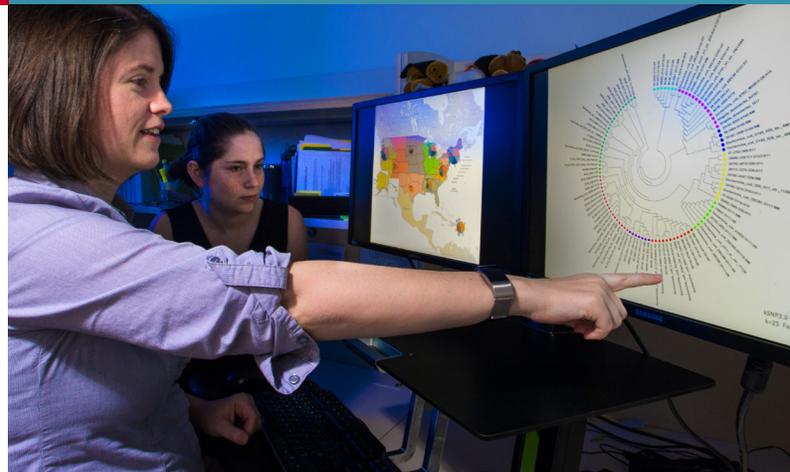
Centers for Disease
Control and Prevention
National Center for Emerging and
Zoonotic Infectious Diseases



A “whole” new way to detect foodborne outbreaks

In 2019, the [PulseNet](#) national laboratory network transitioned to using the laboratory and data analysis method [whole genome sequencing \(WGS\)](#) to identify and investigate foodborne outbreaks caused by intestinal (enteric) infections. **Eighty-three PulseNet laboratories across the United States, at least one in every state, now have the tools to generate, analyze, and share WGS results with the other network participants, letting public health officials find the source of outbreaks with more precision.**

For instance, in 2018 and 2019, a *Salmonella* outbreak causing illness in more than 400 people was linked to contaminated ground beef. WGS data helped investigators define which ill people were part of the outbreak, guiding the US Department of Agriculture (USDA) to [recall more than 12 million pounds of beef](#). CDC is working with its partners at the US Food and Drug Administration (FDA), USDA, and state health departments to share what they have learned about harmful foodborne pathogens using WGS technology. Information flow between these federal partners helps outbreak investigators rapidly identify sources of infection and trace those food items back to where the contamination occurred, saving lives and protecting our food supply.



Investigators used WGS to track down a *Salmonella* outbreak, resulting in a USDA recall of 12M pounds of ground beef.

Estimating the burden: A much-anticipated update of the *AR Threats Report* is released

This year, CDC released [Antibiotic Resistance Threats in the United States, 2019](#), an update of the 2013 report on the national burden of antibiotic resistance using new data sources.

The new report shows that antibiotic resistance is a larger threat in the United States than first estimated in 2013—more than 2.8 million infections occur each year and at least 35,000 people die as a result—but the country has made progress since then. Like the 2013 report, CDC’s new *AR Threats Report* establishes a national baseline of antibiotic resistance and categorizes the top antibiotic-resistance threats as urgent, serious, or concerning. **New data sources show that prevention efforts have reduced deaths from antibiotic-resistant infections by 18 percent since the 2013 report, and nearly 30 percent in hospitals.** But the call to action is as urgent as ever—concerted effort on a national and global scale is needed to reduce infections and deaths caused by these germs.

CDC remains committed to leading the nation to rapidly detect, prevent, and innovate in the fight against antibiotic resistance. The agency continues to work with partners to expand our national response and prevention capacity and enhance our ability to combat the growing threat of antibiotic resistance worldwide.

ANTIBIOTIC RESISTANCE THREATS IN THE UNITED STATES 2019



breaking the mold



In 2019, NCEZID scientists were tapped to provide expertise to help with some of today's most concerning and headline-generating public health problems. Working beyond their usual scope of emerging and zoonotic infectious diseases, they rose to the challenge.



NCEZID's pathology lab worked to find out what was causing vaping-associated lung injuries.

NCEZID lab investigates outbreak of lung injury

As part of a [nationwide investigation into lung injury and deaths](#) associated with the use of e-cigarette, or vaping, products, the **CDC Infectious Diseases Pathology Laboratory** tested patient tissue samples to better understand how the injuries may have occurred. As of December 27, a total of 2,561 cases, including 55 deaths, have been reported to CDC from across the country and US territories. The outbreak has disproportionately affected people under the age of 35 and most patients report a history of using THC-containing vaping products. NCEZID's lab work is a critical component of the ongoing CDC response to this public health issue.





Culex mosquito larvae hang upside down in a sample of standing water taken from a neighborhood in Atlanta, Georgia. The larvae's breathing tubes penetrate the water's surface, enabling them to access their air supply.

New program helps mosquito hunters sharpen skills

Through an innovative program known as the [Vector-Borne Disease Regional Centers of Excellence](#), **students from universities across the country are making strides in preventing mosquitoes from spreading pathogens.** In one example, a local mosquito control unit in southeast Texas called on the [Midwest Vector-Borne Disease Center of Excellence](#) for assistance after a hurricane hit the area.

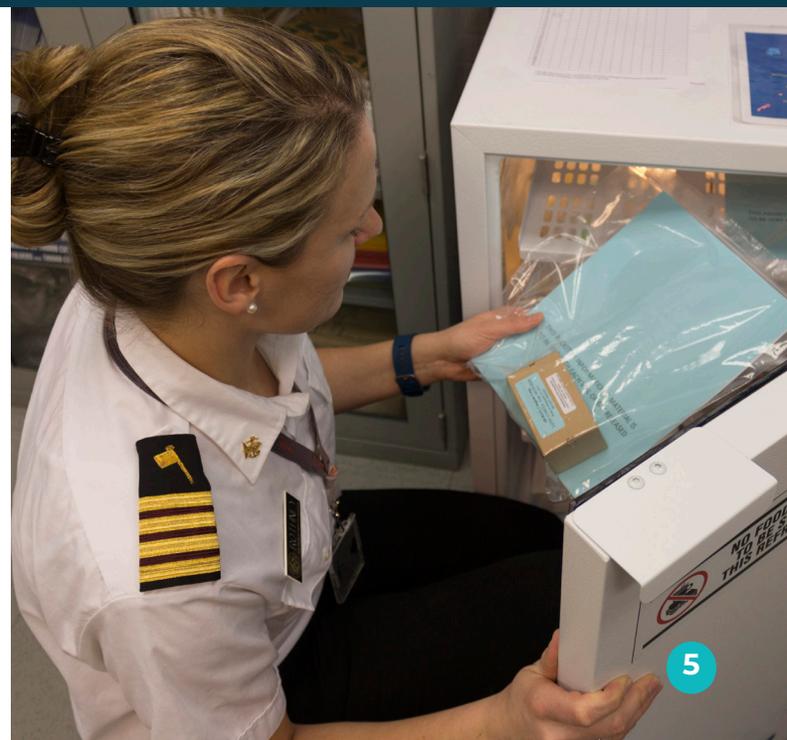
Student trainees and staff deployed to the area where they identified the species of thousands of mosquitoes, set mosquito traps in the field, and assisted with insecticide-resistance field studies. Moving forward, the US Vector-Borne Disease Regional Centers of Excellence will continue to train students while helping communities in need to control mosquitoes and the diseases that can result from their bites.

In 2019, 11 CDC quarantine stations began dispensing a life-saving antimalarial drug to all patients with severe malaria. Photo credit: Derek Sakris, CDC

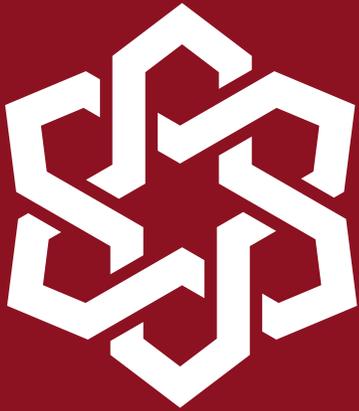
NCEZID action ensures that quarantine stations provide life-saving medicine

For decades, several of NCEZID's [quarantine stations](#) have stocked life-saving medicine to treat botulism, diphtheria, and malaria so they can be delivered rapidly to patients in need across the country.

In late 2018, the manufacturer of quinidine, the only antimalarial drug available for severe malaria in the United States, announced that it would cease production of the drug. CDC has also distributed artesunate, the first-line, World Health Organization-approved medication for severe malaria, but only to patients who didn't improve on quinidine. **In 2019, CDC secured approval to distribute artesunate for all cases of severe malaria.** In April 2019, the [CDC Drug Service](#) expanded operations to provide this life-saving drug. Eleven US quarantine stations work around the clock to ensure quick delivery to treating hospitals. In this year alone, CDC's artesunate supplies reached 247 critically ill people across the country, saving lives that might have otherwise been lost.



collaborating to make a difference



Having the support and collaboration of partners enables NCEZID to make an even bigger mark in saving lives and strengthening our preparedness to fight emerging and zoonotic infectious diseases. Our partners are diverse and have a wealth of expertise, as these examples show.



CDC and FBI conducted workshops to prepare public health and law enforcement professionals to work together to identify suspicious biological threats.

NCEZID partners with the FBI to prepare for biological events

In 2019, NCEZID continued to collaborate with the US Federal Bureau of Investigation's (FBI) Weapons of Mass Destruction Directorate. **Using a Joint Criminal-Epidemiological Investigations Workshop developed with the FBI, NCEZID trained select global public health and law enforcement professionals to work together to identify, assess, and investigate suspicious biological threats.** At the request of

the Japanese government, CDC and FBI instructors worked with Japan's Ministry of Health, Labour and Welfare to conduct a workshop in March. Other training sessions took place in the European Union and South Africa. After participating in these workshops, public health and law enforcement agencies are better equipped to work together to respond to a biological event.





ELC by the numbers

\$231 million

Awarded through the [Epidemiology and Laboratory Capacity for Prevention and Control of Emerging Infectious Diseases \(ELC\) cooperative agreement](#).

64 State, local, and territorial jurisdictions awarded funding to support efforts to combat infectious diseases.

4 Public health programs will be strengthened by:

- Building cross-cutting epidemiology and laboratory capacity
- Combating foodborne and waterborne diseases
- Reducing healthcare-associated infections and antibiotic resistance
- Fighting vector-borne diseases

Fortifying readiness: New guidance for responding to an anthrax event

[Anthrax](#) is an infection caused by *Bacillus anthracis*, which is a tier 1 select agent and considered a bioterrorism agent. The possibility exists of an intentional wide-area aerosolized release of *B. anthracis* spores, potentially exposing millions of people. To prepare for a potential deliberate release, the US government has stockpiled therapeutics for anthrax prevention and treatment.

In 2017, NCEZID scientists presented the latest research to the Advisory Committee on Immunization Practices, which led to [updated anthrax vaccine recommendations in 2019](#). Guidelines are essential for safe and effective use of medical countermeasures. The recommendations also **will help healthcare providers and emergency preparedness officials and planners improve preparation for a wide-area aerosolized release of anthrax.**

What are the top zoonotic disease threats in the United States?

NCEZID released a [report](#) in April 2019 outlining the United States' top [zoonotic disease](#) threats following a workshop with federal and state [One Health](#) experts. The results were a critical step toward a coordinated, United States-specific approach to One Health, which recognizes that human health is connected to the health of animals and the environment. **The top-ranked threats were zoonotic flu** (flu viruses that can spread between animals and humans), **salmonellosis, West Nile virus, plague, emerging coronaviruses like MERS** (Middle East respiratory syndrome), **rabies, brucellosis, and Lyme disease.**

Since the workshop, CDC and other federal partners have established the One Health Federal Interagency Network, bringing together federal agencies to exchange information and opportunities for collaboration in support of One Health.

The One Health Office's US Prioritization Report highlighted the country's top zoonotic disease threats, which can spread between animals (like chickens) and people.

FIGHTING ANTIBIOTIC RESISTANCE: There's an app for that



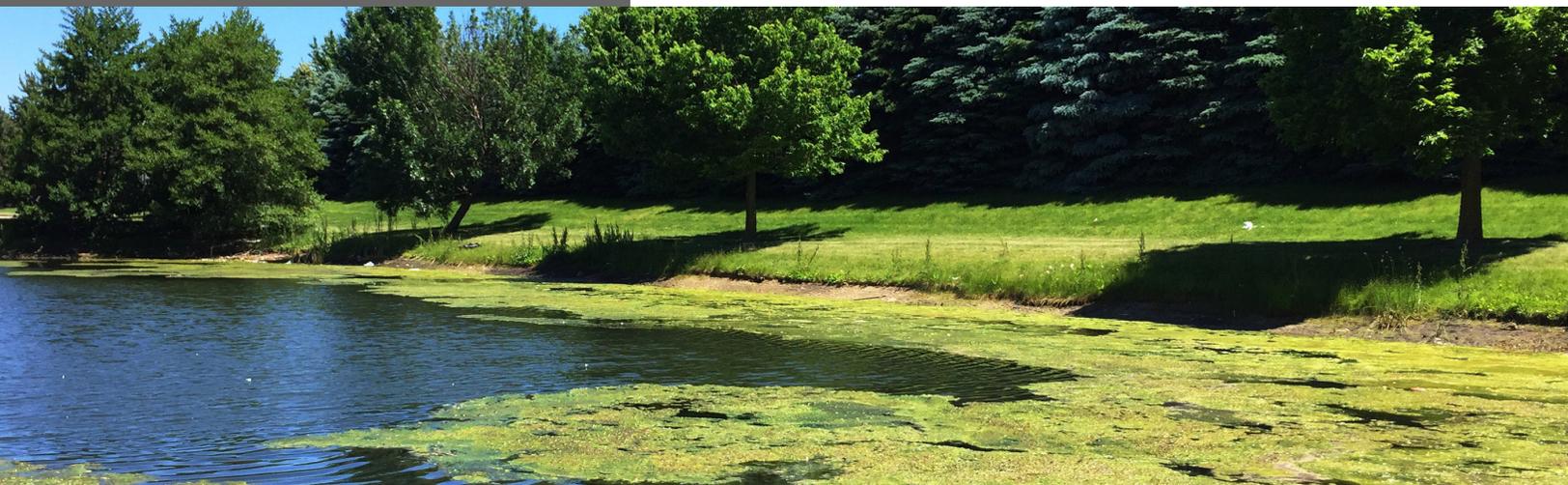
NCEZID works with partners around the world to find innovative approaches to detect and respond to antibiotic resistance threats that occur in healthcare settings. A recent collaboration was with the technology company Ilum that designed a smartphone app called Acumen. Acumen was given to healthcare providers in Colombia, providing them instant access to antibiotic resistance data specific to their geographic area. That helped ensure that the right antibiotic was used at the right time and at the right dose.



combating infections in the US



Whether it's tracking down the cause of foodborne outbreaks or protecting patients from deadly infections, NCEZID is laser-focused on safeguarding the public's health in the United States.



Working to keep waterborne disease at bay

NCEZID tracks and investigates waterborne disease cases and outbreaks, develops effective prevention strategies to reduce the burden of illness in the United States, and helps states and local communities prevent and respond to these outbreaks. [Harmful algal blooms \(HABs\)](#) are an emerging issue in US lakes, rivers, oceans, and drinking water supplies. HABs can hurt animals and people as well as the local ecology and economy. In 2019, CDC provided funding to Florida, Oregon, and Tennessee to support HABs-related surveillance,

mitigation, and response. Michigan, Ohio, and Wisconsin also received funding for state HABs activities as a result of NCEZID participation in the [Great Lakes Restoration Initiative](#).

Our scientists responded to other water safety threats in 2019. They provided technical assistance to multiple state and federal partners, including joint investigations with FDA to identify environmental sources of multistate outbreaks of *E. coli* infections associated with romaine lettuce.





Salmonella in pig ear dog treats

NCEZID worked with partners to investigate a wide-ranging and drug-resistant *Salmonella* outbreak linked to pig ear dog treats imported from at least three countries. **The contaminated treats passed illness to pet owners who touched and handled them before feeding them to their dog.** By December, this outbreak had spread to 34 states, with more than 154 illnesses and 35 hospitalizations reported. As a result, FDA issued guidance to industry to reduce *Salmonella* contamination in these products.

Outbreak linked to raw oysters

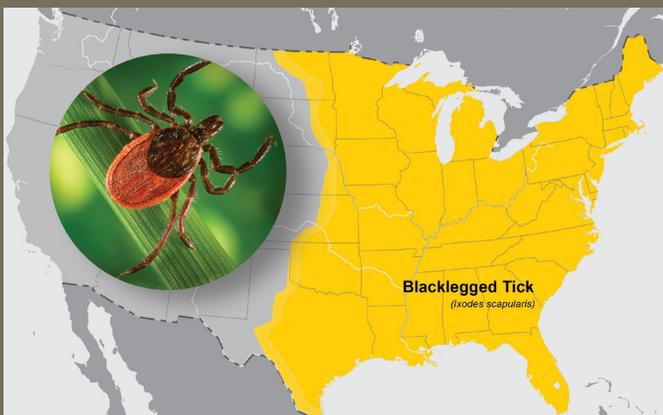
In 2019, CDC and partners investigated an outbreak of gastrointestinal illnesses linked to raw oysters in several states. **A total of 16 sick people were reported from five states, and two people were hospitalized.** In May, at the request of Mexico's public health authorities, all oysters from Estero el Cardon were recalled.



C. auris can often spread under the radar, but NCEZID investigators worked vigilantly to control and prevent this deadly fungus from spreading.

Rapid response prevents spread of deadly fungus in medical facilities

Candida auris is a drug-resistant fungus that can cause serious and often fatal infections in vulnerable people, like those with existing medical conditions. *C. auris* can live on patients' skin without causing symptoms, allowing the fungus to spread undetected. Detecting this hidden reservoir of disease is vital to stopping spread and protecting patients. In 2019, a patient in California tested positive for *C. auris*. With the support of NCEZID, an extensive containment response followed, involving screening more than 1,000 patients across 17 facilities, which identified approximately 100 patients who could be a source of spread. As of December 2019, only 24 clinical cases have been identified. **This rapid response helped control the spread of *C. auris* in the southern California region, protecting many vulnerable patients from this deadly threat. NCEZID has also successfully implemented this approach to contain other dangerous infections.**



The area in yellow shows the estimated distribution of blacklegged or deer ticks, the tick that transmits Lyme disease.

Over the past 13 years, cases of vector-borne disease in the United States have more than doubled. **Tickborne diseases accounted for more than 75% of all vector-borne diseases reported in the continental United States during 2004–2018.** NCEZID is responding



to these threats by supporting states to improve tick surveillance so we can better understand the human disease burden and risk; improve early and accurate diagnosis of tickborne pathogens, including novel ones; and identify, develop, and evaluate effective prevention and control practices.

confronting

infections across the globe



NCEZID's experts know that deadly infections can be just a plane ride away. That's why our experts work around the clock to protect people around the world from emerging and zoonotic infectious diseases like Ebola, yellow fever, and rabies.



NCEZID experts have improved public health screenings at border crossings.



Red Cross volunteers look at community feedback data to help them strengthen outreach efforts—with inspirational message in background, "Together, it is possible."

The risk of Ebola spreading globally is currently low—**CDC is working to keep it that way**

NCEZID and partners are employing several strategies to control the ongoing outbreak:

- NCEZID is working with the Democratic Republic of the Congo (DRC) and neighboring countries to keep travelers from spreading **Ebola**. NCEZID experts **improved public health screenings at border crossings and airports** in DRC and surrounding countries. US authorities also continue to implement routine border health security measures at US ports of entry.
- **Preventing Ebola transmission in healthcare facilities** is one of the core strategies to stop the ongoing outbreak. NCEZID's International Infection Control Program staff have supported trainings across eight geographic areas in DRC, contributing to infection prevention and control improvements in more than 2,300 healthcare facilities throughout the region.
- **Innovative work by researchers in CDC's high-containment laboratories** demonstrated that two Ebola treatments—remdesivir and the antibodies in the ZMapp cocktail—effectively blocked the growth of the strain of Ebola causing the DRC outbreak.
- **NCEZID used mathematical models to inform decision making** of leaders at CDC and other US government agencies involved in the response. These models helped leaders to more accurately assess the effectiveness of response efforts and plan for additional needs, such as vaccine supply.
- **NCEZID behavioral scientists** have been working closely with Red Cross volunteers to **gather information about people's beliefs, observations, questions, and suggestions about combating Ebola**. CDC and Red Cross have recently shifted their focus to building capacity of local Red Cross front-line volunteers—people who know how to effectively engage their communities so they can interpret and use the data they gather and become better advocates for change.





Aedes aegypti
Yellow Fever Mosquito

Better tests for yellow fever

Yellow fever is a reemerging and explosive public health threat. To help address this threat, NCEZID produced a new diagnostic kit that cuts testing time down from the standard 3 days to just 4 hours. **The test, which was validated in 2019, provides laboratory staff in resource-poor countries with all the materials they need in just 1 box**, allowing countries to mobilize a response quickly, potentially reducing the overall disease burden. NCEZID also developed a novel test that can rapidly distinguish between wild-type and vaccine yellow fever viruses. This test could greatly improve yellow fever diagnostics and allow for timely public health decisions without eroding public trust in the vaccine.

Contact with infected bats is the leading cause of rabies deaths among people in the US.



under
the microscope

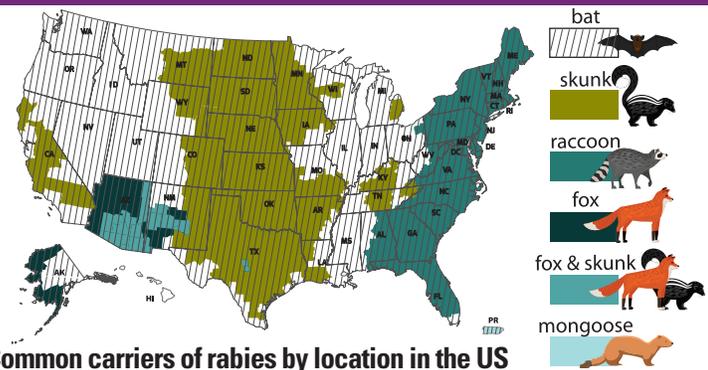
RABIES



Each year, rabies kills nearly 60,000 people worldwide. In the United States, the threat of rabies is low, thanks to the routine vaccinations of pets. But many wild animals still carry the virus—and unvaccinated cats and dogs in other countries may still spread the disease, which is 100% preventable with the right medication.

- In January 2019, NCEZID published [new guidance](#) on importing dogs into the United States. **CDC now requires only a vaccination certificate to import a dog from a country that's high risk for canine rabies virus.** This will reduce the requirements of importing dogs while continuing to protect the United States from rabies importation.
- NCEZID joined an international effort to control a rabies outbreak after reports that 3 people died in a [Dominican Republic](#) town near the [Haitian border](#) in 2018. **Haitian authorities and CDC vaccinated nearly 25,000 dogs**, including about 4,000 dogs in communities near the border.
- A CDC [Vital Signs](#) report this summer focused on the **rabies threat still posed by US wildlife**; rabies prevention strategies; and what the public, international travelers, and healthcare providers need to know about rabies.

Greatest Risk from Wildlife, Especially Bats



Now, CDC requires **only** a vaccination certificate to import dogs from a country that's high risk for canine rabies virus.

protecting travelers' health



Protecting the public's health in the United States requires a dedicated focus on infectious disease threats that can happen outside the United States and cross US borders. Here are just a few examples of how NCEZID has been protecting health at our borders.

CDC took action to prevent drug-resistant infections among US residents who may have had plans to undergo medical procedures in Mexico.

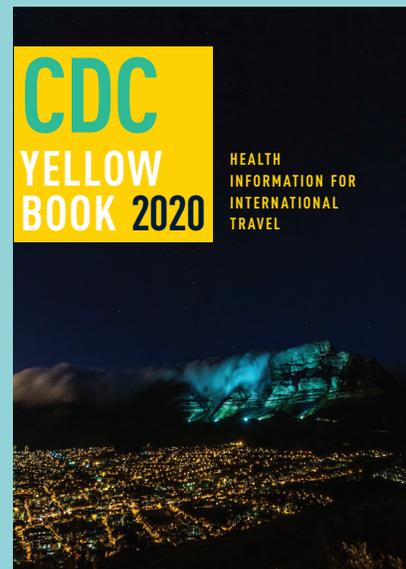


Alerting travelers about drug-resistant infections in Mexico

In early 2019, NCEZID alerted travelers about drug-resistant infections reported in United States residents who had surgery in Tijuana, Mexico. **Most of the patients who developed carbapenem-resistant *Pseudomonas aeruginosa* infections had undergone weight-loss procedures.** More than half of the patients had surgery at a specific hospital in Tijuana. The Mexican government ordered the hospital to suspend operations, and NCEZID experts posted a notice recommending travelers not have surgery at the hospital until the hospital addressed the infection control concerns. NCEZID also worked with state health departments to identify patients involved to ensure they received correct treatment.

Investigating Valley fever outbreak in students returning from Mexico

When two high school students were hospitalized in New York with pneumonia after returning from a community service trip in Baja California, Mexico, CDC staff quickly suggested the cause might be **Valley fever (*coccidioidomycosis*)**, a fungal disease that was later confirmed by laboratory tests. **CDC worked with state and local partners to investigate how the students were infected and whether other cases of Valley fever had gone undiagnosed.** Experts discovered eight confirmed cases of Valley fever connected to the trip from four states, several of which involved severe illness, hospitalization, and invasive procedures, as well as dozens of other likely cases involving respiratory infections. The investigation, which was published in a 2019 report, showed that a total of 225 travelers from this organization alone had taken part in trips to the area. Experts notified travelers of their risk for Valley fever and authorities in Mexico.



Travel health guide revamped

In 2019, NCEZID released the online 2020 edition of the **CDC Yellow Book**, the definitive guide for healthy international travel. Completely revised every 2 years, the Yellow Book offers healthcare providers and travelers information ranging from travel health guidelines to vaccine recommendations. **The Yellow Book is available in print and online, with the online edition receiving over 5 million views each year.** NCEZID updated the 2020 edition with new information, including updated traffic safety advice, emerging travel-related illnesses, new FDA-approved drugs, and more.



Preventing importation of measles

In 2019, **measles**—a highly contagious disease that is common in parts of the world—made a resurgence in the United States and became one of the largest outbreaks CDC responded to that year. **Travelers continued to bring measles into the United States throughout 2019, resulting in the greatest number of cases in the country since 1992.**

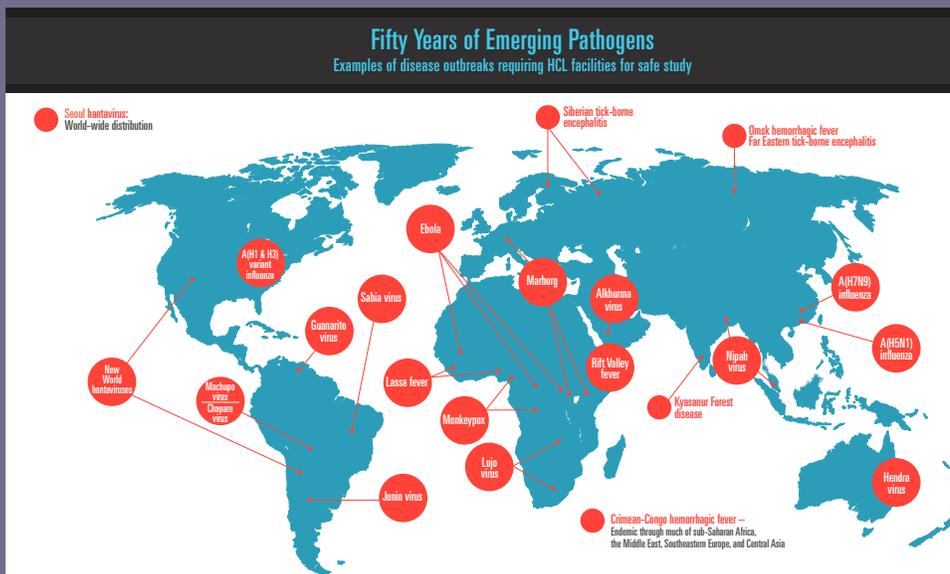
NCEZID posted a global measles outbreak travel notice, and conducted 247 investigations to find people potentially exposed to sick travelers on airplanes, known as “contacts.” NCEZID experts notified health departments of 3,464 contacts in 2019 alone. NCEZID also worked with partners to ensure that US-bound refugees were vaccinated or immune to measles before they traveled.

In 2019, NCEZID conducted 247 measles investigations to find people potentially exposed to sick travelers on airplanes.

observing significant milestones



In 2019, while the world heralded the 50th anniversary of Apollo and the first moon walk, NCEZID highlighted two important historic accomplishments, both involving laboratories—the backbone of what we do.



CDC's fifth high-containment laboratory, slated to open in 2025, will ensure that the agency can remain at the forefront of disease response and discovery.

CDC's high-containment laboratories: Making the world safer for half a century

2019 marked the 50th anniversary of **CDC's high-containment laboratories (HCL)**, spaces where our scientists study some of the world's deadliest diseases, including **Ebola, smallpox, and new types of influenza**. Though the design, space, and research capabilities of the HCLs have changed over the years, CDC's commitment to stopping infectious diseases and making the world safer for Americans and others around the globe hasn't. CDC's fifth HCL, funded in fiscal year 2018 and slated to open in 2025, will ensure CDC remains at the forefront of disease response and discovery.

Laboratory Response Network: Detecting public health threats for 20 years

In another 2019 milestone, the CDC-run **Laboratory Response Network (LRN)** marked 20 years of detecting biological and chemical threats in the United States. **This constellation of federal, state and local public health, and clinical laboratories plays a crucial role in public health emergencies.** CDC trains LRN laboratory scientists to perform CDC-developed and deployed tests so that the nation has high confidence in these high-consequence results.



looking ahead



At the start of a new decade, NCEZID faces numerous infectious disease challenges...and we have been developing plans on how to most effectively address them.



1

PROBLEM: The ongoing threat of **tickborne diseases**

SOLUTION: NCEZID works to implement a robust national system that can detect, prevent, and respond to these threats and invest in bigger diagnostics and prevention tools.

2

PROBLEM: **Increases in zoonotic diseases**, which spread between animals and people and account for 6 in 10 infectious diseases in people

SOLUTION: NCEZID strengthens activities in combating diseases like rabies and brucellosis and partner collaborations using a **One Health** approach that brings together human, animal, and environmental health sectors.

3

PROBLEM: **Keeping pace with technological advances** to better conduct surveillance, detect outbreaks, understand how infectious diseases are spread, and target interventions

SOLUTION: CDC's **Advanced Molecular Detection (AMD)** program continues to incorporate transformative next-generation sequencing technology here at CDC and in public health programs across the US. Working in a rapidly evolving technological landscape, AMD is developing new methods, promoting data modernization, and supporting needed workforce development.

4

PROBLEM: Critical **gaps in global health preparedness** to fight threats like Ebola

SOLUTION: NCEZID strengthens its commitment to global health security by quickly responding to international outbreaks and working with partners to prevent and control infectious disease threats.

5

PROBLEM: Annually, there are **>1.7 million illnesses and ~270,000 deaths from sepsis in the US**. Some infections caused by HAI and antibiotic resistant pathogens can lead to sepsis.

SOLUTION: NCEZID increases understanding of the magnitude of the sepsis burden, assesses the impact of interventions, and educates providers about early diagnosis and appropriate treatment. NCEZID leads **Get Ahead of Sepsis**—a national educational effort that emphasizes preventing infections that can lead to sepsis, early recognition, timely treatment, and reassessment of antibiotics. Antibiotics are the most critical element in sepsis care, and stewardship efforts help preserve antibiotics as life-saving tools.

6

PROBLEM: 7 million people get sick every year from **waterborne disease** in the United States, resulting in 7,000 deaths and more than \$3 billion in healthcare costs.

SOLUTION: NCEZID is creating a comprehensive estimate of US infectious waterborne disease. It identifies the top pathogens driving illness and high healthcare costs to create effective interventions for those most at risk.



www.cdc.gov/ncezid

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COVER ART: Amie Esslinger, *Collisions*
Featured in the David J. Sencer CDC
Museum's 2019 special exhibition "The World
Unseen—Intersections of Art and Science."