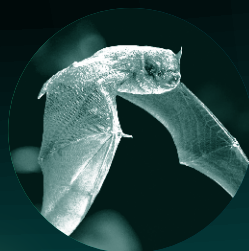


Protecting Health in 2020

NCEZID PROGRESS REPORT



National Center for Emerging
and Zoonotic Infectious Diseases



U.S. Department of
Health and Human Services
Centers for Disease
Control and Prevention



WHO WE ARE

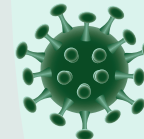
The National Center for Emerging and Zoonotic Infectious Diseases (NCEZID) is one of 16 national centers, institutes, and offices that together make up the US Centers for Disease Control and Prevention (CDC).

NCEZID is committed to protecting people from domestic and global health threats and has extensive experience leading efforts across CDC in preparing for and responding to infectious disease outbreaks. NCEZID is also one of the agency's principal sources of epidemiologic, clinical, laboratory, and subject matter expertise for bacterial, viral, and fungal pathogens as well as **infectious diseases of unknown origin**. Our infectious disease experts are at the forefront of critical efforts to prevent, prepare for, detect, and respond to **zoonotic** and emerging infections that pose a threat to the United States and communities around the world.



In 2020, close to 2,000 NCEZID staff were heavily involved in the COVID-19 response. At the same time, the center had to prioritize regular (core) work, rely on other staff to help sustain it, and plan for the year ahead. This report features stories about all three types of work, designated by the following:

LEGEND



COVID-19 response



NCEZID core work

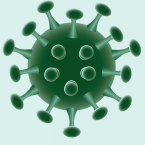


Work planned for 2021 and beyond

Photo above: CDC and partners oversaw the disembarkation and repatriation of more than 260,000 cruise ship passengers and crew members affected by COVID-19 in 2020. In March, NCEZID epidemiologist and quarantine public health officer Maureen Fonseca-Ford (pictured here) worked with deployed medical responders from the federal Disaster Medical Assistance Teams and the Office of the Assistant Secretary for Preparedness and Response to follow up on the health status of the 490 Grand Princess cruise ship passengers at Marine Corps Air Station Miramar and manage the federal orders of quarantine and isolation being served. Photo credit: Jake McClung

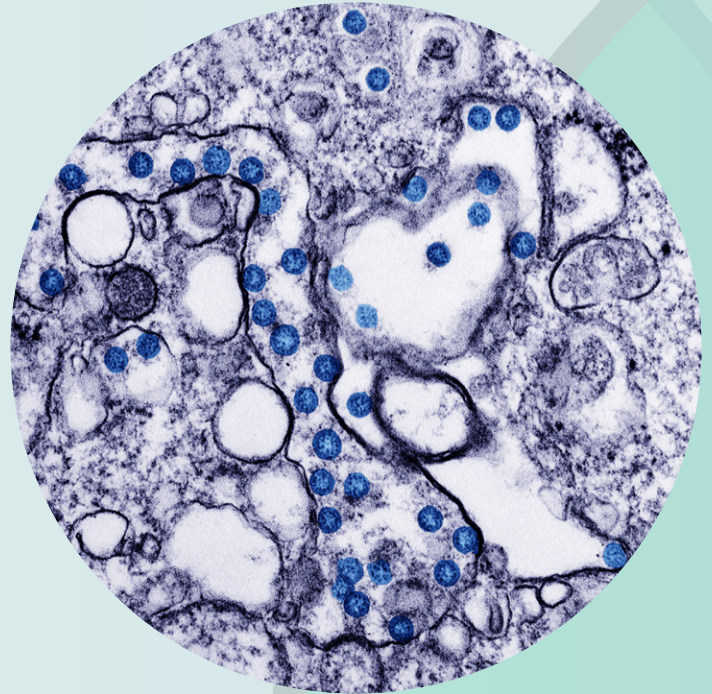
LEADING DISCOVERY

into novel or dangerous pathogens



Autopsy tissues: Providing clues about how COVID-19 kills

NCEZID's team of skilled pathologists and scientists can determine the process and progression of a disease by examining tissue specimens in their unique lab. When a new disease like COVID-19 emerges, understanding how it affects the body is important to patient care and developing treatments that could block its deadly effects. Since the pandemic began, **NCEZID's pathology lab—the only lab in the nation with the depth of experience and COVID-19-specific tests to find these answers—has conducted 6,417 tests on specimens from 275 autopsies** submitted by states, including some of those hardest hit by COVID-19. Their findings help states determine causes of death and offer more clues about how COVID-19 kills.



Electron microscopic image of infected tissues

Blue dots highlight SARS-CoV-2 virus particles in upper airway tissues. NCEZID scientists have probed deep into cells and found evidence that the virus targets and kills critical cells deep within the lung.



Staying the course to stop Ebola in the DRC

In 2020, NCEZID supported efforts to stop two Ebola outbreaks in the Democratic Republic of the Congo (DRC), including one that was the second-largest Ebola outbreak ever recorded. In June, as the nearly 2-year-long outbreak in eastern DRC counted down to its end, a **new Ebola outbreak** began in western DRC. NCEZID sent experts in epidemiology, communication, laboratory diagnostics, infection prevention and control, and social and behavioral science to the outbreak area. The team established a laboratory in a remote health zone, promoted strong case detection and contact tracing activities, and supported ongoing communication with and feedback gathering from communities—all essential components to bringing an end to the outbreak.

Flare-ups of Ebola cases remain a threat in DRC as the animal reservoir is most certainly widespread throughout the country.

NCEZID will continue to support capacity building efforts to quickly detect and respond to outbreaks of Ebola — now and in years to come.



Danger lurking in the fish tank

NCEZID investigations have uncovered evidence that melioidosis may be an emerging risk in the United States, not just a concern for international travelers. Melioidosis is a life-threatening disease caused by Burkholderia pseudomallei bacteria that are found in soil and water. Recently, people in Texas, Louisiana, and Maryland (none of whom had traveled internationally) developed melioidosis. CDC suspects that they were infected near their homes or worksites, and that the bacteria may be present in the southern states. The investigation for the source of the Maryland case led Epidemic Intelligence Service Officer Patrick Dawson (pictured here) to a California tropical fish distributor, where he found evidence of the bacteria in the transport water of imported fish.

EQUIPPING states to fight disease



Delivering \$11 billion in COVID-19 funding to health departments

NCEZID's Epidemiology and Laboratory Capacity for Prevention and Control of Emerging Infectious Diseases (ELC) Cooperative Agreement has awarded \$11 billion to support COVID-19 response efforts in 64 state, local, and territorial health departments. Funding came from the Paycheck Protection Program and Healthcare Enhancement Act (PPPHEA); Coronavirus Aid, Relief, and Economic Security (CARES) Act; and Coronavirus Preparedness and Response Supplemental Appropriations Act, 2020.

This is the largest single award any one CDC program has ever dispersed. The funds assist health departments by supporting enhanced testing for COVID-19; surveillance and reporting; contract tracing and case investigations; infection prevention and control measures; infectious disease preparedness capacity; and other life-saving activities. Using COVID-19 resources, ELC funded more than 15,000 full- and part-time state and local public health professionals. These positions include epidemiologists, laboratorians, informaticians, contact tracers, case investigators, and other positions critical to the nation's response to COVID-19. Nearly half of the funds (\$5B) are dedicated to supporting local health departments. ELC team members worked at a record pace to make the funding available, supporting urgent COVID-19 response efforts while maintaining core infectious disease preparedness programs.

Surveillance & reporting

\$1B

Contact tracing & case investigation

\$3.8B

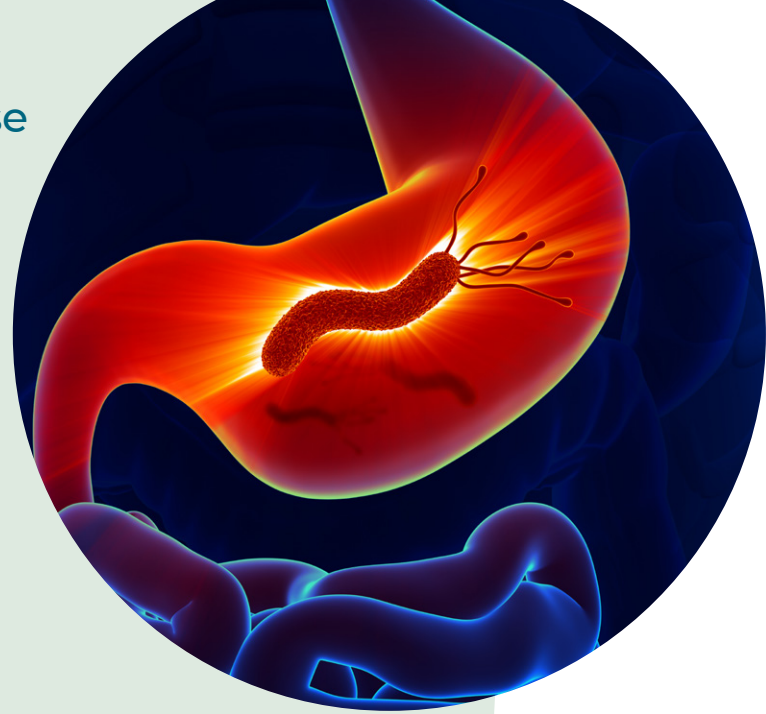
COVID-19 Funding
\$11B*

\$.5B

Infection prevention and control

\$5.6B

Testing & lab capacity



Rates of gastric cancer associated with *Helicobacter pylori* infection are almost four times higher among Alaska Native people.



Protecting Alaska Native people from aggressive cancer-causing bacteria

In 2020, CDC's Arctic Investigations Program (AIP) worked with tribal health partners and **used genetic sequencing data to help understand why rates of gastric cancer associated with *Helicobacter pylori* infection are almost four times higher**, and why the disease is more aggressive among Alaska Native people compared with other populations. Located on the Alaska Native Medical Center campus in Anchorage, CDC's lab uses advanced diagnostic technologies to enhance surveillance and identify genetic markers that can help inform screening and treatment options for *H. pylori*. These efforts support AIP's mission to prevent infectious diseases in people of the Arctic and sub-Arctic, especially those that disproportionately harm Alaska Native and other northern indigenous peoples.

RUNNING POINT



“Being able to scale up easily and get billions of dollars out to our state and local public health partners has been a uniquely rewarding experience.”

Angelica O'Connor
ELC Program Coordinator, NCEZID

on getting support to states

*Funding categories/amounts as of September 30, 2020

KEEPING A VIGILANT EYE on global health

NCEZID

Snaring another scourge spread by animals

Today, new disease threats are being discovered, re-emerging after years of dormancy or spreading to new areas. Bats are the primary culprit in the spread of diseases like rabies, Ebola, and another fatal hemorrhagic fever, **Marburg**. NCEZID scientists found that Marburg virus is primarily shed in an infected bat's saliva and urine, suggesting that people and animals can catch Marburg through contact with these fluids or perhaps by eating fruit that infected bats have gnawed on or otherwise contaminated. After Marburg jumps from bats to humans, it can spread rapidly between people, infecting hundreds and killing many of those infected. Outbreaks have been rare, and NCEZID is working to keep it that way.

In 2020, NCEZID scientists confirmed that the Marburg virus is carried among Egyptian rousette bats, a fruit bat in Sierra Leone. This was the first time the virus was found in West Africa.

By night, in full-body protective gear, NCEZID staff and partners from Njala University snared bats in nets, and lab tests revealed that some of these bats were carrying a particularly deadly strain of Marburg.

CDC and its partners continue to search for the animal, likely a bat, that maintains Ebola virus in nature and spreads it to people and other animals.

NCEZID scientists confirmed that the Marburg virus is spreading among fruit bats (pictured here) in Sierra Leone, the first time the virus was found in West Africa.



Woman from Rwanda carrying plantains washes her hands at a handwashing station set up at the border crossing into Goma, Democratic Republic of the Congo (DRC). NCEZID supported efforts to stop many outbreaks of Ebola in DRC in 2020.

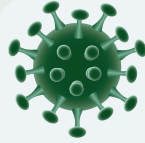


At the ready: Preparing for the next disease threat

NCEZID works with other countries **across the globe** to strengthen infectious disease capacity in surveillance and epidemiology, laboratory diagnostics, and infection prevention and control. These efforts are vital to address known threats like Ebola, and they allow countries and regions to better adapt when a new outbreak emerges. For example, **investments made over last few years in developing molecular diagnostic capabilities at the national arbovirus laboratories in Indonesia and Uganda now provide these countries with key resources needed to diagnose and characterize SARS-CoV-2** as part of their COVID-19 pandemic response activities.



ACCELERATING the collection and interpretation of data



Building a network to share lab test results years before COVID-19 struck

Prior to COVID-19, NCEZID made critical and strategic investments through the Epidemiology and Laboratory Capacity for Prevention and Control of Emerging Infectious Diseases (ELC) Cooperative Agreement to ensure that more than 90 percent of state and local health departments had widespread use of electronic laboratory reporting within their jurisdictions.

As early as 2005, CDC, in partnership with the Association of Public Health Laboratories, began paving the way for what is now the **COVID-19 Electronic Laboratory Reporting (CELR)** program. They created a secure, cloud-based platform to help state health departments, state laboratories, regional commercial laboratories, and federal agencies report their data. State health departments have increasingly used this platform, supported by ongoing financial and technical support from CDC, to increase the proportion of the reportable disease results they share with CDC.

Building upon these advances **allowed the CELR program to quickly enable detailed data reporting from public health departments to CDC for approximately 90 percent of the COVID-19 testing volume conducted nationwide.** This robust dataset, which has been stripped of personally identifiable information, informs public health decision making to help reduce disease in communities.



Increased computing power to fight COVID-19

When exhausting all possibilities to fight a pandemic, it's helpful to have virtually inexhaustible computational capacity, and the **Advanced Molecular Detection (AMD)** program's Scientific Computing (SciComp) resource delivers flexible, powerful tools to CDC and public health departments for use against COVID-19.

Over the past 7 years, AMD has assembled a state-of-the-art computing center infrastructure (see below). The SciComp environment hosts systems and applications critical to the COVID-19 pandemic response. One system powers a dashboard that allows real-time analysis and visualization of syndromic surveillance data from across the nation. Another application, built by AMD SciComp developers, lets state public health labs get much clearer results with COVID-19 tests, while another eases shortages of COVID-19 test kits by matching unused supplies with places that need more kits. SciComp is modernizing data collection and analysis at CDC as big data continues to reshape health sciences.

SciComp infrastructure includes:

140+ computing machines filling 15 racks

750+ virtual computing machines

30+ specialized computing systems

Provides:

4+ petabytes of fast, efficient, on-premise storage to expedite COVID-19 genomic data analysis

Cloud archiving for efficient off-site backup and archiving

Networks:

100+ lab instruments uploading data in real time to permit rapid analysis

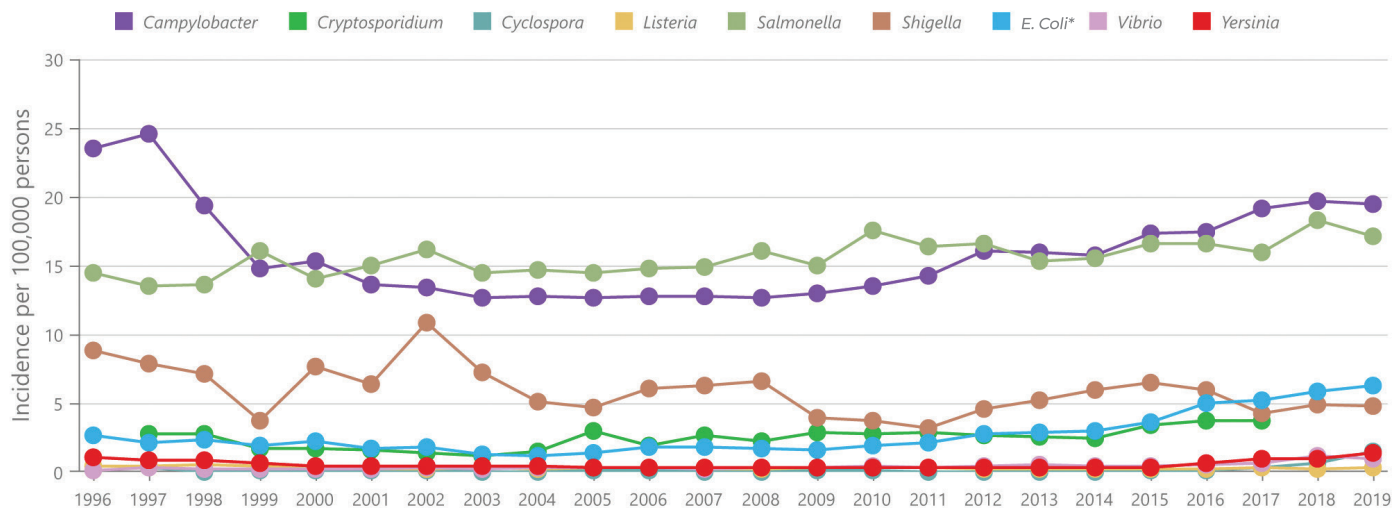
2000+ user accounts support the expanding computational needs of the agency



Incidence of Foodborne Infections by Year

Incidence per 100,000 persons by year for FoodNet sites
1996-2019; all test methods

Source: FoodNet, Centers for Disease Control and Prevention



*Shiga toxin-producing *Escherichia coli*



Following COVID-19's genetic breadcrumbs

CDC's **Advanced Molecular Detection (AMD)** program has built a national network of more than 600 scientists who are using genetic data to track COVID-19 and fight its spread. Representing more than 150 national laboratories, universities, medical companies, foundations, and health departments, these scientists have joined forces to form **SARS-CoV-2 Sequencing for Public Health Emergency Response, Epidemiology and Surveillance (SPHERES)**.

The genetic blueprint, or genome, of SARS-CoV-2, the virus that causes COVID-19, changes gradually as the virus reproduces and spreads from person to person. Public health scientists track these changes to follow the disease's path through the world like a trail of breadcrumbs. They then identify clusters of people who caught COVID-19 from the same sources. This helps public health professionals zero in on outbreak hotspots to find communities that need increased testing and treatment. **Keeping tabs on genomic changes is needed to track new variants and to monitor the impact they could have on diagnostic tests, drugs, and vaccines.** This requires a lot of samples, data, and coordination. The SPHERES consortium brings labs together to make this detective work possible. AMD's role is to coordinate efforts to ensure that the data being generated across hundreds of laboratories are rapidly available and have the greatest impact.



FoodNet Fast's Pathogen Surveillance Tool shows how rates of illnesses have changed in FoodNet's surveillance area since 1996 for selected pathogens transmitted commonly through food.

Making data on foodborne diseases easier to digest

Because seeing is believing, CDC is using data visualization to help people better understand threats from **foodborne diseases**.

CDC's **FoodNet Fast** web tool allows users to effortlessly interact with color-coded graphs of nine common infectious microbes that grow in food. For example, you can see in the graph above how rates of illness caused by different foodborne pathogens have changed over the years. This graph shows that *Salmonella* and *Campylobacter* are the most common foodborne microbes. In 2020, FoodNet Fast was updated to show users how different types of diagnostic tests are impacting the overall number of reported cases of foodborne illness. This **streamlined searchable database offers instantaneous search results to anyone curious about how rates of illness have changed since 1996.**

RUNNING POINT

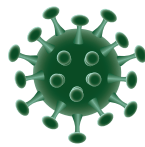


“Sequence data sharing is an incredibly powerful tool in understanding this virus and in responding to the pandemic.”

Duncan MacCannell
AMD Chief Science Officer, NCEZID

on accelerating genomic sequencing

PROTECTING HEALTH at our borders



Safe harbor from COVID-19's tempests at sea

In early 2020, CDC and the US Coast Guard helped more than 260,000 people disembark from cruise ships that were threatened by COVID-19. The crisis started with infection spreading among passengers on a single cruise ship and led to the largest cluster of COVID-19 cases outside mainland China at that time.

- In March, COVID-19's sudden spread on cruise ships **led CDC to issue the first-ever industry-wide No Sail Order to keep the disease from spreading on the ships and into communities.** In addition, CDC issued a Level 3 Travel Health Notice that warned all travelers to defer cruise travel worldwide based on widespread ongoing transmission of COVID-19.
- Since the crisis began, CDC and the Coast Guard have supported medical triage and evacuations for 41 cruise ships affected by COVID-19.

CDC continues working closely with cruise lines to develop public health guidance and preventive measures for the safe resumption of passenger travel on cruise ships.



Innovating and expanding to protect the United States from disease

The emergence of COVID-19 underscored the critical need to expand CDC's quarantine and border activities to prevent the spread of disease. In the years ahead, **NCEZID will innovate and expand programs that protect the United States from communicable disease**, including

- Modernizing CDC's quarantine station network through an integrated system involving international and domestic coverage of air, land, and sea points of entry.
- Increasing our capacity to work with cruise and cargo ships to better allow CDC to rapidly identify and respond to maritime public health risks.
- Expanding comprehensive traveler management systems to quickly provide travelers with essential information to contain infectious diseases before they spread.



A surge like no other: CDC screened a record-setting number of travelers at US airports

COVID-19 spread around the world at the speed of air travel, and to slow its entry into the United States, **CDC screened a record number of international air passengers for symptoms of the disease.** An estimated 766,044 people, arriving in the United States from 31 countries, went through the health checks at 15 airports.

CDC recruited and trained approximately 600 new staff for a surge to CDC's 20 **quarantine stations** at the country's borders and points of entry, where they and border agents helped identify infected travelers. CDC and state and local health departments found treatment for passengers who needed it.

CDC also posted travel health alerts (*pictured above*) on airport monitors and on postcards to warn people about the symptoms of COVID-19 and how to better prevent getting or spreading the disease.



IMPROVING the health of patients



Uniting data to shield older adults from COVID-19

Long before COVID-19 struck, NCEZID was thinking about infections in healthcare settings. This allowed **NCEZID to quickly create the first and only consistent source of data on the pandemic's burden on nursing homes.**

Because older adults have a higher risk of getting severely ill from COVID-19, CDC and the Centers for Medicare & Medicaid Services (CMS) mandated that long-term care facilities report their COVID-19 cases and deaths as well as shortages of personal protective equipment and staffing. More than 12,000 nursing homes complied within weeks, and now, nearly all 15,400 CMS-registered facilities are reporting to CDC's **National Healthcare Safety Network (NHSN).**

The rapid success was made possible by NCEZID's 15-year investment in NHSN, the nation's most comprehensive and widely used system for healthcare quality measurement and improvement. These investments included making NHSN flexible enough to take on new diseases and healthcare facilities rapidly.



Project Firstline empowers healthcare workers

COVID-19 has exposed gaps in the ability to prevent the spread of infections in healthcare settings like nursing homes. In fall 2020, **CDC launched Project Firstline to close those gaps by training millions of US healthcare workers to better control infections, including COVID-19.** With COVID-19 supplemental congressional funding in FY20 and FY21, CDC is collaborating with healthcare and public health organizations, health departments, and academic investigators to spread the latest knowledge, science, and best practices on infection control to healthcare's frontlines.

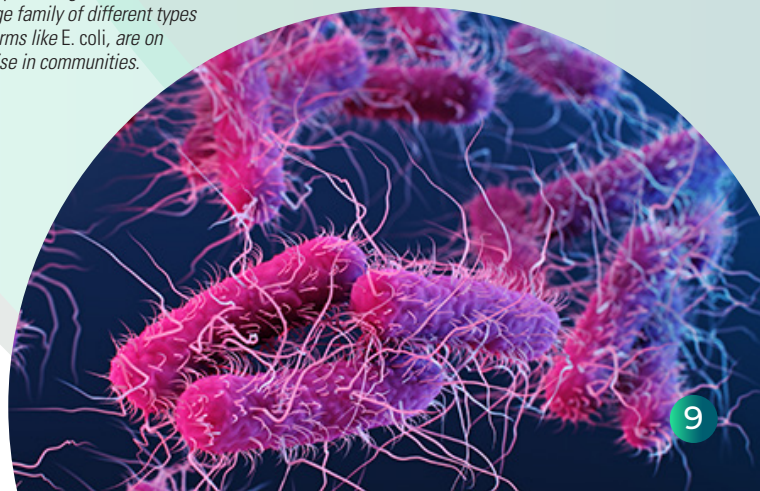


Spearheading the fight against the creeping killer: antibiotic resistance

Antibiotic-resistant bacteria and fungi kill more than 35,000 people per year in the United States. Although CDC and other healthcare organizations have helped tamp down these infections since 2013, some resistant pathogens are on the rise in communities.

CDC will continue to lead the public health response to antibiotic resistance through the 2020–2025 National Action Plan for Combating Antibiotic-Resistant Bacteria (CARB), a US government-wide charge against antibiotic-resistant threats. CDC will continue its sharp focus on preventing the spread of resistant pathogens across healthcare, community, and the environment while building domestic and global capacity to address existing and emerging antibiotic-resistant threats.

Some resistant pathogens, such as ESBL-producing Enterobacteriaceae, a large family of different types of germs like E. coli, are on the rise in communities.



HARNESSING the power of laboratories



NCEZID labs offer novel solutions to pandemic challenges

When CDC launched its response to the COVID-19 pandemic in January 2020, NCEZID laboratories quickly went above and beyond their routine workload to provide surge capacity to the agency.

- Early in the response to the pandemic, NCEZID played a primary role in conducting SARS-CoV-2 clinical diagnostic testing. This created a potential model for CDC's implementation strategy and a framework for future outbreak responses.
- **To better understand how COVID-19 spreads, NCEZID laboratory scientists used specialized techniques to create different types of antibodies**, which are part of the human immune system and critical to fighting infections. NCEZID experts have shared their inventory of COVID-19 antibodies with researchers, universities, and biotechnology companies to help them develop treatments and better testing capabilities.
- After a COVID-19 nasal swab test is taken, the swab needs to be placed in a special liquid for sterile transport to a testing facility. During the early days of the pandemic, the United States experienced a critical shortage of that liquid, known as viral transport medium. In response, NCEZID scientists created a standard "recipe" on how to make this liquid and shared it on CDC's website for hospitals and laboratories to use. This resource went viral, and now countless hospitals and labs have used it successfully when normal supply routes could not meet demand.

To better understand how COVID-19 spreads, NCEZID laboratory scientists used specialized techniques to create different types of antibodies and shared their inventory with researchers, universities, and biotechnology companies to help them develop treatments and improve testing capabilities.

NCEZID scientists responded to a shortage of the sterile liquid needed for transporting nasal swabs by posting a standard "recipe" for it on CDC's website for hospitals and laboratories to use.





Island labs fortified after hurricane devastation

After three devastating hurricanes tore through Puerto Rico (PR) and the US Virgin Islands (USVI) in 2017, NCEZID’s Hurricane Recovery Team partnered with their health departments to help restore public health laboratories.

- One of PR’s labs was so damaged by Hurricane Maria that it was unable to do any testing—a dangerous situation after a natural disaster when the risk of infection from spoiled food and contaminated water is high. **NCEZID worked with the Association of Public Health Laboratories (APHL) and the PR Department of Health to restore and improve testing capacity.** As a result, PR’s Bacteriology Lab is now fully connected to **PulseNet**, a national surveillance network that detects foodborne disease outbreaks.
- Damage to water quality monitoring systems left fears that drinking water was contaminated. NCEZID’s team partnered with APHL to ensure USVI and PR had access to the training, equipment, and supplies needed to resume microbial and chemical water quality testing.
- In USVI, the Department of Health saw an opportunity to expand their limited testing capabilities as part of the rebuilding process. NCEZID’s team worked with public health officials to develop a workflow for the brand-new modular lab that can now test for 42 intestinal diseases. In 2021, plans to help USVI strengthen their lab procedures will take place virtually.

Ebola diagnostic lab set up in record time

In September 2020, NCEZID scientists were part of the team deployed to the Democratic Republic of the Congo (DRC) that demonstrated exemplary flexibility and innovation by setting up an Ebola diagnostic laboratory in the remote health zone of Ingende in a matter of days. **CDC significantly contributed to ending the outbreak by setting up this much-needed lab in an area with active Ebola transmission.** It expanded testing to an area with otherwise limited accessibility, infrastructure, and telecommunications in Equateur Province, which the Ministry of Health and partners eagerly welcomed. The lab introduced diagnostic capacity for Ebola to the area, allowing for results to be received quicker so actions to contain the outbreak could be implemented faster. CDC will continue to provide partners in DRC with training on Ebola diagnostics to help facilitate Ebola survivor programs. CDC will also support future serological studies to better understand Ebola epidemiology and transmission in Equateur Province, including Ingende.

James Graziano using a piece of lab equipment called a “glove box” that CDC flew to DRC for use in the Ebola outbreak response. The glove box allows experts to safely work with patient samples while testing for Ebola.



RUNNING POINT



on leading the hurricane response

“Thanks to collaborations with CDC programs and partners, we rebuilt stronger public health labs and trained lab workforce, creating sustainable change.”

Jeniffer Concepcion-Acevedo
Division Hurricane Recovery Lab Lead, NCEZID

TRACKING INFECTIONS in food, water, and soil

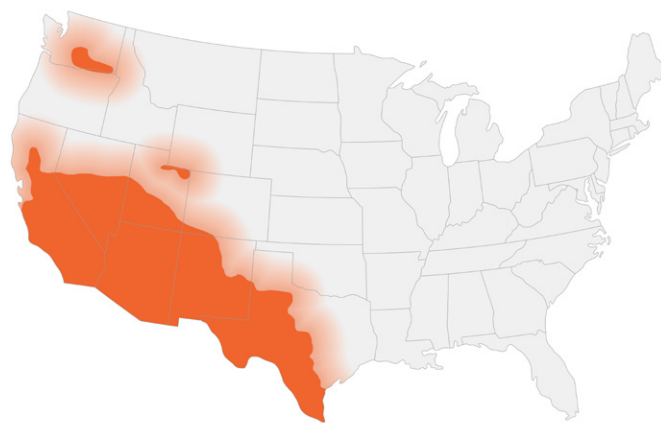


No time to waste: Discovering telltale signs of COVID-19 in wastewater

Fragments of SARS-CoV-2, the virus that causes COVID-19, have been found in wastewater systems and can serve as an alarm bell for communities. **Examining wastewater offers unique benefits.** It's efficient, because a pooled sample can reveal infection levels across an entire community. It can serve as an early warning system because fecal shedding (virus excreted in poop) can occur even before symptoms of infection appear. And it's quick. Changes in infection levels in a community can be detected within a few days versus the 2-week lag for other types of surveillance data.

One group of NCEZID scientists is focusing on examining wastewater from nursing homes, since they are a major hot spot for COVID-19 and can amplify spread into the community. Finding SARS-CoV-2 in nursing home wastewater may help detect infections quicker and stop the spread of disease faster compared with the standard swabbing and screening of individuals when they enter a facility.

NCEZID experts, in collaboration with university and federal partners, evaluated the usefulness of wastewater surveillance for the COVID-19 response, posted technical considerations documents on CDC's COVID-19 website, and built the [National Wastewater Surveillance System](#) (NWSS). In FY20, the NWSS team provided emergency funding for external partners like universities, health departments, and wastewater utilities to facilitate communities of practice where expertise, lessons learned, and best practices can be shared across disciplines. We are poised to expand these systems in FY21. Public health officials can use NWSS data to rapidly identify presence and trends of COVID-19 within a community and get a head start on preventing its spread.



This map shows CDC's current estimate of where the fungi that cause Valley fever live in the environment in the United States. The disease is also common in northern Mexico, including areas along the US border, as well as parts of Central and South America.



Valley fever and COVID-19: They may look similar, but one is a deadly fungus

Valley fever is an infection of the lower respiratory tract resembling community-acquired pneumonia. The disease is caused by the fungi *Coccidioides*, which live in the soil in the southwestern United States and parts of Mexico and Central and South America. The fungus was also recently found in south-central Washington. People get Valley fever by breathing in the microscopic fungal spores from the air, although most people who breathe in the spores don't get sick.

The problem is that Valley fever can look like other lung infections, including COVID-19. Fungal disease experts at NCEZID are working to educate the public and alert healthcare partners of the similarity in symptoms to ensure that Valley fever is not mistaken for COVID-19.



Causing more than crying

NCEZID foodborne disease experts were busy in the summer of 2020 snuffing out an [outbreak of Salmonella Newport infections](#). The culprit causing this unusually large 48-state outbreak with 1,127 confirmed cases was red onions. But because of the way onions are grown and harvested, white, yellow, and sweet yellow varieties were possibly contaminated and included in a large recall. Despite the diversion of many state resources to the COVID-19 response, the outbreak was swiftly detected, investigated, solved, and controlled.



FINDING NEW WAYS

to control diseases from mosquitoes, ticks, and flea bites



Clearing hurdles: EPA registers CDC-discovered active ingredient for new insecticides and repellents

In August 2020, a new active ingredient, **nootkatone**, discovered and developed by CDC, was registered by the Environmental Protection Agency (EPA) for use in new insecticides and insect repellents for protecting people and pets. **Nootkatone repels and kill ticks and mosquitoes.** It is responsible for the characteristic smell and taste of grapefruit and is widely used in the fragrance industry to make perfumes and colognes. Nootkatone is found in Alaska yellow cedar trees and grapefruit skin.

CDC's years-long work with licensed partner Evolve demonstrated that nootkatone is as effective at repelling and killing mosquitoes and ticks as currently available products. Nootkatone-based products will offer people reluctant to use insect repellents currently on the shelves a new option. Another benefit is insecticides with nootkatone will offer a new method for killing mosquitoes that have become resistant to insecticides. The EPA registration paves the way for manufacturers to develop nootkatone-based products for consumers to buy. Nootkatone-based consumer products could be available in 2022.



COEs often assist state health departments when there are outbreaks of vector-borne disease. Pictured here is a mosquito trap used to identify the type of mosquitoes causing an outbreak.

Centers of Excellence help address mosquito-borne and tickborne diseases

The number of reported cases of vector-borne diseases (spread by mosquitoes, ticks, or fleas) doubled from 2004 to 2018; Lyme disease represents almost 8 in 10 of all cases. In 2020, 350 dengue cases have been reported in Puerto Rico, and almost 70 locally transmitted cases were reported in Florida.

In 2017, CDC established and funded five university-based* **Vector-Borne Disease Regional Centers of Excellence (COEs)** through 2021. These COEs develop innovative solutions to reduce these diseases and provide training. They also support research on vector-borne disease prevention and control. Collectively, COEs serve millions of people across 41 states and territories.

The centers build regional capacity and collaboration with health departments and the vector control workforce. COEs are training the next generation of critically needed medical entomologists. Since 2017, the COEs have trained over 5,300 professionals and students through over 80 training opportunities.

COEs serve a critical role in preventing and rapidly responding to emerging vector-borne diseases across the United States. For example, one center oversees a central surveillance system that allows public health officials to make data-driven decisions in real time, such as targeting mosquito control efforts to areas where mosquitoes are spreading viruses.

* Cornell University; the University of California, Davis and Riverside; the University of Florida; the University of Texas Medical Branch in Galveston; and the University of Wisconsin, Madison

Notable work that flew beneath the radar in 2020

"The COVID-19 response has been incredibly challenging—from its toll on human life to the incredible stress it has placed on every aspect of our society. Despite that adversity, I've been privileged to have worked with many different people in the states, local jurisdictions, and federal agencies while deployed and while working in the CDC Emergency Operations Center. During the largest, most complex public health response of our lifetimes, their dedication and commitment to helping mitigate and end this pandemic has been incredibly heartening."

Medical Officer Satish Pillai, NCEZID



RUNNING POINT
on responding to COVID-19

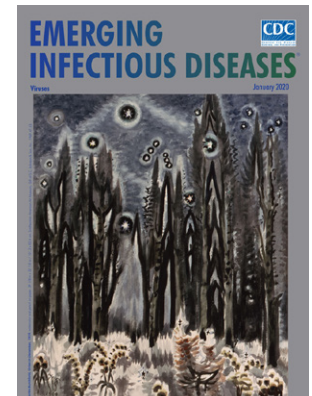


A novel way to reduce mosquito populations

NCEZID staff are working with partners in Puerto Rico to release male mosquitoes with *Wolbachia* bacteria to evaluate how effective the technique is in reducing *Aedes aegypti* mosquitoes. These mosquitoes spread viruses including dengue, Zika, and chikungunya. An added benefit is that *Wolbachia* bacteria are not harmful to people or animals and are found in half of all insects, but not *Ae. aegypti* mosquitoes. When male mosquitoes with *Wolbachia* mate with wild females, their eggs will not hatch. Communities in Texas and California that have released mosquitoes with *Wolbachia* have reported a significant drop in the number of *Ae. aegypti* mosquitoes.

A significant birthday for a significant publication

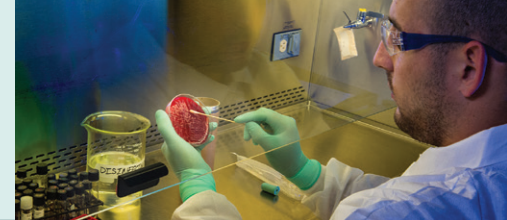
Emerging Infectious Diseases, an open access, peer-reviewed journal published monthly by CDC, marked its 25th year of publication in 2020. As COVID-19 spread around the world, EID's mission to promote the recognition of new and reemerging infectious diseases became even more urgent and focused. EID received a record number of submissions (4,750+), published more articles and more pages than during any previous year in its history, and saw its site visits peak at more than 3,500,000 in the spring before settling to about a million visits each month.



One Health looks for connections between animal and human health

In 2020, CDC's *One Health* experts have been working to learn more about how SARS-CoV-2 (the virus that causes COVID-19) affects animals. One Health is also looking at the possible role that animals play in the spread of this virus. A One Health approach recognizes the close connection between the health of people, animals, and the environment and the role of this connection in the emergence of new diseases like COVID-19. For the COVID-19 response, CDC created the One Health Federal Interagency COVID-19 Coordination Group to help 18 federal agencies coordinate activities related to the One Health aspects of COVID-19.

Next up: Priority work for NCEZID in 2021 and beyond



The COVID-19 pandemic represents a critical juncture for public health and infectious diseases. For NCEZID specifically, responding to the outbreak of SARS-CoV-2 has underscored the center's contribution to preparedness as well as areas for needed growth. At the same time, we need to address our non-COVID priorities of protecting people from domestic and global health threats. This is mission-critical work and cannot be forgotten. Looking forward to 2021 and beyond, we will work with a variety of external partners to build national and global capacity in the following areas:

State and local support

NCEZID'S ELC (Epidemiology and Laboratory Capacity for Prevention and Control of Emerging Infectious Diseases) program has provided \$11B in COVID-19 funding for state and local partners. The increased support combined with NCEZID's expansive subject matter expertise has made ELC an even more critical funding mechanism. Looking ahead, ELC will explore new ways to support all levels of public health (from state to local and territorial) and the infectious disease workforce.

Laboratory strengthening

With more than 120 national, state, and local laboratories, the Laboratory Response Network's (LRN) purpose is to respond to public health emergencies. An updated LRN-B network will be critical to responses to future infectious disease emergencies and must remain prepared for these threats.

Keep up with important changes in the virus

CDC's response to COVID-19 has highlighted the central role of NCEZID in addressing gaps in healthcare preparedness and response, particularly related to infection control across the healthcare system and within facilities like nursing homes. Looking forward, we will need to establish preparedness and response plans that enhance the healthcare system's capacity to prevent, detect, and respond to emerging diseases.

Travelers' health and quarantine

Preventing and mitigating future pandemics will require

- Modernizing our quarantine station network
- Increasing our capacity in maritime settings (cruise ships and cargo ships) so that we can rapidly identify threats
- Developing a comprehensive program to quickly provide travelers with essential information to contain infectious diseases before they spread.

Vector-borne disease

The US is increasingly vulnerable to diseases spread by mosquitoes, fleas, and ticks. Looking to 2021 and beyond, we need better data to develop disease prevention tools and research, which would then be made available to states and local jurisdictions for implementation. We need to continue to improve support for states to ensure they have the staff, laboratories, and data systems needed to implement full vector-control programs.

Antibiotic resistance

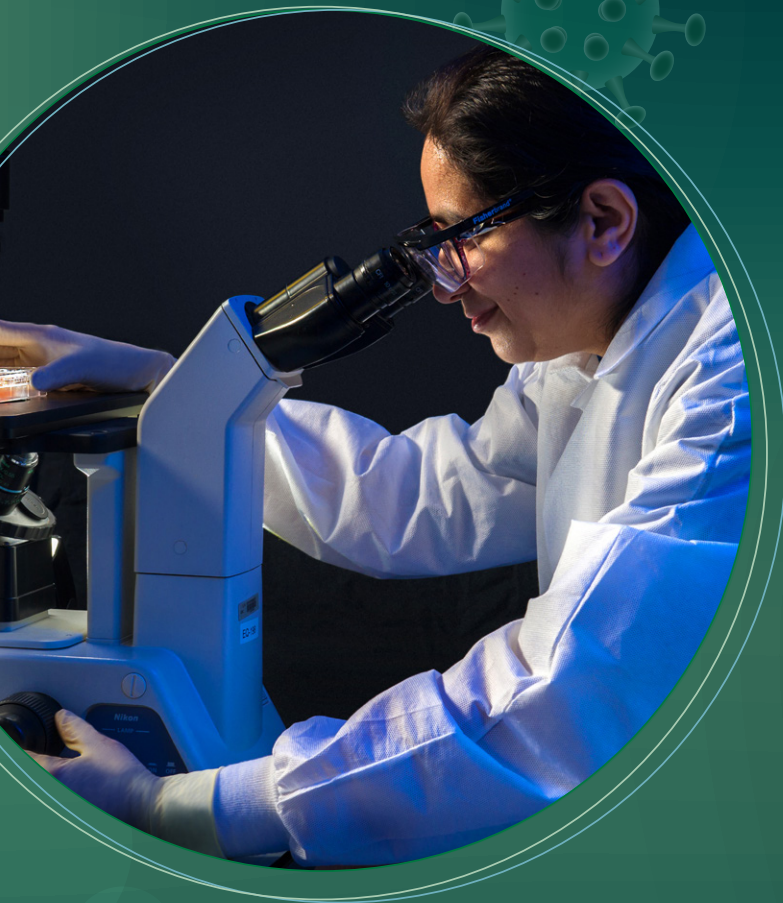
NCEZID remains committed to addressing the threat of antibiotic resistance, one of the biggest public health challenges of our time. In the US, we continue to drive change through greater implementation of infection prevention programs, antibiotic stewardship, and collaboration between public health and healthcare. Looking forward, we must address antibiotic resistance on a global scale to improve detection and infection prevention and support improved use of and access to antibiotics.

Advanced Molecular Detection

Genomic sequencing has been critical for our response to COVID-19, allowing us to keep up with important changes in the virus and contributing to better diagnostics and therapeutics. But as we already knew, AMD is important for all infectious diseases, and we will need to continue to prepare for the next pathogen and outbreak on the horizon.

Global health

NCEZID's global portfolio includes everything from full-scale programs to discrete research and assistance, as well as cross-cutting bodies of work that underpin major global responses. NCEZID is also a main implementing partner in global health security. Looking forward, we want to move the needle of impact in multiple areas of global health including antibiotic resistance, cholera, rabies, and viral hemorrhagic fevers, just to name a few. Supporting these prevention and control efforts helps us strengthen capacities in our partner countries for responding to emerging disease threats.



SO NOTED

Noteworthy facts inside this report

These deadly bacteria have been found in an unexpected place—tropical fish tanks. *(Lurking in the fish tank, p 3)*

CDC formed a nationwide team that will identify clusters of people who caught COVID-19 from the same sources. *(Following COVID-19's genetic breadcrumbs, p 7)*

Early in the pandemic, NCEZID labs posted a "**recipe**" on the CDC website for a hard-to-find liquid needed to transport nasal swabs. The recipe went viral and helped hospitals and labs brew their own batches. *(NCEZID labs offer novel solutions to pandemic challenges, p 10)*

NCEZID quickly created the first and only consistent **source of data** on the pandemic's burden on nursing homes. *(Uniting data to shield older adults from COVID-19, p 9)*

In the summer of 2020, an **outbreak of more than 1,100 *Salmonella* infections** was linked to this source. *(Causing more than crying, p 12)*

Nootkatone, the key ingredient in a new insect repellent, is found in the skin of this citrus fruit. *(EPA registers CDC-discovered active ingredient for new insecticides and repellents, p 13)*

Examining wastewater offers unique benefits for tracking COVID-19 in communities. *(No time to waste: Discovering telltale signs of COVID-19 in wastewater, p 12)*

Rates of a type of gastric cancer are four times more common among Alaska Native people than in other populations. *(Protecting Alaska Native people from cancer-causing bacteria, p 4)*