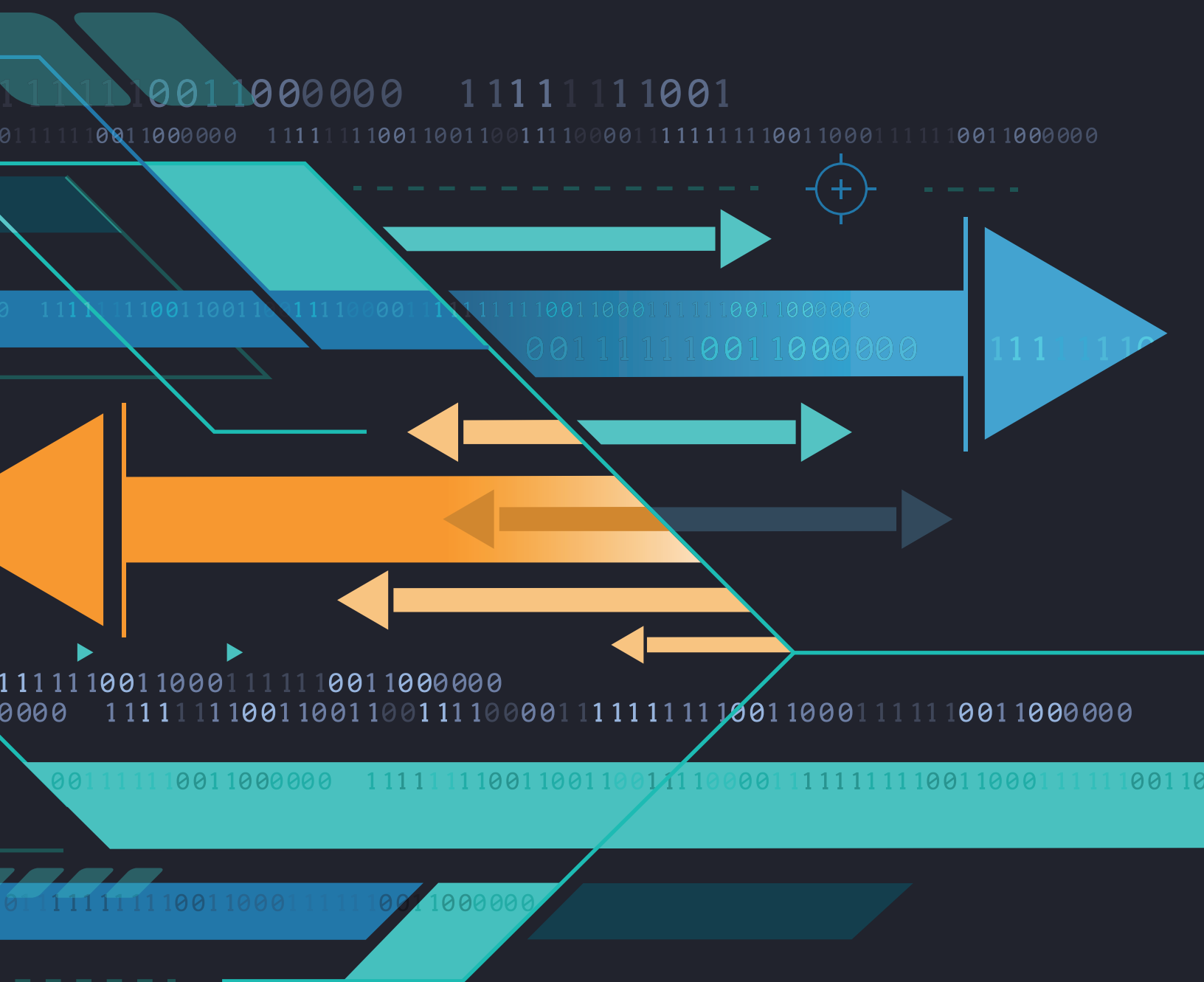


INNOVATIVE TECHNOLOGY



RABIES REACT APP



In the fight against rabies, app streamlines work- and dataflow

Rabies kills 59,000 people each year globally, and in some countries, the danger of infection is widespread. To streamline these countries' efforts to stop the disease's spread, NCEZID created a free app and data system and offers free training on how to use them.

The Rabies Exposure Assessment and Contact Tracing (REACT) app runs on smartphones and tablets. It enables professionals in the field to open a new case when they suspect a person or an animal has been exposed to rabies. REACT guides field professionals to take life-saving actions like making sure people who need them get access to rabies shots, and dogs suspected of having rabies are quarantined. REACT reminds field professionals of follow-up tasks and connects them with labs and public health specialists who can add data and feedback through the app. Data are compiled and shared with regional, national, and global health organizations to help everyone involved with fighting rabies improve their efforts.

REACT is currently in use in eight countries and has recorded more than 30,000 rabies exposure investigations. Once symptoms appear, rabies is almost always deadly.

NEW TICKBORNE BACTERIA



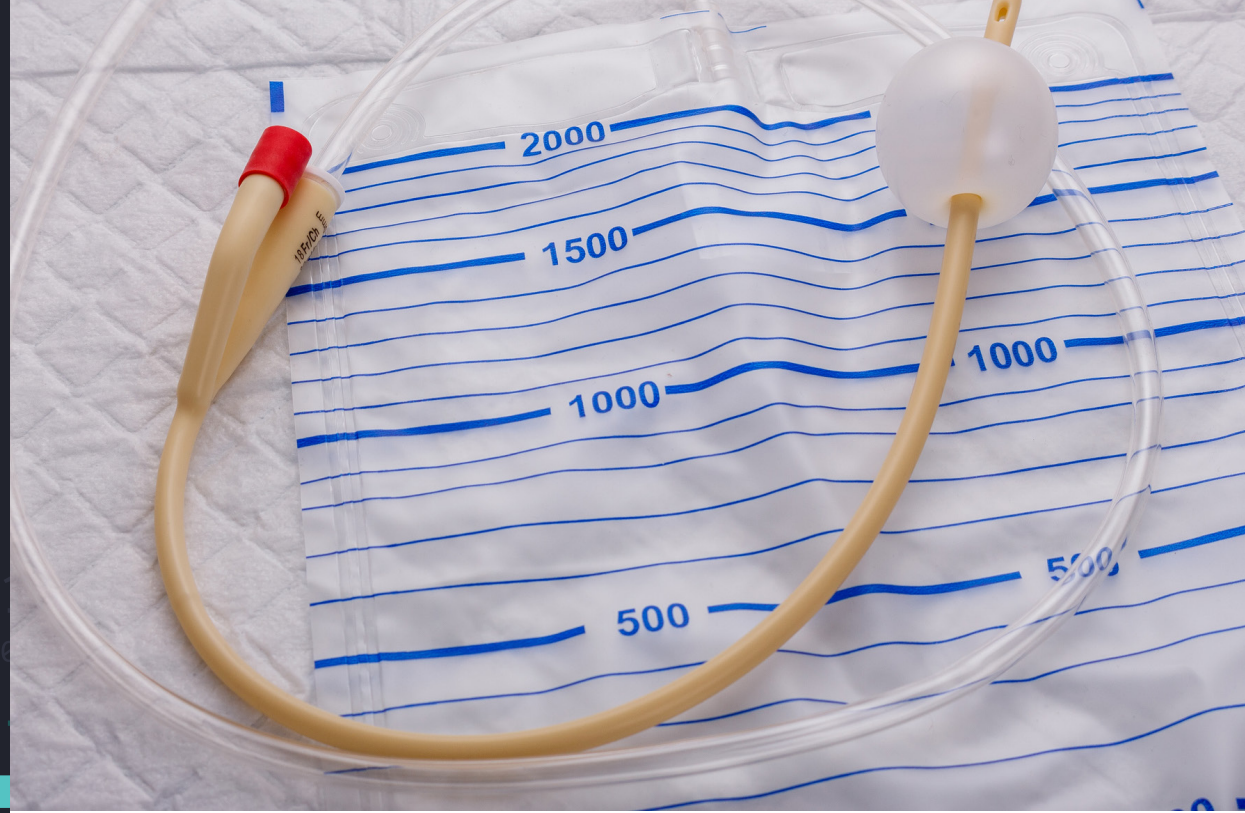
New tickborne disease bacteria discovered with advanced technology

NCEZID scientists have discovered two tickborne bacteria not previously known to cause illness in people. The team used an advanced genomic sequencing technology called 16S metagenomics that can precisely identify bacterial genes in clinical samples, like blood. Analyzing them with standard technology is more painstaking and less productive.

The 16S metagenomic technology enabled the team to analyze, with a single evaluation, over 13,000 samples collected by medical partners from people suspected of having a tickborne illness. The team found 12 tickborne bacteria species that cause illness, including the two new bacteria. The advanced technology identified twice as many tickborne bacteria among the tested samples as compared to initial testing using standard diagnostic tools.

The 16S metagenomics technology is a form of Advanced Molecular Detection (AMD). NCEZID scientists are using another AMD method that reveals key molecules in other tickborne bacteria that are challenging to study. The team is combining technologies to take stock of tickborne germs and ticks that spread them, and it is building a database to track the spread of both across the country. It's the first database of its kind in the Western Hemisphere.

INFECTIONS FROM CATHETERS



A Solution to Urinary Tract Infections Caused by Catheters

Urinary tract infections (UTI) are the most common type of healthcare-associated infection reported to CDC, and some bacteria that cause UTIs can be resistant to the antibiotics that treat them. In the United States, urinary catheters cause roughly 75% of UTIs, and biofilms - complex communities of microorganisms that irreversibly attach to a surface - are often the cause.

Traditionally, clinicians prevent biofilms on catheters by prescribing patients a high concentration of antibiotics (prophylaxis). This method can be ineffective and increases the risk of a patient getting an antibiotic-resistant infection. To prevent UTIs and reduce unnecessary antibiotic use, NCEZID staff and Georgia Institute of Technology (Georgia Tech) developed a coating made of bacteriophages (phages), or viruses that selectively kill bacteria to prevent biofilm development on catheters.

The phages effectively fight the development of biofilms, avoid potential dangers of antibiotic overuse, and can target multiple infectious bacteria at once, which might otherwise require a combination of antibiotics. The team from NCEZID and Georgia Tech aim to expand this effort to make the catheter coating available and accessible worldwide.



GEOFENCING

Targeted text messages alert travelers to infectious disease threats

You step off a plane into an airport terminal, and a text message buzzes your smartphone. It's a CDC Travel Health Alert Notice (T-HAN) informing you about a new faster-spreading variant of COVID-19 in the country you just visited. The T-HAN recommends that you monitor yourself for symptoms and gives you recommendations on how to protect yourself and others.

NCEZID is working on a system that sends T-HANs like this one to international travelers when they enter the United States at designated locations. The location is determined by a geofence, an invisible border drawn by wireless technology. A geofence can encircle an airport or just a gate to send targeted messages to people coming from countries at risk for specific diseases. Currently, T-HANs are distributed in print, but a digital system could reach more people with tailored information. Updating digital alerts would be much faster and more effective than reprinting and distributing paper versions. Quickly updating T-HANs is particularly important in rapidly evolving outbreaks like COVID-19 when public health guidance can change frequently with growing knowledge and spread of the disease. CDC previously ran small tests of geofence-triggered alerts during the Zika response and early on in the COVID-19 pandemic.

TRACKING ANTIBIOTIC RESISTANCE



MODERNIZATION IS A MINDSET



MODERNIZING DATA

Tracking antibiotic-resistant bacteria with better, faster detection

If bacteria in something you ate made you sick, you probably got over it within a week. Had your immune system been weaker, you may have needed antibiotics. If you did, the antibiotics might not have worked. That's because some enteric, or intestinal, bacteria, such as Salmonella, have become resistant to antibiotics. Tracking the growing health threat caused by antibiotic resistant bacteria is an urgent need to protect people's health.

The National Antimicrobial Resistance Monitoring System for Enteric Bacteria (NARMS) tracks antibiotic resistance in bacteria collected from ill people, animals, and food found at stores. The program, a collaboration among CDC, FDA, USDA, and state and local health departments, uses advanced technology called whole-genome sequencing (WGS) to identify resistant bacteria. Public health workers use WGS information to identify resistance trends, link illnesses to sources, such as food or animal contact, and help solve outbreaks. Since 2016, CDC and state and local health departments have collaborated to build capacity for WGS technology with the help of federal funding to combat antibiotic resistant bacteria and, in 2019, WGS replaced older technologies as the new standard for outbreak detection. WGS and the NARMS surveillance system are powerful tools in the fight against antibiotic resistance.

Urgently modernizing U.S. public health data systems

"Brittle and siloed" is how NCEZID once described the nation's public health data systems. Health departments and parts of CDC used different data systems and differing approaches to handling data. Many were out of date. CDC's Data Modernization Initiative (DMI) works to unify and advance data systems at CDC and in the nation's health departments, and when COVID-19 struck, the Coronavirus Aid, Relief, and Economic Security (CARES) Act awarded \$500 million to CDC for DMI. The support has brought CDC much closer to our goal.

At NCEZID, we are collaborating to build resilient data networks that can help prevent and control new infectious disease outbreaks while interlinking the nation's health data systems to meet some of CDC's DMI goals. Here are some examples:

- Initiatives enabling lab data sharing between CDC, public health labs, healthcare providers, and academic labs
- EZ Data Exchange, a data infrastructure that NCEZID shares with all of CDC and which interacts with important central data resources at CDC, while handling data that NCEZID and partners use to track the spread of infectious diseases
- Expanding the National Healthcare Safety Network, the nation's most widely used system to track infections associated with healthcare settings



Developing a vaccine against a tickborne hemorrhagic fever

With symptoms to rival Ebola, Crimean-Congo Hemorrhagic Fever (CCHF) is often as deadly. There is no approved medication to treat the disease, usually spread by ticks, and no proven vaccine. CCHF can also spread directly between people through contact with blood or other bodily fluids, and it can spread through animal blood. Early symptoms resemble flu and can include stomach pain and vomiting. CCHF often causes redness in the eyes, face, and throat; jaundice; vision and hearing problems; severe bruising; nose bleeds; and death.

NCEZID scientists are in the experimental stages of developing a new vaccine with promising initial results. A successful vaccine would help effectively fight CCHF, which currently infects people from Eastern Europe to Central Asia and Africa. NCEZID's team made the vaccine by genetically engineering a fake, non-infectious version of the CCHF virus to train the immune system to fight the real virus. A single dose of the vaccine has proven 100% effective in protecting mice engineered to be susceptible to CCHF.



Wastewater: A new early-warning tool

COVID-19 drove innovation across CDC and the rest of the scientific world; one such area has been wastewater testing, which can serve as a bellwether for communities in the COVID-19 pandemic. Samples taken from wastewater systems can contain genetic material from the SARS-CoV-2 virus in feces of infected people. CDC experts, working with academic researchers, wastewater utilities, and public health colleagues, found that tracking the amount of virus in wastewater systems can provide early detection and reliable trends of community-level COVID-19 cases. Data from wastewater testing supplement existing COVID-19 surveillance systems by providing an efficient pooled community sample that can monitor infections, regardless of whether someone has symptoms, sees a doctor, or gets tested.

In 2020, CDC established the National Wastewater Surveillance System (NWSS), an innovative and unique collaboration among CDC, state and local health departments, academic institutions, wastewater utilities, and private laboratories to help communities put this tool to work. As of December 2021, CDC has funded 43 jurisdictions to conduct wastewater surveillance for SARS-CoV-2. More than 30,000 wastewater samples have been tested, representing more than 44 million Americans. As we continue to see COVID-19 outbreaks, NWSS data will be a critical tool to help healthcare providers prepare for case increases and the impact on hospitals and healthcare workers. Wastewater surveillance can also target data collection from specific institutions such as nursing homes and correctional facilities where cases can spread quickly, and provide data in vulnerable communities where other forms of disease surveillance may not be enough. In coming years CDC will build on this capacity by expanding NWSS to better understand and respond to many other infectious disease threats like antimicrobial resistance or foodborne diseases.

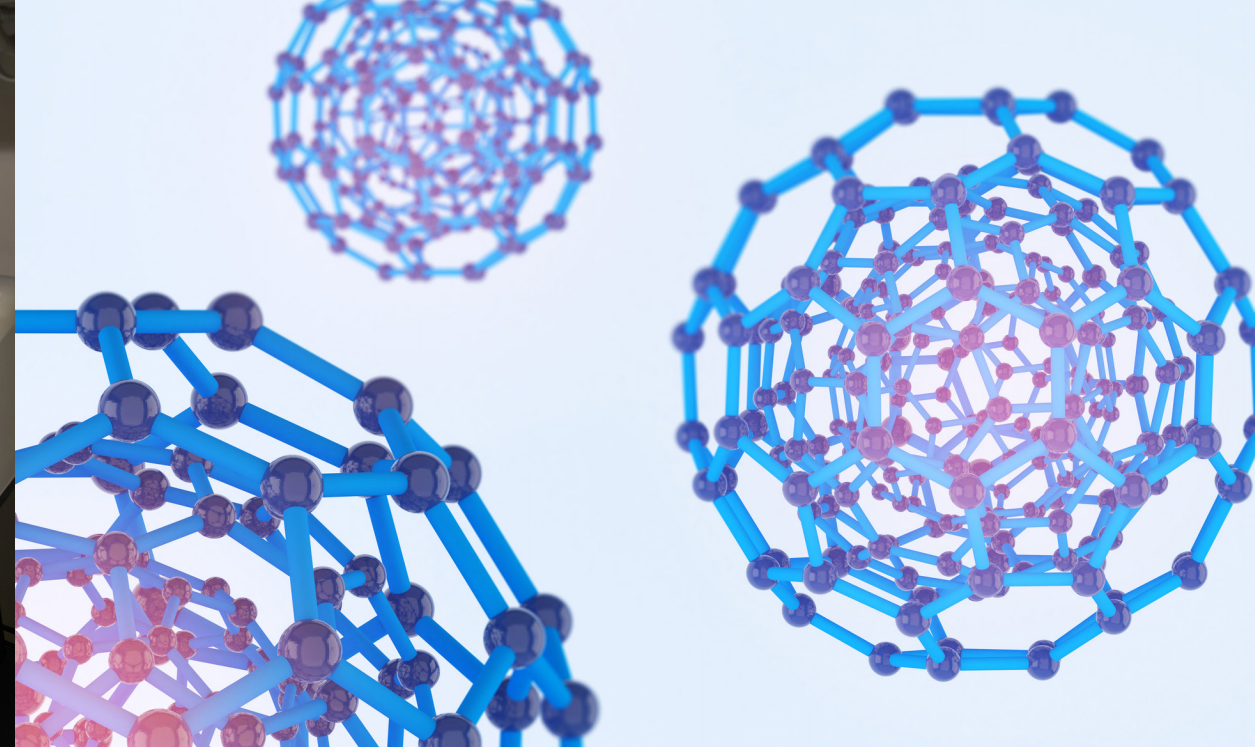
IDENTIFYING BIOTHRREATS



Enabling laboratories to detect bioterror agents and other biothrreats

In the event of a bioterror attack in the United States, accurate and rapid identification of disease-causing agents prevents illness and saves lives. Thanks to a collaboration between CDC and the Department of Defense (DOD), 16 laboratories around the United States stand ready to identify biothrreat agents close to home using a new laboratory diagnostic test. The labs are members of a larger partnership called the Laboratory Response Network (LRN), and each of the 16 labs provides regional coverage.

CDC and DOD have worked closely to equip the 16 LRN laboratories with Warrior Panels—a DOD-laboratory developed diagnostic test—and the instrument needed to run the tests. The Warrior Panel tests human samples for biothrreats such as those that cause anthrax, tularemia, plague, Q fever, and some viral hemorrhagic fevers, all at the same time. Testing for multiple agents simultaneously means that laboratories can quickly identify or rule out potential threats and take public health action. CDC took necessary steps to ensure the Warrior Panel could be easily and consistently used by highly trained staff in LRN laboratories. With the tests, equipment, and required skills, these laboratories are ready to provide reliable results—quickly enabling public health leaders to make informed decisions with confidence.



RAPIDLY IDENTIFYING OUTBREAKS

Nanoparticles could concentrate germs and help hospitals quickly identify outbreaks

Healthcare-associated infections cause nearly 700,000 illnesses in the United States every year. But when an outbreak occurs, zeroing in on the source of an infection in a hospital can be difficult and time-consuming.

To simplify source identification, CDC is testing whether nanoparticles can be used to draw out disease-causing germs from environmental sampling swabs taken around a hospital. The nanoparticles, which are generally bigger than the size of a virus but smaller than bacteria, are treated with a chemical coating that latches onto specific pieces of protein, free-floating DNA, or even the whole germ itself. That process can concentrate any germs the swabs picked up, making it easier to identify them.

“If successful, applying this technology could let hospitals get to the source of an outbreak faster and more cheaply than they can today,” says Angela Coulliette-Salmond, a CDC public health environmental microbiologist.

“The idea is to have something you could do in the field, so someone collecting samples in a hospital room could process that sample on site, and you would have your results in a few hours.” Coulliette-Salmond says.

CDC is currently testing how well the commercially available nanoparticle technology works in laboratory studies. Field tests in healthcare settings will be possible within two years. Similar efforts are under way to use the same nanoparticle technology to detect the virus that causes COVID-19 in samples taken from surfaces or wastewater.

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