National Center for Emerging and Zoonotic Infectious Diseases

GLOBAL HEALTH PRIORITIES 2023-2026

CDC

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Introduction

The National Center for Emerging and Zoonotic Infectious Diseases (NCEZID) prevents infections, protects health and security, and saves lives. In this highly connected world, zoonotic and emerging infectious diseases are a growing threat in the United States and globally. Scientists estimate that more than six out of every 10 known infectious diseases in people can be spread from animals. The number of outbreaks is increasing for diseases such as cholera and viral hemorrhagic fevers; the spread of diseases is accelerating due to vector range expansion for diseases such as dengue and yellow fever; and the morbidity and mortality from antimicrobial-resistant pathogens is increasing dramatically.

NCEZID infectious disease and laboratory experts are at the forefront of critical global health security efforts. We provide leadership in international disease identification, control, elimination, and prevention; advance research and science; and build collaborations with international stakeholders, including bilateral and multilateral partners from multiple sectors. NCEZID works across CDC with a One CDC approach, collaborating with CDC's Global Health Center (GHC) and its regional and country offices, the National Center for Immunization and Respiratory Diseases, and the Office for Readiness and Response; other US government agencies; country partners; and international organizations. Through these partnerships, NCEZID strengthens outbreak response, infectious disease capacity in surveillance and epidemiology, laboratory diagnostics, and infection prevention and control through a One Health approach. In collaboration and close partnership with GHC and regional and country offices, the work of NCEZID builds on core capabilities in workforce, laboratory, surveillance, and preparedness and response. NCEZID programs also develop and validate medical countermeasures (MCMs) for known and emerging infectious diseases. These efforts are vital to address known threats, like mpox and viral hemorrhagic fevers (VHFs), including Ebola and Marburg virus diseases, and to mitigate known and re-emerging threats that pose a risk to the United States.

NCEZID's global health vision is to equitably protect the United States and global populations from infectious disease threats in support of CDC's mission. The **global health mission of NCEZID** is to promote strategic leadership, multisectoral collaboration, innovative science and technologies, and capacity building to prevent, detect, mitigate, and control infectious diseases, including spillover to humans from natural or deliberate threats to the United States.

As part of NCEZID Moving Forward, the goals described in this document focus on NCEZID global priority programs and provide measurable outcomes for the next 1–3 years. Programs develop monitoring and evaluation metrics to measure success and inform program impact. Collectively, work on these priority areas deepens scientific understanding of infectious diseases; builds multisectoral public health capacity to detect, prevent, and respond to outbreaks; and provides flexibility to address urgent public health needs as they arise. In addition to furthering the scientific and public health evidence base for emerging and zoonotic infectious diseases, NCEZID's global health activities support CDC's commitment to implementing the US Government's Global Health Security Strategy and National Biodefense Strategy.

NCEZID GLOBAL HEALTH PRIORITIES

NCEZID Cross-Cutting Global Priorities

Across all global programs, NCEZID's work is a continuum of efforts from research and science to development and assessment of diagnostics and MCMs, to capacity building, all of which contribute to regional and national capacities and capabilities to detect, prevent, and respond to public health threats.

NCEZID:

- Provides leadership and scientific support for preparedness, outbreak response, and mitigation efforts globally to prevent cross-border spread of infectious diseases, including Tier 1 select agents
- Integrates epidemiology, surveillance, laboratory, and mitigation measures to enhance prevention, detection, and response
- Conducts research and science to inform prevention, detection, mitigation, and response
- Assists partner countries and regions to develop national policies or plans to address priority zoonotic and infectious disease threats within their borders
- Strengthens binational, regional, and global public health communication and coordination networks to enable immediate notifications of public health threats to other countries
- Uses a multisectoral, One Health approach to address infectious disease threats at the human-animal-plant-environment interface, including preventing spillover of zoonotic and emerging infectious diseases
- Trains workforce and builds capacity for a One Health approach to infectious disease prevention, detection, and response
- Develops standardized assays to detect new and emerging pathogens, and disseminates them to multisectoral partners through laboratory networks
- Provides leadership and support to expand access to advanced technologies for molecular detection, including next-generation sequencing (NGS) and bioinformatics
- Ensures that research, programs, and response activities focus on preventing the spread of infectious diseases to the United States

NCEZID One Health Approach

NCEZID utilizes a One Health approach, partnering with public health, animal health (agriculture & wildlife), environment, and other relevant sectors when addressing global public health threats. Working collaboratively across One Health sectors to strengthen coordination, surveillance, data and information sharing, outbreak response, and joint multisectoral training ensures a more holistic approach to addressing priority zoonotic diseases and enhancing preparedness to address emerging and re-emerging infectious diseases. CDC's One Health Office collaborates with the Quadripartite* to develop guidance and operational tools that can be used by countries, regions, and CDC programs.

**The Quadripartite consists of the Food and Agriculture Organization of the United Nations (FAO), the United Nations Environment Programme (UNEP), the World Health Organization (WHO), and the World Organisation for Animal Health (WOAH, founded as OIE).*

HIGH-PRIORITY THREATS

Introduction

The number of outbreaks of high-priority threats, including VHFs and orthopoxviruses, is increasing, with new outbreaks occurring in non-endemic countries. NCEZID works with countries to understand the risk factors for exposure, geographic expansion, and appropriate preventive measures to detect and respond to these outbreaks as quickly as possible. NCEZID's work in developing new MCMs, including diagnostic tests, vaccines, and therapeutics, has helped decrease the morbidity and mortality associated with these events.

Viral Hemorrhagic Fevers

VHFs, such as Ebola, Marburg, and Lassa fever, are life-threatening and highly infectious and pose high outbreak potential. Since few VHFs are vaccine-preventable, early detection of outbreaks is critical to saving lives. NCEZID engages in disease surveillance, education, and laboratory capacity-building for dozens of the world's deadliest VHF viruses and has provided expertise and support for over 50 outbreaks of VHFs in several dozen countries since 2000.

NCEZID leads outbreak responses for VHFs and provides technical assistance for case investigation, contact tracing, case management, infection prevention and control, safe burials, community engagement, risk communication, health education, and survivor follow-up. NCEZID also supports laboratory testing and data management and has assisted with vaccination campaigns for VHFs. NCEZID furthers research to better detect, track, treat, and prevent VHFs, with a focus on incorporating emerging technologies such as unbiased virus genome sequencing approaches, mobile sequencing laboratories, and development and evaluation of rapid diagnostics tests. In addition, NCEZID works to prevent diseases from crossing borders, including into the United States.

Goal: *In the next 1–3 years, the program will develop national diagnostic testing capacity for Nipah, Marburg, and Zaire and Sudan ebolaviruses in three Global Health Security-intensive support countries (Bangladesh, Uganda, and Democratic Republic of the Congo [DRC]). It will also establish action plans, including response frameworks for at least two countries (DRC and Uganda) with recent VHF outbreaks.*

Mpox

Mpox is a disease caused by infection with an orthopoxvirus in the same genus as variola virus, which causes smallpox. Mpox is a re-emerging zoonotic disease that can lead to a painful and debilitating rash and death. The 2022 multinational mpox outbreak highlighted the risks for pandemic spread of these viruses and demonstrated the need to better understand risk factors for infection (including severe disease), the origins and evolution of the virus, and therapeutic options for immunocompromised people. To better control re-emerging outbreaks across West and Central Africa, NCEZID is collaborating with partners to strengthen mpox surveillance and response in Nigeria, Cameroon, and DRC. These collaborations include developing and testing new MCMs for mpox (such as therapeutics, vaccines, and diagnostics). NCEZID is also strengthening capacity to conduct epidemiologic and ecologic investigations to understand the circulation and transmission of the virus that causes mpox (MPXV) in animal and human populations. NCEZID supports expanded access to vaccines and research to evaluate the safety and effectiveness of the JYNNEOS vaccine to protect against MPXV infection.

Goal: *In the next 1–3 years, the program will strengthen poxvirus diagnostic capacity in DRC, Cameroon, and Nigeria, and will increase ecological and epidemiologic partnerships in these countries. The poxvirus program will assess the effectiveness of the JYNNEOS vaccine to protect against MPXV infection in healthcare workers and other at-risk groups with data from DRC.*

Introduction

The threat of vector-borne diseases is expanding rapidly across the globe due to climate change and increased globalization. NCEZID concentrates efforts in key global sites predisposed for vector-borne disease emergence and works to prevent exposures to and mitigate consequences of vector-borne pathogens through improved diagnostics, surveillance, and control programs. NCEZID provides foundational support in developing critical molecular diagnostic and surveillance capabilities, including at laboratories in Indonesia and Uganda, to detect arboviruses like West Nile virus. The skills that staff developed at these labs played a crucial role in diagnosing and characterizing cases of COVID-19 and yellow fever (YF), and the Indonesia lab was instrumental in the discovery of Zika and West Nile viruses in Asia and the south Pacific.

Yellow Fever

Much of Africa and the Americas are at risk for epidemics of YF, which is spread by mosquitoes. Recent vaccine shortages hampered prevention efforts and put US travelers at risk. NCEZID is a major partner in WHO's Eliminating Yellow Fever Epidemics (EYE) Strategy, which provides technical assistance to all countries at risk for YF outbreaks and supports CDC staff responding to epidemics. NCEZID develops, validates, and distributes molecular assays to at least eight at-risk countries in Africa and South America, trains local staff in their proper use, and supports WHO reference laboratories, such as the Uganda Virus Research Institute. NCEZID continues to further YF control with research to evaluate the duration of immunity and long-term efficacy of the YF vaccine.

Goal: *In the next 1–3 years, the program will strengthen laboratory testing for YF in five countries in sub-Saharan Africa, three countries in South America, and two regional reference laboratories (Cameroon and Uganda), through the development and distribution of the YF HD ELISA assay, an advanced enzyme detection technology. NCEZID will work with partners (e.g., EYE secretariat, WHO regional and country offices, and Ministries of Health) to determine optimal vaccination strategies in three high-risk countries (Chad, Niger, and Somalia), and to assess long-term immunogenicity of YF vaccine in children in 2 countries (Argentina and Uganda).*

VECTOR-BORNE DISEASES AND VECTOR CONTROL

Dengue

Dengue is the most common arboviral disease worldwide and is projected to increase in both disease burden and geographic range. For the first time in the history of dengue, there are effective interventions available to support dengue control, including novel vector control methods, such as *Wolbachia*-based strategies, and WHO-approved vaccines. NCEZID will help develop an effective dengue vaccination and control program for partner countries and US territories where dengue already exists and prepare for potential expansion of dengue cases in the continental United States. In partnership with our expanding regional public health networks that concentrate on insect vectors, NCEZID is working to evaluate the effectiveness of these new interventions and understand how they impact dengue transmission.

Goal: *In the next 1-3 years, the program will evaluate the implementation of* Wolbachia *mosquito population replacement in El Salvador, monitor the impact of this intervention on dengue transmission, and lead implementation of insecticide resistance surveys in at least one country. The program will monitor dengue vaccine approval processes and provide technical assistance for vaccine implementation in selected countries in the Americas where the vaccine is approved. The program will continue to strengthen dengue laboratory testing and sequencing to monitor introduction of novel genotypes in the Americas.*

GLOBAL PARASITIC DISEASES

Introduction

Spread by the bite of an infective mosquito and other insects, from eating contaminated food, or passed from a mother to her baby, parasitic diseases are responsible for an enormous global burden of illness, disability, and death. CDC is the world's safety net in the diagnosis and treatment of parasitic diseases. NCEZID provides expertise in prevention, diagnosis, treatment, surveillance, monitoring, and evaluation to states and countries. NCEZID also provides this integral expertise for the US government and public health partners. Additionally, it conducts vital research to improve public health programs, including the development and evaluation of new pharmacologic, epidemiologic, laboratory, and vector control tools.

Malaria

Malaria is a parasitic infectious disease spread by the bite of infective female *Anopheles* mosquitoes. The disease can cause fever, chills, and flu-like illness. If it is not treated promptly, it can cause severe complications and death. The World Health Organization estimates that in 2022, malaria caused 608,000 deaths and 249 million illnesses across 85 countries. The African continent has the highest burden of malaria, accounting for 94% of all malaria cases and 95% of deaths; children under 5 years of age account for nearly 78% of all malaria deaths. Additionally the public health threat from malaria in Africa and globally may increase if the mosquito vector, *Anopheles stephensi*, continues its geographic expansion. Unlike other *Anopheles* vectors, *Anopheles stephensi* thrives in both urban and rural areas and is resistant to many commonly used insecticides. This vector was originally limited to South Asia and the Middle East but has been spreading in Africa including Djibouti, Ethiopia, and Kenya since 2012.

Malaria is a threat to American travelers, military personnel, and citizens living and working abroad. On average, 2,000 malaria cases are diagnosed each year in the United States, mostly in travelers returning from an area with malaria. However, during May-October 2023, 10 locally acquired cases of malaria were reported; locally acquired mosquito-borne malaria has not occurred in the United States since 2003. Additionally, emerging data show growing resistance to the commonly used first-line malaria treatment, artesunate. If resistance to artesunate continues to grow, treating malaria infections in the US and globally will become more difficult.

NCEZID leads efforts in surveillance, prevention, and treatment of malaria in the United States. Globally, in addition to prevention and treatment support, NCEZID provides scientific leadership in the development of innovative strategies for surveillance, monitoring and impact evaluation. We work hand in hand with ministries of health, other US Government agencies, and partners to support these efforts. Led by USAID, CDC co-implements the US President's Malaria Initiative (PMI) in 27 sub-Saharan African countries and has three programs in the Greater Mekong Subregion. Since 2005, PMI, in collaboration with the Global Fund and Roll Back Malaria, have worked with endemic partner countries to scale up science-based malaria interventions. These efforts have saved nearly 12 million lives globally. Moreover, an estimated 94% of malaria deaths in Africa, the continent hardest hit by malaria, were averted between 2000 and 2022.

Goal: *In the next 1-3 years, complete, analyze and disseminate the findings from five trials assessing novel pharmacologic (L9LS monoclonal antibodies and RTS,S vaccine pilot implementation) and vector control interventions (attractive targeted sugar bait, spatial repellant, housing modifications) to decrease malaria parasitemia, cases, hospitalizations, and deaths in endemic countries.*

GLOBAL PARASITIC DISEASES

Neglected Tropical Diseases

Neglected tropical diseases (NTDs) are a group of preventable and treatable parasitic, viral, bacterial, fungal, and non-communicable diseases that affect more than one billion people globally. NTDs cause devastating health and economic problems. NTDs cause disability that hinders school attendance, care of families, and earning wages. They disrupt productivity in already fragile economies.

NCEZID provides global scientific leadership on NTD control and elimination programs through collaborations with organizations like the World Health Organization (WHO). Some NTDs, including lymphatic filariasis (elephantiasis), blinding trachoma, onchocerciasis (river blindness), and schistosomiasis can be controlled or even eliminated by providing safe and effective medicines to individuals in affected communities through mass drug administration (MDA). CDC focuses on improving the implementation of MDAs, including evaluation and training.

This is accomplished in part by supporting research to develop better laboratory surveillance tools to guide programs and improve coverage of MDA, and by supporting morbidity management and disability prevention for individuals suffering with lymphatic filariasis (LF). Scale-up of proven interventions by CDC, USAID, WHO, and partners, including private sector and endemic countries, allows communities to no longer fear morbidity from these NTDs. Support from the US government has resulted in 391 million people no longer requiring treatment (after having been treated) for LF and 196 million people no longer requiring treatment for trachoma. Fifty countries worldwide have successfully eliminated at least one NTD. MDA-based programs, which utilize $29.9 billion in donated drugs from the private sector, are considered one of the most cost-effective programs in public health—with a cost of about $0.10 to $0.50 per person per year who receives treatment.

Goal: *In the next 1–3 years, strengthen the laboratory and epidemiologic surveillance capacity for endemic neglected tropical diseases by: supporting surveys for persistent trachoma in nine countries; evaluating new diagnostic tests for schistosomiasis in three countries; and implementing operational research studies on the serologic threshold for stopping mass drug administration for onchocerciasis to inform WHO guidance in three countries.*

COMBATING ANTIMICROBIAL RESISTANCE GLOBALLY AND STRENGTHENING INFECTION PREVENTION AND CONTROL

Introduction

NCEZID works to protect patients, healthcare workers, and communities from infectious disease threats, including antimicrobial resistance (AR). In healthcare settings, NCEZID builds effective infection prevention and control (IPC) programs, including water, sanitation, and hygiene (WASH), and establishes networks globally to rapidly detect and respond to AR and other infectious disease threats. Programs include enhancing laboratory capacity to detect and report AR, establishing or strengthening national tracking systems to respond rapidly to outbreaks, identifying emerging pathogens and tracking trends, and supporting innovative solutions to stop the spread of AR globally.

During outbreaks, healthcare facilities must implement effective IPC interventions to prevent transmission of infectious pathogens, including back into the community. NCEZID works with ministries of health, healthcare facilities, public health organizations, and implementing partners to improve IPC practices during public health emergencies, including recent outbreaks of Ebola and the COVID-19 pandemic.

Antimicrobial Resistance

NCEZID continues expanding CDC's Global Antimicrobial Resistance Laboratory and Response Network (Global AR Lab & Response Network), which takes a broad-reaching, One Health approach to improve the detection of antimicrobial-resistant threats and prevent their spread globally. The Global AR Lab & Response Network spans nearly 50 countries and works with more than 20 organizations worldwide to build laboratory capacity so that laboratorians are able to detect antimicrobial-resistant pathogens, prevent infections in healthcare and the community through proven infection control practices, and respond in new and innovative ways to AR threats. This network identifies risk factors driving the emergence and spread of AR threats across One Health sectors and responds to those threats, including those found in healthcare, the community, food, animals, and the environment (e.g., water and soil). These settings are impacted by many types of infections – such as healthcare-associated infections (HAIs) and sexually transmitted infections – and many types of pathogens, including fungal, enteric, and invasive bacterial and respiratory pathogens. The Global AR Lab & Response Network builds on NCEZID's successful domestic Antimicrobial Resistance Laboratory Network to help identify and respond to AR threats before they can further spread globally.

Goal: *In the next 1–3 years, the Global AR Lab & Response Network will strengthen sustainable laboratory capacity in up to 50 countries across at least nine antimicrobial-resistant pathogens; improve data management, analysis, and interpretation for appropriate public health action; and foster data-sharing locally, nationally, regionally, and globally, including through WHO's Global Antimicrobial Resistance and Use Surveillance System (GLASS).*

COMBATING ANTIMICROBIAL RESISTANCE GLOBALLY AND STRENGTHENING INFECTION PREVENTION AND CONTROL

Infection Prevention and Control

NCEZID prioritizes IPC investments made during the Ebola and COVID-19 responses and is leveraging them to develop long-term IPC programs led by ministries of health to increase preparedness and response capabilities and build more resilient healthcare systems with a safety culture aimed at preventing HAIs and protecting the healthcare workforce.

NCEZID's Global Action in Healthcare Network (GAIHN) is a global collaborative network consisting of countries, institutions, and partners at global, regional, national, and subnational levels working together to address emerging infectious disease threats in healthcare settings through rapid detection, prevention, and response. GAIHN has two modules: AR and HAI. The GAIHN-AR module identifies AR-related threats in healthcare settings as a part of CDC's Global AR Lab & Response Network. In addition, it applies evidence-based measures to prevent and contain the spread of AR threats through a network of local, regional, and global level IPC experts. The GAIHN-HAI module addresses HAIs in participating facilities through enhanced surveillance and diagnostics, IPC activities, and coordination of relevant local and regional public health experts. GAIHN builds on NCEZID's successful surveillance and prevention initiatives in US healthcare settings to reduce AR and HAI rates globally.

Goal: *In the next 1–3 years, GAIHN will expand to over 30 healthcare facilities in at least 13 countries, strengthening HAI and AR surveillance and epidemiologic capacity globally to better detect, prevent, and respond to AR pathogens and other critical infectious disease threats in healthcare settings. NCEZID will also implement IPC programs to prevent the spread of infections in healthcare settings in at least 15 countries.*

MIGRATION AND TRAVEL AND BORDER HEALTH

Introduction

Globalization makes it easier to move people and goods across the world in a short time, increasing the risk of diseases spreading across international borders as well. NCEZID's migration, travel, and border health activities focus on reducing that risk. Scientific evidence and expertise in infectious disease prevention and surveillance, and lessons learned from previous epidemic responses, including those for outbreaks of Ebola, Zika, yellow fever, pneumonic plague, and COVID-19, help us continuously improve our efforts to protect US borders.

Migration and Travel Health

NCEZID works to prevent the importation and spread of disease by implementing evidence-based practices that promote safe public health actions for people coming to the United States. As part of this work, NCEZID develops the requirements for the medical exam for over 300,000 immigrants and 125,000 refugees who come to the United States each year. Unlike immigrants, refugees are not required to get vaccinated before coming to the United States. Recognizing that vaccination is an important measure to improve refugee health and reduce the risk of disease spread through these mobile populations, NCEZID works closely with US federal and global partners to increase vaccination in refugee settings around the world.

NCEZID also promotes and improves the health of people coming to the United States by conducting surveillance and epidemiologic investigations in refugee settings and among travelers to inform interventions and recommendations on how to protect oneself before, during, and after travel. One way NCEZID does this is through the Traveler-based Genomic Surveillance program (TGS) that provides an early warning system for multiple respiratory pathogens, such as new SARS-CoV-2 variants or influenza strains, by voluntarily testing arriving international travelers with nasal swabs at US airports. The TGS program has also been working to expand genomic traveler surveillance through aircraft wastewater surveillance in the United States and plans to explore ways of working with airport partners globally to establish aircraft wastewater surveillance at international airports overseas. These surveillance activities provide an early and more complete picture of global disease spread that informs travel health recommendations and preparedness and response activities to combat public health threats.

Goal: *In the next 1–3 years, the program will promote and improve the health of refugees coming to the United States by ensuring that 85% of refugees resettling to the United States are appropriately vaccinated with two doses of measles-containing vaccine. NCEZID will also establish surveillance for pathogens that threaten public health by testing aircraft wastewater in at least three international airports in the United States or overseas to better understand the disease importation risks to the United States.*

MIGRATION AND TRAVEL AND BORDER HEALTH

Border Health

NCEZID's border health program focuses on strengthening international public health systems through

1. implementing preparedness and response capacities at official points of entry;
2. supporting analysis of population movement patterns to identify at-risk areas or populations; and
3. enhancing information sharing between neighboring countries, regionally, and globally.

Strong border health systems require up-to-date plans and procedures, well-trained staff, and the legal authorities to implement travel public health measures that affect the movement of people or goods. Since the program began, NCEZID has provided technical assistance to at least 70 countries to strengthen their border health capacities to better detect and respond to communicable diseases in mobile populations and prevent the diseases' geographic spread.

Goal: *In the next 1–3 years, the program will improve detection of infectious diseases at border crossings and increase Joint External Evaluation border health indicators by identifying two to three high-priority countries in each of the six WHO regions that will establish cross-border information-sharing agreements, map and analyze migration patterns, and enhance ill traveler detection and response systems at priority points of entry.*

GLOBAL WATER, SANITATION, AND HYGIENE, GLOBAL WATERBORNE INFECTIONS, AND GLOBAL FOODBORNE DISEASES

Introduction

NCEZID's critical work in waterborne and foodborne diseases helps advance international health regulation (IHR) core capacities across foodborne and waterborne diseases, strengthens laboratory systems and surveillance to detect pathogens prior to their importation into the United States, and supports WHO's Global Strategy for Food Safety. NCEZID's work focuses on integration of rapid diagnostic testing, whole genome sequencing (WGS), epidemiologic coordination, and complementary use of vaccination to improve detection and control of waterborne and foodborne diseases.

NCEZID strengthens epidemiology, behavioral science, and environmental microbiology capacity to improve access to and use of WASH systems and practices, as well as capacity for designing, implementing, and evaluating robust WASH preparedness and response.

Global Water, Sanitation, and Hygiene

Access to and use of WASH services and practices for preparedness and outbreak response is limited globally, given that 2 billion people lack access to safely managed drinking water, 3.6 billion people do not have access to safely managed sanitation, and 2.3 billion people lack basic hygiene services. Both households and institutions, including community public spaces like schools, border locations, markets, and community centers, often lack organizational guidance, standards, and management practices to establish and maintain safe WASH.

NCEZID supports the institutionalization of WASH preparedness and response components of community mitigation activities. Many were built during Ebola and COVID-19 (e.g., hand hygiene, sanitation, laboratory practices, and capacity and behavior change campaigns) in healthcare settings, community public spaces, and household settings in high-risk countries. NCEZID works with governmental and non-governmental partners to establish evidence-based guidance and preparedness activities by aligning health sector objectives with WASH sector practices. These efforts helped increase key hand hygiene interventions, including alcohol-based hand rub, hand hygiene messages, and cleaning and disinfection guidance, for preparedness and response to outbreaks of Ebola, cholera, COVID-19, and other illnesses of public health importance over the last 3 years. During the COVID-19 pandemic, WASH program activities took place in 114 healthcare facilities, 59 community institutions, and 405 households across six countries. NCEZID continues to support the development of evidence-based guidance to fill gaps in best practices for access to and use of WASH measures for community mitigation. Additionally, WASH subject matter expertise in sanitation systems present in low-resource settings globally enables support for capacity building and implementation of global wastewater and environmental surveillance in non-sewered systems within these settings.

Goal: *In the next 1–3 years, the program will strengthen guidance and capacity for WASH preparedness and response in selected regions of sub-Saharan Africa and in at least two countries (Uganda and Kenya) and contribute to priority outbreak responses. NCEZID will contribute to global guidance around WASH preparedness for hand hygiene in public places and support WASH capacity by bringing together health- and WASH-sector partners to prepare for and respond to outbreaks of waterborne or WASH-related diseases.*

GLOBAL WATER, SANITATION, AND HYGIENE, GLOBAL WATERBORNE INFECTIONS, AND GLOBAL FOODBORNE DISEASES

Cholera

Cholera is a severe, epidemic-prone disease that causes an estimated 2.9 million cases and 95,000 deaths annually. In 2017, the Global Task Force on Cholera Control (GTFCC) launched a new cholera elimination initiative, *Ending Cholera: A Global Roadmap to 2030*, with a goal to end cholera as a public health threat by reducing cholera deaths by 90% and eliminating cholera transmission in 20 countries. Despite this bold initiative, the world is facing an acute cholera crisis due to multiple humanitarian emergencies driven by political conflict and climate change. In January 2023, 30 cholera outbreaks were occurring simultaneously, more than at any other time in history.

Cholera prevention leverages many of the WASH capacities mentioned above. NCEZID also informs countries' cholera planning activities and surveillance efforts, evaluates rapid diagnostic tests for cholera, and shares findings with country and international partners. NCEZID strengthens public health, clinical, and environmental microbiology laboratory systems and supports countries' diagnostic capacity (e.g., rapid diagnostic tests, PCR, and WGS) to improve understanding of the global dynamics of cholera and support elimination efforts. These investments help public health officials monitor the spread and duration of outbreaks and inform rapid interventions.

Goal: *In the next 1–3 years, the program will strengthen clinical and environmental laboratory and surveillance capacity in four countries (DRC, Kenya, Tanzania, and Haiti) at high risk for cholera. NCEZID will develop and implement advanced methods, standardized training materials, and best practices for cholera detection, and evaluate national and subnational laboratory capacity for readiness. NCEZID will support implementation of GTFCC adaptive surveillance and testing decentralization strategies and promote national and regional outbreak preparedness in these priority countries.*

ENHANCING SURVEILLANCE AND DETECTION OF EMERGING INFECTIONS THROUGH PATHOGEN-AGNOSTIC METHODOLOGIES

Introduction

NCEZID programs and experts are committed to improving quick detection of emerging infectious diseases through expanding pathogen-agnostic methodologies and platforms including wastewater surveillance, PulseNet (enteric pathogens), MicrobeNet International (bacterial and fungal pathogens), and advanced molecular detection. These laboratory surveillance modalities and networks, along with integrated, technology-driven data platforms, allow partners to identify outbreaks and their causes more quickly, improving outbreak response times.

PulseNet International

PulseNet International (PNI) strengthens over 80 countries' capacity to detect and characterize potential outbreaks due to foodborne, waterborne, and One Health-related illnesses. Through regional trainings and technical assistance, PNI builds and strengthens laboratory capacity for WGS for outbreak detection and AR surveillance of enteric bacteria, supports quality assurance, and enhances data interpretation for action through genomic epidemiology in seven regions.

Goal: *In the next 1–3 years, PNI will support training and capacity building for WGS in the PulseNet Asia Pacific, PulseNet Latin America and Caribbean, and PulseNet Middle East regions. PNI will support WGS trainings and development of a community of practice in PulseNet Africa. PNI will evaluate WGS capacity in the Eastern Europe and Central Asia regions for enteric bacteria and start a new regional network hub.*

Wastewater and Environmental Surveillance

Wastewater and Environmental Surveillance (WES) supports the development and implementation of robust, sustainable, and adaptable surveillance of sewered wastewater and non-sewered fecal waste streams (environmental surveillance) in low-resource settings globally. The program collaborates with global partners to establish and maintain evidence-based guidance on the use and utility of WES systems through decision support tools, sampling assessment tools, laboratory best practices, and other guides. Finally, the program helps partners and communities of practice (CoPs) create peer-to-peer learning of global WES best practices.

Goal: *In the next 1–3 years, the program will develop training platforms in three regions (sub-Saharan Africa, Eastern Europe and Central Asia, and Southeast Asia), implement and expand wastewater and environmental surveillance programs within these regions, expand platforms to include multiple disease targets, and develop guidance documents and decision support tools.*

ENHANCING SURVEILLANCE AND DETECTION OF EMERGING INFECTIONS THROUGH PATHOGEN-AGNOSTIC METHODOLOGIES

MicrobeNet International

MicrobeNet International provides databases for MALDI-TOF large molecule detection results, DNA sequences, biochemical data, and soon WGS data for more than 15,000 species of bacteria and fungi to users in 97 countries. This helps laboratorians identify rare bacterial and fungal species within minutes, enhancing early detection and response times.

Goal: *In the next 1–3 years, MicrobeNet will expand and launch the WGS module to allow users to send genome data directly to MicrobeNet on species, antimicrobial resistance markers, virulence factors, and toxins, bringing bacterial and fungal identification for over 15,000 species to clinical and public health labs worldwide.*

Advanced Molecular Detection

Advanced molecular detection brings advanced technologies, including NGS and bioinformatics, into practice in global settings to more effectively prevent and respond to critical public health threats such as antimicrobial resistance, *Candida auris*, *Vibro cholerae* (the bacterium that causes cholera), and hemorrhagic fever viruses. CDC's Office of Advanced Molecular Detection's Global Pathogen Genomic Surveillance Strategy aims to build regional sequencing nodes that together form a global pathogen genomic surveillance network.

Goal: *In the next 1–3 years, the program will release CDC's Global Genomic Pathogen Surveillance Strategy to coordinate efforts across the agency and with global partners. NCEZID will establish pathogen-agnostic surveillance pilots in at least two countries to strengthen early warning and outbreak response to novel and emerging infectious diseases and provide technical assistance to at least three countries to develop their national pathogen genomic surveillance strategies.*

OTHER INFECTIOUS DISEASE THREATS

Introduction

NCEZID programs work in additional areas that pose a threat to the United States through importation and potential use in bioterrorism. This section describes additional priority areas of work.

Rabies

While rabies is 100% preventable, nearly 60,000 people die from the disease around the world each year. Rabies is an ever-present threat to the US population and is a top-10 risk for animal-to-human spillover, and the top risk for importation through animal trade. NCEZID efforts to prevent rabies include developing and testing new MCMs, such as more affordable and thermostable vaccines and therapeutics that can be utilized in resource-limited countries, and implementation of critical cross-cutting capacities for surveillance and response. Since 2019, NCEZID has supported the investigation of suspected rabies virus exposures globally, ensuring that victims and exposed pets receive appropriate post-exposure prophylaxis, treatment, and testing (when indicated). NCEZID is a WHO Collaborating Center for Rabies and a WOAH Reference Laboratory for Rabies, both of which have designated rabies elimination as a global priority under the Neglected Tropical Diseases Roadmap. NCEZID continues to further research to better detect, track, treat, and prevent rabies virus infections with a focus on incorporating emerging technologies, such as electronic applications, field-deployable virus genome sequencing approaches, and point-of-care tests, to support outbreak investigations and surveillance.

Goal: *In the next 1–3 years, the program will pilot implementation of the WHO/CDC Rabies Healthcare Center DHIS-2 Module in three countries in Africa and Southeast Asia, with >10,000 bite victims receiving in-clinic consultation support; evaluate the cost, benefit, and suggested uses of point-of-care diagnostic tests in five countries in Africa, South America, and the United States, with at least 800 direct comparisons to a gold-standard test; and support the expansion of CDC's Integrated Bite Case Management System into four new countries in Africa and Southeast Asia, with the system used to document at least 1,000 new surveillance case investigation outcomes.*

Fungal Diseases

Fungal diseases, including sporotrichosis, cryptococcosis, histoplasmosis, candidemia, and coccidioidomycosis, pose a global public health challenge. Global capacity to detect fungal pathogens is currently limited. Building global capacity for surveillance of fungal pathogens is critical to establishing preparedness and response capabilities for emerging and re-emerging fungal threats. NCEZID provides laboratory and epidemiology capacity-building support to more than 23 countries to improve the ability to identify, conduct surveillance, and respond to fungal threats. NCEZID has implemented the FungiNet Global pilot, which has initiated WGS for *C. auris* in Colombia and South Africa. Plans to further develop regional fungal centers of excellence to support genomic epidemiology and detection of emerging threats will help support efforts to rapidly identify and respond to fungal threats.

Goal: *In the next 1–3 years, the program will help establish laboratory capacity to identify fungal pathogens in more than 16 countries, help establish three regional fungal centers of excellence in South America, Africa, and Asia to support fungal disease detection and genomic epidemiology, and identify mitigation strategies to reduce the spread of zoonotically transmitted fungal diseases such as sporotrichosis.*

Rocky Mountain Spotted Fever

Rocky Mountain spotted fever (RMSF) is a tick-borne disease with high mortality. Epidemics of RMSF have been occurring along the US-Mexico border for the past 10 years. There are increasing reports of the disease moving into areas in the southwestern United States, including tribal communities, where the incidence is 150 times the national average. NCEZID has shown that reduction of RMSF is possible with a multi-factorial approach using tick preventives on dogs, application of pesticides to homes, spay/neuter campaigns, and community education.

Goal: *In the next 1–3 years, the program will work in one study site in northern Mexico affected by RMSF to 1) obtain accurate canine population estimates, 2) establish baseline infection rates of* R. rickettsii *in brown dog ticks, and 3) assess rates of acaricide resistance in brown dog ticks. The program will also isolate and characterize at least two* R. rickettsii *strains contributing to the high prevalence of RMSF in northern Mexico. The information obtained will provide data for implementing control measures at the local level, including application of pesticides, testing, and deploying a potential canine vaccine against RMSF.*

OTHER INFECTIOUS DISEASE THREATS

High-Consequence Bacterial Diseases

High-consequence, select-agent bacterial diseases, such as anthrax, brucellosis, and melioidosis, can have serious public health, animal health, and economic consequences, in addition to being potential bioterrorism threats. *Bacillus anthracis* and *Burkholderia pseudomallei*, the causative agents of anthrax and melioidosis, respectively, are Tier 1 select agents. *Bacillus anthracis* has successfully been used as a bioterror weapon in the United States and recent evidence shows expansion of environmental suitability within the United States for *Burkholderia pseudomallei*. Where these pathogens are endemic, NCEZID is working globally to build capacity for surveillance and laboratory detection, and to support coordination and collaboration between animal and human health sectors to reduce the risk of importation of these diseases by travelers, products, or intentional means. NCEZID also provides support during outbreak investigations, including through case investigation, sample collection, community engagement, and recommendations on treatment, control, and prevention measures. Lastly, NCEZID is developing new MCMs, including point-of-care tests and the ability to detect antimicrobial resistance patterns, to improve timely detection and treatment of these pathogens. NCEZID has provided technical assistance to enhance anthrax and brucellosis surveillance, laboratory capacity, and outbreak response in 10 countries since 2013. Globally, NCEZID is planning to work with countries in the Americas to better understand the expansion of melioidosis towards the United States and importations that may lead to further introduction of this disease into the United States.

Goal: *In the next 1–3 years, the program will evaluate and provide training on lateral flow point-of-care devices for anthrax in Cameroon, Bangladesh, and Uganda to improve timely diagnosis and treatment. NCEZID will conduct environmental surveillance for* B. pseudomallei *in Bangladesh, Thailand, and the Americas to better understand the expansion of the threat to the United States and study the prevalence of antimicrobial resistance.*

Looking Ahead

NCEZID has begun the process of placing key subject matter experts (Regional Technical Advisors) in IPC/AMR, Emerging and Zoonotic Infectious Diseases, and Border Health and Migration in CDC regional offices to strengthen coordination between NCEZID programs and multisectoral partners, and allow programs to fully meet their public health goals. NCEZID programs will continue to work closely with GHC and CDC regional and country offices, as well as other centers and offices, using a One CDC approach to prevent, detect, and respond to infectious disease threats. Within this framework, NCEZID activities are poised to further CDC and US government global health strategies, sustain partnerships, and improve surveillance and response information and data sharing within and across sectors.

NCEZID global programs focus on key areas of subject matter expertise that are critical in most infectious disease outbreaks that currently threaten the United States. Additional cross-cutting areas, such as One Health, capacity building for pathogen-agnostic testing, and diagnostic development, further strengthen our ability to respond to new and emerging threats. Continued investments in NCEZID global health activities are needed to maintain the capacity to prevent, detect, and respond to the next outbreak and pandemic. The priority programs highlighted above, along with the goals outlined, will guide NCEZID programs over the next 1–3 years to focus on activities most critical to protecting the United States from global public health threats.

NCEZID Priorities by Region – Highest-Priority Threats to the United States

A One Health approach is used when addressing the below threats

Eastern Europe and Central Asia (EECA)

- AR (bacterial and fungal) and IPC
- Border health, migration, and points of entry/exit
- Waterborne and foodborne (enteric) diseases and WASH
- High-consequence pathogens: Crimean-Congo hemorrhagic fever (CCHF) virus, Rift Valley fever virus

Middle East and North Africa (MENA)

- Border health and migration
- High-consequence pathogens: CCHF virus, Rift Valley fever virus
- AR (bacterial and fungal) and IPC
- Waterborne and foodborne (enteric) diseases, cholera, and WASH
- Other infectious disease threats: anthrax, brucellosis

South America (SAM), Central America and Caribbean (CAC) (including Mexico)

- Vector control and vector-borne diseases: dengue, yellow fever
- Border health, migration, and points of entry/exit (migrants and US-Mexico border, cross-border surveillance)
- Parasitic diseases (malaria, Chagas, leishmaniasis)
- Antimicrobial resistance (AR) (bacterial and fungal) and infection prevention and control (IPC)
- Waterborne and foodborne (enteric) diseases, cholera, and WASH
- High-consequence pathogens: South American hemorrhagic fever viruses
- Other infectious disease threats: rabies, *Burkholderia pseudomallei* (i.e., melioidosis), Rocky Mountain spotted fever

Southeast Asia (SEAS) and East Asia and Pacific (EAP) (including Bangladesh and India)

- Vector control and vector-borne diseases: dengue, Japanese encephalitis
- High-consequence pathogens: Nipah virus
- Parasitic diseases (malaria, lymphatic filariasis)
- AR (bacterial and fungal) and IPC
- Border health, migration, and points of entry/exit (cross-border surveillance)
- Other infectious disease threats: rabies virus, anthrax, *Burkholderia pseudomallei* (i.e., melioidosis)

Sub-Saharan Africa

- Waterborne and foodborne (enteric) diseases, cholera, and WASH
- High-consequence pathogens: orthopoxviruses (e.g., mpox), viruses that cause VHFs (Ebola, Marburg, Crimean-Congo, Lassa, Rift Valley)
- Parasitic diseases (malaria, lymphatic filariasis, onchocerciasis, blinding trachoma, schistosomiasis, soil-transmitted helminth infections, and Guinea worm disease)
- Vector control and vector-borne diseases: yellow fever, plague
- AR (bacterial and fungal) and IPC
- Border health, migration, and points of entry/exit (cross-border surveillance, mapping migration routes)
- Other infectious disease threats: rabies, anthrax

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