Biosafety and infectious disease occupational health training from the NIEHS Worker Training Program: A historical look at capacity building that supported a COVID-19 response

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BACKGROUND

The COVID-19 pandemic demonstrated that large segments of the workforce—many of which were not previously considered or valued—are needed to keep the economy moving and critical societal functions going. From first responders to bus drivers, this expanded essential workforce needed training to build a solid knowledge of infectious disease protection practices. However, most workplaces had no existing plan or training for infectious disease exposure control. The National Institute of Environmental Health Sciences (NIEHS) Worker Training Program (WTP) was able to immediately respond with health and safety curricula, resources, and course delivery based on decades of building capacity for disaster and infectious disease response.

WTP was initiated under the Hazardous Substance Basic Research and Training Program authorized by the Superfund Amendments and Reauthorization Act of 1986 (42 USC 9660a), in response to the growing concerns about hazardous waste cleanup endangering worker health.\(^1\) NIEHS WTP, at the National Institutes of Health (NIH), funds nonprofit organizations throughout the United States (US) to provide health and safety training to prepare workers who may be exposed to hazardous materials at work or while assisting with emergency response. Additionally, some grants are awarded to small businesses to develop e-learning products through the Small Business Innovative Research program.\(^2\)

WTP's network reaches a wide variety of industries and occupations, such as construction; environmental remediation; manufacturing; industrial; health care; first responders; retail; and federal, state, and municipal employees. The organizations provide training not only to the traditional workforce but also to the groups that can be hard to reach or may not have easy access to health and safety education, such as day laborers, Native Americans and Alaska Natives, and un- or underemployed individuals. WTP also funds the National Clearinghouse for Worker Safety and Health Training (the Clearinghouse) to develop training resources and provide technical assistance to WTP-funded organizations and the public.\(^3\)

WTP aims to empower workers to take actions that improve safety and health in their workplaces and can lead to organizational change.\(^4\) WTP’s model includes extensive training of worker-trainer or peer instructors, resulting in a cadre of trainers across occupations and industries. These trainers can further disseminate training and education within their workplaces and communities, increasing the sustainability of meeting local or regional training needs and building the program’s nationwide capacity for response to ongoing and new hazardous work situations and emergencies. WTP funding also supports the development of curriculum and other occupational safety and health training materials.
WTP’s first large-scale disaster response followed the terrorist attacks on September 11, 2001 (9/11). WTP responded to the occupational safety and health training needs of cleanup workers, emergency responders, and others at risk of exposure to hazardous substances in the debris.5 In the following years, the National Response Plan (NRP) was developed, a guide on how the nation responds to disasters and emergencies. The NRP evolved into the National Response Framework (NRF) and NIEHS WTP was included in the framework under the Worker Safety and Health Support Annex, allowing the Occupational Safety and Health Administration to request training assistance during a disaster. This role in the NRF supports WTP as a recognized and trusted partner in Federal disaster response efforts.6 Also under Homeland Security Presidential Directive-8, crane operators, heavy equipment, and other workers were recognized as first responders under the title, “skilled support personnel” highlighting the need for disaster health and safety training for workers that WTP grantees have relationships with.7

Over time, WTP has responded to various disasters and crises facing workers nationally and has taken an all-hazards approach to emergency response. In this, WTP recognizes that workers need training to protect themselves against multiple types of hazards and focuses on developing key knowledge and skills that can be used in a variety of responses. This has included responding to multiple infectious disease events, delivering biosafety trainings across worker populations with exposure risk (Figure 1).

Figure 1. Timeline of capacity building of NIEHS WTP for infectious disease response. IDRT refers to the Infectious Disease Response Training Program.

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EARLY TRAINING ON INFECTIOUS DISEASES

Some WTP grantees provided training to prevent Lyme disease and Hantavirus to construction workers in the late 1990s and early 2000s. With the promulgation of the blood-borne pathogen standard in 1991, that became another key health and safety course for WTP grantees.8 When safer needlestick legislation was passed in 2000, some grantees began delivering modules on safer needle selection in the healthcare sector. First receiver courses, to protect hospital-based first receivers of victims from mass casualty incidents involving the release of hazardous substances were provided as early as 2004.

ANTHRAX RESPONSE 2001

One week after the 9/11 terrorist attacks, a series of anthrax attacks occurred in the US. Letters containing anthrax spores were mailed to news media offices and US Senators and resulted in the deaths of five people, including two postal workers.9 The incidents brought to the forefront the need to enhance US biological warfare preparedness and prepare workers for exposure to biological contaminants.*

WTP held a workshop following the 9/11 and anthrax responses, reflecting on lessons learned from individuals who delivered training and actively participated in cleanup or remediation.8 The workshop session on biological and chemical threats and anthrax response aimed to understand training revisions necessary for future infectious disease events. The issues considered included looking at longer-term health effects of exposure rather than just immediate health outcomes; broadening the reach of audiences beyond cleanup workers and first responders; addressing misinformation for those instructing training; keeping training materials up-to-date with the latest anthrax-monitoring guidance; rethinking personal protective equipment and protective measures; and revisiting the appropriate level of response for the typical worker, who is not an emergency responder, to be engaged in.

Conclusions critical to WTP future planning included that training materials should be “ever-green,” which refers to keeping materials flexible and current to reflect the most up-to-date science and technology, and that anthrax training materials can form the basis of curriculum for other and future infectious disease agents.

AVIAN AND SWINE INFLUENZA OUTBREAKS IN 2006 AND 2009

WTP awarded four avian influenza (Avian Flu) preparedness training supplemental grants in 2006,10 supporting the development of biosafety tools and curricula to protect high-risk workers who were preparing for and responding to the outbreak. The high-risk workers were defined as health care workers, emergency responders, and poultry workers.

By this time, the Clearinghouse had been developing and distributing training tools, slide sets for several years that provide health and safety guidance for those who involved in a specific type of disaster response and cleanup activities. The Clearinghouse developed “Protecting Yourself from Avian Influenza” in response to the need for worker safety awareness level training using federal agency standards and guidance, such as Occupational Safety and Health Administration and National Institute for Occupational Safety and Health.11

The Clearinghouse Avian Flu training tool, available in English and Spanish, provided awareness level education and training for funded organizations and the broader occupational safety and health community to use. The tool included modules on avian influenza awareness; working in avian influenza-infected areas; and controlling general hazards such as animals and insects, blood-borne hazards, heat and cold stress, and confined spaces. The training tool contained in-depth instructor notes on the slides which were made available through the Clearinghouse’s webpage. The tool covered avian influenza basics and symptoms and transmission, specific hazards and protective measures for high-risk workers, coping with traumatic stress, and general risks to injury and illness. Representatives from the US Department of Agriculture (USDA) Animal and Plant Health
Inspection Service (APHIS), other USDA agencies, the Environmental Protection Agency, and the North Carolina Department of Agriculture provided feedback on the training tool during a meeting in April 2007, as these agencies and organizations would be involved in a response. Obtaining their expertise and input was critical and supported buy-in for using the tool.

In September of 2007, approximately 300 representatives from government, labor, and industry convened for an NIEHS and USDA APHIS sponsored conference, “Protecting Avian Influenza Responders.” The conference brought together agencies and organizations likely to be involved in an avian influenza response to discuss, coordinate, and participate in a practice exercise for such an event.11 Presentations and breakout sessions focused on sharing online tools, training, and outreach and communication initiatives.

The Clearinghouse also developed “Protecting Yourself from H1N1 in the Workplace” in response to the safety and health awareness needs for responders to Swine Flu (the H1N1 virus) in November 2009.12 WTP was able to adapt the Avian Flu training tool for the needs of workers at risk to H1N1. The H1N1 training tool followed a similar module outline as the Avian Flu training tool, including H1N1 basics, assessing the risks of exposure to H1N1 in the workplace, and methods to prevent infection. From the years 2009 to 2011, the funded organizations trained more than 1,900 workers for H1N1 in the workplace.


Communities were devastated from flooding and water damage following the hurricane disasters of Katrina in 2005 and Sandy in 2012.13,14 Water damage to buildings and homes following hurricanes can lead to conditions where mold, a biohazard, can grow. Molds can also produce a number of biochemicals that are harmful to human health.15 WTP recognized the need to prepare workers who were engaged in small-scale mold cleanup and treatment of flood damage, and had held workshops in 2004 to develop guidelines for the protection and training of workers engaged in maintenance and remediation work associated with mold. Additionally, WTP received federal disaster funding after both hurricanes to complete activities such as providing health and safety training to recovery workers and their supervisors, providing technical assistance as needed, and participating in a mold task force.13,14

WTP trainers from grantee organizations responded locally to educate clean up workers and those in the affected community on hurricane and flood response health hazards.16,17 Site assessments found mold to be among the most hazardous issues workers were facing in hurricane and flood response efforts.14 After hurricane Katrina, the Clearinghouse created “Safety Awareness for Responders to Hurricanes: Protecting Yourself While Helping Others,” and after Sandy, created “Mold Cleanup and Treatment Orientation” and a guide “NIEHS Disaster Recovery: Mold Remediation Guidance, Health and Safety Essentials for Workers, Volunteers, and Homeowners.” Overall, WTP trained more than 23,000 workers after Hurricane Katrina, and more than 6,000 after Hurricane Sandy.14 The Clearinghouse provided tens of thousands of booklets for distribution in multiple languages. The mold cleanup training and resources from WTP provided urgently needed health and safety information to cleanup workers, homeowners, and business owners.

These hurricane and flood response training tools and curricula have proved invaluable as WTP and its funded organizations have been called to support cleanup and recovery efforts following other major hurricanes, such as Matthew (2016), Harvey (2017), and Maria (2017). The responses have included on-site training for vulnerable communities and day laborers in the immediate days and weeks following a storm and training for organizations involved in the long-term recovery process.18-20 As of May 2021, the Clearinghouse has distributed 150,916 hurricane and flood booklets in English, Spanish and Vietnamese, and 62,354 mold booklets.

EBOLA VIRUS DISEASE PREPAREDNESS TRAINING 2013-2020

Congressional funding via the Centers for Disease Control and Prevention (CDC) provided WTP with Ebola emergency supplemental appropriations in
2014 for worker health and safety training activities during the Ebola outbreak. With input from key stakeholders, WTP and the Clearinghouse conducted a needs assessment and gap analysis and developed training tools for both awareness and operations-level infectious disease response courses. The resulting report discussed gaps in integration between public health, medical, occupational health, and worker safety activities; the lack of protective guidance informing the full spectrum of workers; and the difficulty of sustaining a high level of readiness and worker competency. WTP worked to address these gaps as it implemented the Ebola Biosafety and Infectious Disease Response Worker Training Program (IDR), funding eight grantees to deliver courses on Ebola and prepare for future infectious disease events. The program trained workers across occupations and industries who may be exposed to infectious diseases. Over the life of the IDR program (June 2016–May 2020), the funded organizations trained approximately 44,000 workers in 1,900 courses with more than 165,000 contact hours, with in-person training occurring across the US and Puerto Rico. Over 40 new curricula were developed under this program.

The gap analysis also indicated a need to clarify the use of pathogen safety data (PSD) resources for workers who have a potential for exposure to infectious agents. WTP created a PSD Guide to address this gap. The PSD Guide reviews existing PSD resources, their strengths and limitations, and explains how to access them. An accompanying training module was also developed.

The IDR-funded organizations reported two common challenges for training delivery. First, there was a lack of motivation for infectious diseases that are not in the news from organizations. Second, it was difficult to get the commitment of workers and organizations for longer courses needed to provide operational-level training and in some instances for shorter awareness level training. Additionally, researchers involved in one WTP-funded grant program found that without an apparent threat of Ebola or other highly infectious diseases, public interest was reduced, and government resource allocations shifted elsewhere. Efforts to sustain training beyond the program’s duration included certification of training courses for continued education credits and integrating infectious disease topics into broader curriculum and other programs.

Due to sustained funding over the multiple program years, IDR organizations were able to quickly add in information and deliver training on new infectious diseases as they arose, such as Zika in 2015-2016 and COVID-19 in the program’s final months. The IDR program demonstrated the importance of continued capacity building and regular funding support to respond to infectious disease events. The capacity and funding allow immediate delivery of training courses and give workers access to the education and skills they need to protect themselves from exposure.

COVID-19 PANDEMIC

In March 2020, the federal government declared a state of emergency due to the COVID-19 pandemic. First responders, healthcare workers, and a variety of other frontline essential workers were at the highest risk of exposure to SARS-CoV-2. The COVID-19 pandemic also demonstrated health disparities in working conditions, as lower income and essential workers were at greater risk of exposure to SARS-CoV-2, and the chronic health conditions that are associated with higher severity of COVID-19 are disproportionately found in occupations and industries with stressful working conditions.

At this time, WTP had nearly 30 years of hazardous waste worker and emergency response experience and nearly two decades of infectious disease preparedness and response training, capacity building, and lessons learned. The program was in a position to immediately develop, implement, and disseminate occupational safety and health and infection control training to the breadth of worker sectors facing exposure. WTP mounted a rapid, robust response through congressional supplemental funding from the Coronavirus Preparedness and Response Supplemental Appropriations Act, 2020 and through other WTP funding mechanisms. In March and April 2020, the Clearinghouse created training tools on general awareness and on essential and returning...
workers. WTP further created technical resources for grantees such as a Train-the-Trainer course, best practices, factsheets, and webinar presentations and funded grantee organizations to deliver training and develop technological tools to train workers.

WTP conducted a COVID-19 needs assessment in mid-2020 to explore COVID-19 training efforts and challenges. The needs assessment findings included that all Ebola IDR program grantees noted that the transition to COVID-19 was relatively easy. The grantees were able to build on the Ebola curricula and use their cadre of infectious disease trainers to begin their COVID-19 health and safety response. Many grantees noted that general NIEHS WTP funding helped them transition and continue training during the COVID-19 pandemic.

In the needs assessment and regular grantees meetings, WTP grantees also stated many challenges that had to be addressed as they trained their worker populations, several similar to those discussed during the Anthrax response. Some audiences were difficult to reach, and others had issues with technological fluency, comfort, and accessibility for training in an online setting, which was required for many audiences due to restrictions on face-to-face interactions. Other topics included broadening the reach of audiences, addressing misinformation, keeping training materials up-to-date, and understanding guidance and best practices for personal protective equipment and protective measures.

Overall though, trainers and organizations rose to the occasion and adopted virtual technology or instituted safe in-person practices to successfully continue sharing important information with impacted workers, including new audiences previously unreached by grantees.

As of May 2021, more than 70,000 workers have been trained on COVID-19 by WTP grantees. WTP and the Clearinghouse continue to develop and share resources as the pandemic shifts, such as fact sheets on vaccines and the selection and use of portable air cleaners to protect workers from exposure to SARS CoV-2. Additionally, WTP recently funded COVID-19 Recovery Centers, which will partner with local businesses, community organizations, and worker centers to assess COVID-19 health risks, train workers, and promote resilience and recovery by connecting communities facing disadvantage to social services, referrals for housing and food, and accessibility to COVID-19 vaccinations.

UNDERLYING THEMES: RESILIENCE AND RESEARCH IN DISASTERS

Throughout the COVID-19 pandemic, mental health has been a great concern for first responders and essential workers, with the unusually long and arduous demands of them. Many grantees delivered resiliency training to support their worker populations, based on curricula developed in earlier years. Following the 9/11 response, WTP began to emphasize the need to address responder mental health in some of their programs. Following the 2010 BP Oil Spill response, WTP recognized the need to address unmet mental health and resilience needs among clean-up workers. With funding from the Substance Abuse and Mental Health Services Administration, they developed behavioral health training for communities impacted by disasters by launching the Gulf Responder Resilience Training Project in 2012. Awareness-level training materials were developed for disaster-impacted workers, including those in response, recovery, and rebuilding activities; supervisors; and care providers, such as community care centers, health-care facilities, and disaster recovery centers. Since then, WTP and its grantees regularly integrate disaster resilience materials into broader training programs and disaster responses. In a randomized clinical trial, researchers found that Hurricane Sandy disaster workers who participated in the Disaster Worker Resiliency Training Program had reduced mental health symptoms at a 3-month follow-up. The use of the resilience training in multiple disasters, including COVID-19, demonstrates the ongoing importance of this curriculum and the need to integrate this topic into future infectious disease events.

Additionally, the ability of researchers to implement studies and collect environmental health data during disasters has been a focus for NIEHS for...
Table 1. Lessons learned from WTP's infectious disease response programs

<table>
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<tr>
<th>Topic</th>
<th>Lesson learned</th>
<th>Example from WTP’s response from Ebola and COVID-19</th>
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<tr>
<td>When infectious diseases are not an apparent threat</td>
<td>When infectious diseases are not an apparent threat, training becomes less of a priority by employers and workers, public interest is reduced, and government resource allocations shift elsewhere.</td>
<td>Under WTP’s Ebola IDR program, which mostly occurred in the years following the height of the epidemic in the US, grantees found it difficult for organizations and workers to commit to the longer courses that are needed for operations-level training. In some cases, was even difficult for them to commit to the shorter awareness-level training.</td>
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<td>Stable funding of an infectious disease response training program</td>
<td>When there is stable funding of an infectious disease response training program, organizations can quickly pivot and respond to a new infectious disease event. If that is not in place, immediate supplemental funding allows for a more robust early response with increased capacity to delivery worker health and safety training.</td>
<td>Six grantees were still funded under the WTP Ebola program through May 2020 and reported that the grant infrastructure, training curricula, and connections helped them transition easily to the COVID-19 response.</td>
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<td>Training curricula and train-the-trainer programs</td>
<td>Development of a training curriculum or slides and delivery of a train-the-trainer program by a central/funding organization allows for sharing across the occupational health and safety network and is instrumental in disseminating key knowledge to unions, businesses, community organizations, and other partners. All training organizations must work to keep the training curricula up-to-date (or “evergreen”) as the science progresses and clarify facts versus myths for trainees.</td>
<td>At the beginning of COVID-19, the combination of NIEHS training tools and training programs developed by previously funded infectious disease grantees created a national network prepared to respond quickly. Training tools have needed several updates throughout the pandemic, and WTP and grantees have revised to explain developing issues, such as worker protection and vaccines.</td>
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<td>Pathogen safety data resources</td>
<td>Pathogen safety data (PSD) resources for workers clarify the use of existing materials for workers and organizations, teach workers how to research the characteristics of infectious pathogens that they may be exposed to, and help organizations develop infectious disease risk assessments and control plans.</td>
<td>The lack of PSD resources was identified as a gap at the beginning of the WTP Ebola IDR program, so WTP developed a PSD Guide and a PSD Training Module. These materials clarify the use of PSD resources currently available for the development of infectious disease occupational exposure control plans across industries.</td>
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<td>Skills-based training</td>
<td>Ongoing hands-on, skills-based training and practice drills give workers experience in how to properly put on or take off personal protective equipment without contamination. This is a critical skill during a highly infectious disease event but is not a regular activity for many workers.</td>
<td>WTP grantees under the Ebola IDR program delivered more than 140 operations-level infectious disease response courses that were between 8 and 40 hours in length, between June 2016 and March 2020. These courses provided hands-on skills to workers, helping to keep them ready for the next infectious disease event.</td>
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<td>Reach to broad worker population sectors</td>
<td>The health and safety training provided to workers should reach a large variety of sectors that are at risk for exposure to the infectious disease.</td>
<td>Under Ebola IDR and COVID-19, WTP grantees reached first responders and healthcare workers, but also an extensive list of other worker sectors including environmental service workers, sanitation workers, and domestic cleaners; construction trades; death care; airline and airport workers; public transportation workers; grocery and retail workers; food processing workers; manufacturing workers; and nail salon technicians.</td>
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several years. To address this, the NIEHS developed the Disaster Research Response (DR2) Program, focusing on improving timely research in response to disasters and public health emergencies. WTP has worked closely with DR2 over the years, including bringing partners together during disaster recovery, developing a guide for researchers involved in disaster responses, and helping conduct training workshops in partnership with local, state, and federal agencies; universities and research institutes; industry; and community groups to strengthen local capabilities for conducting research. DR2 has played an important role in NIH's COVID-19 response, compiling survey tools and disseminating researchers' findings. This partnership helps ensure that impacted workers and communities needs are considered in disaster research, including during biosafety emergencies.

**CONCLUSION**

NIEHS WTP has been building its capacity to respond to infectious disease and biosafety events over nearly three decades. WTP has gathered lessons learned throughout that may support future occupational safety and health biosafety responses (Table 1). With sustained funding, technical resources, and a network of nationwide programs, WTP can remain in a position to provide occupational safety and health and infection control training that protects at-risk worker populations. Specific disaster-related funds for worker health and safety training such as during Hurricanes Katrina and Sandy, the Deepwater Horizon oil spill, Ebola, and COVID-19 greatly increased WTP's capacity to support training delivery and development of technical assistance resources, including preparedness for future infectious disease events. Additionally, the Clearinghouse has played an important role in the creation and dissemination of training materials, lessons learned, and reports that enable WTP resources to reach a wide audience in a timely manner (Figure 2).

WTP implemented a nimble and timely response to the novel SARS-CoV2 virus and COVID-19 disease. The response was based on years of disaster and biosafety curricula development, increased grantee expertise and capacity, lessons learned, and trusted partnerships with a wide variety of health and safety leaders. WTP quickly and effectively filled COVID-19 knowledge gaps with training resources, funded grantees to implement training across the country, and ensured vulnerable populations were included. WTP will continue to implement lessons of past responses to prepare for future infectious disease outbreaks, as it built off previously developed resources, infrastructure, and training capacity to swiftly respond to the COVID-19 pandemic with the delivery of occupational health and safety and infection control training programs.

### Table 1. Lessons learned from WTP's infectious disease response programs (continued)

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<td><strong>Vulnerable population outreach</strong></td>
<td>Education and outreach to vulnerable and hard-to-reach communities can help ensure people receive accurate health and safety information when their job or personal situation does not allow them to participate in traditional training.</td>
<td>NIEHS and WTP grantees have developed outreach beyond the classroom during COVID-19 that includes podcasts, videos, fact sheets, social media events, and technical assistance.</td>
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<td><strong>Mental health and disaster resilience</strong></td>
<td>It is important to address mental health and disaster resilience needs of responders and community members and integrate these resources into infectious disease and broader disaster training programs.</td>
<td>WTP developed the Responder and Community Resilience training tool after the Gulf Oil Spill in 2012. Since that time, the course has been delivered by many grantees and integrated into disaster response trainings after hurricanes, within the WTP's Ebola IDR program, and during COVID-19.</td>
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