

Concepts in Disaster Medicine

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Developing a Concept of Operations Template to Guide Collaborative Disaster Research Response Between Academic Public Health and Public Health Agencies

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Abstract

Research conducted in the context of a disaster or public health emergency is essential to improve knowledge about its short- and long-term health consequences, as well as the implementation and effectiveness of response and recovery strategies. Integrated approaches to conducting Disaster Research Response (DR2) can answer scientific questions, while also providing attendant value for operational response and recovery. Here, we propose a Concept of Operations (CONOPS) template to guide the collaborative development and implementation of DR2 among academic public health and public health agencies, informed by previous literature, semi-structured interviews with disaster researchers from academic public health across the United States, and discussion groups with public health practitioners. The proposed CONOPS outlines actionable strategies to address DR2 issues before, during, and after disasters for public health scholars and practitioners who seek to operationalize or enhance their DR2 programs. Additional financial and human resources will be necessary to promote widespread implementation of collaborative DR2 programs.

Introduction

The science needed to develop evidence-based public health emergency preparedness and response practice has been previously described as insufficient.¹ Research conducted in the context of a disaster response offers opportunities to improve our understanding of the health consequences of disasters, identify effective approaches to prevent or reduce harm, evaluate response and recovery activities, and identify strategies to address gaps before another similar disaster strikes.² In addition, research activities implemented in the context of a disaster response can yield data that can be operationalized to inform both current and future response and recovery activities.²

There are several challenges to conducting health research in the context of a major disaster response, including: (1) research issue identification and prioritization (including issues related to aligning research priorities with community concerns, identifying and engaging subject matter experts, and creating opportunities for bi-directional discussion and co-production); (2) research process challenges (including issues related to funding, institutional review board [IRB], and site access); (3) infrastructure and implementation challenges (including issues related to logistics, training, and data collection); and (4) relationships, coordination, and engagement (including issues related to integrating research into response, coordination across multiple stakeholders, and engagement of research networks).³ For example, during the 2009 H1N1 pandemic, there were significant delays in IRB reviews of changes to data collection protocols, which prevented important findings from being integrated into practice, and a lack of Disaster Research Response (DR2) infrastructure at the organizational level thwarted clinical trials to determine the effectiveness of both non-pharmaceutical and pharmaceutical interventions.²

Prior disasters have demonstrated the value of collaboration between academic researchers, particularly those based within colleges, schools or programs of public health (ie, academic public health), and public health agencies (PHAs) to successfully execute time-sensitive disaster research.⁴ Forming relationships early on, during the preparedness phase, helps investigators be better prepared to act rapidly and decisively once a disaster occurs.² Moreover, pre-developed

study protocols as well as IRBs with experience conducting rapid reviews can facilitate the ability to conduct research across disasters resulting from both natural and technological hazards.⁴

Recognizing the importance of conducting collaborative, timely, and community-responsive public health research in the context of a disaster response, the National Institute of Environmental Health Sciences (NIEHS) and National Library of Medicine established the DR2 program in 2013.³ The DR2 program serves as an important resource for furthering the nation's capacity to develop and implement timely research in response to disasters and public health emergencies through global access to data collection tools, ready-to-go IRB-reviewed protocols, guidance for ethical reviews of research proposals, and support for a growing network of researchers ready to respond to the diverse scientific challenges posed by these situations.^{3,5} Additionally, NIEHS has sponsored 4 large-scale "training workshops" to promote and elevate the role of academic institutions and researchers as an integral part of the nation's efforts to more effectively field vital studies to inform response, recovery, and future preparedness. These workshops, conducted in Los Angeles (2014), Houston (2015), Boston (2016), and Tucson (2019), leveraged a range of locally relevant scenarios to prepare universities and communities to work together and, in collaboration with health officials, emergency managers, first responders, industry, and community organizations, to address a range of environmental health research concerns in the context of a major disaster.⁶

There are several examples of the success of these early DR2 workshops. For example, when Hurricane Harvey hit the city of Houston in August 2017, research collaborations quickly formed across institutions that had been previously connected through an NIEHS DR2 training workshop held in Houston in 2015. The expertise and ongoing activities and relationships established from the earlier workshop allowed researchers and practitioners to quickly organize and pursue a range of questions concerning the health and environmental impacts of Hurricane Harvey, leading to a more efficient research process that was able to directly inform the disaster response and support impacted communities.⁵ Moreover, the DR2 relationships and infrastructure developed during Hurricane Harvey were used to springboard DR2 activities following an unrelated technological hazard 18 months later.⁴

The next NIEHS DR2 workshop, co-hosted by the University of Washington, focuses on the process of conducting research in the immediate aftermath of a disaster. While prior workshops have largely focused on enhancing DR2 capacity among participating stakeholders, the University of Washington's planning team is committed to developing legacy products to support DR2 capacity development in other communities and contexts. To facilitate our own workshop planning while providing tools for others embarking on similar DR2 planning and capacity development endeavors, our team created a DR2 Concept of Operations (CONOPS) describing a framework for management of collaborative research activities before and during a disaster. A CONOPS is a user-oriented document that provides an outline of a proposed system,⁷ and the DR2 CONOPS specifically identifies adaptable and actionable strategies for academic public health and PHAs to collaboratively plan for and implement DR2.

The University of Washington's NIEHS DR2 workshop planning has coincidentally occurred in the midst of the coronavirus disease (COVID-19) pandemic, which has yielded tremendous, unprecedented, and near-universal challenges for PHAs to respond to due to its extent and duration. While the magnitude of the COVID-19 response has been unique, it has also had

similarities to other disaster responses, such as insufficient information, slowly evolving studies, and poorly coordinated communications. This underscores the need for rapid, reliable, and well-coordinated research to inform response and recovery activities. The pandemic has also provided a unique opportunity to solicit real-time feedback on strategies and challenges related to conducting practice-based disaster research. Collectively, the authors' experience with practice-based COVID-19 research with that of other academic public health researchers and practitioners that were engaged in its development have uniquely informed the CONOPS development.

Specifically, the CONOPS developed and presented here was refined through engagement with the existing literature, interviews with public health emergency preparedness and response researchers, and discussion groups with public health practitioners to ensure its broad applicability. We carried out 7 formative interviews with disaster researchers who were recruited based on their affiliations with former Centers for Disease Control and Prevention-funded Preparedness and Emergency Response Learning Centers (PERLCs) and Preparedness and Emergency Response Research Centers (PERRCs). These interviews confirmed and expounded on specific challenges described in previous literature. Then, to understand the public health practice perspective, in addition to the academic perspective, we conducted discussion groups with public health practitioners from 10 health departments across the United States to refine the CONOPS and solicit feedback on implementation challenges. These formative activities were determined to be human subjects research that qualified for exempt status (Category 2) by the University of Washington Human Subjects Division.

Here, we summarize the findings from our formative interviews, as well as core components of the final CONOPS, informed by both academic disaster researchers and public health practitioners, including specific, yet adaptable and actionable strategies for academic public health and PHAs to collaboratively plan for and implement DR2. We also describe potential facilitators and barriers related to its implementation, including those proposed during our discussion groups with public health practitioners.

Discussion

Formative Interview Findings With Academic Public Health

We successfully identified and invited the former principal investigators of 12 of the 14 PERRCs or PERLCs to participate in the study. Of those 12, we conducted 7 interviews (a 58% response rate). The remaining 5 either declined to participate or ceased responding to e-mails regarding participation and interview dates. Of the 7 participating former principal investigators, 6 (86%) were based at publicly funded institutions and 1 (14%) was based at a private institution. The former principal investigators were dispersed geographically across the country.

Through a thematic analysis of the interview transcripts, 8 key barriers and facilitators related to collaboration between academic public health and PHAs were identified, within the context of conducting research during a disaster response (Figure 1):

1. **In general, participants perceived that practice-based partners did not view research as a near-term priority during a response.** Participants observed that the limited time and competing priorities of practitioners were a challenge in conducting collaborative research with PHA partners. In general, academic

Barriers and Facilitators to Implementing DR2 by DR2 Challenge Area				
	Research issue identification and prioritization	Research process	Infrastructure and implementation	Relationships, coordination, and engagement
1. In general, researchers perceived that practice-based partners did not view research as a near-term priority during a response.	●	○	○	○
2. The majority of collaborative activities among academic public health and PHAs are practice-, rather than research-related.	●	○	○	○
3. Practice-based response activities and practice-based research during the response are not consistently or distinctly defined.	●	●	○	○
4. Pre-established, longstanding relationships between researchers and practitioners are crucial to undertaking joint research activities during a response.	○	○	○	●
5. All academic public health organizations had formal agreements of some kind with their state or local PHAs, however this was most often on an individual or project basis, not institution-wide or centrally coordinated.	○	○	●	●
6. Having a pre-established infrastructure and plan in place for how researchers and practitioners should collaborate during a response could expedite DR2.	○	●	●	○
7. Funding is a significant barrier to rapid research response, and a research response plan should address this challenge.	○	○	●	○
8. Several common administrative challenges of the research response, such as IRB approval timelines, were addressable.	○	○	●	○

Figure 1. Summary of key barriers and facilitators to Disaster Research Response (DR2) implementation by DR2 challenge area.

- public health participants reported that PHAs perceived a trade-off between research versus response activities, where practitioners are focused on the information they need in the near term to respond to the emergent situation at hand, while research is not perceived as helpful for response (rather, it is perceived as having longer-term benefits).
- The majority of collaborative activities among academic public health and PHAs are practice-, rather than research-related.** Participants reported that most of the activities they engaged on with PHAs were in direct support of COVID-19 response rather than conducting research. Many types of data collection and support activities were implemented by individuals affiliated with academic public health during the response, including epidemiological modeling, contact tracing, database setup, and geographic mapping. However, the focus was on providing practitioners with operational information and support, not on publishing results or producing generalizable findings.
 - Practice-based response activities and practice-based research during the response are not consistently or distinctly defined.** Some academic public health-PHA collaborative activities such as contact tracing support or conducting training sessions were described as clearly public health practice, while interventional evaluations and some modeling studies were clearly research. However, some participants had difficulty categorizing certain

data collection and analysis activities as only research or only practice and felt there was not necessarily a clear or meaningful distinction.

- Pre-established, long-standing relationships between researchers and practitioners are crucial to undertaking joint research activities during a response.** Every participant emphasized that pre-established, individual relationships have been a necessary factor for successful academic public health-PHA collaboration. The trust and familiarity established prior to a disaster were widely considered foundational for success.
- All participants reported that their academic public health organizations had formal agreements of some kind with their state or local PHAs; however, this was most often on an individual or project basis, not institution-wide or centrally coordinated.** Every participant described the existence of memorandums of understanding (MOUs), Academic Health Department agreements, data sharing agreements, or similar formalized agreements in place between their organization and PHAs at some level. Some agreements had larger scope than others, but operationally most operated on a project-by-project basis rather than institution-wide. No organization had a designated point of contact for triaging or managing research relationships; rather, they were on individual or departmental basis, which impeded collaboration.

6. **Having a pre-established infrastructure and plan in place for how researchers and practitioners should collaborate during a response could expedite DR2.** Not having a research response plan in place pre-disaster caused unnecessary delays or confusion, and all participants stated that having such a plan would be ideal. Participants described that components of this pre-planned infrastructure should include defined roles and responsibilities (including a main point of contact), a system to recruit and deploy researchers, available and streamlined funding, efficient approvals including pre-approval from as many mechanisms as reasonable prior to a disaster, an advisory group to establish a research agenda either prior to a disaster or very early in the response, formal agreements in place to seamlessly share resources (including personnel, data, ethics approvals, and funding), and a cadre of students trained on disaster response and public health practice.
7. **Funding is a significant barrier to rapid research response, and a research response plan should address this challenge.** The majority of participants described funding as a challenge to rapid response research. At the federal level, funding sources like the Centers for Disease Control and Prevention (CDC)/Prevention Public Health Emergency Preparedness (PHEP) or Assistant Secretary for Preparedness and Response (ASPR) has challenging grant cycles and administrative requirements which were perceived to be poorly suited to disaster response needs. Most participants stated that one component of an ideal DR2 infrastructure would be an existing funding stream to be applied quickly and flexibly to assist in the response. Last, an ability to transfer funds easily between state institutions, such as a PHA and public university, was suggested by 1 participant as a means for expediting the funding process.
8. **Several common administrative challenges of the research response, such as IRB approval timelines, were addressable.** Several participants could not comment on the performance of IRBs for practice-based research during COVID-19 research due to lack of engagement with their IRBs, or were not aware of any challenges. Of the 3 participants who were able to comment on their academic institution's IRBs, all said they had prioritized COVID-19-related projects and that review results were received much faster than usual (sometimes in a matter of days).

Concept of Operations Plan

The CONOPS, provided in Supplementary Materials and summarized in Figure 2, identifies and describes several strategies that can be undertaken by academic public health and PHAs to prepare for, implement, and evaluate DR2. The CONOPS attempts to address barriers previously identified in the literature, integrates the real-world experiences of the project team and the key informants who participated in formative interviews, and reflects the feedback provided by public health practitioners who participated in our discussion groups. These strategies are intended to be developed and implemented by a standing DR2 committee and established in collaboration with academic public health and local and state PHAs within a given region. The DR2 committee's responsibilities include overseeing and coordinating the execution of each of the preparedness and response strategies outlined herein, as well as planning, implementing, and integrating the findings of evaluative activities. While academic public health and PHAs often engage in various partnerships and collaborative activities on a wide variety

of health programs, the committee's focus would be specifically on planning and implementing activities that support the collection and analysis of information in the context of a disaster. If possible, we recommend that the committee is co-chaired by academic public health and PHA representatives with disaster research knowledge, experience, and interests, as well as decision-making authority or direct access to decision makers as it relates to disaster research. Academic public health and PHA leadership should be involved to ensure the committee is adequately resourced and staffed both during the event and in the post-event period, as capacity is a well-documented challenge for health department emergency preparedness.⁷

Notably, the DR2 committee should prioritize including community representatives to gain insight into the community's concerns. Community input to guide research and response priorities is crucial to adequately meeting the needs of, as well as fostering trust with, the populations that PHAs ultimately serve. Community concerns will also evolve over time, and the DR2 committee should be prepared to have ongoing means of gathering community input as needs and threats change. The committee should also consider inclusion of regional emergency management professionals or other disaster response group members to increase opportunities for collaboration. The committee will develop and nurture relationships across PHAs and academic public health specific to the conduct of disaster research. Since major disasters may occur relatively infrequently, these relationships must be honed prior to a disaster. As such, we recommend that the committee host continuous, standing, and (if possible) in-person meetings.

It is recommended that strategies proposed in the CONOPS template be customized for academic public health/PHA regional stakeholders. Additionally, a documented DR2 plan should be regularly updated and reviewed by the standing committee. This plan should outline specific roles and responsibilities for groups and positions within both academic public health and PHAs, as well as triggers for plan activation. The plan should include a schedule for review and processes for updates based on findings from exercises, real-world incidents, and ongoing process evaluations. Ongoing evaluation is an important component of the CONOPS, as it has the potential to address barriers and opportunities of DR2 implementation and improve DR2 over time. This is further discussed in the Supplementary Materials (1.3.4 and 2.3.2).

In the full CONOPS (Supplementary Materials), we further describe each of the proposed strategies and align them with each of 4 core DR2 challenge areas (research issue identification and prioritization; research process; infrastructure and implementation; and relationships, coordination, and engagement).

Discussion Group Findings With Public Health Agencies

Feedback on the content and utility of the CONOPS was solicited from PHAs through 3 structured feedback sessions. A purposive sample of participants from county and city PHAs was identified in collaboration with the National Association of County and City Health Officials to represent urban and rural PHAs in different geographical areas across the United States. Participants were responsible for emergency preparedness activities or programs within their PHAs. Feedback sessions were held via video conference using a discussion guide developed *a priori*. Participants were provided with the draft CONOPS in advance of the session. Detailed notes were taken, and key points were summarized and used to refine the version presented herein. PHA representatives received a disaster-related book to incentivize participation.

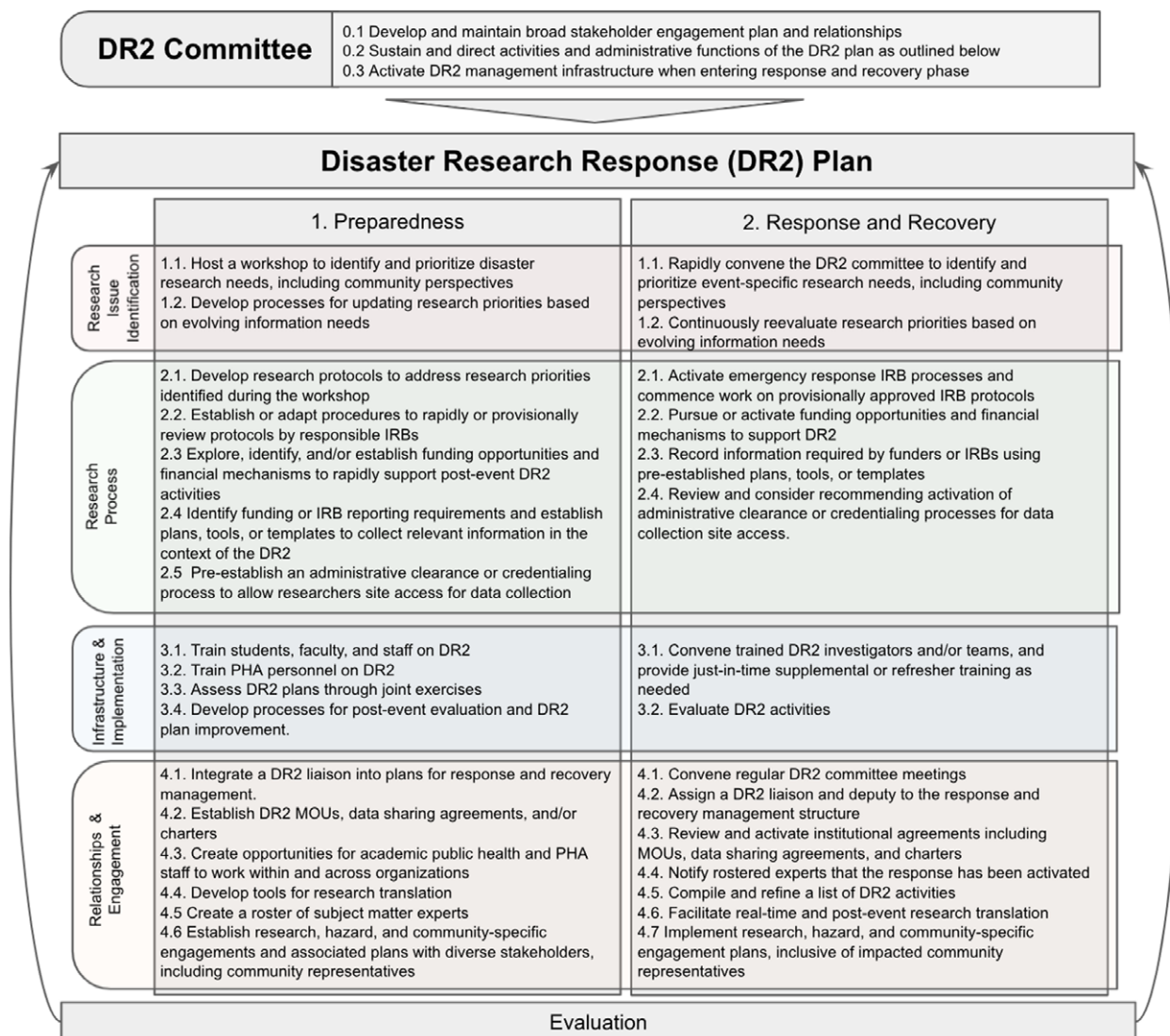


Figure 2. Summary of Concept of Operations (CONOPS) plan for DR2 Capabilities.

This CONOPS integrates specific suggestions and amendments proposed by the public health practitioners who participated in the discussion groups. Practitioners suggested various approaches to mitigate barriers to CONOPS implementation, including administration through established committees or infrastructures (eg, health care coalitions, local emergency planning committees), and shared service arrangements wherein small and/or rural PHAs can be integrated into DR2 programs established by state or nearby, larger local PHAs. Feedback from practitioners grouped by the corresponding DR2 challenge area is summarized in Table 1.

Recommendations and Next Steps

The proposed CONOPS provides a first-of-its-kind resource for PHAs and academic public health organizations interested in the formation of a DR2 capability that is adaptable and scalable to align with local needs and resource availability. While the CONOPS emphasizes research translation, it falls short of identifying internal processes and mechanisms for PHAs to integrate research findings into practice during or after a disaster. Producing actionable evidence that can be applied in real-world

settings is the goal of practice-based research, which is often operationalized by bringing together practitioners and researchers.⁸ Challenges associated with evidence-based practice in public health emergency preparedness and response are related to both translation and implementation.¹ A recent report from the National Academies of Science, Engineering, and Medicine described how this gap between knowledge and practice has led to a trend for the public health emergency preparedness and response field to rely on “long-standing rather than evidence-based practice.”⁹ As such, we suggest the CONOPS be coupled with nimble PHA plans and procedures that allow for adaptation to response and recovery activities following evidence generated through DR2. Further, to successfully operationalize DR2 findings into practice, addressing implementation challenges of evidence-based practice is needed, such as engaging PHA leaders in innovative thinking around evidence-based research tools, providing additional funding for public health academic programs centered on DR2 efforts, and allowing public health practitioners to engage in research as part of their PHEP-funded activities and programs.^{1,10}

Our findings indicate that DR2 design and implementation could be facilitated through relationships established during the preparedness phase. Needed relationships can be advanced

Table 1. Summary of results from 3 practitioner discussion groups on the DR2 CONOPS

DR2 Challenge Area	Practitioner* Feedback on CONOPS
Research Issue Identification and Prioritization	• The CONOPS provides appropriate standards for academic public health and PHAs to navigate their participation. • Alignment of research questions with PHA deliverables and reporting needs may facilitate PHA participation. • Research needs to be directly valuable to the PHA and the community.
Research Process	• Practitioners have feasibility concerns based on highly limited staff, time, and funding, particularly in rural PHAs. • IRB delays are a major challenge, and strategies to expedite human subjects research approval should be considered. In response to significant delays, participants reported adapting approaches so that their activities would no longer be human subjects research, including use of aggregated, de-identified data.
Infrastructure and Implementation	• Identifying funding and reporting requirements is important. • PHAs that are smaller, rural, or without academic public health connections may not need to create their own DR2 capability. • A toolkit with example MOUs and resources would be helpful. • Time, funding, and staff limitations constrain PHAs' ability to participate in DR2.
Relationships and Engagement	• DR2 seems important but achieving buy-in may be difficult. An academic public health or PHA champion may serve to socialize this concept within each group. • Communication internally and externally will be vital for this effort. • Relationships will need to be strong for this to be effective, especially for anyone who is a research liaison within the PHA. • Relationships with researchers should begin in the preparedness phase. • The researcher liaison needs to be fluent in both PHA and academic public health languages to be an effective communicator.

Note. Participating practitioners were from a mix of city, county, and region-level PHAs in each of the following states: CT, IN, KS, MI, NV, OK, TX, TN, VA, WA.

through joint appointments of faculty/practitioners across organizations, central organizational points of contact, and a collaborative research plan that is implemented before an event occurs. The proposed CONOPS centers on collaboration between academic public health and local and state PHAs, primarily by establishing an initial standing DR2 committee, which can be adapted to meet regional needs. The utility of a pre-established committee to springboard DR2 has been demonstrated in multiple disaster scenarios.^{5,11,12} Given resource limitations and competing priorities, public health practitioners reviewing the CONOPS suggested integrating DR2 as a focus and function of existing committees (eg, local emergency planning committees and/or health care coalitions). Integrating academic public health representation on these committees may concomitantly facilitate the development of additional “whole community” relationships beneficial for DR2 (eg, with emergency management agencies, businesses, health care organizations, and community-based organizations). Further, integration of DR2 into existing work streams may facilitate the identification of opportunities to use DR2 to help PHAs build capabilities, as required through the CDC Public Health Emergency Preparedness Cooperative Agreement.¹³

The lack of funding for public health disaster research made available by the federal government¹⁴ is a tremendous challenge for DR2, as discussed by nearly all researchers and practitioners who provided feedback. The National Science Foundation has made strides to advance disaster research responsive to community information needs and scientific priorities through its support of the Natural Hazards Engineering Research Infrastructure, including 7 Extreme Events Research networks.¹⁵ This support allows for the development of research infrastructure and communities of practice prior to a disaster, as well as funding to support rapid post-event deployment of these resources to collect time-sensitive, perishable data when a disaster strikes. The NIH DR2 program has developed and catalogued resources (eg, data collection tools and protocols), trained researchers through workshops and webinars, and convened a community of practice through its nascent DR2 Working Group, yet extramural funding opportunities to develop

local DR2 relationships and infrastructure, especially that which involves robust community participation, have lagged. While the NIH has a mechanism to help fund disaster research via Time-Sensitive R21s,¹⁶ the time from proposal submission to funding averages upwards of 3 months with the resultant loss of important information. Further, there are no currently identifiable sources of funding to support the development of needed DR2 infrastructure across the nation. Mechanisms to financially support pre-disaster DR2 collaboration between academic public health, PHAs, and other key community stakeholders will be critical for widespread adoption of the CONOPS proposed herein.

A main limitation of the CONOPS is that it is context-specific to the University of Washington's NIEHS DR2 workshop and would thus benefit from additional academic and non-academic partner feedback. While those recruited for formative interviews were former leaders of longer-standing disaster research and training centers (PERRCs and PERLCs) who theoretically should have knowledge of disaster research dynamics and relationships, this may have limited our ability to capture more current response-focused academic perspectives in instances where the interviewees were no longer in those same roles. Moreover, given the length of time since PERRCs and PERLCs were actively funded, those who responded to our interviews may have differing perspectives than those who have become more recently engaged in disaster research. While additional evaluation of the CONOPS, including pilot-testing, is necessary, feedback was solicited from PHAs across the United States with demographically diverse service areas. While this CONOPS has the benefit of being established during a public health emergency, participant input may have been unduly influenced by their current experience with the COVID-19 response. However, this timely and informed tool remains an asset that has been previously lacking in DR2 capacity development.

Improving our understanding of the health impacts of disasters requires collaborative approaches between multiple stakeholders, standing teams of trained researchers, and an adaptable CONOPS that delineates roles and responsibilities for operationalization of

research.³ Our findings pave the way for future research investigating the facilitators and barriers to successful DR2 implementation, as well as how successfully the proposed CONOPS is used at various regional levels, and how it can be effectively adapted for wide-spread use. Furthermore, understanding how evidence generated through DR2 can be rapidly disseminated and translated to inform ongoing response operations, and forward looking preparedness and emergency response plans will be an important area for future study.

Conclusion

Research conducted in the context of a disaster response has the potential to inform ongoing response and recovery operations and future public health preparedness and response plans, while contributing to a scientific understanding of the health impacts of disasters and the effectiveness of response and recovery strategies. Yet, specific challenges have been shown to hinder the development and implementation of truly collaborative DR2 programs. The CONOPS template proposed herein responds to these challenges and provides a pathway for interested stakeholders to begin developing DR2 programs in advance of the next disaster. Widespread DR2 program development will require sustained, dedicated funding mechanisms and alignment with existing work-streams and programmatic requirements.

Supplementary material. To view supplementary material for this article, please visit <https://doi.org/10.1017/dmp.2021.280>

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