

# NIOSH Disaster Science Research Initiative

## Summary of the July 2014 DSRI Workshop

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## Preface

The National Institute for Occupational Safety and Health (NIOSH) launched the Disaster Science Research Initiative (DSRI) in 2014 to develop an approach for "timely, scalable, scientifically sound responder-based research that can feasibly be implemented before, during, and after a large-scale disaster." As part of this initiative, NIOSH convened a workshop in July of 2014 to help define research questions, identify key definitions and themes related to DSR, discuss the potential roles DSRI could play in this area, and address other issues associated with building a disaster science research program. This report summarizes the discussions in the workshop in terms of a set of central themes in disaster science research, suggests possible roles NIOSH can play in these emerging and important areas, and describes possible next steps for the DSRI.

### *The RAND Safety and Justice Program*

The research reported here was conducted in the RAND Safety and Justice Program, which addresses all aspects of public safety and the criminal justice system, including violence, policing, corrections, courts and criminal law, substance abuse, occupational safety, and public integrity. Program research is supported by government agencies, foundations, and the private sector.

This program is part of RAND Justice, Infrastructure, and Environment, a division of the RAND Corporation dedicated to improving policy and decisionmaking in a wide range of policy domains, including civil and criminal justice, infrastructure protection and homeland security, transportation and energy policy, and environmental and natural resource policy.

Questions or comments about this report should be sent to the project leader, Tom LaTourrette (Tom\_LaTourrette@rand.org). For more information about the Safety and Justice Program, see <http://www.rand.org/safety-justice> or contact the director at [sj@rand.org](mailto:sj@rand.org).

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## Abbreviations

CBPR	Community Based Participatory Research
CDC	Centers for Disease Control and Prevention
DSR	Disaster Science Research
DSRI	Disaster Science Research Institute
ERHMS	Emergency Responder Health Monitoring and Surveillance Program
HSP	Human Subjects Protection
ICS	Incident Command System
IRB	Institutional Review Board
MOU	Memorandum of Understanding
NIOSH	National Institute for Occupational Safety and Health
SME	Subject Matter Experts



## Introduction and Background

Emergency response to disasters can entail a wide variety of activities carried out by emergency management, fire service, emergency medical service, law enforcement, the public health and health care sectors, as well as construction and other skilled support, disaster relief, and volunteer organizations. Given the pivotal role of emergency responders and front-line health care workers in planning and responding to disasters and their potential exposure to dangerous working conditions, it is imperative to minimize the hazards faced by responders as they carry out their work. However, given the urgent nature of disaster response and the broad range of workers who encounter many different types of hazards while engaging in a wide variety of activities, it is challenging to conduct research and develop ways to protect their safety and health. Response workers' safety and health is therefore both an important policy concern and a challenging research area. Much has been learned from research addressing emergency responder safety and health. However, important gaps remain, in large part because many questions can only be addressed in actual disaster settings, which are very difficult environments in which to conduct scientific research. The National Institute for Occupational Safety and Health's (NIOSH) Disaster Science Research Initiative is an effort to help fill that gap by developing a research program on emergency responder safety and health designed to be conducted during disaster responses.

### *Mission and Scope of the DSRI*

NIOSH is the federal agency committed to researching and protecting worker safety and health. Its mission is to conduct research that identifies and reduces risk to workers (NIOSH, 2013). NIOSH has long played a role in developing, conducting and promoting research related to emergency responder health and safety. NIOSH established its Emergency Preparedness and Response Program in 2002 to “to advance research and collaborations to protect the health and safety of emergency response providers and recovery workers by preventing diseases, injuries, and fatalities in anticipation of and during responses to natural and man-made disasters and novel emergent events” (NIOSH, 2014a). This program seeks to accomplish this through high quality research, practical solutions, partnerships, and by translating research into practice. A good example of NIOSH applying these four tenets is its work with the U.S. National Response Team (NRT) and a number of federal agencies, state health departments, labor unions, and volunteer emergency responder groups to develop the Emergency Responder Health Monitoring and Surveillance (ERHMS) system—“a health monitoring and surveillance framework that includes recommendations and tools specific to protect emergency responders during all phases of a response” (NIOSH, 2014b). Although ERHMS provides an excellent framework and tool to be used in all phases of a response for both small- and large-scale events, it was not intended to fill the multitude of gaps in knowledge, and the corresponding research needed, to ensure responders

remain safe and healthy before, during and after their responses to disasters. NIOSH began its Disaster Science Research Initiative to Enhance Responder Safety and Health (DSRI) in January 2014 with the intent of further protecting worker safety and health by “developing an approach to timely, scalable, scientifically sound responder-based research that can feasibly be implemented before, during, and after a large-scale disaster” (NIOSH, 2014c). In order to achieve this intended goal, NIOSH must decide several critical issues, such as defining which populations are included within the term “responder” and determining how to prioritize and facilitate needed research.

Therefore, the institute created an internal work group that met regularly to discuss what research is most needed, existing barriers that hinder such research, how NIOSH might contribute further to disaster science research, and to provide input to NIOSH leadership. One important need identified by this internal workgroup and the institute’s leadership was the need for input from stakeholders and subject matter experts (SMEs) to help ensure the initiative achieves its objective to support meaningful, practical research to protect the safety and health of emergency response providers and recovery workers. As a first step to obtain stakeholder and SME input, NIOSH hosted a workshop in July 2014 at the Centers for Disease Control and Prevention (CDC) in Atlanta, Georgia to discuss and help articulate the needs and objectives of disaster science research in the U.S.

### *Goal and Overview of Report*

NIOSH asked RAND to support this effort by producing this report, which draws principally on the workshop hosted by NIOSH and attended by SMEs in the field of DSR. Workshop discussions are supplemented in places by findings from associated research literature selected by NIOSH. For the purposes of the workshop and this report, research was defined broadly to include the continuum of designing, conducting, analyzing, interpreting, communicating, disseminating, using, and evaluating. This report summarizes NIOSH’s DSR workshop in terms of key themes in disaster science research and makes recommendations for possible next steps for the DSRI.

The workshop, held on July 10, 2014, was intended to help NIOSH better define DSR, articulate its critical elements, identify key research needs, and explore options for creating and managing a DSR program, including roles for NIOSH and the extramural community.<sup>1</sup> It included twenty-five SMEs from academia, responder organizations, non-profit entities, CDC/NIOSH, and CDC Office of Public Health Preparedness and Response.

This workshop resulted in a thoughtful discussion of issues related to DSR. While the discussion did not identify specific research questions, several broad research approaches were raised, such as utilizing pilot projects to determine the feasibility of DSR in specific contexts,

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<sup>1</sup> The workshop agenda, an outline of proceedings, and a list of participants are provided in the appendices.

focusing on small and medium scale disaster responses, and concentrating on particular occupational groups that may be more practical research subjects. A substantial portion of the workshop discussion focused on structural/logistical/procedural issues that participants felt needed discussion prior to targeting substantive research questions. In particular, given the challenges of conducting research in a disaster setting, a considerable amount of time was spent discussing a variety of barriers to DSR and possible ways of overcoming them. The workshop also addressed potential roles for NIOSH and other participants in DSR. Overall, the workshop addressed many important threshold issues and has positioned NIOSH to start addressing more specific research questions.<sup>2</sup>

## Key Themes Framing Disaster Science Research

Based on both the workshop results and the supplemental literature, we have identified six prominent themes that appear to be key considerations in framing disaster science research questions. These are:

- Defining emergency responders and their roles
- Identifying priority research areas
- Partnerships
- Facilitating DSR logistics
- Ethical concerns in DSR
- Ensuring the uptake and use of DSR

We describe each theme below.

### *Defining Emergency Responders and Their Roles*

Both the workshop and the literature discuss the importance for DSR of defining the persons involved in emergency response and the roles they play. The workshop began with a discussion of who should be considered an emergency responder. As suggested by representatives from NIOSH, workshop participants agreed to adopt a broad definition of emergency responders; this decision is also reflected in the literature. While traditional emergency personnel, such as police, firefighters, paramedics, and emergency medical technicians, are unambiguously included within the definition of emergency responder, a broader range of professions can foreseeably be involved in responding to an event. Doctors and other medical clinicians may be called upon to respond to disasters, epidemics, and other public health risks. Utility workers may be engaged to stabilize hazards from damaged electrical, gas, and water lines; and heavy equipment operators and tree-clearing personnel may play an essential role in ensuring access to disaster sites and cleaning up after an event (Benedek et al., 2007). For example, one workshop participant spoke about the role tree trimmers played in responding to Hurricane Sandy and the risks they incurred

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<sup>2</sup> Appendix A provides a detailed outline of the workshop proceedings.

by doing so. In addition, disasters typically attract large numbers of volunteer responders, both off-duty professionals and non-specialists. Finally, participants discussed bystanders who take on responder roles during an emergency and the need to consider them in responder protection efforts. Adopting a broad definition of emergency responders carries with it a need to consider research that will protect all workers who could be imperiled by responding to a disaster.

In addition to discussing the breadth of professions that might be called upon to respond to a disaster, workshop participants discussed how clearly defining the roles that these groups play before, during, and after a disaster can help characterize the range of responder safety and health concerns in disasters and define important DSR questions. Even though a wide range of potential workers may be involved in disaster response, different groups have different types of training and should respond in different ways. For example, one workshop participant discussed instances where emergency room doctors not trained for on-site deployment were injured after traveling to the scene of a major disaster. This was described as a “classic example of not understanding your role” and demonstrates one of the challenges in protecting responder safety and health in disaster settings.

### *Identifying Priority Research Areas*

As one research participant noted, it is infeasible and prohibitively expensive to fully document and explore all potential safety and health hazards faced by responders. Rather, it is necessary to prioritize research questions that can be feasibly answered and address the most important responder safety and health risks. While the workshop did not delve into specific research questions, there was some discussion about how to think about prioritizing research topics. In order to determine the most important disaster science research questions, both the workshop and the literature highlighted the need to better identify and analyze the key elements of preparedness and response activities. The workshop discussion addressed these activities on two levels: personnel and management.

On the personnel level, aspects of preparedness and response that guide DSR include determining what new equipment can be developed to provide better protection, whether individual responders have the equipment and skills necessary to act in a disaster, what can be done to ensure they obtain and maintain those skills, and whether they are able to effectively utilize those skills during a disaster. Each of these issues has direct relevance to responder safety and health. Because major disasters occur rarely and unpredictably, it can be difficult to ensure that emergency responders are sufficiently prepared to respond through drills and other training. This is particularly the case for workers in professions that do not conventionally act as emergency responders. Furthermore, since there is often an urgent need to respond immediately to a disaster, there is little time to engage in supplementary or incident-specific safety and health training once an event has begun. One workshop participant, relaying a comment made by a responder at the 9/11 World Trade Center response, noted that “the midst of a disaster is not the time or place to be pulling out the training slides.”

On the management level, preparedness and response issues that help frame DSR include how responder leadership assesses needs, accesses resources, and deploys and monitors those resources during a response. In the realm of leadership decisionmaking, for example, incident command system training courses could be evaluated to assess their effectiveness in protecting responder safety and health. These factors can have a profound impact both on the effectiveness and safety of the response. One workshop participant spoke about the role that management should play in fostering a set of shared values that enforce an individual responder's decision to use personal protective equipment and take other safety precautions that are consistent with agency goals. Participants emphasized that it is important to encourage workers to think of themselves as the valued asset that they are and to consider their own safety and health during response to a disaster. One participant described the elements of a safety climate—enforcing worker safety and health requirements, empowering individuals to be involved in safety decisionmaking, and maintaining processes for safety inspection, reporting, and hazard mitigation—which is believed to be associated with lower accident and injury rates (e.g., Zohar, 2000; Gillen et al., 2002), and suggested that additional research might be needed to determine how to instill such a climate in a disaster response setting (Gershon et al., 2010).

### *Partnerships*

Workshop participants also discussed the role that partnerships can play in DSR. For the purposes of conducting research on responder safety and health, the participants identified a wide variety of potential partners, including universities, responder associations and unions, private businesses, local community organizations, state and local government, Tribal agencies, and the general public. Emergency responders were seen as particularly important partners in research. Such relationships must operate before, during, and after a disaster response to ensure research can be conducted, disseminated, and translated into practice. Participants noted that it is crucial to ensure that these groups can communicate and collaborate with each other, and it may be necessary to enlist "boundary spanners" to facilitate this interaction. As defined by some workshop participants, a boundary spanner is someone with experience in multiple settings relevant to DSR that can communicate the objectives and results of research to responders and the activities and needs of responders to researchers in ways that are understandable and credible. Additionally, partnerships between researchers and responders may help promote ethical research by ensuring that responders who participate in research benefit accordingly (Collogan et al., 2004). Participants identified community-based participatory research (CBPR)<sup>3</sup> as a potentially appropriate framework for involving responders in DSR, since it encourages relationships between study subjects and researchers.

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<sup>3</sup> CBPR is a methodological approach "meant to increase the value of studies for both researchers and communities being studied" (Viswanathan et al., 2004).

In addition, workshop participants discussed the importance of partnerships between different responder organizations and between responder organizations and the broader community for effective disaster response. Therefore, methods of facilitating multi-jurisdictional and multi-disciplinary partnerships were identified as an important area of concern. The need for cross-jurisdictional partnering is common in emergency response and mechanisms for facilitating such partnerships are generally well-established. A recent review of the disaster medicine literature found that “the need to develop cross-jurisdictional or nontraditional partnerships” was frequently discussed in academic articles (Abramson et al. 2007, p. 57).

### *Facilitating DSR Logistics*

Another key theme that emerged was the need for facilitation of DSR logistics. Conducting DSR is difficult for many of the same reasons that responding to a disaster is difficult: events are unpredictable, the situation is chaotic and quickly evolving, and efforts to preserve human life must take priority. Workshop participants discussed at length many potential barriers to timely, effective, and ethical DSR, and how NIOSH can play a key role in helping to overcome these barriers. The barriers discussed during the DSRI workshop can be categorized into two groups: informational barriers and procedural barriers. Informational barriers inhibit the flow of information from responders and others involved in a disaster to researchers, and vice versa. These barriers can make it difficult to gather data in a timely and effective way, or make it difficult for the results of research to be used during an emergency. Procedural barriers make it difficult for researchers to obtain the resources, expertise, and institutional support necessary to conduct research during or after a disaster. We have summarized the barriers and potential methods of overcoming them, as identified by the participants, in Table 1. While this list identifies many salient barriers to conducting DSR, it is not exhaustive.

**Table 1. Barriers and Potential Methods of Overcoming Barriers**

Barrier	Methods of Overcoming Barrier
<b>Informational barriers:</b>	
Baseline health data may not be available for responders arriving on-scene	<ul style="list-style-type: none"> <li>• Include a data-gathering component as part of the credentialing process (such as required by ERHMS)</li> <li>• Establish minimum standards for data collection, including privacy protections</li> </ul>
Responder organizations may not have easy access to the results of DSR, particularly under emergency conditions	<ul style="list-style-type: none"> <li>• NIOSH can help translate and communicate research to responders and others in the broader community</li> <li>• Results of research can be incorporated into training programs</li> <li>• Communication mechanisms, such as websites, can be established</li> <li>• NIOSH may be able to help connect first responders to research and SMEs during a disaster to facilitate situational awareness</li> </ul>
Critical data may be lost if information gathering does not commence quickly	<ul style="list-style-type: none"> <li>• Develop relationships prior to a disaster so that research can commence quickly if an event occurs</li> <li>• Develop mechanisms for quick funding and IRB approval so that research can commence</li> </ul>
Researchers may not be aware of what information is captured during a disaster or be able to gain access to those data	<ul style="list-style-type: none"> <li>• NIOSH can help to ensure information captured during a disaster is made widely available after the fact, subject to appropriate data sharing agreements.</li> </ul>
People may be unwilling to provide information during and after a disaster because of potential civil and criminal liability concerns	<ul style="list-style-type: none"> <li>• <i>Not discussed during the workshop</i></li> </ul>
<b>Procedural barriers:</b>	
Political pressures may create obstacles to conducting research after a particularly politically sensitive disaster	<ul style="list-style-type: none"> <li>• <i>Not discussed during the workshop</i></li> </ul>
Researchers may not be able to gain access to a disaster site	<ul style="list-style-type: none"> <li>• Researchers could be included in the ICS so that they have ready access</li> </ul>
Complying with and reconciling rules and policies of different agencies can be difficult and time-consuming	<ul style="list-style-type: none"> <li>• “Boundary spanners” can help navigate interactions with differing agencies</li> <li>• Determine what practices and information may be needed to conduct DSR and develop procedures and policies to ensure that the required agencies can fully participate in response research</li> </ul>
There may be little support for DSR prior to a disaster	<ul style="list-style-type: none"> <li>• Ensure funding for DSR between disasters</li> <li>• Conduct research into preparedness and readiness during period between disasters</li> </ul>
Interdisciplinary studies crucial to protecting first responder safety and health may be inhibited by “silos of competency”	<ul style="list-style-type: none"> <li>• “Boundary spanners” can help connect researchers from different disciplines and organizations</li> <li>• Develop culture of interoperability, information sharing, and access</li> </ul>

As can be seen by the above table, the workshop participants thoroughly discussed the barriers to DSR. They provided many specific examples of how these barriers have arisen in the past and could arise in the future. For example, without rapid action from researchers or rostering to document responder physical and mental health status, baseline data about the health of first responders and their prior exposure to hazardous materials may not be collected. The absence of this baseline information will limit researchers' ability to draw conclusions about the

safety and health effects of a disaster response. Similarly, one participant recounted a particular situation where she was unable to obtain information from a responder organization that was concerned about political fallout after a disaster response. She noted that many agencies are risk averse and therefore hesitant to share information after the fact.

The workshop participants also discussed potential methods for overcoming several of the identified barriers. For example, they discussed how the barrier created by a lack of baseline data might be overcome by including a data-gathering component as part of the process for granting responders credentials to operate at a disaster site. In this respect, biomonitoring and the Emergency Responder Health Monitoring and Surveillance (ERHMS) protocol were seen as important efforts to integrate into disaster response. Such data could include physical examinations and self-reported physical and mental health assessments. Workshop participants further discussed how this process could be first conducted as a pilot project during a small-scale disaster, in order to demonstrate the feasibility of this approach.

In addition, workshop participants also discussed research programs that may serve as models for developing mechanisms to overcome barriers to DSR. For example, the National Institute of Environmental Health Sciences, the National Library of Medicine, and other Department of Health and Human Services agencies, have established the NIH Disaster Research Response Project to rapidly collect human data during disasters (NIEHS, 2014). Additionally, the National Science Foundation operates the Grants for Rapid Response Research program for research involving time sensitive data, including quick-response research on disasters and other unanticipated events (NSF, undated).

Both the workshop participants and the supplemental literature suggested that it may be possible to sidestep some of these barriers by directly integrating research into disaster response protocols. The National Biodefense Science Board<sup>4</sup> found that “during emergencies, scientific investigations and associated pre-planning for scientific work must be a fully integrated part of the framework of disaster planning and response” (National Science Biodefense Board 2011, p. 4). Lurie et al. (2013) suggested a similar approach to research in the context of public health emergencies. Shimabukuro and Redd (2014) discussed the importance of planning for evaluation: making a decision to conduct research during the response planning process and following through during the actual response to a public health emergency. They note that, while research integration may seem like a daunting task to underfunded responder agencies, “[e]ven modest evaluation efforts will increase knowledge and advance preparedness” (Shimabukuro and Redd 2014, p. 714). Workshop participants similarly discussed ways that research to protect responder safety and health could be incorporated into disaster response activities and planning. For example, participants seemed particularly interested in piloting

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<sup>4</sup> The National Biodefense Science Board was renamed the National Preparedness and Response Science Board in 2014.

research integration by “baking a research component into an exercise.” This would allow NIOSH to determine best practices for incorporating research without inhibiting disaster response, and would be an effective way of demonstrating the feasibility of integrated disaster research.

### *Ethical Concerns in DSR*

While ethical conduct is always a critical concern in research, it is particularly challenging in the context of DSR. Workshop participants noted that DSR must never interfere with rescue efforts. In particular, the workshop discussed the fact that DSR should only be conducted at a disaster site during rescue efforts if the research has clear occupational safety and health benefits and there is no way to conduct the research at a different time or in a different place.

Furthermore, it is necessary to weigh both the financial and intangible costs of conducting the study against the potential improvements to responder safety and health. Decker et al. (2012) developed a decision process for determining whether post-disaster research is an effective use of public health resources. They recommended considering a set of “gatekeeper factors” before deciding whether to commence research, including: (1) the strength of the theoretical basis for the study, (2) the ability to gather the necessary evidence, (3) the feasibility of the suggested research, and (4) the strength of the research design.

Protection of research subjects from harm (referred to as human subjects protection, or HSP) is similarly challenging in the context of DSR. Workshop participants discussed the value that HSP considerations can play in ensuring ethical, reputable research. As one workshop participant commented, institutional review boards (IRBs) can “facilitate good research since they help protect research subjects, the public, and researchers.” Furthermore, HSP and ethical issues are particularly salient to NIOSH given their dual role as a research organization and public health agency. NIOSH must protect responders and researchers from improper or unethical research and will need to consider criteria for determining what research activities are appropriate under particular circumstances.<sup>5</sup>

HSP can be particularly difficult in the context of first responder research because of the strain and short time frame when responding to a disaster. Collogan et al. (2004) identified four crucial concerns related to conducting research involving people impacted in a disaster: (1) capacity to consent, (2) vulnerability, (3) risks and benefits of research, and (4) obtaining informed consent. While Collogan et al. were considering the risks of research to all members of the public impacted by a disaster, these concerns may also apply to responders. Similarly, Rosenstein (2004) suggests that “a significant minority of individuals under such extreme circumstances [as a disaster] do react with emotional, cognitive, perceptual, and behavioral

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<sup>5</sup> For further discussion about determining whether to conduct research during a disaster, see Decker, et al. (2012).

responses that raise legitimate questions about whether those individuals are in a position to provide adequate informed consent for research participation.”

Addressing HSP challenges in DSR will require careful consideration. Despite the concerns raised by Collogan et al. (2004) and Rosenstein (2004), researchers have found little evidence to support the idea that persons impacted by a disaster are typically unable to give voluntary, informed consent (Ausbrooks et al., 2009). Furthermore, given the broad definition of emergency responder adopted at the workshop, some responder groups may be more vulnerable than others, making it appropriate to evaluate ethical concerns on the basis of the type of responder implicated by the research. An undocumented cleanup worker or spontaneous volunteer may be vulnerable in a way that a unionized firefighter may not be (and vice versa).

Beyond the challenge of ensuring HSP in DSR is the added concern that the time required to address HSP concerns may delay the initiation of research in time-critical circumstances. Workshop participants noted that the need to collect data quickly will be impeded by a long IRB approval process. As noted by workshop participants, the time for IRB approval could be reduced by identifying and pre-screening candidate projects before a disaster.

### *Ensuring the Uptake and Use of DSR*

Workshop participants emphasized the importance of deriving lessons from past disasters and noted that DSR could help clarify lessons and translate them into improved safety and health protection for emergency responders at disasters. These lessons could include descriptions of successes, missteps, technology performance, and the instances in which policies or procedures impact responder safety and health. The workshop participants discussed potential methods of identifying lessons from past disasters. In particular, participants thought that case studies and case histories can provide important insights into the circumstances of a disaster and response, and are vital tools for identifying potential lessons related to knowledge, policies, or technology. These methods can also be observed in the literature. For example, Jackson et al. (2002) and Newman (2011) used the response to the World Trade Center attacks to discuss potential policy changes that should be made to protect emergency responder safety and health. Similar processes, such as after action reports and “hotwash” discussions, are commonly employed by responder organizations to identify potential lessons (Phelps, 2007). After identifying lessons that can be used to improve response and further protect safety and health during the next disaster, the next step is to ensure that the identified changes in policy are actually implemented. Workshop participants emphasized that only when changes in practice have been implemented can “lessons identified” be considered “lessons learned.” Participants discussed ways of determining whether lessons identified after a disaster resulted in policy changes, and whether those policy changes resulted in better actions and outcomes during the next disaster. Surveys of responder agencies and case studies can be used to evaluate if lessons learned from past emergencies were implemented, the factors that influenced their adoption or non-adoption, and whether they resulted in improved protection for responder safety and health. The development

and distribution of best practices and model policies based on lessons identified after a disaster can be a way of sharing appropriate policy changes. Adoption of lessons is most effective when shared by a trusted and respected entity, a position that NIOSH clearly holds in the worker safety and health realm.

Furthermore, even if lessons are learned after a disaster, it is necessary to ensure that the lessons learned are maintained over time. Priorities change as time passes after a disaster, which can lead to the scaling back or cancellation of programs based on lessons from previous disasters. For example, one workshop participant noted that well-developed emergency responder training programs were established after the September 11, 2001 attacks. However, funding was reduced over time and these programs shifted from being offered in-person at the National Fire Academy to being offered through an online platform.

Workshop participants also spoke about the importance of translating research into tools and resources that can be used by responders in present and future disasters. Such tools might be in the form of ad hoc guidelines for particular situations, best practices, training guidance, model policies, or other resources. Additionally, studies have shown that aid workers find particular types of post-disaster research products, including systematic reviews, helpful in responding to subsequent disasters (Clarke, 2013). This is relevant to both immediate sharing of initial findings during a disaster and to sharing more comprehensive analytical results afterwards. Particularly, workshop participants spoke about the importance of making research results—and subject matter experts to explain those results—available to first responder management during an emergency to increase situational awareness and help safeguard first responder safety. NIOSH’s Research to Practice (r2p) initiative provides a useful model of how DSR could be conveyed to the responder community (NIOSH, 2011).

## Potential Roles and Next Steps for NIOSH

The workshop included discussion about the relative roles of different stakeholders in DSR and periodically returned to the question of NIOSH's role in various themes. We conclude with a summary of the roles that NIOSH could assume in DSR and the next steps it could take to begin to undertake them. Based on the workshop discussions, we have identified potential roles that NIOSH could undertake in each of the theme areas described above. The identified themes and associated roles are summarized in Table 2. Further insights about these potential roles and potential next steps for NIOSH developed through the workshop are discussed below.

**Table 2. Summary of Key Themes and Potential Roles for NIOSH**

Theme	Potential Roles for NIOSH
Defining emergency responders and their roles	<ul style="list-style-type: none"> <li>Promote research that characterizes the activities and needs of the wide variety of first responders</li> </ul>
Identifying priority research areas	<ul style="list-style-type: none"> <li>Convene additional workshops focused specifically on developing a research agenda for DSR</li> <li>Design research programs that target the greatest responder risks and that are feasible to undertake</li> </ul>
Partnerships	<ul style="list-style-type: none"> <li>Leverage its position and credibility to foster cooperative agreements and other partnership arrangements among researchers, subject matter experts, and emergency responders/management</li> </ul>
Facilitating DSR logistics	<ul style="list-style-type: none"> <li>Utilize its complementary roles in both research and response to propose expectations, standards, and policies that promote and facilitate DSR</li> </ul>
Ethical concerns in DSR	<ul style="list-style-type: none"> <li>Establish ethical research standards in the specific context of responder-focused DSR to ensure that DSR minimizes impact on response activities, safeguards responder safety and health, and maintains necessary confidentiality</li> </ul>
Ensuring the uptake and use of DSR	<ul style="list-style-type: none"> <li>Compile and make available DSR to both the responder community and the general public</li> <li>Fund efforts to translate DSR findings into improved technologies, policies, and practices</li> </ul>

NIOSH can assist in defining emergency responders and their roles by promoting research aimed at characterizing potential emergency responders and their relative rolls in different disaster settings. Such information would help clarify the subjects and scope of activities to which DSR applies.

An essential step in developing the DSRI is to develop a concrete roadmap for DSR. While the workshop made an initial foray into exploring knowledge gaps and research questions, more work is needed to clarify and prioritize a research agenda. NIOSH may want to convene a working group tasked with the specific objective of developing a DSR agenda and roadmap. A key consideration will be to decide how much the research should address responder safety and health directly versus the more indirect safety and health benefits of improving disaster response operations more generally. A related consideration is the extent to which the program would entail relatively prescriptive calls for specific types of research versus a more investigator-initiated approach.

Research topics raised in the workshop may provide a starting point for subsequent conversations that build off the previous workshop. These include:

- How does responder culture and climate impact compliance with PPE and safety requirements?
- What can and what should be done to ensure responders and other practitioners are able to utilize the results of DSR? What can be done to disseminate best practices in real time?

- What policy levers are available to enable improvements to protect responder safety and health and what are their strengths and weaknesses?
- What training programs are effective in protecting responder safety and health? How can training programs be evaluated to determine their effectiveness?
- How might responder safety and health-related research questions be integrated into the incident command structure?

The workshop participants extensively discussed NIOSH's potential role as a facilitator of relationships among the broad range of actors involved in disaster response and DSR. Given NIOSH's role in protecting public health, it may be able to help connect researchers, local responder agencies, public health departments, labor and trade organizations, and other stakeholders before, during, or after a disaster. NIOSH is also well-placed to connect with responder professional organizations, and could therefore help ensure that research is used to increase protections for first responders. A number of options for the division of labor and collaborative arrangements among researchers and practitioners were proposed at the workshop. These include cooperative agreements, grants, memoranda of understanding, multi-institution research centers, and collaborative participation in training, drills, and exercises. The most appropriate partners and collaboration approach may depend on the nature of the research being undertaken, suggesting that a variety of arrangements should be pursued.

In a similar manner, NIOSH may be able to utilize its combined capabilities in research and emergency response to articulate and promote steps to remove barriers to DSR. It could help adjust expectations about the role of research in disaster response, help propose model policies and procedures that define roles and responsibilities of researchers and responders in conducting DSR, and sponsor exercises that include DSR elements to help introduce DSR to responders. Ultimately, a goal might be to coordinate with the state and federal disaster management agencies to have DSR included as an element of disaster plans and the incident command system.

Workshop participants felt that DSR posed special ethical challenges and that NIOSH may be able to help establish guidelines or standards that are specifically tailored to DSR settings that ensure that research is conducted ethically, safely, and effectively.

Finally, workshop participants spoke extensively about the role NIOSH can play as a reliable, accessible source of information related to DSR findings. These findings may be used by a variety of constituencies, including responders, management, policymakers, and other researchers; it is likely that different types of stakeholders would require different types of research products. NIOSH may have a central role in facilitating DSR by acting as a collection and distribution hub for important information related to research methods and outcomes in this field, as well as helping to translate research products for different audiences. Dissemination and adoption of recommendations, tools, and other research products is most effective when they are evidence-based and conveyed by a trusted and respected organization such as NIOSH.

## Appendix A: Summary of Workshop

- I. Workshop Objectives
  - A. Putting together an initiative pulling together disaster science research is a huge task, and the National Institute for Occupational Safety and Health (NIOSH) wanted to make sure they brought other voices to the table, particularly first responders, health departments, and the academic community
  - B. Goal is to obtain input on:
    - 1. The types of research that are most feasible and most needed to address responder safety and health
    - 2. The best role for NIOSH researchers
    - 3. The involvement of the extramural community
    - 4. Possible barriers going forward
  - C. A document summarizing the results of this workshop will be produced and shared with participants to obtain their feedback
- II. Context for DSRI at NIOSH
  - A. NIOSH is the only agency for worker safety and health research
  - B. In 2014, NIOSH launched the Disaster Science Research Initiative (DSRI) to encourage study of the effect of disasters on first-responders
    - 1. After inviting interested parties to contact them, they developed a listserv to communicate with practitioners and the research community
    - 2. This workshop was convened to obtain input from researchers, academics, and practitioners
  - C. NIOSH has identified potential research questions, but is looking for additional feedback. According to the slides from NIOSH's presentation at the workshop, these research questions include:
    - 1. "What are the primary questions needing research considering the possible types of responses and the responders involved?"
    - 2. Where are the major gaps in our understanding of exposures and other factors influencing responder health?"
    - 3. What are the major barriers to disaster science research to enhance responder safety and health?"
    - 4. What research is NIOSH uniquely positioned to do and what is the role of the academic community in responder safety and health research?"
    - 5. What is the role of emergency preparedness and response practitioners and consultants in responder safety and health research?"
    - 6. What role should bio-monitoring play and how is it best implemented?"
    - 7. How can ERHMS best be used to complement responder disaster research?"
    - 8. How does responder disaster research best fit into existing national response policies and systems?"
  - D. NIOSH has constructed a decision matrix that explains the factors that should be considered whether or not to do disaster research.<sup>6</sup>

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<sup>6</sup> For further discussion of this topic, including the complete version of this decision matrix, see Decker, John A., Max Kiefer, Dori B. Reissman, Renée Funk, John Halpin, Bruce Bernard, Richard L. Ehrenberg et al. "A decision process for determining whether to conduct responder health research following large disasters." *American journal of disaster medicine* 8, no. 1 (2012): 25-33.

1. In particular, there is a need to conduct this research ethically – to ensure that it is really helping first responders and that the fact that it is helping them is communicated.
2. Additionally, disaster research is complicated by the fact that it can be difficult to get a baseline, so that the effects of the disaster can be fully understood. The difficulty of developing a baseline might vary among different types of disasters, and it might be worth conducting a pilot study to see what can be done.

### III. Key Definitions and Themes

- A. NIOSH has proposed to define certain key terms very broadly, and it was generally agreed that this was a suitable approach.
  1. “Research” should be defined broadly to encompass a wide variety of research.
    - a. Throughout the course of the workshop, several people mentioned how informative case studies can be.
    - b. The exact protocol and design will be based on disaster type and circumstances.
  2. “Responder” is also defined broadly to include volunteers and contractors, as well as disaster cleanup workers who may be exposed to hazardous conditions after the fact.
    - a. For example, during Hurricane Sandy, tree care workers were first responders, since they were necessary to clear roads to allow response activities.
    - b. Public health workers may need to be included in this definition if they are exposed to the disaster as part of their work.
- B. Ethics are a major concern in disaster research, and NIOSH wants to be particularly sensitive to that.
  1. There is always a concern that research might impede first response activities
  2. If a particular type of research can be done after the fact, then it should be done after the fact
- C. NIOSH has multiple roles: both to protect the health of workers and to conduct research about threats to their health.
  1. These roles are complementary: research develops information that can be used to protect the health of responders and NIOSH’s role in public health can help them conduct research.
  2. But, there is a need to ensure that NIOSH has the relationships and associations necessary to get on the scene early to fulfill both roles.
  3. Consider separating the roles so that operational people can worry about operations, and researchers can think about research.
- D. The need for translation of research was a key theme throughout the course of the day.
  1. There’s a real need to make sure that research is used to implement changes that will improve public health and safety.
  2. Additionally, there is a need to ensure communication across specialty areas, response organizations, and jurisdictions.
- E. Research into the logistics of responding to a disaster was another key theme.
  1. A disaster may destroy the relevant command structure, making it difficult to ensure that workers have the necessary safety equipment.

2. There is a need for research that explains what logistic and behavioral barriers might prevent someone from using PPE, and what can be done to encourage its use.
  - F. Research also needed into organizational/behavioral issues, including management structures of organizations involved. How do the structures differ? How do expectations differ? This is critical for managing response operations and safety.
- IV. Role of NIOSH in DSR
- A. NIOSH could potentially play a role in disaster science before an event, during an event, and after an event.
  - B. NIOSH can help develop relationships before disasters
    1. Before a disaster occurs, NIOSH can: (1) develop relationships between the DSRI and first responders and (2) help develop relationships between extramural researchers and first responders
    2. Since disasters occur without warning and critical data may be lost if research does not begin quickly, preexisting relationships help ensure that research is conducted expediently and in a manner appropriate for the situation.
    3. One particularly interesting suggestion was “to bake a research component into an exercise” – have researchers present during a drill. This would serve several important functions:
      - a. Establish vital relationships between researchers and first responders
      - b. Allow researchers to investigate interesting questions about logistics and management during an emergency situation
  - C. During an event, NIOSH can help develop and provide information that can be used to help keep first responders safe.
    1. NIOSH can help to maximize situational awareness by providing first responders with information.
    2. When necessary, they can also act as a conduit between first responders and researchers who might be able to provide useful information.
  - D. NIOSH should also be involved with documenting an event that has occurred or is occurring.
    1. Information is often lost during a disaster, and it can be hard to ensure that it is not only captured, but made widely available after the fact so that research can be performed and translation to practice occurs (implying “lessons learned”).
    2. Case studies can be particularly valuable tools in disaster research.
    3. NIOSH could help by distributing data related to disasters to the broader community; this is in fact a role they have filled in the past.
  - E. NIOSH can help translate research to increase its impact.
    1. NIOSH can help connect researchers with first responders and encourage the incorporation of research results into response plans.
    2. Additionally, NIOSH can facilitate access to DSR results by the broader community. For example, they could develop an online repository of articles or write summaries of articles aimed at a general audience.
- V. Critical Elements of DSR
- A. Preparedness and response activities
    1. It is important to know who has the skills to respond to a disaster, and to ensure that those skills are kept up-to-date. (“The site of the disaster is not the time to pull out training slides”)
      - a. This is particularly difficult because many kinds of disasters happen infrequently.

2. There is a need for research into what kinds of PPE are available and who has access to PPE.
  3. There is also a need to prepare the general public for disasters.
- B. Disaster research
1. Disaster research can help the first responder command structure with situational awareness.
  2. There is also a need to document the event, but it is impossible to collect everything and do research on it later.
  3. It is important to understand the implications of disasters during and after the event.
  4. It may be possible to do research after the fact.
  5. There may be opportunities to do research in exercise settings.
  6. Many of the interesting research questions may have less to do with conventional exposure estimates and more to do with management and decisionmaking.
- C. People and roles
1. First-responders and management are key stakeholder groups in DSR.
  2. In addition, support is needed for non-official responders (people on the scene who respond immediately to a disaster before the first responders arrive).
  3. Also, NIOSH may want to consider the impact of disasters on the workplace more broadly.
    - a. What happens when a disaster occurs in the workplace?
    - b. What happens when a workplace needs to continue operating during a disaster?
- D. Lessons learned/lessons identified
1. There is a critical distinction between the two: lessons are often identified after a disaster, but these lessons are rarely used to implement change.
  2. Various education and training programs implemented after 9/11 are being cancelled now as funding priorities shift elsewhere.
- E. Potential barriers to DSR
1. There may be civil and criminal implications to DSR and data.
    - a. Since “something has generally gone wrong” in the case of a disaster, people involved may be hesitant to provide data or speak candidly about their experience due to liability concerns.
    - b. Additionally, researchers may encounter political obstacles in cases of particularly sensitive accidents.
  2. There is a need to be able to start research quickly so as to preserve perishable data.
    - a. NSF has a rapid granting program available which makes small grants extremely quickly to preserve perishable data.
    - b. NIH is launching a disaster research initiative focusing on non-occupational topics. NIOSH needs to communicate with them to help leverage and build off of that.
- VI. Developing a Comprehensive Approach to DSRI at NIOSH
- A. Understanding the gaps in the current research
1. How does culture and climate affect compliance with safety requirements?
    - a. Why are some groups not compliant with safety requirements?
    - b. In particular, what role management plays in encouraging or discouraging compliance? What role does training and practice play?
  2. What kinds of outreach to practitioners are effective?

- a. DSR may provide information and recommendations that the first responder community could use to improve safety.
    - b. How can we ensure that we are not just disseminating results, but also facilitating policy changes based on those results?
  - 3. How can we facilitate knowledge transfer among first responders?
    - a. As some types of disasters may happen infrequently, responders with first-hand experience in particular situations may be nearing retirement.
    - b. How can we facilitate knowledge transfer to more junior first responders?
- B. Identifying needed research
  - 1. There was general consensus that the gaps in current knowledge (identified above) should be the subject of research.
    - a. Several additional gaps were explicitly identified.
  - 2. As first responder personnel need to leave quickly, it is important to know who is available and what is needed to ensure they are ready.
  - 3. Additionally, methods for facilitating interactions between responder organizations during an emergency would be helpful.
- C. Research themes
  - 1. It is very important to have people who can act as “boundary spanners”: conduits and translators between jurisdictions and communities. Related to interoperability.
  - 2. Similarly, there’s a need to understand how information is shared and what can be done to improve information sharing. Information sharing may include:
    - a. Electronic medical records
    - b. Encouragement of sharing of information between jurisdictions
    - c. Passing information to the field
  - 3. There was some discussion of the distinction (if any) between evaluation and research in this area.
  - 4. Community-based research and social justice issues are a critical concern in this research area.
- D. Research questions
  - 1. The group agreed that it was too early in the process to narrow down on particular research questions.
- E. Community engagement
  - 1. “Boundary spanners” should help with community engagement.
  - 2. First responders (including public health personnel) should be encouraged to think of their own safety – workers are a valued asset, and they should be encouraged to protect themselves.
  - 3. The research community may want to conduct research during first responder drills both to analyze the training itself and to familiarize themselves with key players and practices within the first responder community so that they can effectively conduct research during an emergency situation.
  - 4. DSRI/researchers should try to promote awareness of their work within the first responder community, particularly by becoming recognized in documents and training manuals.

## VII. Building a DSRI

### A. Roles

- 1. There are roles for both intramural and extramural research.
  - a. Intramural



- a. Specifically trained researchers and personnel who can span the boundaries between jurisdiction and specialty
- b. Development of MOUs with key partners
- c. Utilization of existing organizations and structures, including ICS structure, local emergency planning structure, CDC preparedness centers
- d. Pre-event communications and relationships
- e. Case studies and case histories
- f. Communication mechanisms, including webpages
- 2. Several barriers to DSR were also identified, including:
  - a. Time crunch to start studies
  - b. Silos of competency, which may impede interdisciplinary research
  - c. DSR may be a “low priority” until a disaster occurs
  - d. Difficulty in complying with inconsistent agency rules, guidelines, and policies
  - e. The sensitivity of information and data collected, as it could relate to a potential criminal or civil investigation
  - f. The culture and climate of first responders.
- 3. Institutional Review Boards were considered both a facilitator of and a barrier to DSR.
  - a. IRBs facilitate good research since they help protect research subjects, the public, and researchers.
  - b. However, IRBs may also function as a barrier to research since they impose an extra hurdle on researchers and may prevent researchers from getting in the field quickly.

#### D. Results

- 1. Both impact and outcomes could be improved by conducting pre-event research, including:
  - a. Assessments of drills
  - b. Research that assists in preparation for disasters
- 2. “Metrics of success” could be developed to help also help measure and improve outcomes.
- 3. Impact of research can also be improved by conducting case studies that demonstrate success of prior interventions.

### VIII. Next Steps

- A. RAND will be developing a document that captures the themes and trends which emerged during today’s conversation.
  - 1. A short paper is expected by December 1<sup>st</sup>.
- B. Summary of workshop results will be distributed through the listserv.
  - 1. Additionally, they may convene a town hall meeting to elicit further comments.
- C. DSRI is still in the process of identifying exactly what they plan to do next, but they are hoping to develop a plan that allows them to progressively develop their role in this area.
- D. They are considering a funding initiative to address some of the issues raised today.
  - 1. This funding initiative may involve either creating new centers of excellence or utilizing their existing centers of excellence
- E. DSRI is also working to raise visibility, increase buy-in from key constituencies, and identify key opportunities going forward.

## Appendix B: Workshop Agenda

<b>DSRI Workshop Agenda</b>		
<b>8:30am</b>	Gather in Building 1825 Century Center Blvd Atlanta, GA 30345 Badging and Security	
<b>9:00am</b>	Welcome and Introductions Workshop Objectives and Expected Outcomes	Margaret Kitt
<b>9:20am</b>	Context for Disaster Science Research Initiative (DSRI) at NIOSH <ul style="list-style-type: none"> <li>• Background on DSRI at NIOSH</li> <li>• Disaster Research Decision Matrix</li> </ul>	Margaret Kitt Lisa Delaney
<b>9:40am</b>	Key Definitions and Themes <ul style="list-style-type: none"> <li>• Disaster Science Research (DSR) <ul style="list-style-type: none"> <li>○ NIOSH definition</li> </ul> </li> <li>• Populations of Interest <ul style="list-style-type: none"> <li>○ Emergency response and recovery workers</li> </ul> </li> <li>• Group discussion</li> </ul>	Sarah Felknor Lisa Delaney  Sarah Felknor
<b>10:00am</b>	Role of NIOSH in DSR <ul style="list-style-type: none"> <li>• Discuss in large group</li> </ul>	Margaret Kitt Lisa Delaney
<b>10:20am</b>	Break	
<b>10:30am</b>	Critical Elements of DSR <ul style="list-style-type: none"> <li>• Panelist 1 (10 min)</li> <li>• Panelist 2 (10 min)</li> <li>• Panelist 3 (10 min)</li> <li>• Panelist 4 (10 min)</li> <li>• Discussion of main themes/criteria of critical elements</li> </ul> Key participants - Competencies and capacity – Environment	Sarah Felknor Robyn Gershon (UCSF) Tom LaTourrette (RAND) Robert Brackbill (WTCHP) Margaret Lumia (NJHD)  Sarah Felknor
<b>11:30am</b>	Lunch	
<b>12:15pm</b>	Developing a comprehensive approach to DSRI at NIOSH <ul style="list-style-type: none"> <li>• What are the gaps in current research?</li> <li>• What research is needed?</li> <li>• What are research themes?</li> <li>• What are the research questions?</li> <li>• How do we engage the responder community?</li> </ul>	Sarah Felknor
<b>1:45pm</b>	Break (15 min)	
<b>2:00pm</b>	Building a DSRI <ul style="list-style-type: none"> <li>• Intramural and Extramural</li> <li>• Mechanisms of collaboration – data, ownership, initiative</li> <li>• Community and Volunteer Partners</li> <li>• DSRI Networks</li> </ul>	Sarah Felknor Lisa Delaney

	<ul style="list-style-type: none"> <li>• Facilitators and Barriers to DSRI research</li> <li>• Outcomes and Impact</li> </ul>	
<b>3:30pm</b>	<p>Next Steps</p> <ul style="list-style-type: none"> <li>• Workshop summary</li> <li>• Workshop deliverables <ul style="list-style-type: none"> <li>○ Workshop report</li> </ul> </li> <li>• NIOSH next steps <ul style="list-style-type: none"> <li>○ Responder input</li> <li>○ Action plan</li> </ul> </li> </ul>	<p>Sarah Felknor Lisa Delaney</p> <p>Margaret Kitt</p>
<b>4:00pm</b>	Adjourn	

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