Building Gulf Coast Resilience through Interdisciplinary Disaster Response Research

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Introduction

The coastal regions of the U.S. Atlantic and Gulf of Mexico are attractive places to live and work, but are increasingly exposed to some of the most powerful storms on earth. For example, since 1980, hurricanes and tropical storms causing more than $1 billion in damages have increased from an average of 0.4 per year to more than 1 per year (National Research Council 2014). According to Hanson et al. (2011) and Hallegatte et al. (2013), eight of the twenty cities most at risk from flood losses from coastal storms in the world are located along the U.S. Atlantic and Gulf Coast. Population growth rates in Southeastern Atlantic (20.8%) and U.S. Gulf Coast (17.8%) regions was been nearly double the national average (11.4%) between 2000 and 2012 (National Research Council, 2014). The persistent movement of people and economic development to coastal regions has dominated the growth in disaster losses for much of the past century (Pielke et al., 2008). Since 1960, in spite of large national efforts to reduce the impacts and costs of disasters, average annual federal expenditures to fund rebuilding from catastrophic losses in the U.S. have been rising faster than either overall population or gross national product (Gall et al., 2011).

The physical and social vulnerabilities of the U.S. Gulf Coast to natural disasters were exacerbated by the release of approximately 5.0 million barrels of oil into the Gulf of Mexico, which resulted from the catastrophic explosion and fire on the *Deepwater Horizon* oil platform on April 20, 2010 (McNutt et al., 2012). The *Deepwater Horizon* oil spill highlighted the persistent need for sustained, multi-disciplinary collaborations and partnerships to identify, assess, and mitigate existing deficiencies in disaster planning, response, and recovery affecting the highly vulnerable communities in the Gulf of Mexico. There were also major challenges associated with the rapid deployment of assessment teams to evaluate environmental damage and human health risk stemming from this event. Efforts to assess damage and risk were hampered various delays, including the need to identify experts, develop research methodologies, and receive institutional review board approval to execute the research.

Additional challenges were identified by multiple groups. For example, the U.S. Coast Guard's Incident Specific Preparedness Review identified the absence of interoperable technology to facilitate inter-agency communication and real-time information exchange, deficient and inconsistent knowledge and planning related to disaster response and crisis management, insufficient availability of trained responders and resources, lack of infrastructure to conduct essential research rapidly, and ill-defined research questions and assessment criteria (Papp, 2011). The National Commission on the BP *Deepwater Horizon* Oil Spill and Offshore Drilling (2011) identified a number of challenges which hindered the ability of investigators to conduct sound research in the aftermath of this disaster, including the lack of research related to the ecological, environmental, and human health outcomes which may result from exposure to dispersants and oil, the lack of existing infrastructure to facilitate and expedite essential data collection as is needed to assess these impacts longitudinally, and the scarcity of research funding that could be procured rapidly to support and inform response and recovery efforts. In the absence of critically needed baseline metrics and real-time impact assessments that would elucidate the consequences of this disaster on the delicate, complex, and inter-connected

environmental, economic, and human systems in the Gulf of Mexico, decision-makers and community stakeholders were ill-equipped to develop and implement strategies and plans that would be conducive to reducing exposure, mitigating vulnerability, and building resilience to more successfully adapt to future adverse events (NAS, 2012).

Texas OneGulf, a consortium of nine Texas institutions, led by the Harte Research Institute for Gulf of Mexico Studies at Texas A&M University-Corpus Christi, was established as a RESTORE Center of Excellence, governed by the RESTORE Act, to guide the Gulf restoration after the Deepwater Horizon oil spill. The mission of the Texas OneGulf Center of Excellence is to gather and improve knowledge about the Gulf of Mexico to inform decision making around the challenges of environmental and economic sustainability of the Gulf and its impact on the health and well-being of Texans and the nation. Texas OneGulf is the first entity to combine these human-health focused resources with experts in marine and ocean science, policy and law, and interface with sophisticated data acquisition, management and retrieval programs.

As one of the Center's defining activities, the Texas OneGulf Disaster Research Response (DR2) program was established to create for the first time an infrastructure to support disaster research response encompassing environmental, human health and economic assessment capabilities that can be employed rapidly to assess the impact of disasters along the Texas Gulf coast in real-time. DR2 activities will contribute to disaster preparedness, response and recovery in the Gulf of Mexico by fostering a deeper understanding of disaster risks and recovery, and by providing critical information key to effective decision-making when disasters strike. In our efforts to identify and convene individuals with the expertise to make a significant contribution to developing a DR2 plan for Texas OneGulf, we created five working groups, each with a specific focus.

Emergency Management Partnership Network

The Emergency Management Partnership Network working group was conceived with the goal of building organizational capacity and leadership in jurisdictions along the Texas Gulf Coast through the development of a sustained network of emergency management and public health professionals. The goals of the Partnership Network will be to identify opportunities for the integration of emergency management and public health response to disasters and to develop memoranda of understanding between partners that can be implemented during a disaster response, initially focusing on the Houston / Galveston Health Care Coalition. Part of the integration may also be driven by the working group's identification of opportunities for shared training and equipment between emergency management and public health responders. Additionally, this group aims to further synchronize disaster response planning where possible. Disaster planning is currently conducted by various agencies (e.g., hospitals, public health, emergency management, planning and urban development) and sectors (e.g., public safety, private industry, academia) operating in a siloed fashion. In order to advance both research and response capabilities, and to promote health and safety of responders and researchers, more cross-agency and cross-sector collaborations are needed. In addition to improving research and response, this type of integration across emergency management and public health could provide

a more synergistic approach to the response to natural or man-made disasters that will yield optimal post-disaster outcomes for disaster-affected communities.

Disaster Research Response Preparedness

The Disaster Research Response Preparedness working group will establish effective, scalable, and scientifically robust disaster response research systems to facilitate rapid and sustained disaster research in the Gulf of Mexico. After the Deep Water Horizon disaster, the National Institute of Environmental Health Sciences (NIEHS) developed the Rapid Acquisition of Pre-and Post-Disaster Data (RAPIDD) protocol, which include standardized questionnaires and other materials that have been pre-approved by the NIEHS's Institutional Review Board (IRB). Materials are re-reviewed on an annual basis to keep all protocols active and up-to-date. Based on the success of this national effort, this workgroup, in coordination with the University of Texas Medical Branch and Texas A&M University's Institutional Review Boards are working to develop a synchronized process for activating disaster research response activities by researchers at Texas universities, including generic IRB templates and pre-approved research study protocols to enable expedited approval of disaster response research and facilitate real-time, systematic collection and analysis of data post-disaster while balancing human subject protections. This work group will work with University IRB partners to design an ongoing review process and timeline that will ensure that when a disaster occurs, preapprovals to conduct rapid research are in place.

Community Access and Baseline Health Assessments

The Community Access and Baseline Health Assessments working group will contribute to the effort to improve disaster research response by building on existing relationships between academic researchers and community stakeholders that have been developed at Texas A&M University as part of the University's Environmental Grand Challenge. Input from existing community partners, including the Texas Environmental Justice Advocacy Services (t.e.j.a.s) and Furr High School (an XQ Super School with a Texas A&M University living laboratory on campus), help communicate Galveston Bay and Houston Ship Channel neighborhood residents' priorities for disaster research response. Engaging with community partners around the development of disaster research priorities, questions, and objectives can inform and facilitate the work of DR2 by including local knowledge into the research, making the research more relevant to residents, and the research findings more likely to be translated and implemented. Community partners also serve as a conduit for the distribution of research findings back into the Galveston Bay and Houston Ship Channel communities. Further, by working with community partners, the Community Access and Baseline Health Assessments workgroup has enhanced capacity to conduct environmental risk assessments that provide baseline measurements of exposure prior to a disaster, such as collecting indoor air and tap water samples, as well as in the future potentially collecting human bio-sampling (urine, hair, fingernails). By building on existing relationships with community groups, this workgroup will facilitate the collection of survey and other data over an extended period of time. This baseline and future longitudinal data, when utilized by public health and other research experts, can potentially be used to find correlations between future health effects and disasters to strengthen the evidence base for the

health impacts of disasters. Strong community engagement relationships will also aid in the retention of human subjects for longitudinal assessments and help mitigate some of the potential structural and cultural barriers to disaster research.

Environmental Health and Disaster Education for Practitioners

The overreaching aim of the Environmental Health and Disaster Education for Practitioners working group is to inventory existing trainings for Board Certified Occupational and Environmental Health clinicians and other health professionals who serve as first responders in environmental health disasters. According to the published research, due to the shortage of Board Certified Environmental and Occupational Health physicians, general practitioners with little specific training are seeing up to 75% of patients with environmental and occupational injuries. A website housing the inventory of trainings will be hosted by the Department of Environmental and Occupational Health at the Texas A&M University School of Public Health. Where gaps in existing training are identified, new training materials will be developed. The group plans to develop three disaster scenario case studies, with student and facilitator guides, which can be used to train responders to environmental health disasters to evaluate adaptive options for health professionals and the health care system during different types of environmental disaster scenarios. Working through the facilitated trainings with regional or local colleagues may also help health professionals who respond to environmental health disasters facilitate a more cohesive and organized response. The trainings may also help to build health professionals' capacity to appropriately recognize and treat environmentally-induced symptoms and illnesses and the psychosocial impacts of such disasters. We will apply for appropriate continuing education credits for the three trainings to encourage practitioner participation and completion.

Ethical, Legal, Social Issues

Disaster research is subject to a number of unique ethical and legal challenges. The Ethical, Legal, Social Issues group, including experts in health law, public policy, and environmental justice from around the U.S. Gulf Coast, is led by experts from the University of Houston Law Center. The group will work to ascertain existing gaps, identify potential research questions, and communicate regulatory or standardization barriers related to the legal and ethical parameters of disaster research response to the other workgroups. Consultation provided by the experts in this group will allow researchers to address some of the inherent challenges of conducting disaster research; for example, the burdens that research post-disaster may place on individual participants or health systems during disaster response and recovery. By consulting with the workgroup, researchers could better ensure that their research is mutually beneficial to academic research and the local community, as well as work towards post-disaster research that is more culturally sensitivity and has a reduced potential for bias. Future efforts of this workgroup will examine questions about the feasibility of merging existing datasets (perhaps collected by different researchers in different locations post-disaster under the approval of multiple Institutional Review Boards) to answer questions of broader regional relevance to Gulf policy makers, provide subjective guidance to inform policy decisions, and expand upon the existing evidence base for data driven decision-making.

Future Directions

Ensuring the social and economic well-being and the health of human communities is tightly linked to the integrity and functioning of natural systems impacted by natural disasters and environmental stressors (Petkova et al. 2015). It necessitates a fundamental shift away from the current reactive, piecemeal and disjointed approach to managing coastal hazards towards a more proactive, integrated systems approach focused on the synthesis and integration of existing scientific data, supplemented by new data collected during the post-disaster period. The Texas OneGulf Disaster Research Response (DR2) Program is an interdisciplinary approach to disaster research that integrates emergency management partnerships, new processes for activating disaster research response activities, community engagement, environmental health and disaster education for practitioners, and ethical, legal, and social vulnerability issues. This type of interoperable approach, which includes the use of big data and data integration tools, interdisciplinary research and collaboration, and dialog between community members and researchers is essential to build the resilience of the U.S. Gulf Coast and its communities, institutions, and residents to future disasters. This approach – started well in advance of the next disaster –is essential to provide baseline data to assess the health impact of environmental exposures associated with natural and man-made disasters, and serve as a resource for the academic, industry, and public health, and regulatory agencies across the state of Texas.

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