Research Priorities for Assessing Health Effects from the Gulf of Mexico Oil Spill: A Letter Report

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Research Priorities for Assessing Health Effects from the Gulf of Mexico Oil Spill

A Letter Report

Committee to Review the Federal Response to the Health Effects Associated with the Gulf of Mexico Oil Spill

Board on Population Health and Public Health Practice

INSTITUTE OF MEDICINE
OF THE NATIONAL ACADEMIES

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"Knowing is not enough; we must apply.
Willing is not enough; we must do."
—Goethe

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COMMITTEE TO REVIEW THE FEDERAL RESPONSE TO THE HEALTH EFFECTS ASSOCIATED WITH THE GULF OF MEXICO OIL SPILL

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This report has been reviewed in draft form by persons chosen for their diverse perspectives and technical expertise, in accordance with procedures approved by the National Research Council's (NRC's) Report Review Committee. The purpose of this independent review is to provide candid and critical comments that will assist the institution in making its published report as sound as possible and to ensure that the report meets institutional standards for objectivity, evidence, and responsiveness to the study charge. The review comments and draft manuscript remain confidential to protect the integrity of the deliberative process. We wish to thank the following individuals for their review of this report:

Ignatius Bau, Health Policy Consultant
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Although the reviewers listed above have provided many constructive comments and suggestions, they were not asked to endorse the conclusions or recommendations, nor did they see the final draft of the report before its release. The review of this report was overseen by **Stephen Fienberg,** Carnegie Mellon University, and **Jonathan Samet,** University of Southern California. Appointed by the National Research Council and the Institute of Medicine, respectively, they were responsible for making certain that an independent examination of this report was carried out in accordance with institutional procedures and that all review comments were carefully considered. Responsibility for the final content of this report rests entirely with the authoring committee and the institution.

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INSTITUTE OF MEDICINE
OF THE NATIONAL ACADEMIES

Committee to Review the Federal Response to the Health Effects
Associated with the Gulf of Mexico Oil Spill

October 25, 2010

The Honorable Kathleen Sebelius
Secretary of the U.S. Department of
Health and Human Services
200 Independence Avenue, S.W.
Washington, DC 20201

Dear Secretary Sebelius:

In August 2010, the Department of Health and Human Services (HHS) asked the Institute of Medicine (IOM) to provide periodic independent review of the federal response to the Gulf of Mexico oil spill as it relates to the surveillance and monitoring of acute and long-term physical and behavioral health effects of workers and the affected public.

The committee's first report, *Review of the Proposal for the Gulf Long-Term Follow-Up Study*, was released to the public on October 8, 2010. That report summarized feedback obtained during the IOM's September 22, 2010, workshop to review the National Institutes of Health's draft protocol to study long-term health effects of oil spill clean-up workers (the Gulf Long-Term Follow-Up Study).

The attached report, the committee's second, provides consensus advice to HHS on research priorities for assessing health effects associated with the Gulf of Mexico oil spill, beyond the Gulf Long-Term Follow-Up Study.

On behalf of the committee, I would like to thank HHS for the opportunity to assist with the Agency's continuing efforts to respond to the Gulf of Mexico oil spill.

Sincerely,
Lynn Goldman, M.D., M.P.H.
Chair, Committee to Review the Federal Response to the Health Effects
Associated with the Gulf of Mexico Oil Spill

EXECUTIVE SUMMARY

At the request of the U.S. Department of Health and Human Services (HHS), a committee appointed by the Institute of Medicine (IOM) is tasked with providing advice to HHS on research priorities for assessing health effects of the Gulf of Mexico oil spill. The committee's recommendations are included in this report.

The committee believes that it is important to study health effects from the Gulf of Mexico oil spill for three reasons:

- To learn about the impact of oil spills on human health,
- To improve mitigation efforts, and
- To prevent adverse health effects from occurring in individuals affected by the Gulf of Mexico oil spill and in future disasters.

During its information-gathering process, the committee learned about many potential areas of research aimed at improving its understanding of the physical and behavioral health effects of oil spills. All of those areas are important. The committee evaluated the information and narrowed the list of possible research opportunities to those that it believes should be considered priorities. The committee's research priorities encompass five main areas: behavioral health, exposure assessment, seafood safety, communication, and developing a research response framework for disasters. The research priorities, summarized in Box 1, are not presented in any specific order. They address current gaps in knowledge and the order of priority will depend on further scientific review and community input.

BOX 1 Summary of the Committee's Recommended Research Priorities

Research priority 1. The committee recommends that priority be given to research that is designed to generate evidence about the psychological and behavioral effects of the Gulf of Mexico oil spill. Policymakers and health officials can use such evidence to guide efforts to improve the health status of individuals affected by the Gulf of Mexico oil spill, as well as contribute to the prevention and treatment of similar health outcomes in future disasters. The research should identify factors associated with either vulnerability or resilience to situations such as oil spills and other disasters.

Research priority 2. The committee recommends that priority be given to obtaining information that is as comprehensive as possible about exposure to the oil, dispersants, and by-products of the controlled burns.

Research priority 3. The committee recommends that priority be given to assessing seafood safety in both the near term and long term and clearly communicating results to the affected communities.

Research priority 4. The committee recommends that priority be given to conducting research to evaluate and compare communication and engagement methods to determine which are the most effective for disaster and disaster-preparedness research.

Research priority 5. The committee recommends that priority be given to conducting research on the framework needed to deploy a rapid research response for future oil spills and other potential disasters.

CHARGE TO THE COMMITTEE

The charge to the IOM Committee to Review the Federal Response to the Health Effects Associated with the Gulf of Mexico Oil Spill broadly relates to health effects from the Gulf of Mexico oil spill. This letter report specifically provides advice to HHS on research priorities related to assessing the health effects of the Gulf of Mexico oil spill. Overall, the IOM is tasked with providing periodic independent review of the federal response to the Gulf of Mexico oil spill as it relates to the surveillance and monitoring of workers and volunteers involved in efforts to stop the spill and environmental cleanup efforts and the affected public for acute and long-term physical and behavioral health effects.

BACKGROUND

On April 20, 2010, the Deepwater Horizon, a semisubmersible offshore drilling rig in the Gulf of Mexico, exploded, killing 11 workers. The well that the rig was drilling began to spew crude oil into the Gulf and continued to spew millions of liters of crude oil until it was successfully capped in mid-July. This oil spill is unprecedented in its size, duration, and deepwater nature and in the use of dispersants and controlled burns in an attempt to ameliorate the consequences of the spill. The potential for human health effects linked to exposure to the oil in the environment and to the dispersants and fumes from the controlled burns is of concern. Also of concern are mental and behavioral health effects due to the temporary or permanent loss of livelihoods and uncertainty about the health of the environment and when people can return to work.

Although the findings of studies of previous oil spills provide some basis for identifying and mitigating the human health effects of oil spills, the existing data are insufficient to provide a full understanding of and to be able to predict the overall impact of hazards from the Gulf of Mexico oil spill on the health of individuals, including workers, volunteers, residents, and visitors (Aguilera et al., 2010). Many of the previous studies were designed to evaluate only short-term health effects and dealt with spills that were of known volume (for example, the *Exxon Valdez* and *Prestige* spills in 1989 and 2002, respectively).

To explore the needs for appropriate surveillance systems to monitor the Gulf of Mexico oil spill's potential short- and long-term health effects on affected communities and individuals, HHS Secretary Kathleen Sebelius contracted with the IOM to convene the public workshop Assessing the Human Health Effects of the Gulf of Mexico Oil Spill in the Gulf region. This workshop, which was held on June 22 and 23, 2010, in New Orleans, Louisiana, explored available scientific evidence to guide the development of appropriate surveillance systems and to establish possible directions for additional research. A summary of this workshop has been published (IOM, 2010a).

Aiming to fill the gap in knowledge on the health effects of oil spills, as well as to assemble information that can be used for prevention of adverse health outcomes and interventions against such outcomes in any similar situations in the future, the National Institute of Environmental Health Sciences (NIEHS) plans to conduct a study designed to investigate

workers engaged in cleanup activities linked to the Gulf of Mexico oil spill for potential short- and long-term health effects. That study, the Gulf Long-Term Follow-Up Study for Oil Spill Clean-Up Workers and Volunteers (the GuLF study), aims not to study a few narrow hypotheses but, rather, aims to allow the investigation of individuals for a wide range of adverse health effects, including physical, psychological, and biological effects.

As part of its work, the IOM Committee to Review the Federal Response to the Health Effects Associated with the Gulf of Mexico Oil Spill planned a workshop to bring together experts to review and make comments on the GuLF study protocol, which was published on the IOM website just before the conference.[1] The workshop was held on September 22, 2010, in Tampa, Florida. Highlights from the presentations and discussions at this workshop have been published (IOM, 2010b).

To inform the development of research priorities, the Committee to Review the Federal Response to the Health Effects Associated with the Gulf of Mexico Oil Spill gathered information during a public session held on September 23, 2010, also in Tampa, Florida. Nicole Lurie, assistant secretary for preparedness and response at HHS, charged the committee. In addition to research priorities directly related to the Gulf of Mexico oil spill, Dr. Lurie stated that HHS is interested in learning about priorities related to developing research protocols that could be used in future disasters and considers such recommendations to be within the scope of work. Presentation topics included lessons learned from the World Trade Center Health Registry, the Gulf Health University Consortium, and the perspectives of individuals in Gulf region communities. After the public session, the committee met in closed session to review the evidence and deliberate about research priorities for assessing the health effects of the Gulf of Mexico oil spill. This letter report contains a summary of the review of the evidence and the committee's recommended research priorities.

The committee recognizes that the federal government has already determined that study of the potential short- and long-term health effects among workers engaged in cleanup activities linked to the Gulf of Mexico oil spill is a major priority—so much so—that a planning effort for the GuLF study already was well underway at the time of the committee's September 23, 2010 meeting. Given that and the fact that the committee hosted a workshop to review issues related to the GuLF study on September 22, 2010, the committee interpreted its charge for the evaluation described in this letter report to focus on studies to be conducted in addition to and building on the GuLF study. In her remarks, Dr. Lurie emphasized that this letter report was not for the purpose of further critiquing the GuLF study.

RATIONALE FOR STUDYING HEALTH EFFECTS FROM THE GULF OF MEXICO OIL SPILL

The committee believes that it is critical to study health effects from oil spills for three reasons: to learn about the impact of oil spills on human health, to improve mitigation efforts,

[1] The version of the GuLF study protocol that the workshop participants provided comments on can be accessed at http://iom.edu/~/media/Files/Activity%20Files/PublicHealth/FedResponseOilSpill/GuLF%20Study%20Protocol%20DRAFT%20to%20IOM%202010-09-17.pdf. Additional details of the GuLF study can be accessed at http://www.niehs.nih.gov/about/od/programs/gulfworkerstudy.cfm.

and to prevent adverse health effects from occurring in individuals affected by the Gulf of Mexico oil spill and in future disasters.

The committee recognizes that distinctions can and should be made between emergencies (which are handled within response systems), disasters (which overwhelm response capacities), and catastrophes (which have enormous consequences because of loss of life and cost). However, these distinctions are blurry, and precise lines of demarcation depend on the extent to which communities are prepared to respond to incidents. The committee also realizes that such lessons learned may or may not be relevant to responses to or mitigation of future events.

The information gathered from research on oil spills can inform actions to prevent and address health effects in affected communities. For example, data collected in the World Trade Center Health Registry, which was established in response to the events of September 11, 2001, were used to assess the health effects in people in New York City of exposure to the air pollutants that stemmed from the burning of jet fuel and the collapse of the World Trade Center Towers. This information has been useful to provision of medical care for the survivors of the World Trade Center event and formed the basis of the information used to develop clinical guidelines for physicians so that they would know what types of questions to ask their patients when assessing if the patient's health was affected by the event. Registry data were also used to help determine appropriate interventions. For example, research demonstrated that rescue workers who wore protective masks were less likely to develop asthma (that is, have new asthma diagnoses) than those who did not use masks. This research provided evidence that rescue workers should wear protective masks in future similar situations. Such information may be relevant in the management of future events with the potential for smoke inhalation over many days. The registry research also revealed the risk factors that made it more likely that residents near the site would develop posttraumatic stress disorder (PTSD), leading to more effective identification of the at-risk populations that should be given targeted interventions (Cone, 2010).

An effective research response to a disaster includes having a research framework in place prior to the disaster so that the study of health effects associated with the event can be initiated quickly. Studying the effectiveness of various operational measures is an important part of the development of the framework. Operational measures include best practices for engaging affected communities and utilizing community health care services and local researchers, fostering intergovernmental cooperation, and providing fast-track approval (for example, institutional review board [IRB] approval) and funding study protocols. The committee believes that studies of the Gulf of Mexico oil spill will inform researchers about how to establish a more effective, faster, and less expensive research framework for responding to future disasters, including oil spills.

POPULATIONS TO STUDY

The committee believes that it is important not only to study the health effects of the oil spill on cleanup workers (as will be under way in the GuLF study), but also to assess other populations likely to be affected by the oil spill for physical and behavioral health effects. Such populations would include men and women who depend on the oil industry and fishing for their employment; those who work in tourism or other affected industries in the area; frequent fin- and shellfish consumers who may not have heeded warnings to restrain from catching seafood in the affected areas and then consuming it or, alternately, consumers who avoid seafood that has been

determined to be safe; and individuals, families, and communities who live or work near areas affected by the oil spill.

Specific subpopulations should be assessed for health effects, including children; pregnant women; elderly individuals; disabled people; and those who are chronically ill, have had a prior psychological trauma (for example, people also affected by Hurricane Katrina), and the medically underserved. Research on these subpopulations may reveal health effects that might not be discerned in a large cohort study and may also identify specific populations that should be given targeted interventions. For example, an emerging body of literature describes differential health effects in different ethnic populations following disasters (for example, Kulkarni and Pole, 2008; Verschur et al., 2010; Weems et al., 2010). Affected populations may have language, cultural, and literacy barriers to obtaining information, accessing services, and coping with ongoing impacts of the oil spill that should be taken into account when such studies are conducted. Some populations may have developed protective strategies. Such protective strategies may inform responses to future disasters.

Although most postdisaster research focuses on populations that have been adversely affected by these events, a better understanding of individuals and communities who exhibit resilience or posttraumatic growth is also needed. Such an understanding may lead to the development of strategies and interventions for building resilience in affected individuals and communities along the Gulf of Mexico.

STUDY DESIGN CONSIDERATIONS

The committee believes that to effectively conduct studies of the health effects of the Gulf of Mexico oil spill there should be

- Improved coordination across federal, state, local, and tribal government entities;
- Increased fostering of cross-cultural communication and community engagement efforts, including the involvement of community health workers and organizations and assessments of the concerns of local communities; and
- National and local capacity building to develop a framework for a research response to a disaster that can be rapidly put into place as soon as a disaster strikes.

Coordination of Information Sharing

At the September 22, 2010, IOM workshop, participants pointed out that several existing resources housed by different federal, state, or local agencies and institutions could enable more accurate and complete exposure assessments and provide better documentation of the health effects of the Gulf of Mexico oil spill. These resources include food, air, water, and sediment samples and data collected by the National Oceanic and Atmospheric Administration, the Environmental Protection Agency (EPA), and the Food and Drug Administration (FDA); a state-based health surveillance system established by the Centers for Disease Control and Prevention (CDC); military health records; biospecimens from some of the cleanup workers; National Institute of Occupational Safety and Health injury, illness, and task data for the cleanup and oil rig workers; and data collected by local community mental health centers and clinics. In addition, many of these agencies have specialized expertise or tools, such as EPA's exposure

reconstruction tools, that could be applied to studies on the health effects of the Gulf of Mexico oil spill. Other agencies have expertise on ecosystem changes and how they affect human health.

A number of factors impede the sharing of these useful resources, including legal constraints on sharing of data related to patient privacy and incompatibility among various databases, which impedes integration and, therefore, the utility of the data. In addition, some oil spill-related data were not collected with the intent of using them for research purposes (for example, they may have been collected for public health purposes) and may lack appropriate documentation.

Coordination Among Institutional Review Boards

A lack of coordination among the various IRBs that must review a research protocol might be another major impediment to being able to quickly launch large-scale, multi-institutional research studies on the health effects of the Gulf of Mexico oil spill. The World Trade Center Health Registry was launched in 2002, but it took another year to acquire IRB approval because of lack of coordination among the CDC, NIEHS, and local IRBs. The multiple-IRB-approval requirement was a major obstacle to moving forward quickly, and there was a need for closer coordination among governmental agencies at the local and federal levels on this and other issues (Cone, 2010). Lessons can also be learned from the National Children's Health study, which dealt with the complexities of having multiple IRBs involved by giving local IRBs the option of ceding their authority to the central National Institutes of Health IRB.[2]

To facilitate studies of the health effects of the Gulf of Mexico oil spill, the committee believes improved coordination across federal, state, local, and tribal government entities and among IRBs is needed. Furthermore, data on the oil spill and related health effects should be accessible to researchers and members of the community and should be compatible across databases. The availability of appropriate mechanisms and consent forms will enable development of such data sharing and coordination.

Community Engagement and Communication

Several participants at the September 22, 2010, IOM workshop stressed the importance of having community engagement in studies on the health effects of the Gulf of Mexico oil spill. Multiple approaches to community engagement exist and are relevant to studying health effects of the Gulf of Mexico oil spill. Definitions of community engagement include

- "structured dialogue, joint problem solving, and collaborative action among formal authorities, citizens at-large, and local opinion leaders around a pressing public matter" (Schoch-Spana et al., 2007, as cited in IOM, 2009); and
- "the process of working collaboratively with and through groups of people affiliated by geographic proximity, special interest, or similar situations to address issues affecting the well-being of those people" (Fawcett et al., 1995).

As discussed by participants at the September 22, 2010, workshop, for a health study to have maximal impact, to build trust in any subsequent results, and to provide credible results, the

[2] David Tollerud, University of Louisville, presented this information during the September 22, 2010, workshop in Tampa, Florida.

study needs to take into account both the language and the concerns of local stakeholders as well as demographic characteristics, such as socioeconomic status, education, health literacy, and culture. Investigators need to engage the affected communities through systematic identification and outreach to various community groups, carefully listening to their concerns and expectations for the study and incorporating those concerns into the study design. The community affected or perceived to be affected by the Gulf of Mexico oil spill is diverse. Affected ethnic groups include those of Vietnamese, Creole, Cajun, Croatian, Native American, Hispanic, and Isleños (Canary Islander) descent. The questions, concerns, and information needs among these groups will vary. Additionally, the concerns that a community has about health effects may differ from the concerns of the researchers conducting the studies (Baker et al., 1999).

A community's definition of effects may go beyond that of health alone. For example, a primary concern of many of the people affected by the oil spill is whether their food is safe to eat and their water is safe to drink. Researchers should aim to address community members' questions, in addition to the questions that researchers have made a priority to address. Understanding what matters to those affected by the Gulf of Mexico oil spill will be important to doing studies that are meaningful to everyone and that will form the basis for future communication.

Study participants should be involved early and often. Multidirectional communication and mutual relationships established early in the study design process can help to identify and respond to any problems emerging early during the process. Community involvement in all stages of study design and implementation also helps to build trust. For example, the lack of a community advisory board when the World Trade Center Health Registry first began may have led to a lack of trust by the potential participants. This lack of trust may be a reason for limited enrollment in the registry (Cone, 2010). Affected communities are also likely to be more engaged in a study if they have input. In addition to engaging communities through active means such as community advisory boards, passive methods to channel and evaluate inquires from community members may be utilized as well.

Community engagement also can help set the framework for ongoing communication. Numerous participants at the September 22, 2010, IOM workshop noted the need for effective communication about risk. That communication should be clear, concise, consistent, and timely; and a systematic process should be in place to ensure that this happens (NRC, 2003). A plan for how information about studies and their results will be communicated should be developed with community input and should be integrated into the research protocol. Researchers should ensure that their communication materials meet various literacy requirements; are appropriate to cultural differences, such as how health concerns are viewed and reported; and be appropriately translated into relevant languages (IOM, 2004). Communication materials and key messages that have been developed should be pretested using focus groups representative of the diverse communities affected. It is critical that the people responsible for outreach and communication have both cultural and language competencies for these communities (IOM, 2003). In addition, even within specific ethnic groups, age-related differences in understanding and responding to study communications should be taken into account.

The committee believes that all studies on the health effects of the Gulf of Mexico oil spill should be conducted with adequate community engagement and communication, which includes collaboration on the study design, discussion and clarification of expectations and the consent process, and communication of study results. Such engagement will be critical at every

point in a study, from the onset, when the research protocol is first developed, to the end of the study, when the results are reported.

Building the Capacity to Quickly Respond to Disasters

At the workshop several participants, including Dr. Lurie, noted that the United States needs to be prepared to quickly mount research efforts after future events. However, much of the sampling and data collection that are done after an oil spill or some other disaster are not done for the purposes of conducting research on health effects but, rather, are done to address more immediate health decisions, such as whether residents can consume food produced locally or need to take precautions to protect themselves from air pollution. Such early sampling and data collection are also essential for accurately assessing individuals for exposures that may be linked to the health problems that develop later. Such data and other types of data that are available during and in the immediate aftermath of an event are useful for ascertainment of baseline conditions as well. The longer that the period between exposure to a contaminant and when people affected by that exposure are questioned, examined, and asked to give biospecimens or household samples is, the less accurate the exposure assessments will be. Moreover, in the absence of planned research efforts the data may not be optimal for research.

The need to quickly begin a research study on the health effects of a disaster goes counter to the lengthy time usually needed to build the infrastructure for such a study. That infrastructure includes funding, sample repositories, IRB and Office of Management and Budget (OMB) approvals, staffing, local community relations, and communication networks. Best practices in how to organize research responses to future disasters should therefore be developed. Such a predisaster infrastructure could be realized through the development of disaster preparedness centers or consortia that have template research protocols preapproved by the IRB and OMB, established relationships with the community and community health care providers, and established sample repositories or repositories that can quickly be activated. IRB approval and waivers for exempt activities (for example, routine public health surveillance) could be obtained in advance. Existing funding mechanisms could be used to ensure the development of a fast and research-focused response to future oil spills and other disasters.

RESEARCH PRIORITIES

Many potential avenues of research for assessing health effects from the Gulf of Mexico oil spill were discussed during the IOM workshop and public session on September 22 and 23 and among the committee members during their subsequent deliberations in closed session. On the basis of the evidence reviewed, along with the committee members' expertise and judgment, the committee narrowed the list of possible research opportunities to those that it believes should be considered priorities. The committee's research priorities encompass five main areas: behavioral health, exposure assessment, seafood safety, communication, and developing a research response framework for disasters. The committee is not implying that other areas of research are not worthy of study. For example, assessing physical health effects in the affected communities may be a priority; however, to design such studies, exposure should, ideally, first be assessed to identify the populations to be studied and health outcomes. As an example, the federal government has already identified the Gulf of Mexico oil spill cleanup workers to be potentially exposed and has initiated the GuLF study. The research priorities address current

gaps in knowledge but are not presented here in any specific order. The order of priority will depend on further scientific review and community input.

Behavioral Health

Numerous studies have documented a heightened prevalence of psychiatric disorders, domestic violence, and substance use in the aftermath of most major disasters, including the *Exxon Valdez* oil spill, Hurricane Katrina, and the events of September 11, 2001 (Yun et al., 2010). One year after the *Exxon Valdez* oil spill, for example, the prevalence of generalized anxiety disorder in residents who were classified as highly exposed was 35 percent, which was more than three times the rate of the disorder in the unexposed group (Palinkas et al., 1993). After the World Trade Center collapse on September 11, 2001, the prevalence of PTSD in nearby residents was 16 percent, which is three to four times the rate of the disorder in the general population (Cone, 2010). Likewise, state, mental health, and substance abuse treatment agencies in the region of the Gulf of Mexico oil spill have reported an increase in calls for help by emotionally distressed individuals, and calls to domestic violence hotlines have also increased (Yun et al., 2010).

Yun et al. (2010) noted, "As the Deepwater Horizon oil disaster enters its next phase, consensus is emerging that among its most profound immediate health effects are those on the emotional and psychosocial health of Gulf coast communities." Mental and behavioral health effects also proved to be the most important outcomes of the September 11, 2001, attacks (Cone, 2010).

Studies of past events have documented that disasters do not affect every person or community in the same way, nor does every disaster produce the same effects. However, the Gulf of Mexico oil spill is likely to produce effects that are similar in many ways to what occurred after the *Exxon Valdez* oil spill (Dyer et al., 1992; Palinkas, 2009), as well as after other human-caused and natural disasters, such as Hurricane Katrina (Abramson et al., 2008; Corrarino, 2008; Gallacher et al., 2007; Rhoads et al., 2008).

Therefore, the most immediate and visible behavioral health impacts of the Gulf of Mexico oil spill for which the population should be evaluated include an increase in psychiatric disorders, particularly PTSD, depressive disorders, generalized anxiety disorder, and substance abuse. The incidence of these disorders is likely to increase in communities along the Gulf of Mexico that are affected by the oil spill. Symptoms of nonspecific psychological distress are also likely to increase.

The behavioral health impacts, however, are not likely to be limited to psychiatric disorders or symptoms. Individuals in communities affected by the Gulf of Mexico oil spill should be monitored for other behavioral health impacts, including changes in behaviors that affect health, such as patterns of substance use, sexual behaviors that place a person at risk, nutrition, and physical activity. As has happened with other disasters, the Gulf of Mexico oil spill might generate increased levels of stress that will be manifested in physiological changes that increase the risk of chronic diseases, such as cardiovascular disease and diabetes, as well as poor reproductive outcomes, such as miscarriages, low-birth-weight infants, and preterm deliveries. Other changes likely to occur include increased rates of intentional and accidental injuries; changes in youth behaviors that lead to impaired relations with parents, siblings, and peers and to

poor academic performance; and changes in social relations and family dynamics that increase the risk of domestic violence, child abuse, and neglect.

Research priority 1. The committee recommends that priority be given to research that is designed to generate evidence about the psychological and behavioral effects of the Gulf of Mexico oil spill. Policymakers and health officials can use such evidence to guide efforts to improve the health status of individuals affected by the Gulf of Mexico oil spill, as well as contribute to the prevention and treatment of similar health outcomes in future disasters. The research should identify factors associated with either vulnerability or resilience to situations such as oil spills and other disasters.

Exposure Assessment

Informative epidemiologic investigations of relationships between environmental exposures and human health effects rely on accurate, quantifiable exposure measurements. Obtaining accurate and comprehensive exposure information from those affected by the Gulf of Mexico oil spill will be difficult, because many of those assessments will be made several months after exposure occurred, hampering accurate recall and sampling efforts. The delay also extends beyond the biological persistence of well-established biological markers of exposure. The immediate concerns of public health officials who responded to the oil spill were protecting the workers and community members from contamination, rather than collecting samples and other information needed to ascertain exposure for a future research study. In addition, many workers will have had multiple exposures, and the intensity of those exposures will vary over time, such that single exposure measurements may not be sufficient to fully assess overall exposure.

In addition to exposures to oil spill-related contaminants, after oil spills indirect exposures occur as a result of destruction of the ecosystem. Damage to areas along the coast used for commercial, subsistence, and recreational fishing and for tourism has negative economic consequences, as does damage to boats and other property. Such indirect exposures had adverse health effects on cleanup workers and communities in the Gulf of Alaska after the *Exxon Valdez* oil spill (Palinkas, 2009).

Research priority 2. The committee recommends that priority be given to obtaining information that is as comprehensive as possible about exposure to the oil, dispersants, and by-products of the controlled burns.

The committee recommends the following specific actions:

- Compiling sources of exposure information and validating exposure assessments, including the assumptions made to deal with missing data;
- Minimizing exposure measurement errors and misclassifications;
- Collecting as much relevant exposure information as possible, including measurements made from food, air, soil, and water samples;
- Assessing and estimating low-level exposures and exposures to mixtures (for example, the oil and dispersants);

- Taking into account confounders and effect modifiers, such as age, gender, socioeconomic status, behavioral characteristics, health status, and access to health care, when cumulative exposures are estimated;
- Characterizing variability in individuals;
- Exploring how biomarkers and other surrogates can aid exposure assessments;
- Assessing a variety of different populations for exposure, including elderly individuals, children, pregnant women, members of ethnic groups, and those with preexisting medical, psychiatric, and substance abuse conditions;
- Integrating and using a number of databases to more fully assess exposures; and
- Assessing exposure to economic and other forms of resource loss incurred by individuals and communities in the Gulf region.

Consideration should be given to how health effects differ according to how contaminants are transported, exposure routes, and exposure points and how all those factors affect different target populations. Exposure information will help support toxicity investigations related to the Gulf of Mexico oil spill that, according to participants at the September 22, 2010 workshop, already are under way within the federal government. Such research may point to health effects of potential concern, dose-responses, and possibly the cumulative impacts of exposure to oil, dispersants, and by-products from the controlled burns. This research was not described in detail at the workshop, nor was it reviewed by the committee.

Seafood Safety

A major concern that those affected by the Gulf of Mexico oil spill voiced is whether the fin- and shellfish from the area of the oil spill are safe to eat. Some members of this community, many of whom have lived and fished in the area for many years, have expressed distrust of public officials who claim that the seafood is safe. Their own visual inspection of seafood possibly discolored by oil or dispersants is a strong sensory cue that affects their perception of risk, and others in the community who hear about these experiences may put much weight on this information. In addition, the committee heard that many question the effectiveness of the seafood safety monitoring, as fish continually move from one area to another, so sporadic testing of fish in a single area may not be adequate.[3]

Gulf fishers and the Gulf seafood industry are facing a number of challenges since the oil spill and the subsequent cleanup operations. One challenge is reinstating consumer confidence in their product. Since the reopening of some previously closed Gulf of Mexico waters to fisheries in July, numerous groups, including members of the U.S. Congress, nongovernmental organizations, scientists, local fishers, processors, and chefs, have raised concerns over the adequacy of the protocols used for ensuring the safety of the seafood caught in the Gulf (Severson, 2010). For example, some people may mistrust the risk assessment methods used at the state and federal government levels to establish safe levels of exposure to contamination related to the oil spill.

[3] Tap Bui, Mary Queen of Vietnam Community Development Corporation, presented information on community concerns about the safety of seafood following the Gulf of Mexico oil spill during the September 23, 2010, public session in Tampa, Florida.

Recent research suggests that oil spills alter the natural processes of filtration of heavy metals, particularly arsenic, by sediments on the seafloor, raising the concern of increased exposure to metals through seafood consumption. Low-dose exposure to heavy metals is of particular concern in pregnant women and children because of their well-known impacts on infant neurodevelopment (Mendola et al., 2002; NRC, 2000; Wainipee et al., 2010; Wigle et al., 2008).

Research priority 3. The committee recommends that priority be given to assessing seafood safety in both the near term and long term and clearly communicating results to the affected communities.

The committee recommends the following specific actions:

- Determining the safety of fish caught by subsistence or recreational fishers and harvested by major commercial operations;
- Coordinating and synthesizing data between federal and state agencies and acquiring baseline data available before the Gulf of Mexico oil spill, such as FDA's spot testing of seafood in markets to delineate the types and levels of chemicals in seafood before the oil spill (In synthesizing results, researchers should consider the adequacy of the sampling and testing methods used and should cross-check information between different data sources. Consolidated data may be useful to characterize the geography of coastal and open waters most affected by the oil spill. Further, the data would be potentially useful in a dietary exposure assessment for the community.);
- Conducting research on the long-term fate of certain oil spill-related chemicals in seafood, particularly how it relates to bioaccumulation in the food chain and the toxicity of these chemicals in fin- and shellfish;
- Exploring whether measurements made from single samples instead of composite samples of seafood, incorporating a variety of site selection methods that focus on both fin- and shellfish, are more accurate measures of contamination;
- Creating a repository of serial seafood samples that can be used to sample for such chemicals as polycyclic aromatic hydrocarbons derived from oil, dispersants, and the heavy metals used in drilling fluids;
- Gathering information to assess the dietary exposure via seafood of residents affected by the oil spill and linking those exposure data to specific health effects;
- Assessing the patterns of seafood consumption before, during, and after the oil spill, in particular, by considering vulnerable populations, including pregnant women, young children, individuals with chronic medical illnesses, and individuals who depend on harvesting of seafood for their food; and
- Understanding how fin- and shellfish consumption advisories have been provided to communities, how the information has been interpreted, and how various diverse communities use the information to make decisions.

Communication

Communication is a well-established and well-studied field within the social sciences (Berger et al., 2009; Freimuth and Quinn, 2004; Maibach and Holtgrave, 2005; Maibach and Parrott, 1995; Rogers, 1986). Two subspecialties within the communication field, health

communication (IOM, 2004; Rootman and Hershfield, 1994; Sharf, 1993) and risk communication (NRC, 1989), are particularly relevant to assessing health effects from the Gulf of Mexico oil spill. Communication is an essential component of engaging the affected communities in research. It must be done appropriately at every point in a study's progress. Community input should aid the development of the research protocol and influence how participants are enrolled and retained, how they are asked for their informed consent, and how study results are reported to participants and the broader community. Timely communication and timely feedback are essential to keep enrollees informed, to hear and address their concerns, and to keep them engaged. Despite the importance of adequate communication in any large community-based study, little research has been conducted on understanding the values, perceptions, and concerns of the broad community and on what communication tools and resources are effective in the context of conducting research on the health effects of a disaster.

Research priority 4. The committee recommends that priority be given to conducting research to evaluate and compare communication and engagement methods to determine which are the most effective for disaster and disaster-preparedness research.

The committee recommends the following specific actions:

- Developing and testing appropriate communication materials, which may include oral and written materials and social media, tailored to relevant communities, taking into account cultural differences and literacy levels;
- Identifying reliable and evidence-based sources for message content and ensuring that messages are created with those people in need of them; and
- Testing communication materials to be sure that the message content clearly communicates understandable, actionable, and useful information.

This is not to say that each and every communication and message must be developed and pretested for every study related to the Gulf of Mexico oil spill. Rather, the purpose of such research would be to develop general approaches to messaging and preparation of materials for the unique populations that have been affected.

Developing a Research Response Framework

The committee stressed the importance of learning from how scientific inquiry has been put into place in response to previous disasters and how that knowledge can help build capacity to implement a rapid and effective research response for future disasters.

Research priority 5. The committee recommends that priority be given to conducting research on the framework needed to deploy a rapid research response for future oil spills and other potential disasters.

The committee recommends the following specific actions:

- Reviewing the body of literature on disaster research;
- Developing preapproved basic research protocols, questionnaires, sample banks, registries and surveillance systems, community communications, health provider networks and

strategies, and fast-track IRB and OMB approval mechanisms so that the research response can be quickly integrated into the early stages of the overall emergency response to disasters;
- Assessing the types of legal interventions that need to be in place not only to ensure greater data access but also to ensure privacy protections for research subjects;
- Establishing funding mechanisms for building the research response capacity in the face of disasters;
- Coordinating among the research-oriented arms (for example, the National Institutes of Health) and the emergency-response arms of the federal government to understand each others' needs and priorities in the face of a disaster and to help identify best strategies for a research response;
- Building and sustaining centers in disaster research that would have established relationships with the larger research community (that is, a network of centers and experts) and with the local community;
- Continue developing interinstitutional agreements about data sharing so that in future situations governmental agencies would be able to share information with other groups, such as centers in disaster research (At the September 22, 2010, IOM workshop, representatives from a number of governmental agencies talked about their efforts to make data related to the Gulf of Mexico oil spill available to each other as well as to other organizations. In addition, the National Institutes of Health hosted an interagency meeting on August 19, 2010 to gain a fuller understanding of governmental efforts to respond to the Gulf of Mexico oil spill. There are plans to hold additional interagency meetings in the future. The committee supports this type of cooperation and believes that these efforts should continue.); and
- Evaluating how research responses and provision of health care to affected populations will be impacted by changes in health care delivery and financing because of the Patient Protection and Affordable Care Act.[4]

SUMMARY OF RESEARCH PRIORITIES

The committee identified research priorities in five main areas: behavioral health, exposure assessment, seafood safety, communication, and developing a research response framework for disasters. As mentioned above, these areas are not presented in priority order. The research priorities are summarized in Box 1.

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[4] Patient Protection and Affordable Care Act, Public Law 111-148, 111th Congress, March 23, 2010

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