Statement for the Committee on Transportation and Infrastructure
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Chairman Oberstar, Ranking Member Mica, and members of the Committee, thank you for the opportunity to provide information about the potential human health issues associated with oil spills. My name is Scott Masten, and I am a staff scientist at the National Institute of Environmental Health Sciences (NIEHS), one of the Institutes of the National Institutes of Health (NIH), an agency of the Department of Health and Human Services (HHS). My work supports the National Toxicology Program, an interagency program that is administratively housed at the NIEHS, whose mission is to evaluate agents of public health concern by developing and applying tools of modern toxicology and molecular biology. The program maintains an objective, science-based approach in dealing with critical issues in toxicology and is committed to using the best science available to prioritize, design, conduct, and interpret its studies.

I am testifying today on behalf of NIH, and I shall present a brief overview of our current understanding of possible human health effects of exposures related to oil spills, along with a preview of some of our research efforts aimed at increasing our understanding of and hopefully preventing adverse health impacts among oil spill response workers and exposed communities.

Chemical nature of crude oil

Crude oil is a complex combination of chemicals consisting predominantly of carbon and hydrogen, known collectively as hydrocarbons. These elements are predominantly present in straight chains or in a variety of cyclic configurations. Oil may also contain small amounts of nitrogen, oxygen, and sulfur compounds and trace amounts of metals. Crude oils are broadly categorized as light, medium, or heavy depending on the relative proportion of different sized hydrocarbons. A light crude oil has a higher proportion of smaller, more volatile hydrocarbons. The chemical composition of crude oils can vary substantially from different geographic regions and even within a particular geological formation.[1] It is worth noting that the crude oil released from the Deepwater Horizon rig in the Gulf of Mexico is a light crude, while the oil spilled from the Enbridge pipeline in Michigan is a heavy crude oil.

There are hundreds if not thousands of chemicals in crude oil, and we have incomplete knowledge of the toxicity of many of them. We are most concerned about a particular class of hydrocarbons, known as aromatic hydrocarbons as well as other volatile organic compounds (VOCs), such as benzene, naphthalene and polycyclic aromatic hydrocarbons (PAHs). Sulfur compounds, such as hydrogen sulfide, and heavy metals such as aluminum, lead, nickel and vanadium can also be present to varying degrees in crude oil. These substances may also be of concern depending on their level in the crude oil. From studies of these chemicals individually, we know quite a bit about their hazardous properties and we believe these are some of the chemicals most likely to be encountered in air, sediment or water subsequent to an oil spill. The composition of spilled oil changes over time, and the oil nearest the

[1] National Library of Medicine, 2010. Hazardous Substances Data Bank record for Crude Oil.

source of a spill contains higher levels of some of the more volatile hazardous components. Oil that has been exposed to air and water for a period of time, so-called "weathered oil", has lost most of these volatile components. Nonetheless, weathered oil still contains less volatile hazardous chemicals, and therefore skin contact should be limited. If aerosolized by wind or physical disturbance, weathered oil also could be taken into the body through respiration. It is critically important to note that the specific risks of developing adverse health effects are dependent on many factors, but most importantly, risks increase with prolonged exposures to higher concentrations of the chemicals. Protective equipment can be effective at reducing exposures and thereby reducing risks.

Effects on human health from oil spills

Determination of actual exposure and risk for any hazardous chemical release is not a trivial task. Given the chemicals present in crude oil, the potential for human health effects exists; however, understanding and quantifying these effects requires further study. There has been relatively little long-term research into the human health effects from oil spills, although between 1970 and 2009 there were 356 accidental spills of more than 700 metric tons from oil tankers worldwide, with approximately 38 of those spills affecting coastal populations. In a recent article in the *Journal of Applied Toxicology*, the authors reviewed the results of studies of human health effects related to oil tanker spills as reported in 34 publications.[2] The clearest conclusion from the examination of these studies is that we have very little data; followup of exposed people has occurred only for a handful of the tanker spill incidents from the past several decades. The few studies that have evaluated the human health consequences of oil spills have primarily focused on acute physical effects and psychological sequelae. Historically, the workers involved in cleanup have reported the highest levels of exposure and the most acute symptoms, when compared to subjects exposed in different ways, as seen in the reporting of higher levels of lower respiratory tract symptoms in fishermen who participated in cleanup following the *Prestige* tanker accident off the coast of Spain. Studies have examined the *Exxon Valdez* (Alaska, 1989), *Braer* (Shetland Islands, UK, 1993), *Sea Empress* (Wales, UK, 1996), *Nakhodka* (Oki Islands, Japan, 1997), *Erika* (Brittany, France, 1999), *Prestige* (Galicia, Spain, 2002) and *Tasman Spirit* (Karachi, Pakistan, 2003) oil tanker spills. A number of the studies reported respiratory symptoms, including cough and shortness of breath[3] and decreased lung function[4], among workers involved in cleanup operations. Other commonly reported symptoms in these studies include itchy eyes, nausea/vomiting, dizziness,

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[2] International Tanker Owners Pollution Federation Limited (ITOPF) 2009. Oil Tanker Spill Statistics: 2009 London: International Tanker Owners Pollution Federation Limited; Aguilera F, Mendez J, Pasaro E, Laffon B. 2010. Review on the effects of exposure to spilled oils on human health. J Appl Toxicol 30: 291-301.

[3] Carrasco JM, Lope V, Perez-Gomez B, Aragones N, Suarez B, Lopez-Abente G, Rodriguez-Artalejo F, Pollan M. 2006. Association between health information, use of protective devices and occurrence of acute health problems in the Prestige oil spill clean-up in Asturias and Cantabria (Spain): a cross-sectional study. BMC Public Health 6: 1; Janjua NZ, Kasi PM, Nawaz H, Farooqui SZ, Khuwaja UB, Najam ul H, Jafri SN, Lutfi SA, Kadir MM, Sathiakumar N. 2006. Acute health effects of the Tasman Spirit oil spill on residents of Karachi, Pakistan. BMC Public Health 6: 84; Meo SA, Al-Drees AM, Rasheed S, Meo IM, Al-Saadi MM, Ghani HA, Alkandari JR. 2009. Health complaints among subjects involved in oil cleanup operations during oil spillage from a Greek tanker "Tasman Spirit". Int J Occup Med Environ Health 22: 143-148; Sim MS, Jo IJ, Song HG. 2010. Acute health problems related to the operation mounted to clean the Hebei Spirit oil spill in Taean, Korea. Mar Pollut Bull 60: 51-57; Zock JP, Rodriguez-Trigo G, Pozo-Rodriguez F, Barbera JA, Bouso L, Torralba Y, Anto JM, Gomez FP, Fuster C, Verea H. 2007. Prolonged respiratory symptoms in clean-up workers of the Prestige oil spill. Am J Respir Crit Care Med 176: 610-616.

[4] Meo SA, Al-Drees AM, Meo IM, Al-Saadi MM, Azeem MA. 2008. Lung function in subjects exposed to crude oil spill into sea water. Mar Pollut Bull 56: 88-94.

headaches, and skin irritation/dermatitis.[5] Additionally, several studies of *Prestige* oil spill clean-up workers have found evidence of genetic and endocrine effects in exposed individuals. Findings include increased DNA damage and chromosomal alterations in white blood cells and decreases in blood prolactin and cortisol levels.[6] Other studies have looked at psychological effects of spills, both among workers and in affected communities; follow-up studies of affected populations from the *Exxon Valdez* spill, for example, reported higher levels of generalized anxiety disorder, post-traumatic stress disorder, and depressive symptoms approximately one year after the spill occurred.[7] Similar patterns of higher anxiety and depression were observed among communities near the *Sea Empress* spill.[8] The *Braer* spill was associated with increased anxiety and insomnia[9], and lower levels of mental health were related to proximity to the *Prestige* spill.[10] Such research findings remind us of the importance of keeping longer-term, less obvious sequelae in mind, not just the immediate toxicity effects, when considering the overall human health impact of this type of disaster.

NIH-Funded Research

The NIH is using a variety of funding mechanisms and programs to carry out important research related to the human health impacts of oil spills. We expect this research to provide useful information for policy makers, health care providers, and the public.

The NIEHS, through the NTP, has completed important steps in identifying knowledge gaps for oil spill-related exposures of concern. The NTP has reached out to key agency partners to assess ongoing research activities within the federal government and to begin compiling common toxicology research needs. Initial NTP research efforts are focused on chemical characterization of oil and dispersant samples collected in the Gulf region to gain a better understanding of the physical and chemical changes associated with weathering and biodegradation. The NTP has also partnered with the National Institute for Occupational Safety and Health (NIOSH) within HHS's Centers for Disease Control and Prevention to provide analytical chemistry support for NIOSH's planned toxicology studies. The output from these various chemistry analyses will guide the development and conduct of additional toxicological studies to

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[5] Campbell D, Cox D, Crum J, Foster K, Christie P, Brewster D. 1993. Initial effects of the grounding of the tanker Braer on health in Shetland. The Shetland Health Study Group. BMJ 307: 1251-1255; Janjua NZ, Kasi PM, Nawaz H, Farooqui SZ, Khuwaja UB, Najam ul H, Jafri SN, Lutfi SA, Kadir MM, Sathiakumar N. 2006. Acute health effects of the Tasman Spirit oil spill on residents of Karachi, Pakistan. BMC Public Health 6: 84; Lyons RA, Temple JM, Evans D, Fone DL, Palmer SR. 1999. Acute health effects of the Sea Empress oil spill. J Epidemiol Community Health 53: 306-310; Morita A, Kusaka Y, Deguchi Y, Moriuchi A, Nakanaga Y, Iki M, Miyazaki S, Kawahara K. 1999. Acute health problems among the people engaged in the cleanup of the Nakhodka oil spill. Environ Res 81: 185-194; Sim MS, Jo IJ, Song HG. 2010. Acute health problems related to the operation mounted to clean the Hebei Spirit oil spill in Taean, Korea. Mar Pollut Bull 60: 51-57.

[6] Laffon B, Fraga-Iriso R, Perez-Cadahia B, Mendez J. 2006. Genotoxicity associated to exposure to Prestige oil during autopsies and cleaning of oil-contaminated birds. Food Chem Toxicol 44: 1714-1723; Perez-Cadahia B, Laffon B, Pasaro E, Mendez J. 2006. Genetic damage induced by accidental environmental pollutants. ScientificWorldJournal 6: 1221-1237; Perez-Cadahia B, Lafuente A, Cabaleiro T, Pasaro E, Mendez J, Laffon B. 2007. Initial study on the effects of Prestige oil on human health. Environ Int 33: 176-185.

[7] Palinkas LA, Petterson JS, Russell J, Downs MA. 1993. Community patterns of psychiatric disorders after the Exxon Valdez oil spill. Am J Psychiatry 150: 1517-1523.

[8] Lyons RA, Temple JM, Evans D, Fone DL, Palmer SR. 1999. Acute health effects of the Sea Empress oil spill. J Epidemiol Community Health 53: 306-310.

[9] Campbell D, Cox D, Crum J, Foster K, Riley A. 1994. Later effects of grounding of tanker Braer on health in Shetland. BMJ 309: 773-774.

[10] Sabucedo JM, Arce C, Senra C, Seoane G, Vazquez I. 2010. Symptomatic profile and health-related quality of life of persons affected by the Prestige catastrophe. Disasters 34: 809-820.

identify important biological and tissue targets for the mixed exposure encountered during oil spills. The NTP toxicology studies will be aimed at characterizing long-term health hazards of exposures that are relevant to oil spill response workers and seafood consumers.

In June, NIH Director Francis Collins announced that the NIH will devote at least $10 million to support NTP studies and initial stages of an NIEHS-led large prospective health study of oil spill clean-up workers and volunteers, termed the "Gulf Worker Study". In addition, BP has contributed $10 million through its Gulf of Mexico Research Initiative (GRI) to help fund the Gulf Worker Study.[11]

The Gulf Worker Study will focus on exposure to oil and potential health consequences such as respiratory, neurobehavioral, carcinogenic, and immunological conditions. The study plan also includes evaluation of mental health concerns and other oil spill-related stressors such as job loss, family disruption, and financial uncertainties. A draft protocol for this study was published on the NIEHS website last week [12] and will be reviewed at an Institute of Medicine workshop in Tampa, Florida on September 22, 2010.[13] The study plan will be updated as comments and suggestions are received from the Gulf communities and scientific experts via a series of NIEHS-sponsored meetings, community fora, and webinars.

In addition, the NIEHS has a grants program for time-sensitive research and community education. We are using this program to fund research on the public health impact of the oil spill in the Gulf region. Topics considered for funding include environmental monitoring and characterization related to the Gulf oil spill; toxicity testing of complex mixtures using high-throughput techniques and innovative statistical approaches; exposure assessment for individuals and populations; and research on various health effects, including understanding the unique risks of vulnerable populations, such as children, pregnant women, the elderly, and people with chronic health problems.

Although the above mentioned research activities are focused on the Gulf region, our expectation is that the research results will have widespread applicability to future public health activities relating to oil spills.

Conclusion

It is clear from our current and ongoing review of the available research studies regarding human health effects of spilled crude oil that there is a need for additional health monitoring and research. Follow-up of exposed people has only occurred for a handful of the tanker spill incidents from the past several decades. These incidents involved exposure to different types of crude oil and in some cases refined petroleum products. Historically, cleanup workers have reported the highest levels of exposure, although for most of these studies, there is a lack of quantitative exposure information. Human health impacts are dependent on the scale of the release and on our ability to minimize exposure through proper safety precautions, training and spill containment. Ongoing and planned research in the Gulf by NIH and others will increase our collective understanding and provide a better foundation for making public health decisions for future oil related incidents.

Thank you. I am happy to answer any questions.

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[11] http://www.niehs.nih.gov/news/releases/2010/gulf-study.cfm
[12] http://www.niehs.nih.gov/about/od/programs/gulfworkerstudy.cfm
[13] http://www.iom.edu/Activities/PublicHealth/FedResponseOilSpill