GuLF STUDY:

Gulf Long-Term Follow-Up Study

Dale P. Sandler, Ph.D.
Principal Investigator
Chief, Epidemiology Branch
Division of Intramural Research
National Institute of Environmental Health Sciences

Richard K. Kwok, Ph.D.
Lead Associate Investigator
Epidemiology Branch
Division of Intramural Research
National Institute of Environmental Health Sciences

Lawrence S. Engel, Ph.D.
Associate Investigator
Department of Epidemiology
Gillings School of Global Public Health
University of North Carolina at Chapel Hill
and
Epidemiology Branch
Division of Intramural Research
National Institute of Environmental Health Sciences

Christine Parks, Ph.D.
Associate Investigator
Epidemiology Branch
Division of Intramural Research
National Institute of Environmental Health Sciences

Stephanie J. London, M.D., Dr.P.H.
Associate Investigator
Epidemiology Branch
Division of Intramural Research
National Institute of Environmental Health Sciences

Aubrey K. Miller, M.D., M.P.H.
Associate Investigator
Office of the Director
National Institute of Environmental Health Sciences

Aaron Blair, Ph.D.
Consultant
Occupational and Environmental Epidemiology Branch
National Cancer Institute

Mark Stenzel
Consultant
Exposure Assessment Applications, LLC.

Patricia A. Stewart, Ph.D.
Consultant
Stewart Exposure Assessments, LLC.

Key Research Personnel

Mr. Matt Curry, MA, Project Director, Social & Scientific Systems

David A. Welsh, MD, Associate Investigator, Louisiana State University (Louisiana Clinical Site Director)

Errol D. Crook, MD, Associate Investigator, University of Southern Alabama (Alabama Clinical Site Director)

Table of Contents

Table of Contents 3
List of Acronyms 8
Protocol Summary 10
Précis 11
Schematic of Study Design 13
Background Information and Scientific Rationale 14
1 Study Objectives 16
1.1 Primary Objective 17
1.2 Secondary Objectives 17
1.3 Sub-study Objectives 17
2 Study Design 18
2.1 Description of the Study Design 18
2.1.1 Study Population 18
2.1.2 Study Cohort and Sub-cohorts 19
2.1.3 Exposure Reconstruction 21
2.2 Eligibility Criteria 24
2.2.1 Rationale for including only workers or those who were trained 24
2.2.2 Rationale for Exclusions 25
2.3 Recruitment 26
2.3.1 Recruitment Database 26
2.4 Community and Scientific Outreach 27
2.4.1 Meetings with potentially affected groups 27
2.4.2 Community Advisory Group 30
2.4.3 Communicating the Study to the Community 30
2.4.4 Scientific Outreach 32
2.5 Enrollment Procedures and Enrollment Questionnaire 32
2.6 Tracing 34
2.7 Procedures for Enrolling Cohort Members 34
2.7.1 Recruitment and Retention 34
2.7.2 Recruitment/Retention Strategies and Approach 35
2.8 Recruitment of Special Populations 36
2.8.1 Special Issues in Recruiting Vietnamese Participants 36
2.8.2 Special Issues in Recruiting Creole-Speaking Persons 37
2.8.3 Special Issues in Recruiting Women 38
2.8.4 Special Issues in Persons with Reactive Airways Disease 38
2.8.5 Other Special Populations 38
2.9 Home Visit 38

2.9.1 Advance Study Packet 39
2.9.2 In-Home Visit 39
2.9.3 Baseline Questionnaire 41
2.9.4 Anthropometric/Physiological Measures 42
2.9.5 Collection of Biological Samples 44
2.9.6 Home Environment Sampling 46
2.9.7 In-Home Biospecimen Processing and Shipment 47
2.10 Reports to Participants, Health Care Referrals and Incident Reports 47
2.10.1 Overview 47
2.10.2 Home Visits or Participant Evaluations at other Locations 48
2.10.3 Home Visit/Evaluation Measurements & Testing 49
2.10.4 Follow-up Actions for Abnormal Findings 49
2.10.5 Abnormal Findings Form 55
2.10.6 Follow-up Reports & Information 55
2.11 Laboratory Biospecimen Processing and Storage 56
2.11.1 Central Laboratory Processing 56
2.11.2 Study Sample Long-Term Storage at the NIEHS Repository 57
2.11.3 Analyses (including future studies) 57
2.12 Supplemental Add-on Studies 58
2.13 Follow-Up of Cohorts 59
2.13.1 Telephone Questionnaires 59
2.13.2 Biomedical Surveillance Sub-cohort Follow-up (Year 1 and 3) 59
2.13.3 Annual Morbidity and Mortality Outcomes (Year 2 and later) 59
2.13.4 Follow-up in Years 6-10 60
2.14 Retention Strategies 60
2.14.1 Annual Update of Contact Information 60
2.14.2 Newsletters and Other Mailings 61
2.14.3 Study Website 61
2.14.4 Social Media 61
2.14.5 Community Partnerships and Outreach 61
2.15 Remuneration 62
2.16 Study Timeline 63
3 Evaluation of Benefits and Risks 65
3.1 Potential Benefits 65
3.2 Potential Risks 65
4 Adverse Event Reporting 66
5 Study Oversight 67
6 Statistical Analysis Methods 68
6.1 Treatment of Exposure Status and Health Outcomes 69
6.2 Statistical Methods to Address Study Objectives 69
6.3 Interim and Safety Analyses 71
6.4 Laboratory QA/QC Analyses 71

6.5 Sample Size Considerations and Power 71
6.5.1 Estimated sizes of worker (exposed) and non-worker (unexposed) groups 71
6.5.2 Sample Power 73

7 Analysis Plan 75
7.1 Primary Endpoints 76

8 Training, Quality Control, and Quality Assurance 78
8.1 Staff Recruitment and Enrollment Process 78
8.1.1 Telephone Interviewers 78
8.1.2 Home Visit Personnel 79
8.1.3 Monitoring of Recruitment and Field Activities 80
8.1.4 Personal Safety 80
8.1.5 Mandatory Reporting Requirements 81
8.1.6 Identifying and Dealing with Mental Health Issues, Domestic Violence, and Acute Physical Illness 81
8.1.7 Reporting Individual Results to the Participants 83
8.2 Data Quality Control 84
8.2.1 Data Collection Quality Control 84
8.2.2 Data Storage 84
8.2.3 Data Management & Communications 85
8.3 Laboratory Procedures 86
8.3.1 Laboratory Data Quality Control 86
8.3.2 Quality Control Specimen Collection 86
8.4 Run-in Period 87

9 Human Subjects Protections 87
9.1 Institutional Review Board 87
9.2 Informed Consent Process 87
9.3 Participant Confidentiality 88
9.4 Study Discontinuation 89
9.5 Research with Subjects who May be Unable to Provide Consent 89

10 Data Handling and Record Keeping 90
10.1 Data Capture Methods 90
10.2 Data Management Responsibilities 91
10.3 Data Access and Sharing 92
10.3.1 Access to Biospecimens and Use of Cohort for Add-on Studies 93
10.4 Study Records Retention 93

Appendix A: Scientific References 94

Addendum 1: Current Environmental Exposures in GuLF STUDY Participants Exposure Monitoring Addendum 101
I. Overview 101

II. Background 102
III. Objectives 103
IV. Population 104
V. Data Collection 107
VI. Data Analysis 109
VII. Statistical Power 109
VIII. Reporting of Results 111
IX. Timeline 112
X. Evaluation and Qualitative Interviews 112
XI. Exposure Monitoring Addendum Appendices 115
References 117

Addendum 2: Pilot Study to Estimate Contact Rates for GuLF Follow-up Interviews 119

Addendum 3: GuLF STUDY Biomedical Surveillance Clinical Examination 121

1 Study Objectives & Background 121
A. Objectives 121
B. Background 122
2 Study Overview 123
Study Oversight 124
3 Training, Certification, and Quality Control 125
4 Eligibility and Selection of Participants 126
5 Visit Scheduling 127
6 Components of the Clinical Examination 128
6.1 Informed Consent 130
6.2 Clinic Visit Questionnaire 130
6.3 Heart Rate and Blood Pressure Measurement 130
6.4 Anthropometric Measures 131
6.5 Biological Samples 131
6.6 Peripheral Nerve Testing 134
6.7 Neurobehavioral Examination 137
6.8 Fractional Exhaled Nitric Oxide (FeNO) 139
6.9 Pulmonary Function Testing (PFT) 139
6.10 Mental Health Assessment 141
6.11 Substance Abuse Questionnaire 142
6.12 Biospecimen Processing and Shipment 142
6.13 Reports to Participants and Health Care Referrals 145
6.14 Remuneration 150
7 Data Collection 150
8 Record Retention 151
9 Data Analysis 151

10 Statistical Power 151
11 Institutional Review Board 153
12 Evaluation of Risks and Benefits 153
12.1 Potential Benefits 153
12.2 Potential Risks 153
13 Adverse Event Reporting 154
14 Timeline 155
15 Practice Exams 156
References 157
Addendum 4: Pilot to Test Strategies for Increasing Retention and Follow-up among Hard to Reach Participants 160
Addendum 5: Event Characterization and Reporting to the IRB, Clinical Director (CD) 162

List of Acronyms

ACD	Acid/Citrate/Dextrose
AE	Adverse event
AAPOR	American Association for Public Opinion Research
AIHA	American Industrial Hygiene Association
ASTHO	Association of State and Territorial Healthcare Officials
ATS	American Thoracic Society
ATSDR	Agency for Toxic Substances and Disease Registry
BFR	Brominated flame retardant
BISCO	Bayou Interfaith Shared Community Organizing
BP	British Petroleum
BPA	Bisphenol A
BPM	Beats Per Minute
BPSOS	Boat People SOS
BRFSS	Behavioral Risk Factor Surveillance System
CAG	Community Advisory Group
CAI	Computer-Assisted Interview
CAPI	Computer-Assisted Personal Interview
CATI	Computer-Assisted Telephone Interview
CBC	Complete blood count
CDC	Centers for Disease Control and Prevention
CLSI	Clinical Laboratory Standard Institute
CNS	Central Nervous System
CPL	Central processing lab
CS	Clinical specialist
DMS	Data management system
DNA	Deoxyribonucleic acid
EPA	Environmental Protection Agency
EPL	Environmental Pathology Laboratories
ERS	European Respiratory Society
FDA	Food and Drug Administration
FEV1	Forced Expiratory Volume in First Second
FMV	First morning void
FVC	Forced Vital Capacity
GCF	Gulf Coast Fund
GCP	Good Clinical Practices
GIS	Geographic Information System
GPS	Global Positioning System
HVA	Home Visit Agent
HVAC	Heating, ventilating, and air conditioning
IL-18	Interleukin-18 (IL-18)
IOM	Institutes of Medicine
IRB	Institutional Review Board
JEM	Job-exposure matrix

KIM-1	Kidney injury molecule-1
LFT	Liver function test
LN2	Liquid Nitrogen
LSU	Louisiana State University
MQVN CDC	Mary Queen of Vietnam Community Development Corporation
MVV	Maximum Voluntary Ventilation
NAGs	N-acetyl-beta-D-glucosaminidase
NDI	National Death Index
NGAL	Neutrophil gelatinase-associated lipocalin
NGO	Non-governmental organization
NHANES	National Health and Nutrition Examination Survey
NIEHS	National Institute of Environmental Health Sciences
NIH	National Institutes of Health
NIOSH	National Institute of Occupational Safety and Health
NOAA	National Oceanic and Atmospheric Administration
NSDUH	National Survey on Drug Use and Health
NTP	National Toxicology Program
OSHA	Occupational Safety and Health Administration
PAH	Polycyclic aromatic hydrocarbon
PEC	Petroleum Education Council
PFT	Pulmonary Function Testing
PTSD	Post traumatic stress syndrome
QEESI	Quick Environment Exposure Sensitivity Inventory
RBC	Red blood cells
RFP	Request for proposal
RNA	Ribonucleic Acid
SSS	Social & Scientific Systems, Inc.
USA	University of South Alabama
VOC	Volatile organic compound
WBC	White blood cells

Protocol Summary

Full Title:	Gulf Long-Term Follow-Up Study
Short Title:	GuLF STUDY
Conducted by:	NIEHS and SSS (NIEHS Epidemiology Branch Clinical Research Contractor)
Principal Investigator:	Dale Sandler, Ph.D. Division of Intramural Research Epidemiology Branch National Institute of Environmental Health Sciences
Sample Size:	55,000
Study Population:	Workers and volunteers engaged or potentially engaged in oil spill clean-up operations in the Gulf of Mexico
Accrual Period:	3/2011 – 03/2013
Study Design:	Closed prospective cohort
Study Duration:	10 years initially, with the possibility of extending the follow-up period
Primary Objective:	To investigate potential short- and long-term health effects associated with oil spill clean-up activities/exposures surrounding the Deepwater Horizon disaster
Secondary Objectives:	To investigate biomarkers of potentially adverse biological effect in relation to oil spill clean-up activities/exposures To create a resource for additional collaborative research on focused hypotheses or subgroups To create a resource to better understand the short and long-term human health effects of oil and oil dispersants in the environment
Primary Endpoints:	Respiratory, genotoxic, hematologic, neurologic, immunologic, and mental health
Secondary Endpoints:	Cancer, reproductive, cardiovascular, hepatic, and renal effects

Précis

The Gulf Long-term Follow-up Study (GuLF STUDY) will investigate potential short- and long-term health effects associated with the clean-up activities following the Deepwater Horizon disaster in the Gulf of Mexico on April 20, 2010. Crude oil, burning oil, and the dispersants used during clean-up efforts contain a range of known and suspected toxins. Over 100,000 persons have completed safety training in preparation for participation in clean-up activities related to the spill. While many of these individuals participated in active clean-up efforts, others did not. Exposures among persons involved in clean-up range from negligible to potentially significant, especially for workers involved in tasks associated with direct exposure to crude or burning oil, or to chemical dispersants. However, prediction of adverse health effects is not possible because the long-term human health consequences of oil spills are largely unknown due to the dearth of research in this area. The potential health effects associated with the levels of exposure experienced by clean-up workers are largely unstudied. Heat and stress experienced by these workers may also have adverse long-term health effects. In addition to the oil itself, the widespread economic and lifestyle disruption caused by the oil spill may contribute to mental health problems among this population.

The over-arching hypotheses of this study are:

1. Exposure to constituents of oil, dispersants, and oil-dispersant mixtures, and to spill-related stress by workers engaged in clean-up of the Deepwater Horizon oil spill are associated with adverse health effects, particularly **respiratory**, **neurological**, **hematologic**, and **psychological or mental health**.
2. There are exposure-response relationships between the above exposures and health effects.
3. Biomarkers of potentially adverse biologic effects are associated with the above exposures.

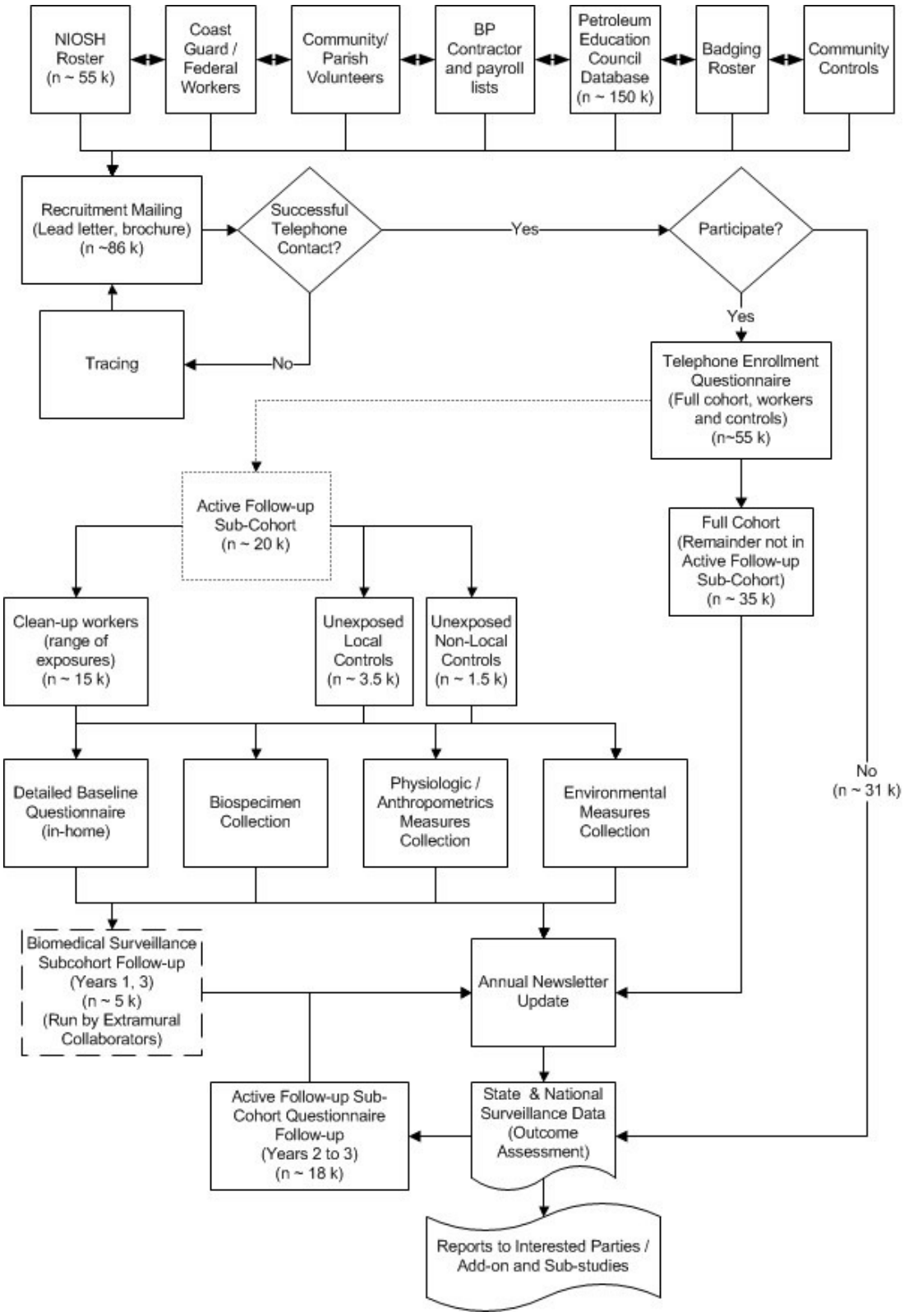
Based on what is known about individuals involved in clean-up efforts, the cohort will consist primarily of English-, Spanish-, or Vietnamese-speaking adults who performed oil-spill clean-up-related work (“exposed”) and similar persons who did not engage in clean-up-related work (“unexposed” controls). Accommodations for enrolling participants speaking other languages will be developed through community collaborations as appropriate. Workers will be sampled from across job/potential exposure groups. A total of approximately 55,000 persons are expected to be enrolled into the cohort. A random sample of the full cohort, stratified by category of job/potential exposure (including N~6,000 with no oil-spill work to serve as controls) and oversampled for workers with higher potential exposures, will be enrolled into an *Active Follow-up Sub-cohort* (N~20,000). A random sample of the Active Follow-up Sub-cohort, also stratified by category of job/potential exposure and oversampled for workers with higher potential exposures, will be enrolled into a *Biomedical Surveillance Sub-cohort* (N~5,000). Participants will be interviewed about their clean-up-related tasks, demographic and socioeconomic factors, occupational and health histories, psychosocial factors, and physical and mental health. Members of the Active Follow-up Sub-cohort will also be asked to provide biological samples (blood, urine, hair, toenail clippings, and possibly saliva) and environmental samples (house dust) and will have basic clinical measurements (height, weight, waist and hip circumference, blood pressure, urinary glucose levels, FEV1 and FVC as a measure of pulmonary function) taken during home visits at baseline. The Biomedical Surveillance Sub-cohort will participate in a more comprehensive clinical assessment after the initial home visit,

including more comprehensive pulmonary function testing, neurological testing, and collection of additional biological and environmental samples. The specific tests to be performed and clinical protocols will be developed in collaboration with extramural investigators selected through a request for proposals (RFP). When developed, the protocol for this portion of the study will be submitted separately to the Institutional Review Board as a study amendment.

Exposures will be estimated using detailed job-exposure matrices developed from data from monitoring performed by different agencies and organizations during the crisis, as well as information on recommended or actual use of personal protection, information obtained by interview, and the available scientific literature. It should be noted that, in the absence of individual or group monitoring data for most workers, estimates of exposure, whether based on job activities or on more refined job-exposure matrices, will indicate the degree of *potential* exposure (i.e., exposure opportunity) rather than *known* exposure. We will investigate acute health effects via self-report from the enrollment interview among all cohort members and also via clinical measures and biological samples from Active Follow-up Sub-cohort members. All cohort members will be followed for development of a range of health outcomes through record linkage (cancer, mortality) and if feasible, through linkage with electronic medical records that may become available during the course of follow-up. Health outcomes among the Active Follow-up Sub-cohort will also be identified through self-report via periodic follow-up interviews. Additional outcome information will be obtained on the Biomedical Surveillance Sub-cohort from periodic follow-up clinical evaluations (e.g., spirometry, neurological testing) and analysis of follow-up biospecimens (e.g., immunologic parameters, liver function, renal function, DNA damage). Follow-up of the entire cohort is initially planned for 10 years, with extended follow-up possible depending upon scientific and public health needs and the availability of funds.

Recruitment of subjects should begin in March 2011, with the telephone interviews expected to be completed within 12-24 months and the baseline home visits within 18-26 months. For the home visits, we will initially target workers residing in the four most affected Gulf States (LA, MS, AL, and FL), although we may expand to other states if further information about the geographic distribution of workers and their potential exposures warrants additional follow-up in these states. We will work closely with a Community Advisory Board to develop community support for this study and appropriate communications and study materials.

Schematic of Study Design



Background Information and Scientific Rationale

There has been little research of the long-term health effects from oil spills despite the fact that between 1970 and 2009, there were 356 spills of more than 700 tons from oil tankers, with approximately 38 of these spills affecting coastal populations [International Tanker Owners Pollution Federation Limited (ITOPF) 2009, Aguilera, et al. 2010]. The Deepwater Horizon disaster, with its release of approximately 5 million barrels (~680,000 tons) of crude oil into the Gulf of Mexico, is far larger than any of these tanker spills. Given the magnitude of this spill and the scope of the potential exposures – at least 55,000 workers involved in clean-up efforts and countless residents of the affected areas – study of the human health effects of this spill is urgently needed to monitor Gulf clean-up workers and to understand the adverse consequences of oil spills in general.

Crude oil is a complex mixture containing a range of known and suspected toxins, including volatile organic compounds (VOCs), polycyclic aromatic hydrocarbons (PAHs), hydrogen sulfide, and heavy metals. VOCs, particularly benzene, have been linked to lymphohematopoietic malignancies [Savitz and Andrews 1997, Hayes, et al. 2001, Glass, et al. 2003, Steinmaus, et al. 2008, Baan, et al. 2009] and kidney dysfunction [Chang, et al. 2010]. They can also cause central nervous system (CNS) depression, respiratory irritation, and immune system alterations [Kirkeleit, et al. 2006, Gillis, et al. 2007, Lee, et al. 2007, Cho 2008]. Naphthalene, which causes olfactory neuroblastomas, nasal tumors, and lung tumors in rodents, is listed as possibly carcinogenic to humans (Group 2B) by IARC [IARC 2002]. Polycyclic aromatic hydrocarbons (PAHs) include known carcinogens and may alter reproductive and immune functions [Agency for Toxic Substances and Disease Registry (ATSDR) 1995]. Hydrogen sulfide can cause acute and chronic CNS effects such as headaches, poor attention span, poor memory, and poor motor function [Agency for Toxic Substances and Disease Registry (ATSDR) 2006]. Heavy metals found in crude oil, including arsenic, cadmium, chromium, manganese, copper, nickel, vanadium, and lead, have a range of adverse health effects, including neurotoxicity and carcinogenicity, renal and immunotoxicity [ATSDR 1999, 2004, 2005, 2007a, 2007b, 2008a, 2008b, 2009, Hazen, et al. 2010, Camilli, et al. 2010, Botello, et al. 1997].

Burning oil produces particulates, which have adverse cardiac and respiratory effects, and may generate dioxins because of incomplete combustion in the presence of chlorine in the sea water (Howard 2010).

The dispersants used to break up the oil contain a number of respiratory irritants, including 2-butoxyethanol, propylene glycol, and sulfonic acid salts. Heat and stress experienced by the clean-up workers may also have adverse health effects. In addition to exposures from the oil itself, the widespread economic disruption caused by the oil spill may also contribute to mental health problems in a population with potentially increased vulnerability due to prior exposures to trauma, financial strain and social stressors arising from other recent disasters [Galea, et al. 2008]. Such stressors may also adversely impact physical health.

The few studies that have evaluated the human health consequences of oil spills have primarily focused on acute physical effects and psychological sequelae. These 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. Most of these studies were cross-sectional. A number of the

studies reported respiratory symptoms, including cough and shortness of breath [Carrasco, et al. 2006, Janjua, et al. 2006, Meo, et al. 2009, Sim, et al. 2010]. In a follow-up study among clean-up workers of the *Prestige* oil spill, Zock et al [2007] observed that lower respiratory tract symptoms persisted 1 to 2 years after exposure had ended (although the excess risk decreased with increasing time from last exposure) and that the symptoms showed exposure-response patterns in relation to number of exposed days, exposed hours per day, and number of activities. Meo et al [2008, 2009] reported a reduction in forced vital capacity (FVC), forced expiratory volume in first second (FEV1), and forced expiratory flow and maximum voluntary ventilation (MVV), including exposure-response trends, in a small study of workers involved in the clean-up of the *Tasman Spirit* oil spill. Other commonly reported symptoms in these studies include itchy eyes, nausea/vomiting, dizziness, and headaches [Campbell, et al. 1993, Lyons, et al. 1999, Morita, et al. 1999, Carrasco, et al. 2006, Janjua, et al. 2006, Meo, et al. 2009, Sim, et al. 2010], and skin irritation/dermatitis [Campbell, et al. 1993, Janjua, et al. 2006, Sim, et al. 2010]. It is worth noting that, among Prestige oil spill clean-up workers, proper safety training was associated with greater use of protective equipment and a lower frequency of health problems [Carrasco, et al. 2006], which indicates that training can be effective in prevention.

In addition to health effects induced by chemical and physical exposures, physical and mental health may be adversely affected through pathways involving physiological and psychological responses to acute and chronic stressors related to the disaster. Adverse psychological consequences have frequently been linked to previous oil spills. Excess prevalence of generalized anxiety disorder, posttraumatic stress disorder (PTSD), and depressive symptoms were observed among communities affected by the *Exxon Valdez* oil spill approximately one year after the spill occurred [Palinkas, et al. 1993]. Similar patterns of higher anxiety and depression scores and worse mental health were observed among communities near the *Sea Empress* spill [Lyons, et al. 1999]. The *Braer* spill was associated with increased somatic symptoms, anxiety, and insomnia, but not personal dysfunction or severe depression [Campbell, et al. 1994]. Worse mental health scores were related to proximity to the *Prestige* spill [Sabucedo, et al. 2010].

In studying stress-related effects, it will be important to consider measures of mental health and biological response to evaluate both subjective and objective outcomes. In a community-based study of residents living near a petrochemical complex, perceived health was related to perceived risks due to chemical exposures, while inflammatory cytokine levels were related to objective proximity to the complex [Peek, et al. 2009]. In the same community, interviews after a petrochemical accident revealed significant decreases in perceived physical and mental health associated with multiple covariates, including lower education, distance and impact of the disaster [Peek, et al. 2008]. Susceptibility to the adverse effects of disasters may be increased by a variety of factors, including extent of exposure, female gender, middle age, ethnicity or minority status, pre-existing mental and physical health, economic and psychosocial resources [Norris, et al. 2002]. Consequently, the stress-related effects of the Deepwater Horizon Disaster may be amplified in a population still recovering from the impact of other recent disasters and in vulnerable subpopulations [King and Steinmann 2007, Galea, et al. 2008]. Research in the affected region also needs to take into account the unique history and potential vulnerability of migrants, ethnic or cultural minorities in the study population, e.g., Vietnamese [Palinkas, et al. 1992, Do, et al. 2009, Norris, et al. 2009].

Studies of genotoxicity and endocrine toxicity also point to potential adverse effects among oil spill clean-up workers. All but one of these studies were conducted among clean-up workers involved in the *Prestige* incident. Findings include significantly higher DNA damage, as measured by the comet assay, but not cytogenetic damage, as measured by the micronucleus test, among exposed individuals compared to controls, which was related to duration of exposure [Laffon, et al. 2006, Perez-Cadahia, et al. 2006]. Clean-up workers were also found to have significantly elevated blood levels of aluminum, nickel, and lead, but decreased levels of zinc [Perez-Cadahia, et al. 2008]. In addition, exposed workers had significant decreases in blood prolactin and cortisol levels [Perez-Cadahia, et al. 2007]. A recently published study of the Prestige cohort [Rodriguez-Trigo, et al. 2010] found an increased risk of structural chromosomal alterations in circulating lymphocytes among exposed workers two years after the spill. These results are consistent with studies showing increased DNA damage in relation to low level exposure to benzene [Bagryantseva, et al. , Maffei, et al. 2005, Chen, et al. 2008, Fracasso, et al. 2010] and PAHs [Bagryantseva, et al. , Novotna, et al. 2007, Gamboa, et al. 2008]. On the other hand, a study of persons affected by the *Braer* spill [Cole, et al. 1997] found no evidence of genotoxicity through either DNA adducts in peripheral blood mononuclear cells or mutations at the *HPRT* locus in T lymphocytes.

Studies of upstream petrochemical workers, who are likely to have many exposures similar to that of oil spill clean-up workers, have reported excesses of leukemia, multiple myeloma, melanoma, and esophageal adenocarcinoma [Schnatter, et al. 1992, Kirkeleit, et al. 2008]. While such rare outcomes may take years to develop, immediate and lasting changes may be seen in intermediate biomarkers indicating toxic effects and potential for future disease risk. The immune system may represent a particularly sensitive and accessible system for determining physiological impact of oil spill exposures. For example, the hematotoxic and immunotoxic effects of benzene exposure have been well-described, occurring even at relatively low levels of exposure [Lan, et al. 2004]. These effects, indicated by downward shifts in leukocyte and red blood cell counts, may also be more apparent in susceptible subgroups defined by genetic variation in inflammatory, apoptotic, or metabolizing pathways [Lan, et al. 2005, Kim, et al. 2007, Lan, et al. 2009, Zhang, et al. 2010]. Benzene's toxicity to hematopoietic progenitor cells may also impart long-term effects on the immune system leading to premature immunosenescence. This idea is supported by the finding that higher personal benzene exposures in traffic officers were associated with significantly shorter leukocyte DNA telomere length [Hoxha, et al. 2009], a marker of immune aging that has been related to risk of multiple chronic disease outcomes and mortality. Other intermediate markers related to chronic disease risk include inflammatory cytokines, antibodies indicating reduced immunity to latent viral infections, or auto-antibodies, though limited information exists on these measures in past studies of oil spill or petrochemical workers.

1 Study Objectives

This research effort is designed to investigate potential short- and long-term health effects among workers engaged in clean-up activities surrounding the Deepwater Horizon oil spill. Given the very limited health effects research conducted to date on oil spill clean-up workers, the GuLF STUDY is designed not to study a few narrow *a priori* hypotheses, but rather to allow the investigation of a wide range of potential adverse health effects, including physical, psychological, and biological effects. The long-term goal of this study is not only to identify adverse health outcomes related to clean-up

activities among the Deepwater Horizon responders, but also to assemble information that can be used for prevention and intervention of adverse health outcomes in any future similar disasters.

The over-arching hypotheses of this study are:

1. Exposure to constituents of oil, dispersants, and oil-dispersant mixtures, and to spill-related stress by workers engaged in clean-up of the Deepwater Horizon oil spill are associated with adverse health effects, particularly **respiratory**, **neurological**, **hematologic**, and **psychological or mental health**.
2. There are exposure-response relationships between the above exposures and health effects.
3. Biomarkers of potentially adverse biologic effects are associated with the above exposures.

1.1 Primary Objective

The primary objective of the GuLF STUDY is to assess a wide range of potential short- and long-term human health effects associated with clean-up and disposal activities surrounding the Deepwater Horizon oil spill in the Gulf of Mexico. Health areas of interest include, but are not limited to, respiratory, cardiovascular, hematologic, dermatologic, neurologic, cancer, reproductive, mental health, substance abuse, immunologic, hepatic, and renal effects.

1.2 Secondary Objectives

A key aspect of assessing these health effects will be to investigate biomarkers of potentially adverse biological effect, including DNA damage, aberrant epigenetic profiles, and alterations in gene expression, some of which have been observed in previous studies of oil spill clean-up workers.

Additionally, secondary objectives of the study are to: 1) create a resource for additional collaborative research on specific scientific hypotheses or on subgroups of interest. We will work with external scientists to facilitate nested sub-studies within the existing cohort to examine outcomes and exposure subgroups of interest; and 2) create a resource to better understand the short and long-term human health effects of oil and oil dispersants in the environment.

1.3 Sub-study Objectives

At this time, one sub-study, the Biomedical Surveillance Sub-cohort, is planned as an integral part of the study proposal although the specific tests to be carried out and the implementation details are not yet designed. The detailed protocol (s) for this Sub-cohort will be developed in collaboration with extramural partners and will be separately peer-reviewed. Objectives of the Biomedical Surveillance Sub-cohort will include investigating immediate and ongoing physiological and clinical parameters in a group of highly exposed workers and a smaller number of unexposed workers. Establishing this exposure-enriched group that contains more detailed information on adverse outcomes and repeated biological measures will provide an important resource for longitudinal studies and enable nested comparisons with measures obtained on the larger cohort.

2 Study Design

2.1 Description of the Study Design

The GuLF STUDY has been designed to allow investigation of potential short- and long-term health effects associated with the oil spill clean-up work and to create a resource for collaborative research on specific scientific hypotheses or subgroups. It is an observational prospective cohort study that will create opportunities for both analyses of the full cohort as well as numerous nested analyses. The design will enable investigators to efficiently address specific hypotheses generated from previous studies of oil spill exposures and, importantly for an exposure that has not been studied in relation to long-term health outcomes, allow them more generally to identify new symptoms and conditions that may occur in excess among the exposed participants and determine the extent to which any physical and mental health conditions persist. The data and the biological and environmental samples that will be collected will allow examination of a wide range of health areas of interest, including respiratory, cardiovascular, hematologic, dermatologic, neurologic, cancer, reproductive, mental health, immunologic, hepatic, and renal. The study is planned to be at least 10 years in duration, although it is anticipated that the study may continue for 20 years or more, through record linkage, at a minimum. Prospective studies typically have a long-term design because some diseases of interest, such as cancer, generally have long latency periods, e.g., 15-20 years or more. Consequently, we will consider extending this study, based on what we learn during the initial study period, scientific and public health needs, and on the availability of funds.

2.1.1 Study Population

To capture a representative sample of the clean-up workers and controls, we will target individuals across the various categories of job/potential exposure from the Petroleum Education Council (PEC), National Institute of Occupational Safety and Health (NIOSH), or other worker/volunteer rosters, security badging and access lists, and other administrative lists maintained by BP contractors such as The Response Group (TRG) Swift, and Foresight Vantage (among others). These individuals are potential participants because they are believed to have engaged in clean-up work or participated in worker training modules in anticipation of such work. We will exclude individuals such as journalists who did not engage in clean-up activities but were required to undergo safety training to gain access to worker staging areas (and, therefore, may appear on the PEC list). These individuals will be determined from either the training lists (i.e., individuals who indicated that they intended to work for less than one week) or via screening questions during the enrollment telephone interview. We will use data from our planned mini-pilot (at the beginning of field work) to determine the feasibility of also *efficiently* identifying and excluding individuals such as caterers and administrative/office staff who engaged in clean-up *related* activities, but not clean-up activities *per se*; however, this issue is complex and requires data that will become available only after we go into the field. We define potentially *exposed* subjects as individuals who completed at least one day of oil-spill clean-up-related work, either paid or volunteer. We define *unexposed* subjects as eligible individuals who either 1) completed safety training in anticipation of performing clean-up work but did not do so or 2) engaged only in clean-up activities such as administration, oversight, and logistics that involved no exposure to spill-related oil, oil byproducts, or dispersants. Selection for the Active Follow-up Sub-cohort will cover all levels of potential exposure but will oversample workers with the

highest potential exposures to oil, oil byproducts and dispersants. We will conduct interviews in English, Spanish, and Vietnamese. Special accommodation will be made for those speaking other languages (e.g. Haitian Creole, Louisianan Creole, etc.), if feasible and warranted by the number of workers speaking these languages. PEC training was conducted in English, Spanish, and Vietnamese only so we do not anticipate a large number of those speaking other languages. However, should this change based on data from the PEC list or input from community groups, we will submit an amendment to the IRB with appropriate translated documents for approval.

2.1.2 Study Cohort and Sub-cohorts

After administering a screening enrollment questionnaire to each potential cohort member, we will use a two-stage sampling design to randomly sample individuals across categories of job/potential exposure for invitation to participate in the *Active Follow-up Sub-cohort* (N~20,000), which will be nested within the full cohort (N~55,000). We will also randomly sample individuals within the Active Follow-up Sub-cohort across categories of job/potential exposure for inclusion in the *Biomedical Surveillance Sub-cohort* ("tagging" N~6,250 with the expectation of obtaining agreement from N~5,000). This nested design represents an efficient and cost-effective way to include most of the clean-up workers in a prospective study and also to obtain comprehensive and detailed clinical and biologic information on a scientifically appropriate sample of the total group while maintaining statistical integrity through the use of the two-stage random sampling design. The study effort, participant commitment, and potential knowledge gain increases from passively followed members of the full cohort to members of the Active Follow-up Sub-cohort to members of the Biomedical Surveillance Sub-cohort. For each sub-cohort, we will oversample from job categories that had higher potential exposures and/or were smaller to ensure adequate representation of higher potential exposures and of all tasks performed.

Workers will primarily be identified from a combined list of workers who completed a voluntary NIOSH Roster form and additional workers identified through the PEC list and other lists that may become available of persons who may have been involved in clean-up activities (see Section 2.3.1 for a description of the lists of potential subjects.)

The *Active Follow-up Sub-cohort* will contain ~15,000 workers ("exposed") from across all job categories and ~5,000 controls ("unexposed"). While these groups are selected on the basis of their potential exposure to oil or dispersants used in clean-up, both groups will contain individuals who are "exposed" and not exposed to the stresses associated with having lost their source of income due to the oil spill or living with economic or social uncertainty due to their residential proximity to the spill. This sub-cohort will be largely restricted to persons residing in one of the four Gulf States primarily engaged in clean-up activities (LA, MS, AL, and FL), prioritizing workers closest to the spill area. Based on data on approximately 44,000 workers from the NIOSH roster, all but 8% of workers were from these four states. Eligibility may later be expanded to include other states based on information on the geographic distribution of workers that we will receive from the PEC list and other worker lists. We will recruit workers from other states only if it is determined, upon receipt of the potential subject lists that a large number of workers with potential high exposures came from a given state. For logistical reasons, we will not recruit controls from outside of the four most affected Gulf States. Federal workers (e.g. Coast Guard, Occupational Safety and Health Administration (OSHA), Fish and Wildlife Service (FWS), National Oceanic and Atmospheric Administration (NOAA), Environmental Protection Agency (EPA), and others) residing

outside of the four Gulf States and other workers who reside outside of the Gulf States are eligible to be included if they had potentially high exposures because of specific clean-up tasks performed. A Federal control group, within the larger sub-cohort control group, will be based on the large number of Federal responders whose participation in the clean-up was limited to roles such as administration, oversight, and logistics that provided no potential exposure to spill-related oil, oil byproducts, or dispersants. We will oversample certain categories of job/potential exposure of particular interest (e.g., those with potential direct exposure to fresh crude or burning oil or to chemical dispersants). Because there is a lack of centralized data concerning the distribution of categories of work/potential exposure and we are likely to determine this distribution only when the enrollment interviews are underway, we will periodically evaluate and revise as appropriate our sampling probabilities. These probabilities will take into account the distribution of jobs/potential exposures and statistical power. Participants in the Active Follow-up Sub-cohort will 1) be administered detailed interviews, 2) provide biological samples (blood, urine, hair, toe nail clippings, and possibly saliva) and environmental samples (house dust), and 3) have basic clinical measurements taken at enrollment, and 4) will be administered two follow-up interviews. In contrast, passively followed members of the full cohort will be administered only a brief telephone interview at enrollment. Disease and mortality during follow-up will be obtained via linkage with cancer registries and State vital statistics records.

The controls will preferentially be drawn from the PEC/NIOSH lists, which include some individuals who were trained in anticipation of being hired for clean-up work but were never hired. At some time during the peak work weeks, employers were advised that heat related health issues might be especially problematic for obese workers or those with high blood pressure. Although pre-employment screening may have been advised, it is uncertain whether or not it was systematically carried out, and if done, may have been contractor specific. Therefore, because some potential workers may have been turned away due to health concerns, potential controls will be asked why they did not participate in clean-up activities. Those indicating they did not qualify for medical reasons will be excluded as will those who completed training to facilitate receipt of a badge to enter the area, with no intention of performing any clean-up related tasks.

We estimate that there will be sufficient potential workers with minimal exposure for internal comparison to serve as controls. However, if it turns out that our estimates are incorrect and we need to consider other mechanisms to enroll a comparison group, we will consider other approaches such as direct media or asking participants to tell their friends and colleagues about the study and have their friends and colleagues contact the study directly.

Because some workers from the four Gulf States will come from areas away from the affected communities and because controls from the affected communities may have experienced some spill-related exposures, including stress and social disruption, we will establish two control groups. Persons from the lists described in Section 3.3.1 who are determined to have not engaged in clean-up activities and are eligible for this study will be placed in either a “local” control group or a “non-local” control group. The “local” control group will consist of controls residing within the affected communities. Their inclusions in analyses of the health effects of chemical exposures will account for the stress and other psychosocial factors experienced by clean-up workers residing in the affected communities. The “non-local” control group will consist of individuals residing within the affected states, but outside of the affected communities. These individuals will serve as a control group in evaluation of spill-related stress and other societal effects

that may affect both exposed clean-up workers and unexposed controls residing in the affected communities. Based on residence information from the 44,000 persons in the NIOSH roster, 77% of the workers were "local" (i.e. lived in a coastal county in one of the four states). Consequently, we will oversample "non-local" trainee controls to provide sufficient statistical power for analyses involving this group. A third control group will consist of the large number of Federal responders whose participation in the clean-up was limited to roles such as administration, oversight, and logistics that entailed no exposure to spill-related oil, oil byproducts, or dispersants.

Passively followed members of the full cohort will be those individuals who completed an enrollment interview but were not included in the Active Follow-up Sub-cohort because 1) they did not reside in one of the targeted Gulf States, 2) they were not randomly sampled for inclusion in the Active Follow-up Sub-cohort, or 3), they were unable or unwilling to participate in active follow-up but are willing to be tracked over time. Outcomes follow-up will be obtained via linkage with State cancer registries and vital statistics databases.

The *Biomedical Surveillance Sub-cohort* will be an intensively evaluated subgroup nested within the Active Follow-up Sub-cohort. It will be sampled from across the categories of job/potential exposure and from controls, with oversampling of workers with the highest potential exposures. Potential members of this sub-cohort will be identified during the enrollment interview, based on their reported clean-up activities. To achieve our target of ~5,000 members in this sub-cohort, we will identify ~6,250 potential members during the enrollment interview, assuming that ~80% will ultimately agree to participate in the further procedures required of the Biomedical Surveillance Sub-cohort (given that they already agreed to participate in the Active Follow-up Sub-cohort and will receive the benefit of more detailed health monitoring during the study) when they are re-contacted later by extramural collaborators. This sub-cohort will undergo the same baseline and follow-up procedures as the rest of the Active Follow-up Sub-cohort, but will additionally participate in multiple follow-up visits involving health assessments that include spirometry with bronchodilator challenge and neurological testing and collection of repeat biological and environmental samples. This sub-cohort will undergo more intensive biomonitoring than the rest of the Active Follow-up Sub-cohort, including having their complete blood counts (CBCs), white blood cell (WBC) differentials and more comprehensive urinalysis measured at baseline. [Note: These tests will be performed for all 6,250 identified as potentially eligible for the Biomedical Surveillance Sub-cohort as they must be performed on fresh samples. Similarly, lymphocytes will be extracted and cryopreserved for the larger sample of potential participants.]

Protocols for the additional clinical examinations will be developed and implemented in collaboration with local university partners identified through a request for proposals (RFP) and, therefore, will not be discussed further in this protocol. These will undergo separate scientific and Institutional Review Board (IRB) review. Consideration will be given to focusing on the more highly exposed Gulf States (e.g. Louisiana and Alabama) to facilitate comprehensive health examinations. We anticipate a standardized core protocol with room for unique investigator initiated options to address additional hypotheses.

2.1.3 Exposure Reconstruction

Although monitoring data will be available on some individuals for some exposures, most participants in the study cohorts will lack such measurements. Because it is critical to

have some indication of quantitative levels of exposure, it will be necessary to construct exposure indicators from the available individual and environmental monitoring data, characteristics of clean-up tasks, work locations, and times that these events occurred. Given the absence of individual or area/group monitoring data for most workers, it is important to note that estimates of exposure, whether dichotomous (exposed/unexposed) or semi-quantitative (e.g., none, low, medium, high), will reflect *potential* exposure rather than *known* exposure and references in this protocol to exposures, except where indicated otherwise, should be interpreted as such. We will validate the self-reported clean-up activities with security badge and payroll records to the extent possible using available data. Moreover, we will work with survey methodologists to ensure valid data collection. Investigators who are experts in industrial hygiene exposure assessment will assemble exposure data and construct job-exposure matrices for the exposures of interest using monitoring data from multiple sources. These monitoring data, including individual measurements for some workers, area measurements, and Health Hazard Evaluations, were collected during clean-up activities and monitoring by OSHA, NIOSH, NOAA, EPA, Fish and Wildlife Service, US Geologic Survey, the Coast Guard, and British Petroleum (BP). An interagency meeting was convened on August 19 in Washington, DC to discuss these issues and identify sources of data that could be used to reconstruct worker exposures across all tasks. An example of these environmental monitoring data is provided in Appendix U. This spreadsheet was first created by EPA as a way to identify data streams and later expanded to identify any sampling within the Deepwater Horizon Response that may be redundant or complementary. It will serve as a useful springboard from which to start cataloging the available environmental data and will aid in the exposure assessment process.

In addition, available chemical analysis data of oil from the well, the dispersants used, samples of weathered oil, and weather data from the period of the spill clean-up will be considered in relation to exposure opportunities. This information will be assembled for the exposure panel and may be used in exposure estimation and reconstruction. By linking this exposure information with self-reported activity data, exposures will be estimated for all included workers, including those from Federal agencies/institutions. We will also use environmental samples (house dust), if available and appropriate, and questionnaire data to identify relevant occupational and non-occupational exposures. Lastly, we will evaluate existing exposure measurements on beach clean-up workers and consider collection of additional biomonitoring data for this large subgroup if clean-up efforts are still underway at the time of cohort enrollment. A detailed protocol of exposure assessment procedures will be developed by the study investigators in close collaboration with the panel of experts described above.

We will work closely with academic and federal partners such as OSHA and NIOSH to convene a panel of experts to systematically work through these exposure assessment issues and develop a scientifically sound method for assigning exposures to the study participants. This expert panel will develop a Job-Exposure Matrix (JEM) based on the varied work tasks of cleanup workers and volunteers. Different dichotomous and ordinal ranking metrics may need to be developed for the different chemicals and exposure pathways that may be associated with different health effects. For example, a single metric will probably not capture important differences in PAH exposure from particle inhalation among oil burn workers versus dermal PAH exposure of absorbent boom operators. The exposure metrics will not only need to consider differential exposures based on job task, but will also need to consider the duration of exposures (e.g., hours per day, total days of work).

One of the challenges of this research is that most workers and controls will have exposures to many of the chemicals of interest that are unrelated to the oil spill. Most persons are exposed to benzene in ambient air (usually at very low levels) and to PAHs from inhalation, dietary ingestion, and house dust. Such exposures are particularly common among residents along the Gulf coast in Louisiana. There are also a number of consumer products that contain 2-butoxyethanol or propylene glycol, two dispersant ingredients of potential interest. Some workers and controls could have significant occupational (non-spill related) exposures to some of these chemicals. In most cases, these types of "background" exposures are likely to have similar distributions among the worker and control populations. However, the study will need to carefully consider and collect information to characterize these exposures. For example:

- Commercial boat operators who participated in cleanup activities could potentially receive higher long-term exposures to fuel oil and engine exhaust, with many of the same chemical constituents as found in the spilled oil, compared to a control group that did not include active boat operators.
- Workers may come from Gulf coast locations affected by point sources of petrochemical pollution not experienced by control living inland or in other states.
- Workers hired directly by BP or its long-term contractors may have had other oil industry jobs.
- Workers hired early on may include those with prior training in hazard remediation and may have been involved in cleanup from other smaller spills.

This potential confounding will be addressed through questionnaire data (occupational and other relevant activities/exposures), GIS mapping as appropriate, and analysis of biological and environmental samples. The expert panel will need to address these and other challenges that face this critical component of the study.

While we have already consulted individually with other researchers who have examined health effects associated with past oil spills, we are exploring the possibility of convening an exposure assessment workshop of all of these study investigators to explore lessons learned and to discuss findings to ensure that the GuLF STUDY is conducted to the state-of-the-science.

It is important to note that many scientifically rigorous epidemiologic studies have successfully used qualitative or semi-quantitative data derived from job-exposure matrices to investigate exposure-disease associations [Coble, et al., 2009, Allen, et al., 2006, Baris, et al., 2004, Kromhout, et al., 1995, Laakkonen, et al., 2008, Young, et al., 2004, Richardson, et al., 2008, Lee, et al., 2003, Elci, et al., 2003]. This representative sample of studies linked job titles and usual job activities to available monitoring data to create job-exposure matrices that were used to estimate exposures in the study population. Indeed, the epidemiologic investigations surrounding the *Prestige* oil spill response in Spain utilized self-reported exposure information to assess health outcomes that otherwise might have been missed [Suarez, et al. 2005, Carrasco, et al. 2006, Zock, et al., 2007], Such studies have yielded scientifically valuable information and demonstrate the important role that qualitative and semi-quantitative exposure data and/or job-exposure matrices can play in epidemiologic research.

Although the development and evaluation of job-exposure matrices for the present worker population would ideally have been done prior to beginning subject recruitment, this was not a feasible option for this study, as is typically the case for studies responding to disasters. A large amount of monitoring data has already been collected,

is currently being aggregated, and will be available to us. Our main concern to this point has been to design a scientifically rigorous study that we can get into the field as quickly as possible and 1) capture the self-reported activities, dates, times, locations, etc. of clean-up work that these workers engaged in before their memories fade and 2) enroll these workers into the study before they move, change phone numbers, or otherwise become lost to follow-up.

2.2 Eligibility Criteria

We anticipate screening as many as 90,000 individuals in order to recruit approximately 55,000 volunteers primarily from the four most affected Gulf States* (LA, MS, AL, and FL) into the cohort, which will include a randomly sampled Active Follow-up Sub-cohort of approximately 24,000 individuals nested within it. Eligibility criteria for the cohort include:

- 21 years of age or older
- Fall into one of two oil-related exposure categories:
  - *Potentially exposed* subjects must have completed at least one day of oil-spill clean-up-related work (other than safety training), either paid or volunteer.
  - *Unexposed* subjects will be individuals who were not directly involved in oil spill clean-up activities, but who worked near the oil spill or completed some oil spill worker training.

Invitation to enroll in the Active Follow-up Sub-cohort will be made based primarily on level of potential exposure as well as state of residence. Sampling probabilities will vary across categories of job/potential exposure, with probabilities of up to 100% for persons who report having engaged in oil clean-up related activities that are suspected of having high exposures (e.g. working at the source, skimming, incineration, booming (specifically retrieval of contaminated boom), wildlife clean-up, etc.). Available funding imposes an upper limit on the size of the Active Follow-up Sub-cohort, but the number of workers in different categories of job/potential exposure is currently unknown (and will likely remain unknown until interviewing commences). Consequently, sampling probabilities will be re-evaluated and adjusted periodically as study enrollment proceeds in order to realize the study objectives and achieve the target size of the Active Follow-up Sub-cohort.

Because of 1) the small proportion of non-Federal clean-up workers from outside of the four most affected Gulf States (< 8%, based on current data) and 2) the substantial logistical challenges of including these workers in the Active Follow-up Sub-cohort, we will include these individuals in the Active Follow-up Sub-cohort only if we determine that an appreciable number of them engaged in clean-up activities with high potential exposure. Otherwise, these individuals will be enrolled into the passive follow-up portion of the cohort. This strategy is the same as that employed for the Federal workers in this cohort.

2.2.1 Rationale for including only workers or those who were trained

Morbidity and mortality rates from the general population include individuals who are often too sick to work. Thus, those who are hired, or trained to be hired, are generally

healthier than those who aren't trained because relatively healthy individuals are more likely to gain employment and remain employed – a phenomenon known as the "healthy worker effect." The healthy worker effect is particularly relevant in the selection of unexposed controls. In order to obtain comparable controls for workers engaged in oil spill clean-up activities, we would need to find individuals who otherwise would have been able to work (i.e., were healthy enough to work), but weren't hired to do so, thus limiting their exposure. We plan to recruit from a master list that incorporates training and badging information (e.g., the NIOSH roster, PEC training lists, Coast Guard deployment logs, etc.) to identify workers who were trained to participate but may or may not have been engaged in clean-up activities ("exposed" and "unexposed," respectively). Since everyone in the spill area was required to have a badge, and completion of a basic training module was required to receive a badge, volunteers should have also completed one or more training modules before engaging in clean-up activities. Others who worked but were not trained through the PEC will also be eligible. This includes workers whose training was separately administered through Parish organizations and individuals who might not have completed required training modules for language or other reasons (e.g. crew on Vessels of Opportunity whose captains, only, received formal worker training).

While exposed and unexposed individuals will be recruited during the same enrollment period, if we aren't able to find suitable non-exposed individuals from this master list, we will seek matched controls in the community through references provided by the participants themselves, individuals from the BP claims databases, or other community selection techniques such as random digit dialing. This may involve more time than identification of controls from the clean-up training lists. We have planned for these activities to occur in the later months of recruitment so that we can focus on enrolling exposed workers first.

We will actively enroll any individual, 21 years or older who is on a worker or volunteer list describing any potential contact with oil and dispersants, regardless of their gender, racial and ethnic background, or pregnancy status. Approximately 19% of the 44,000 workers enumerated by NIOSH were women. Although we do not anticipate a large pregnant population, there may be individuals who were not aware that they were pregnant or who otherwise engaged in clean-up related activities despite knowing that they were pregnant and who may be recruited into the study.

2.2.2 Rationale for Exclusions

Participant selection and rationale for eligibility criteria have been described in detail in Section 2.2 - Eligibility Criteria. Enrollment is open to adults of all racial and ethnic background. Children will not be enrolled because they were not allowed to participate in clean-up activities. Study activities present minimal risk to pregnant women. Therefore, pregnant women will be allowed to enroll in the study, and women who become pregnant during the study will not be withdrawn.

Those who were deemed medically ineligible to participate in clean-up activities because of pre-existing conditions are excluded because they won't be representative of those individuals who were engaged in clean-up activities.

2.3 Recruitment

2.3.1 Recruitment Database

The cohort will be recruited over a 12-24 month period, starting in March 2011 with the baseline home visits completed within 26 months and will initially be followed annually for at least 10 years. (We anticipate that the cohort will be followed for up to 20 years to extract the maximum information from a study with a prospective design). Potential participants will be identified from the existing NIOSH Voluntary Worker Roster (N~55,000) which is being shared with the National Institute of Environmental Health Sciences (NIEHS) through a Data Transfer Agreement. The NIOSH roster is believed to contain a majority of the workers who engaged in clean-up activities, but is known to have left out workers who were on the job early, workers trained through special arrangements or certified as having been trained prior to the spill, and other potentially important worker groups. We have reached an agreement with BP for access to the larger Petroleum Education Council (PEC) list of individuals who completed one or more safety training modules (N≈110,000) and will seek similar agreement to obtain other known lists of individuals involved in clean-up activities (e.g., parish responder lists, BP contractor payroll, and lists of Federal workers and contractors deployed to, or otherwise engaged in, on-site clean-up activities in, the Gulf, including the Coast Guard, OSHA, NIOSH, NOAA, EPA, Fish and Wildlife Service, US Geologic Survey, National Guard, etc.). Because the NIOSH roster was developed in connection with worker training, it is expected that most, if not all, names from the roster will be included on the PEC list. Some, but not necessarily all, of those identified through Federal worker lists will also appear on the PEC list. Some workers trained through Parish organizations and crew members on Vessels of Opportunity are not expected to be found on the PEC list. Thus as many as 130,000 may be enumerated through all lists combined. The PEC list may include some duplicate names as a few workers were required to complete additional training modules at a later date as workplace hazards were identified. Some of these lists, such as those of employees of Federal agencies/institutions, will contain mostly, if not entirely, persons involved in clean-up operations; other lists, such as the PEC list, will include a substantial proportion of persons who did not participate in clean-up (but may have taken the safety training in anticipation of doing so) and can be identified only at the time of the telephone interview. We will work as quickly and efficiently as possible with collaborating partners and other federal agencies in obtaining access to these lists. Time is of the essence because we wish to interview clean-up workers and collect biologic and environmental samples during clean-up activities or as shortly thereafter as possible. This is necessary because biologic indicators of exposure dissipate with time and individual's recall of their activities also diminishes. In addition, it is important to enroll subjects into the study before they move, change phone numbers, or otherwise become lost to follow-up. Getting into the field as soon as possible is also essential to maintain the goodwill of the affected communities, which will profoundly affect the enthusiasm, support, and cooperation they show towards this study.

These databases will be merged into a master recruitment file to identify and remove duplicates. We expect a total of about 130,000 names from the PEC list and other worker lists combined, which we are assuming will be reduced to about 90,000 after eliminating duplicate names and, if possible, those who completed training only to obtain access to the spill site, with no intention of engaging in clean-up work (e.g. reporters, government visitors, etc.). Where possible, we will infer potential exposure through the training the individuals obtained, their reported or anticipated activities (collected on the

NIOSH roster), and/or location in which they reported for work. However, we may not be able to definitively confirm oil spill clean-up related activities until we interview the participant and ascertain the types of activities that they performed. Thus, initial exposure characterization will involve a two-stage process where a participant is flagged for potentially being exposed/non-exposed which may later be modified based on information from the telephone enrollment questionnaire will include a series of questions which will ascertain exposure. Exposure classification for enrollment purposes into the Active Follow-up Sub-cohort will be based on the participant's answers to these exposure questions. We will try to identify and prioritize enrollment of individuals with likely exposures so that we can better characterize their exposures, but given the limitation of not knowing a participant's true exposure status prior to their interview, we will most likely be enrolling exposed participants and unexposed controls at a comparable rate.

2.4 Community and Scientific Outreach

The goal of the community outreach efforts is to fully apprise the community of study activities, to ensure community collaboration and support in all aspects of the study including design, implementation, evaluation, translation, and to disseminate findings and results. Close and ongoing community engagement is expected to enhance the scientific validity of the study, make it more broadly relevant from a public health perspective, and expand its benefits to the affected communities.

2.4.1 Meetings with potentially affected groups

We have already established contacts and are continuing to solicit new contacts with several community organizations, representative worker organizations, advocacy groups, and state and local government representatives to identify the primary health issues of concern locally and to discuss study implementation issues across the four state area.

We have conducted a series of meetings with state and local health department representatives as well as with the NGOs that span the various advocacy and occupational groups representing the workers involved in clean-up throughout the Gulf. We met with groups in Mississippi and Alabama during the week of September 12, 2010; Florida the week of September 19, 2010; and Louisiana during the week of October 3, 2010. Other meetings are ongoing.

The groups we have contacted span cultural, religious, occupational, and state and local government sectors and are continuously updated as more information and contacts are made (current as of 10/22/2010). These groups serve as important links into the community and can act as an informal Community Advisory Board for study protocol issues and concerns for study investigators until a more formal Board can be established. The groups listed below the groups that we have identified and established contact with:

- Advocates for Environmental Human Rights
- Alabama State Health Department
- Alliance Institute

- Asian Americans for Change, Mississippi
- Bayou Grace Community Services
- Bayou Interfaith Shared Community Organizing (BISCO)
- Boat People SOS (BPSOS)
- Coastal Family Health Center
- Commercial Fisherman of America
- Deep South Center for Environmental Justice
- Gulf Coast Fund for Community Renewal and Ecological Health (GCF)
- Gulf Restoration Network
- Interfaith Disaster Network
- Isle de Jean Charles Band of the Biloxi Chitimacha
- Local chambers of commerce
- Louisiana Bayoukeeper
- Louisiana Bucket Brigade
- Louisiana Department of Health and Hospitals, Region 1
- Louisiana Department of Health and Hospitals, Region 3
- Louisiana Disaster Recovery Foundation, Oil Spill Recovery Policy & Advocacy Initiative
- Louisiana Justice Institute
- Louisiana Oystermen Association
- Louisiana Shrimp Association
- Mary Queen of Vietnam Community Development Corporation (MQVN CDC)
- Mississippi Center for Justice
- Mississippi Commission on Volunteer Service
- Mississippi Gulf Coast Community College
- Mobile BayKeeper
- Moving Forward Gulf Coast, Inc.
- Parish Presidents
- South Bay Communities Alliance, Inc.
- SeaGrant Programs in LA, MS and AL
- St. Bernard Project
- Steps Coalition
- The Village/El Pueblo
- Tri-Coastal Community Outreach
- Turkey Creek Community Initiatives
- United Commercial Fisherman Association of Louisiana
- United Houma Nation
- Vietnamese American Young Leaders Association of New Orleans
- Vietnamese Martyr's Church
- Zion Travelers Cooperative Center

The meetings conducted to date with state and local health department and community group representatives have already led to several improvements in questionnaire development and study design. For example, the questionnaire has been revised to:

- Better define labor categories;
- Better characterize definitions of exposure;
- Improve the ability with which the workers can recall key dates in their work history; and
- Include questions about the symptoms that are of the greatest concern to the workers so that prevalence rates can be reported to the community.

Additionally, these meetings have allowed us to expand the resources included in the health referral network and enabled us to better tailor messages to participants about the study's purpose and the importance of their participation. They have also provided us with a better understanding of the barriers in recruitment and enrollment and how to use community-based strategies to avoid these barriers.
As we further extend community outreach efforts, we will identify Community Outreach Coordinators to organize and implement outreach activities in each of the Gulf States who will:

- Help to build strong relationships with NGOs representing the worker and volunteer populations across the four Gulf Coast States.
- Augment an advertising campaign (as described in Section 3.4.3) with grass-roots promotional activities including local media placement (church bulletins, community newspapers, etc) and community presentations.
- Assist in recruitment of special populations as needed.

In addition to the continuing efforts with public health and community group representatives, we have been conducting outreach in the following ways:

Webinars. NIEHS hosted a 90-minute webinar with local researchers, community organizations and others interested in the GuLF STUDY on August 17, 2010 and a two-hour Webinar on September 15, 2010. The purpose of the webinars was to announce publicly the plans for the GuLF STUDY and obtain feedback on study design and implementation from interested stakeholders. Prior to the webinar, NIEHS distributed a draft GuLF STUDY Concept document and a Key Points document. Each webinar was well attended by over 100 participants and we have received multiple offers from community organizations to provide assistance for the study. Suggestions made during and after the webinar have been incorporated into the study design. Additional webinars are planned at future dates to be determined to continue information exchange and dialog.

Phone briefing. As a follow-up to the first webinar and next step in the community outreach efforts, we will invite key stakeholder groups, such as from the list above to a follow-up phone briefing. The purpose of the phone briefing is to meet individually with each stakeholder group to review the study aims and implementation, answer any question or concerns about the study, establish a dialog with stakeholders, and begin discussions on the primary health issues of concern for their constituents. Approximately 10-15 phone briefings will be conducted each lasting up to 30 minutes. At the end of the call, we will document any action items and discuss plans for future meetings in person.

In-person meetings. As a follow-up to the phone briefings, we will travel to the four Gulf States to meet in person with the community stakeholder groups. During the in-person sessions, we will request to meet both with organizational leadership in addition to their constituents. The purpose of these meetings is to further build strong community ties and gather information to finalize the study design. Due to the short timeline to study

launch we will immediately conduct informal discussions with leadership and listening sessions with their constituents. The topics of these discussions are expected to broadly include possible barriers to study implementation, resolutions to those barriers and the best methods to communicate with study participants and publicize the study.

HRSA and State Health Department meetings. Meetings were conducted with State and local Health Department representatives beginning the second week in September, 2010, including a combined meeting of leadership from Health Service Regions covering the Gulf States on September 9-10, 2010. These meetings were intended to inform state and local leadership about study plans and to obtain input into study design and implementation. A specific focus of these meetings was to develop strategies for community based health and mental health referrals for participants identified as needing follow-up medical care (e.g. for follow-up of elevated blood pressure, or glucosuria) or identified as having unmet mental health or social service needs. While the GuLF STUDY is not designed to provide medical care to its participants, we will work closely with local health officials to provide the appropriate referral information to participants identified as having unmet medical and/or mental health needs.

Dockside Chats. Study staff joined the Unified Command in several Dockside chats with workers during the week of August 22, 2010. These informal sessions provided insight into some of the health and community concerns of workers from the affected region.

2.4.2 Community Advisory Group

A Community Advisory Group will be created to provide continued advice on the study and outreach efforts. The group will consist of up to 15 members representing communities as well as organizations representing worker groups from all four states as well as various occupational groups and is expected to engage in the following activities:

- Facilitate dialogue between community members and the study team
- Identify effective communication strategies and vehicles tailored to the communities' needs
- Assist in the dissemination of study related information locally and regionally
- Host community neighborhood meetings
- Proactively identify issues of concern with study implementation and options for resolutions
- Retain participants in the study over time

A Community Advisory Group chair will be carefully selected from among its members and will work in close collaboration with the study investigators. The Community Advisory Group will meet regularly throughout the entire study duration. Meetings are expected to occur more frequently during study planning and initiation and then less frequently in the out years of the study.

2.4.3 Communicating the Study to the Community

Communication of the study activities to oil spill clean-up workers and affected communities is essential. Many of these efforts will involve communications through community leaders directly to their constituents, some will involve targeted outreach by

the study and NIEHS, and other efforts will involve media-based outreach. Typically, it takes multiple points of contact to build study credibility and motivate an individual to participate in a health study, particularly a longitudinal health study. Although we will be working from a known population of oil spill clean-up workers, media-based efforts will afford the study legitimacy in an environment fraught with competing Katrina-focused studies, distrust of the government, and scientific complexity. Additionally, media-based outreach in conjunction with more direct-to-worker outreach will allow for the ability to reach a larger number of individuals in a very short time frame. The Community Advisory Group will be crucial in designing this process and enhancing its effectiveness.

Brochure. A study brochure (Appendix G) will be developed in English, Spanish and Vietnamese. The purpose of the brochure is to introduce the study and provide contact information though the hotline and website. The brochure will be sent with the lead letter inviting study participants during enrollment but may also serve a variety of other purposes for community outreach.

Hotline. We will establish a toll free hotline for the study. During enrollment, the hotline will be used for workers to return a call to participate in the study. A call center representative will answer the hotline during call center hours of operation, i.e. from 9 AM to 9 PM, Monday through Saturday and from 12 noon to 6 PM on Sundays. It will roll to an answering machine after hours with all calls to potential participants returned the following day. Call center hours will be determined based on input from the community groups as to what would be acceptable.

Internet. We will maintain a website to provide information about the study. The website will be updated regularly with details on recruitment efforts, study findings, and links to other organizations and information resources. Additionally, we will seek to have each of our community partners have a link on their website to the study website. We will also explore the possibility of using Web 2.0 resources such as Facebook and Twitter if we can be assured that participant confidentiality can be maintained and there are sufficient numbers of individuals within our study population and community who would be using these sites.

Advertising. Additional forms of media-based advertising will be determined in collaboration with key stakeholder groups. Based on preliminary conversations with various community groups, we anticipate utilizing media-based advertising to both increase awareness and credibility of the study as well as motivate participation. Radio may provide a good medium for communicating the study to certain segments of the population while outdoor advertising may appeal better to other segments. Whenever feasible, we will capitalize on opportunities to collaborate with community partners on radio or TV show interviews, local newspaper articles, and other media as a form of generating awareness and credibility for the study. Media outlets that have been suggested by community members thus far include:

- Radio stations: Q93, 98.5, 102.9, 106.7 (New Orleans, LA)
- Newspapers: Sun Herald, Mobile Press Register
- Television: WLOX, WDSU, WGNO

As a first step in developing a media campaign, we will enlist the support of a public relations/communications firm with an understanding of the various communities along the Gulf Coast in the post-Katrina era and experience using print, electronic and broadcast media to recruit for public health studies. To develop culturally competent materials, this firm will develop key messages for different segments of the worker and

volunteer populations and a communications plan to disseminate these messages. Prototype materials will be submitted for IRB review once they are developed along with details regarding the implementation of the communications campaign when the plan is determined at a later date.

Text Messaging. An additional recruitment tool may include the use of text messaging. We will pilot test a "Make the Call" campaign targeting ~250 individuals who have not responded to recruitment mailings or calls. The plan complies with federal regulations regarding text messaging solicitation in that participants must first opt-in to receive future text messages. After an initial opt-in text, participants will receive no further texts unless they choose to opt-in. Participants who opt-in will receive a series of text messages at a rate of one per week that encourage participants to call the study hotline to enroll. If the pilot effort is successful in increasing enrollment, we will extend the effort to others who have been difficult to reach.

2.4.4 Scientific Outreach

The Webinars specifically targeted members of the scientific community, including researchers from local universities, NIEHS grantees, and researchers with past experience studying communities involved in other environmental disasters such as the World Trade Center cohort. The study concept was reviewed by the National Institutes of Health (NIH) Institutes and Centers Directors at a regularly scheduled meeting. An early draft of the protocol outline was reviewed at a meeting August 12, 2010 with NIOSH and CDC. The proposal was discussed August 19, 2010 at a meeting of multiple federal agencies involved in some aspect of the Oil Spill response. Suggestions received during those meetings have been incorporated into the current protocol draft. The proposed study builds on ideas generated during a scientific meeting hosted by the Institute of Medicine (IOM) on June 22, 2010. In addition to undergoing scientific peer-review prior to submission of the study for NIEHS IRB review, the study received additional review by an IOM panel at a meeting held in Tampa, FL on September 22, 2010. Additionally, presentations of the study design have been (and will continue to be) made to a number of Federal panels and committees (e.g., Association of State and Territorial Healthcare Officials (ASTHO) and National Association of County and City Health Officials (NACCHO)). *The IOM is expected to provide ongoing scientific oversight. Oversight will also be provided (see below) by a Scientific Advisory Board appointed by the Chair of the NIEHS Board of Scientific Counselors, operating as a subcommittee of that Board.*

2.5 Enrollment Procedures and Enrollment Questionnaire

Initial contact with participants will be through a mailing which includes: 1) a one-page lead letter (Appendix F); 2) a study brochure (Appendix G); and 3) a privacy statement. The study brochure will briefly outline the study purpose, study benefits, study sponsorship, contractor name, what will be asked of the participant, compensation if they participate, confidentiality assurance, importance of their participation, and contact information (contact names, toll-free telephone number, and web site address) if they would like more information. Both the lead letter and the study brochure will contain instructions together with the toll-free telephone number for opting out of being contacted about participating in the study. Every attempt will be made to have the lead letter have

the same message in English and either Spanish or Vietnamese, using both the front and back of the page. The lead letter will introduce the enclosed four-color, tri-fold study brochure which will contain instructional graphics and more details of the study. The lead letter and brochure will both point to the website address for additional information.

The telephone contact schedule will be coordinated with the lead letter mailing by parsing the sample into batches and working the mailing and then calling one a batch at a time. Mailing of letters to each batch of names will precede calling by at least two weeks to allow the letter and brochure to be delivered and the potential participant to opt out of the study. The letter envelopes will request USPS to forward mail and to provide us with an address update. Mail returned as undeliverable and with address update notifications will be flagged for tracing.

At least two weeks after the lead letter mailings, the associated telephone numbers will be released to telephone interviewers to commence screening and enrollment dialing and interviewing. Interviewers will discover unusable telephone numbers – fast busy, disconnected, no one by that name, etc. Telephone numbers with outcome codes indicating they are unusable will be flagged for tracing. The telephone number management system will apply calling algorithm rules to each telephone number based on the pattern of interim outcome codes assigned by the interviewers at each dialing (e.g., no more than two calls per day), varied times of day and weekend, weekend only, once-a-day only, wait for a cool down period (initial refusal), scheduled call-backs, soft appointments, etc. The telephone number management system will enforce these rules when delivering telephone numbers to the interviewers. Calls will be conducted from 9 AM to 9 PM (local), Monday through Saturday, and 12 PM to 6 PM (local) on Sunday, if acceptable to the community.

The interviewing staff will include a group of interviewers who are bilingual in English and either Spanish or Vietnamese. We will attempt to identify the primary language of each potential participant in advance of assigning calls to interviewers by considering surname and other information that may be available in the master recruitment dataset (e.g. variable indicating primary language in the NIOSH roster data). Potential participants will be assigned to an interviewer who is fluent in their primary language and English. In some cases, the call assignment process may fail to overcome language barriers between the interviewer and the participant, and the interviewer may be forced to abort the call. If the call is aborted, the interviewer will make notes about the call and attempt to classify the primary language of the potential participant so that the call can be reassigned to the appropriate interviewer.

The entire screening and enrollment telephone call will take approximately 30 minutes to complete. Should the respondent be selected for active follow-up and agree to participate, their contact information and scheduling information will be transmitted to one of 14 regionally distributed clinical field supervisors who will assign the respondent to the most geographically proximate Home Visit Agents (HVA) under their supervision.

Alternative strategies may be employed to enroll potential participants without phone numbers or who cannot be reached by telephone, especially those from populations of special interest such as Vietnamese fishermen involved in the Vessels of Opportunity Program. We will work with community partners to bring such workers to community centers where they may be interviewed by phone or in person or arrange for home visits to complete the enrollment questionnaire (please see section 2.8 for additional details).

In the rare instance of data system technical difficulties that results in interview interruption and in-process data not being saved, the participant will be recontacted and

asked to restart the questionnaire. If they agree, we will provide remuneration in the amount of a $10 gift card.

2.6 Tracing

Tracing will be conducted if we are unable to contact the participant by telephone or reach them through the contact person they named on the NIOSH roster data. Participants who cannot be initially reached with roster information will be flagged and submitted for tracing in monthly batches. Fortunately, we have cell phone numbers (at least for those listed on the NIOSH roster) which should significantly improve our ability to contact participants. However, we are aware that participants may follow regional practices found post Katrina and use “disposable” cell phones only for the time needed. We have projected the need to conduct tracing for as much as 15 percent of the sample and expect that we subsequently will be unsuccessful in tracing 5 percent of this group. Recruitment and tracing efforts will be carried about by different staff members so that the time required for tracing does not disrupt the recruitment process.

Rigorous locating operations will be instituted to reach study participants based on the contact information obtained through the automated batch tracing databases, such as Lexis Nexis Accurint, Telematch, Pension Benefit Information, National Change of Address, and Trans-union as well as InfoUSA and Experian.

2.7 Procedures for Enrolling Cohort Members

Participants will be randomly sampled across categories of job/potential exposure reported during the enrollment interview, with oversampling of categories with higher potential exposures, for invitation to participate in the Active Follow-up Sub-cohort. Additionally, controls will be randomly sampled for invitation to participate in the Active Follow-up Sub-cohort.

Persons who are not randomly selected for inclusion in the Active Follow-up Sub-cohort or who decline to participate in the Active Follow-up Sub-cohort will be enrolled as passively followed members of the full cohort. They will have given verbal consent for completing the telephone interview, providing annual updates on contact information, and having their health and vital status tracked via electronic data. They will include individuals across the range of exposures, including controls. Because this group will include persons not selected into the Active Follow-up Sub-cohort, it will likely be disproportionately weighted towards workers with lower potential exposures to oil-spill related chemicals.

2.7.1 Recruitment and Retention

Effective recruitment is critical to the success of this study yet the nature of the study population, protocol, and the long follow-up period present inherent challenges to recruiting and retention. A multi-faceted approach to participant recruitment and retention will take into account best practices in the participant recruitment literature as well as proven methods utilized in past studies conducted in similar populations.

Participation rates in health studies and surveys have been declining for the last several decades. This general trend serves as backdrop to several specific challenges inherent to this study.

One significant challenge in recruiting and retaining participants will be to address the unique circumstances faced by Gulf Coast families both prior and subsequent to the Deepwater Horizon Oil Spill. Many of the affected communities were already under economic stress because of Hurricane Katrina and the recent recession, which makes it difficult to engage them in research even under the best circumstances. Gulf Coast families are experiencing further environmental, financial, and health-related impacts since the disaster. Recruitment and retention strategies must take into account these day-to-day circumstances and other obligations such as employment, childcare, etc. to mitigate known barriers to participation.

A related challenge will lie in gaining credibility and cooperation from a population that may be wary of research studies conducted by outsiders, particularly government-based studies. It will be important to demonstrate an understanding of the circumstances these individuals face. Recruitment strategies are needed that position the team to capitalize on community outreach efforts as well as efforts to brand the study as something other than “just another government study.” As with all studies, potential participants may be reluctant or unable to spend the time or experience the inconvenience involved in study participation. Recruitment strategies are needed to overcome these sources of reluctance and present the study as beneficial.

After participants are enrolled in the study, maintaining their continued participation over the full follow-up period is critical. Participants will relocate, experience family disruptions such as divorce, death or illness, undergo economic changes, and realize logistical difficulties. Strategies are needed that motivate continued participation and alleviate logistical constraints.

For all of these reasons, this study will develop a comprehensive recruiting and retention plan designed to maximize participation for the entire duration of the study with assistance from the Scientific and Community Advisory Committees, while using study resources efficiently. Although monetary incentives may be necessary, an array of other strategies will be applied to cultivate a sense of loyalty, commitment, and appreciation among study participants and oil-spill communities to the study. We will work closely with state and local officials and local community groups to tailor an approach that will resonate with the local community and foster participation in the study.

2.7.2 Recruitment/Retention Strategies and Approach

Importance. Recruitment interviewers will be trained to convey an appropriate sense of the importance of the research among both exposed and unexposed individuals. This importance relates not only to the oil spill, but also, more generally, to all of the health, environmental, and psychological impacts (e.g., displacement, stress, exposures) associated with disasters, ultimately to support a better understanding of how to respond to such disasters. This will be reinforced throughout the study with communications from health officials and study investigators.

Direct Benefit. The main benefit is pride in having participated in an important public health research effort for their communities. Participants will receive some results from the medical testing. Recruitment approaches will be designed to minimize any potential gap in perceived study benefit between the exposed and unexposed.

Study Identification and Branding. The study will be presented publicly in a manner that appropriately conveys its importance both to participants and to other audiences.

The study website will include information for the public as well as a place for participants to learn more about the study, receive important study information, and allow for the opportunity to email study investigators to schedule visits and update contact information. Scientific publications and results will be posted on the website.

News items and press releases will announce and publicize the study while reflecting local interest group and health department participation. Participants will also receive annual newsletters to keep them informed about the progress of the study.

2.8 Recruitment of Special Populations

Based on data from the NIOSH roster and from reports from the field, we are currently planning to recruit Vietnamese, Spanish, and English speaking participants. Speakers of other languages may be targeted later through special accommodations such as facilitated interviews by a relative or community representative speaking one of these languages or through RFPs (and funded via subcontracts), as described below. Although they may represent a small fraction of the worker population, it may be important to include the Vietnamese and other unique ethnic subpopulations in the Gulf region who may have participated in oil spill clean-up. Based on initial feedback from the community, a multi-modal approach may be needed to ensure sufficient participation amongst these groups that may have had elevated exposure through the Vessels of Opportunity program and other clean-up related activities. Our planned multi-modal recruitment approach would consist of the standard recruitment package of a mailed recruitment letter and study brochure, but also additional community meetings to explain the purpose of the study, opportunities to enroll in-person and/or at a centralized recruitment facility, and other techniques to be developed in conjunction with input from community representatives and state and local health officials. These groups will be included in our pilot effort to provide adequate feedback to the rest of the study.

2.8.1 Special Issues in Recruiting Vietnamese Participants

To address issues around literacy, outreach, and access to the Vietnamese population specifically, we will identify and work with NGOs having connections to, and understanding of, this community. For example, in analysis of data from the NIOSH roster and anecdotal reports from persons in the field it appears that Vietnamese workers are substantially underrepresented on the NIOSH roster and may be similarly underrepresented on the PEC list relative to the general population. This may be due to language / literacy barriers that resulted in Vietnamese workers not receiving the worker training or completing the NIOSH roster. To help identify these workers and suitable controls, and to overcome language and cultural barriers to their participation in this study, we will work closely with community groups, enlisted via RFPs (and funded via subcontracts to the study contractor), that are integrated in the Vietnamese community/communities. These groups include Asian Americans for Change, Boat People SOS, Mary Queen of Vietnam Community Development Corporation, Vietnamese American Young Leaders Association of New Orleans, and Vietnamese Martyr's Church. Many of these community groups, along with Parish governments in Louisiana, have maintained separate lists of clean-up workers from their communities. We will meet with these community groups to explain the purpose of the study, the importance of participation of Vietnamese clean-up workers, the study methods, what will be expected of the participants, and how these groups can help us, and we will attempt to address their concerns.

For groups that agree to assist us in recruitment, we will work with their staff to develop strategies and resources that are both culturally and scientifically appropriate for promoting the study and identifying potential study participants. These groups will be asked not to recruit study participants *per se*, but rather to assist in developing interest and support for the study so that study staff can then approach potential participants in a methodologically rigorous manner. They may be asked to produce and provide to study investigators regularly updated lists of persons who they know or believe to have participated in oil spill clean-up activities, including names, telephone numbers, addresses, and other appropriate contact information (especially for any persons without telephones). They will be requested to provide some basic demographic information and reason for refusal for any workers who indicate that they are unwilling or unable to participate in this study. They will also be asked to provide similar lists of Vietnamese controls who are comparable to the clean-up workers they identify, based on criteria that they will develop together with study investigators. However, it may prove necessary to carry out a parallel supervised process to enroll this group, allowing subcontractors to conduct in-person screening interviews rather than telephone interviews. In that case, we will work with community groups to implement enrollment and data collection directly but provide sufficient oversight to ensure protocol standardization.

To minimize bias in subject selection and data collection, we will attempt to conduct all telephone interviews and in-home visits by study staff in Vietnamese. We will work with community group staff to approach persons who do not have telephones or other individuals recommended by the community group staff who could serve as liaisons. For persons for whom telephone interviews are not appropriate or possible, interviews will be conducted in-person, either at the subject's home or at another suitable location. While we will make every effort to provide Vietnamese-speaking phlebotomists/interviewers, it may be necessary in some cases to provide a trained Vietnamese translator with English-speaking phlebotomists/interviewers. In order to ensure full enumeration of the potential cohort, participants and those who decline to participate will be asked to provide names and contact information of any other Vietnamese clean-up workers they may know. In order to facilitate engagement, commitment, and valid data collection within this community, we will take the necessary steps to maintain as much transparency as possible including inviting community stakeholder groups to the interviewer training sessions and inviting them to assist in developing the training materials to ensure cultural competency among the study staff. We will review these procedures on an ongoing basis and modify them as needed to achieve the dual goals of enumerating as fully as possible the workers and suitable controls in this community, and recruiting and interviewing them in a scientifically rigorous manner.

2.8.2 Special Issues in Recruiting Creole-Speaking Persons

Anecdotal reports indicate that Creole-speaking persons in the Gulf have also been involved in clean-up activities. These persons are likely to be substantially underrepresented on the NIOSH, PEC, and other worker training lists because most of these trainings have been conducted only in English, Spanish, and Vietnamese. We have no information on how many such workers there were nor on what types of clean-up activities did they engage in. To fill in these critical information gaps, we will issue RFPs to local community groups to help us enumerate these population(s) that may be under-represented in other worker lists. If we determine through these means that there are sufficient numbers of potentially exposed workers in this population, we will work with community stakeholder groups to promote the study and help recruit the workers

and appropriate controls from this population in a similar manner to that described above for the Vietnamese.

2.8.3 Special Issues in Recruiting Women

Women will be recruited into the cohort by the same eligibility and selection criteria as men. However, some additional sex-specific questions, focusing on menopausal status, reproductive history, and pregnancy status, will be included in the enrollment questionnaire. Potential sub-studies of women will be considered later, based on the number of women, their exposure profiles, and the numbers of outcomes of interest.

2.8.4 Special Issues in Persons with Reactive Airways Disease

We may consider focused sub-studies among persons identified with, or suspected to have, reactive airways disease at enrollment. The timing and nature of these sub-studies will depend on the number of such persons identified during enrollment and will be described in more detail at a later date.

2.8.5 Other Special Populations

Other subgroups may be identified for add-on studies of **focused** hypotheses related to **specific** exposures or health outcomes. These studies may be initiated by us or by extramural collaborators. Participants will be informed that such **add-on** studies may be possible and that separate informed consent to participate will be obtained.

2.9 Home Visit

Participants selected for the Active Follow-up Sub-cohort will be scheduled for an in-home visit by a field staff member (i.e., a home visit agent or HVA). We will ensure that Home Visit Assistants (HVAs) hired for this study have the necessary education, qualifications and experience to conduct the required home visit activities, or we will provide additional training as needed. We currently plan to hire qualified staff of Certified Medical Assistants (CMAs) who can do both phlebotomy and interviewing. During our initial contact with the participant, we will note their ethnic status and, if they are selected for participation in the Active Follow-up sub-cohort, do our best to match them with a field interviewer of the same ethnicity, though this may not always be possible. Whenever possible, the staff will be hired from within the local communities so they should be familiar with local norms.

Home visits will be scheduled seven days a week between the hours of 8 AM and 9 PM local time. Sunday visits will not be scheduled in communities for which this is considered socially unacceptable. We anticipate that the home visit will take 2-3 hours to complete. By going to participants' homes to complete data collection for the Active sub-cohort rather than requiring that they make their own arrangements for specimen collection or visit a central location, we minimize their burden for study participation while maximizing the likelihood that we will be able to collect the desired study data, biospecimens, and environmental samples.

During the home visit, the HVA will administer informed consent (Appendix D). Should the participant be unable to read, the HVA will read the informed consent verbatim to the participant in front of a witness to ensure the participant understands all aspects of the study. The HVA will return the signed consent document to the study office by overnight carrier. Present plans are for biospecimens and environmental samples to be sent by priority overnight carrier to the central processing laboratory (CPL) for additional processing and storage. Because commercial carriers do not operate on Sundays, we are investigating use of specialty couriers that can make these off-hour pick-ups and deliveries, but typically at a premium price. We are currently exploring options for batching Sunday collections or having samples delivered to a central site for shipping to minimize specialty courier costs.

In field studies, occasionally crucial samples are lost or accidentally destroyed after collection. Some reasons for this include (but are not limited to):

- Specimens are damaged during or after the visit due to breakage or equipment failure;
- Specimens are lost or delayed by overnight carriers during shipment;
- Specimens are damaged or lost/mislabeled during processing in the Central Processing Laboratory;
- Or for other not yet anticipated reasons.

In the rare instances when such losses occur, study staff, with the concurrence of study managers, will ask the participant if they are willing to provide replacement samples. If they agree, we will provide a further token of appreciation in the amount of a $20 gift card.

2.9.1 Advance Study Packet

In advance of the home visits, we will assemble and mail to each participant a home visit kit containing the following materials needed to conduct the visit:

- Appointment cover letter (Appendix R);
- Home visit preparation instruction sheet (Appendix S and Appendix T);
- FAQs (Appendix H);
- Informed consent form for the participant to review in advance (Appendix D);
- Informed consent quick reference guide (Appendix E)
- Urine collection container and lid along with detailed instructions for collecting a first morning void (FMV);
- ID labels for participant -specific documents and specimens/samples.

The HVA will bring all other materials needed for the home visit.

2.9.2 In-Home Visit

At the beginning of the visit, the HVA will obtain informed consent prior to conducting any study procedures. Additional details concerning the informed consent procedure can be found in Section 10.2. After consent is obtained, the HVA will ask if the participant wants abnormal test results for clinical and laboratory assessments conducted at the time of baseline visit reported to their health care provider and obtain contact information for that provider. The HVA will collect physiologic and anthropometric measures; biological specimens (e.g., blood, hair, toenail, and urine); environmental samples (e.g.

house dust); and administer a baseline questionnaire. The HVA will also determine and record the latitude and longitude of the home using a handheld Global Positioning System (GPS) device; this information will be used in later Geographic Information System (GIS)-based studies to determine residential proximity to sites of potentially relevant environmental exposures, such as petroleum refineries and toxic waste dumps and incinerators. If a subject is interviewed away from the home, their residential address will be collected (along with nearest cross-street and landmarks) so that it can be more accurately geocoded using existing software geocoding tools; this will also be done for previous addresses as indicated in the subjects residential history. Table 1 provides an overview and approximate timeline of the home visit activities.

Table 1. Home Visit Overview

Activity	Estimated Time	Notes
Interview is assigned to HVA, and HVA calls participant to schedule in-home visit	N/A	Scheduled at least 3-5 days in advance. Provide toll free number and website to reschedule if necessary
Mail Home Visit Kit	N/A	Packet arrives 3-5 days in advance of scheduled home visit
First morning void urine collection*	N/A	Collected by the participant using urine collection kit provided
Arrival, greeting and set-up	5 minutes	
Informed consent	15 minutes	Review and obtain informed consent
Anthropometric / Physiologic measures collection	20 minutes	Ht, Wt, BP, Waist and Hip Circumference, Spirometry
Biological specimen collection and labeling	20 minutes	Hair, Blood^{+}, Toenail Clippings
Questionnaire measures collection	60 minutes	
Environmental sample collection and labeling	10 minutes	Dust collection

Activity	Estimated Time	Notes
Biological specimen processing and labeling	10 minutes†	
Urine dipstick analysis for glucosuria and writing of report	5 minutes	
Debriefing of blood pressure, pulmonary function, urinary glucose and BMI results report to the participant	10 minutes	
Clean-up and packing	10 minutes	
Departure	**Total time:** 2 hours, 45 minutes	
Post-visit processing		Shipping and data back-up

** If first morning void collection has not been obtained when the study staff arrive, the HVA will request that the participant provide a random or "spot" urine during the home visit instead.*
† Blood will be allowed to clot for at least 30 minutes while the baseline questionnaire is being administered to the study participant and will be centrifuged for 15 minutes following the questionnaire administration (and during the environmental sample collection) in order to minimize the biospecimen processing time and overall time spent in the home during this visit.
+If toenail specimens cannot be collected during the visit, the participant will receive toenail collection instructions and a prepaid self-addressed envelope to ship the toenails separately.

2.9.3 Baseline Questionnaire

The baseline questionnaire elicits information not included in the enrollment questionnaire, including more detailed information on residential and occupational history, personal and family medical history, alcohol and tobacco consumption, mental health and anxiety, and recent eating and drinking and use of medications.

Before designing the questionnaires, study investigators referred to questionnaires used by other data collection efforts occurring in the Gulf States, regionally, and nationally in order to facilitate regional and national comparisons and potential cross-study analyses. National studies such as the National Health and Nutrition Examination Survey (NHANES), Behavioral Risk Factor Surveillance System (BRFSS), and National Survey on Drug Use and Health (NSDUH) were used. We also referred to measures provided in the PhenX Toolkit in developing some sections of the questionnaire. We substituted sections from other questionnaires when we found something that appeared to work better or to better capture our study interests.

Detailed information on oil spill clean-up related activities in the enrollment telephone questionnaire completed by all participants; Questions collected at baseline during the home visit include: residential history; personal and family medical history; occupational

history; reproductive history; history of military service; demographic and socioeconomic factors; alcohol consumption; mental health status; a neurocognitive screener; and other information, including hobbies, sleep patterns, tobacco use and environmental tobacco smoke exposure, and consumption of seafood from the Gulf of Mexico. Occupational histories will enable us to identify, and infer relevant exposures from, occupations such as employment in the petrochemical industry and commercial fishing. Separate questionnaire modules will be developed and administered to subgroups reporting prior employment in the petrochemical industry and prior experience in hazard remediation, including other oil spills or other substances such as lead or asbestos. Residential histories, together with Geographic Information Systems, will help us to infer potentially relevant environmental exposures from sites such as petroleum refineries and toxic waste dumps and incinerators. Additionally, hobbies and use and storage location of gasoline can be important indicators of non-occupational exposures. This exposure information will be incorporated into analyses of health outcomes related to the clean-up work. Information on history of military service will identify persons who may have pre-spill serum samples and medical data available through the Department of Defense Serum Repository and health care system and identify workers with potentially confounding military exposures. Although the interview asks for identifying information from the participant to facilitate follow-up and future linkage with external databases for GIS-based studies, the computer-assisted interview will be programmed to create a separate data file for identifying information in order to maintain a secure data system.

In developing our questions on environmental and occupational exposures, we first considered the chemicals that have been identified in the crude oil and also in the dispersants as identified by the National Toxicology Program (NTP). By linking to various national databases, we will be able to identify the potential toxicity of these agents. We also considered the frequency with which participants were engaged in oil-spill clean-up related activities and their past occupational and recreational exposures to these agents.

2.9.4 Anthropometric/Physiological Measures

The HVA will weigh (kg) participants and measure height (m), hip and waist circumference (cm), and take the participant's heart rate and blood pressure. Height (m) and weight (kg) will be measured using a metal tape measure and digital scale using standard methods from the NHANES IV national survey. All measurements will be taken three times. If a person is unable to stand, we will measure waist circumference and sitting height using the crown to rump method with a cloth tape measure, but we will not measure their weight. Instead, we will collect their self-reported weight). We will use a cloth tape measure to collect waist circumference. We will provide participants with a report of their anthropometric measures during the field visit. To reduce the amount of equipment needed and facilitate training and scheduling, we plan to perform pulmonary function testing during the home visit on members of the Active Follow-up Sub-cohort who live within the immediately affected areas, which represents approximately 75% of the members of this cohort.

2.9.4.1 Heart Rate and Blood Pressure Measurement

Three blood pressure and heart rate measurements will be collected by trained study staff. Heart rate will always be measured prior to respiratory testing. Blood pressure will be measured three times using standard clinical oscillometric (not mercury-based) equipment and these results will be provided to the participant at the home visit along with information regarding what these blood pressure results mean using a form similar

to that being used in the NIEHS Sister Study. Seated heart rate and blood pressure will be taken three times in rapid succession after a 5 minute rest period and the second and third readings will generally be used to calculate average values for analysis and reporting.

2.9.4.2 Pulmonary Function Testing

Pulmonary function testing (PFT) will consist of spirometry data collection. All PFT will be conducted using American Thoracic Society/European Respiratory Society (ATS/ERS) guidelines [Pellegrino, et al. 2005].

The PFT will be performed using a portable, ultrasound transit-time based spirometer (EasyOn; NDD Medical Technologies, Chelmsford MA, USA, or a comparable model). A full Forced Vital Capacity maneuver will be used. We will obtain three ATS acceptable forced expiratory maneuvers out of a maximum of eight attempts. All spirometry examinations will be done with the person seated and wearing a disposable nose clip. We will use new individually packaged, disposable mouthpieces for each subject and a new spacer for each subject.

Combined with the symptom and medical history information, this objective measure of respiratory status will allow for an assessment of obstructive lung disease. By detecting these small changes in pulmonary function in the population as a whole, we will be able to make comparisons to other environmental exposures including air pollution and environmental tobacco smoke in order to assess the potential severity of their disease.

To the extent possible, we will ask participants to withhold their asthma inhalers on the day of the examination (a commonly used protocol). For those participants unwilling or unable to withhold medications, we will document this during the home visit. For all participants, we will record the timing and dosage of all asthma medications over the preceding seven days.

To ensure quality results, we will conduct formal training and recertification on all field procedures. The HVA will be required to take a NIOSH-approved spirometry course, which is a well recognized training among medical professionals. In addition, all HVAs will complete the online exam and submit 10 practice tests administered by a certified spirometry expert. All spirometers will undergo standard quality checks before use in the field. To ensure high quality control and HVA feedback, we will use reviewing software similar to the one recently developed specifically for the EasyOn spirometer by Hankinson Consulting, Inc (Athens, GA). An expert in pulmonary function quality control will review all tracings on a weekly basis and override any software-provided readings if needed. The quality scores and other results will be electronically forwarded to field coordinators who will feed the quality information to the HVAs. If an unexpected number of unacceptable tracings occur, the HVA in question will be retrained.

Participants who answer yes to any of the following questions will not undergo spirometry during the visit:

- In the past three months, have you had any surgery to your chest or abdomen?
- In the past three months, have you had a heart attack or stroke?
- In the past three months, have you had a detached retina or have you had eye surgery?
- In the past three months, have you been hospitalized for any other heart problem?

- Are you pregnant?
- Are you currently taking medication for tuberculosis?

Our exclusion questions include those used in BOLD [Buist, et al. 2007] and PLATINO [Menezes, et al. 2005], multinational studies that enrolled over 14,000 adults over age 40 years for pre and post bronchodilator spirometry with only trained technicians. No adverse events occurred in either the BOLD or PLATINO studies. These exclusions are considered very conservative and these questions are not generally asked before spirometry is done in clinical practice. Note that exclusions for having a resting heart rate > 120 bpm is included.

Figure 1. Example of EasyOn Spirometer and Disposable Mouthpiece

2.9.4.3 Glucosuria Testing

During the in-home visit, a small amount of the urine collected from each participant (described in section 2.9.5 below) will be transferred to a sterile cup. A commercially available dipstick will then be used by the trained study staff to measure the urinary glucose level. The result will be provided to the participant at the home visit, along with information regarding the meaning of the result, using the form in Appendix L.

2.9.5 Collection of Biological Samples

Biological specimens will be collected from participants in their homes by a trained HVA. The HVA will draw blood, retrieve urine specimens, and direct the participant to collect hair and nail samples. The following specimens will be collected:

- **Blood samples**: The HVA will collect 52.5 mL of venous blood into eight Vacutainer tubes:
  - *Lavender Top EDTA Tubes*: Three purple-topped tubes will be collected:
    - One 10 mL and one 6 mL tube will provide plasma, buffy coat, and red blood cells (RBCs) for future analyses.
    - One 2 mL tube will either be 1) analyzed for CBC with WBC differentials upon arrival in the central laboratory for persons tagged to be recruited for

the Biomedical Surveillance Sub-cohort (N=6,250) or 2) aliquotted and stored as whole blood for future analyses for the rest of the Active Follow-up Sub-cohort.

- *Royal Blue Top EDTA Tube*: One 6 mL trace metals tube will frozen for future selected measurement of antimony, arsenic, cadmium, calcium, chromium, copper, iron, lead, magnesium, manganese, mercury, selenium, and/or zinc (i.e., all of the metals for which these trace metal tubes have been validated).
- *Red Top Serum Tube*: Two 10 mL tubes with no additives will provide serum and clots, which will be frozen for future analyses.
- *Yellow Top ACD-B Tube*: One 6 mL tube with Acid/Citrate/Dextrose Solution B tube will be collected from each participant for future analyses. How the specimen is processed will depend on whether the participant is a member of the Biomedical Surveillance Sub-cohort, as described below.
- *PAXgene RNA Tube*: One 2.5 mL PAXgene blood RNA tube will provide stabilized whole blood for mRNA isolation for future analyses.

In the rare event that a partial blood tube is collected due to a temporary interruption of the blood collection procedure, we will retain the partially filled tube.

- **Urine**: Each participant will be asked to collect a first morning void (FMV) urine sample on the day of the scheduled visit in the collection container from the Home Visit Kit. If an FMV was not collected, the HVA will ask the participant to provide a “spot” urine. A small amount of the specimen will be transferred to a sterile cup during the home visit and used to measure glucose levels with a commercially available dipstick. Another portion will used for a more complete basic chemistry urinalysis (by dipstick) upon arrival in the central laboratory to measure protein, glucose, and several other parameters among persons tagged to be part of the Biomedical Surveillance Sub-cohort. The remainder of the urine sample will be processed in the Central Processing Laboratory for storage as described in Section 2.11 and as illustrated in Appendix C2.
- **Toenails**: The HVA will ask each participant to collect toenail clippings from each toe unless they have a medical or physical condition (e.g., diabetes) that would prohibit collection. Toenail clippings will be stored as described in Section 2.11 for future analysis of metals. Participants will be advised in advance of the visit not to clip their toenails before the visit. If toenail specimens cannot be collected during the visit, the participant will receive toenail collection instructions and a prepaid self-addressed envelope to ship the toenails separately.
- **Hair**: Each participant will be ask to collect a small hair sample as close to their scalp as possible. Hair will be clipped to indicate which end is closest to the scalp and stored as described in Section 2.11 for future analysis of metals and cortisol.

Substantial volumes of biospecimens will be required for quality assurance and quality control (QA/QC), cross-sectional surveys, and assay validation over time, but will not directly contribute to addressing the specific aims of this study. To meet this need, we will collect an additional 40 mL urine and four additional tubes of blood, consisting of one 10 mL lavender top, one 6 mL royal blue top, one 10 mL red top, and one 6 mL yellow top (i.e., an additional 32 mL blood) from a 3% random sample of the Biomedical Surveillance Sub-cohort (N=150) and a ~0.7% random sample of the remaining Active Follow-up Sub-cohort (N=150). The extra urine needed (40 mL) will be taken from the sample already collected because participants collect urine in a larger cup and examiners typically pour out excess urine after filling the transport tubes. We will attempt to collect additional QA/QC samples from the group of 150 Biomedical Surveillance Sub-

cohort participants at each subsequent visit in order to have serial samples that will be essential for certain assays.

In total, we will collect these additional QA/QC samples from 300 individuals. These samples will be processed and banked in the same manner as the main study samples. These specimens will be critical when serial samples or samples known to be from the source population are required. For these randomly selected individuals (n=300), an addendum to the consent document detailing this additional biospecimen collection will be administered and they will be remunerated with an extra $10 for these additional samples.

Saliva: All study participants who are unwilling or unable to provide a blood sample during the home visit will subsequently be mailed an Oragene OG-250 DNA Self-Collection kit, together with instructions for using and returning the kit, and a stamped, self-addressed padded envelope for returning the kit to the central processing lab (CPL). The CPL will store these samples as described in Section 2.11 and as illustrated in Appendix C.2.

2.9.6 Home Environment Sampling

The HVA will be trained to collect the following home environmental samples according to detailed sample collection protocols. These samples will provide valuable information about the home environment and enable researchers to better characterize and control for confounding based on residential exposures as opposed to exposure related to clean-up activities.

Household Dust: The HVA will collect a household dust sample using the alcohol wipe collection protocol from the Sister Study. This protocol calls for swiping areas in several rooms that are typically ignored in dusting, such as above door or window frames or the tops of bookshelves. In two Louisiana Parishes, the HVA will also collect a vacuum dust sample collected following the National Children's Study protocol. The HVA will bring a study-provided vacuum cleaner to collect the dust sample. A standardized area will be vacuumed, with dust collected into a special collection device inserted into the vacuum cleaner hose. Collection of both wipe and vacuum samples will allow us to compare levels of specific exposures in dust and wipes and will serve as a pilot study for assessing the confounding impact of molds, dust mites, and other endotoxins and allergens on pulmonary function. The dust sample will be shipped to the CPL along with the biospecimens for further processing and storage as described in Section 2.11 and illustrated in Appendix C.Collecting household dust samples will enable a snapshot view of exposure to potential environmental confounders such as heavy metals, persistent organic pollutants, and (where vacuum samples are collected) endotoxins.

The Biomedical Surveillance Sub-cohort may afford further opportunity to validate the suitability of our proposed approach for rank-ordering exposure levels looking at potential confounders such as persistent organic pollutant levels using alcohol wipes and vacuum samples. We will explore the feasibility of other methods to assess household exposures, including a dipstick test of nitrates in water, and a semi-permeable membrane being developed at the EPA for the detection of volatile compounds.

2.9.7 In-Home Biospecimen Processing and Shipment

After blood collection, the HVA will allow the blood in the serum tubes to clot for 30 minutes before centrifuging the tubes in the participant's home and separating the serum and clot, which will be retained. At the same time, the HVA will centrifuge the 10 mL and 6 mL EDTA tubes, separating and retaining the plasma and the packed cells/buffy coat. The HVA will then package all of the biospecimens and environmental samples for shipment to the CPL. The ACD-B tube and the 2 mL lavender top EDTA tube will be shipped at ambient temperature. The remaining specimens and environmental samples will be shipped cool but not frozen, accompanied by a frozen cold pack. These materials will be shipped by priority overnight service to the central processing laboratory. All biological samples will be shipped according to local, state, and federal requirements governing shipment of biological specimens. In the event that specimens or samples are lost or damaged during shipment, the participant will be offered the opportunity to have specimens recollected, with a small compensation.

2.10 Reports to Participants, Health Care Referrals and Incident Reports

2.10.1 Overview

All HVA personnel will be CMAs with up-to-date CPR certifications. HVAs will receive additional training prior to beginning the study regarding the evaluation and testing procedures, form completion, handling of emergency situations, personal safety, signs of abusive behavior, and appropriate referral strategies for the locality. Prior to any home visits participants will receive information about the study including a brochure (see Appendix N) that lists healthcare providers in their area that can provide health care services, including any that can assist with free or reduced-cost services.

During each home visit, or participant encounter, the HVA will measure BMI, blood pressure, urinary glucose, and spirometry. With the exception of spirometry, which requires a specially trained reader to properly interpret the test results, the HVA will inform participants of their test results at the time of evaluation, as well as any needed actions for identified abnormalities. The HVA will also observe participant behavior in case of any urgent physical or mental health behaviors requiring emergency intervention. Urgent observations or test findings (such as hypertensive crisis, acute mental or physical distress, abusive behavior, etc.) identified at the time of the home visit will be handled immediately as discussed below (Section 2.10.6.1, Follow-up of Urgent/Emergency Situations During In-person Encounter).

In addition to providing the participant with a written summary of test results and recommended actions (Appendix L and M), the HVA will perform the following actions:

- Complete an Incident Report for any acute medical, mental health, or social problems (Appendix J, Baseline Questionnaire, Section N) and report the incident to their RM and the Coordinating Center to inform them of this action. The Project Manager will then immediately notify the NIEHS Principal Investigator of what transpired.
- Enter the results of evaluations and their interpretations provided to participants, and actions taken about abnormal results into the CAPI system (Appendix J, Baseline Questionnaire, Section N).

- Provide referrals for medical and mental health care, as needed, and document referrals (see sample referral handout in Appendix N).

Additionally, all participants will receive a follow-up letter and report within 1 month of the visit that reiterate the evaluation results (i.e. BMI, blood pressure, urinary glucose, and spirometry) and recommended actions (Section 2.10.6, Follow-up Reports and Information and Appendix P and Q). The participant's health care provider will also receive a copy of the report within one month of the encounter, if any significant abnormalities are detected and provided that the participant has indicated that they have a health care provider, consented to sharing this information with their provider, and have given their provider's name and contact information (Appendix O). For individuals in the Biomedical Surveillance Sub-cohort, CBC results and interpretations will be included in the report that accompanies the follow-up letter. Urgent findings identified by the laboratory will be phoned to individuals by the HVA or Call Center within one week of receipt from the laboratory (Section 2.10.6.3, Reporting of CBC Laboratory Tests).

2.10.2 Home Visits or Participant Evaluations at other Locations

2.10.2.1 Participant Mental and Physical Condition Observations

HVA agents will respond to mental health issues, domestic violence situations, and acute medical problems according to the procedures described in Section 8.1.6, Identifying and Dealing with Mental Health Issues, Domestic Violence, and Acute Physical Illness.

2.10.2.2 Other Social Behavior Observations

During the encounter, the HVA will observe the household and be alert for unusual situations suggesting the existence of reportable (varies by state) social or abusive behaviors. If anyone in the home environment is in immediate danger, the HVA will end the visit and, once in a safe location, will call 911, complete an incident report, and report the event to study supervisors by phone. Should a HVA witness signs that lead to suspicion of child, spouse or elder abuse while in the participant's home, the HVA will generate an incident report in the CAPI system at the conclusion of the visit and report the incident by phone, as discussed above. Such situations will not be discussed with the participant, except in instances where it appears that the study participant is the victim of abuse. In those cases, the HVA will discreetly ask if the participant would like to be put in touch with someone who might be of assistance.

2.10.2.3 Incident Report Form

An incident report form will be completed by the HVA for all acute medical, mental health, and social problems that are observed during encounters with participants (Appendix J, Baseline Questionnaire, Section N). This report will be accessible in the CAPI system on the HVA's laptop, and it will include workflow features that prompt the HVA to take appropriate action based on evaluation findings, observed behaviors, or noted circumstances. The CAPI system will also be programmed with automated data checks that alert Coordinating Center staff to problems that require immediate attention and follow-up, such as telephone follow-up to a participant who required a 911 response for a hypertensive crisis. The principal investigator will be responsible for reporting to the IRB all acute medical, mental health, and social problems that are observed during

encounters with participants that result in a call to 911 or social services as well as any adverse events that result from study interventions or protocol violations, as specified in the section 4. Due to the unique nature of the study population which is under substantial stress due to job losses associated with the oil spill and major hurricanes and is medically underserved, it is expected that the majority of emergency contacts will be unrelated to the study per se, but due to the fact that we are screening for medical conditions among individuals without access to care and have an opportunity to observe individual and family behaviors because we will spend several hours in a participants' home.

2.10.3 Home Visit/Evaluation Measurements & Testing

Participant evaluations will include several measures and tests for which the results can be conveyed during the time of the HVA encounter providing potential health benefits for early recognition of disease, as well as enhanced opportunities for health education and utilization of health care resources. HVAs will be trained to provide participants with appropriate and standard feedback about their individual blood pressure and BMI measurements, and urine glucose results before departing the participant's home. HVAs will be trained to record all observations and in-home test results in the data management application as well as on participant **Test Result Forms** that provide the participant with a basic interpretation of the various measurements and test results. HVAs will also be trained to strictly follow scripts when conveying results to participants. The participant Test Result Forms will include scripts that provide recommended actions for participants to take depending on the measured values for each test. For each test result, we provide standard recommendations depending on the result value (see Test Results Forms in Appendix L).

As the HVA performs the various measurements and tests during the visit, the results will be recorded into the data management system and also transcribed onto pre-printed test result forms for each test. The HVA will provide these forms filled-in with the measured results to each participant and go over the results with the participants and any suggested follow-up actions. If any of these results are abnormal, the relevant test result form indicates what actions the participant should take and how soon. With the possible exception of extremely elevated blood pressure, most abnormal findings will lead to a recommendation to contact their health care provider or other community healthcare providers for additional evaluation within a specified time interval.

2.10.4 Follow-up Actions for Abnormal Findings

2.10.4.1 Medical Referral Guidelines

During the home visit or encounters at other locations, participants will receive handouts that provide results of their evaluations, interpretation of findings, recommended action based on findings, and health care referrals for any abnormal results (if needed). These results will be also summarized in a follow-up mailing to participants one month after the visit. The letter will thank participants for their participation in the study, introduce the summary report of findings and recommended actions, and remind them of study activities in the coming years. The handouts and summary report will provide information on BMI, blood pressure, urinary glucose, and pulmonary function test results. The CBC results for the Biomedical Surveillance Sub-cohort will also be included in the summary report, along with recommended actions. The CBC analysis will be done in a Clinical

Laboratory Improvement Amendments (CLIA) certified laboratory (as will any future clinical tests that may be reported back to participants). The urine glucose screening test performed in-home has a CLIA waiver (FDA 2010).

During the consent process, participants will be asked if they would like the study to send abnormal evaluation findings to their health care provider and whether they would like a referral for health care, if they do not have a health care provider but need to see one based on evaluation findings.

If the participant asks that evaluation results be sent to their health care provider, the HVA will collect the name and contact information for the health care provider and record the information in the CAPI system. Within a month of the visit, the results of evaluations and advice regarding health care referrals will be shared with the participant's health care provider, if any abnormal evaluation findings were detected. Any evaluation finding that does not fall within the normal ranges will result in a letter to the health care provider. The health care provider will receive a cover letter that briefly describes the study and the reason the results are being sent, as well as a copy of the summary report that all participants will receive by mail. If the participant does not have a health care provider, the HVA will provide information about local health care resources, if warranted, based on abnormal evaluation findings. Participants who receive a referral will be instructed to present the health care provider with the results handouts at the time of the referral visit.

The advice that participants receive about medical referrals will be based on level of urgency of their findings. For example, the referral levels for hypertension are based upon recently published guidelines from the American Heart Association (AHA) for blood pressure. We tended to select the more conservative guidelines when there were several choices, given the fact that the community under study includes many without access to care and the fact that our study will be highly visible and we want to err on the side of caution. Nonetheless, levels of urgency can vary across practitioners and communities; setting levels too low may unnecessarily over-burden area medical care systems, while setting them too high may put participants at risk. The frequency of referral for care will be monitored as will the outcomes for referrals deemed urgent. If it is determined that we are making too many unnecessary referrals or that these guidelines are inconsistent with local practice, we will consider other less conservative standards. Any proposed changes would be brought back to the IRB for evaluation. Participant referrals or follow-up instructions will be categorized into one of the five classifications below, based upon their test results or findings (see Table 2 below).

1. **Emergency:** The HVA is instructed to immediately offer to assist the participant or family members in contacting emergency medical services or their treating physician. If the participant declines this immediate assistance, the HVA will continue with the minimal risk components of the visit, omitting the blood collection and spirometry components at that time. If it is later determined that the emergency situation has resolved, we will attempt to perform these remaining components after confirming at that time that the emergency situation is indeed resolved.

2. **Urgent**: The Urgent referral category is divided into two levels depending upon the urgency of the results or findings.

> Level 1: the participant is asked to follow-up with their health care provider in 72 hours.

Level 2: the participant is asked follow-up with their health care provider in one week or two week intervals depending on the urgency of the results. HVA or Call Center staff will follow-up with all "Urgent" referral category participants by phone to assess their disposition.

3. **Check-Up:** The participant is asked to follow-up with their health care provider within one to two months.

4. **Routine Care**: The participant is advised to seek guidance from health care providers to learn about healthy lifestyle choices to help prevent disease.

5. **No Referral**: Results are within the normal range.

Alert Levels for Laboratory Results & Spirometry Interpretations:

CBC Abnormalities:

Alert levels for abnormalities associated with the CBC components that are reported to the participant (i.e., white blood cell count, hemoglobin concentration, hematocrit percentage or platelet count) will trigger "Urgent" referrals. Within one week of Alert Level findings being reported by the laboratory, participants will be notified by phone and advised to follow-up with a health care provider in either 72 hours for Alert Level 1 findings or one-to-two weeks for Alert Level 2 findings (as indicated in Table 2). The chosen laboratory urgent referral action levels were based upon values used for the Jackson Heart Study of African-American males and females ages 35-84 living in the Jackson, Mississippi area and reference values used by our central diagnostic laboratory. The Alert Level 1referrals for total white blood cell count (≤ 1.1 x 10^3 / µL), hemoglobin (≤ 6.1 g/dL) and hematocrit (≤18.1%) lead to a recommendation for participant follow-up in 72 hours. These thresholds are based upon the "panic levels" from our central diagnostic laboratory.

Spirometry Abnormalities:

Alert Level for post-exam spirometry interpretations will be reported to participants by phone within one week of receipt from the central laboratory. Participants will be advised to follow-up with a health care provider within one week (as indicated in Table 2). The spirometry alert level for an urgent referral utilizes the lower limits of normal (LLN) which is an index derived from population data based on race, age, sex, and height. The LLN is designed to be the 5th percentile for the index (FEV1, FVC, & Fev1/FVC) of interest (Roberts 2006). The use of FEV1 < 50% results in a "severe classification" regardless of obstructive or restrictive conditions and is consistent with ATS guidelines, assuming a valid and interpretable test (Pellegrino 2005). Given the nature of worker cohorts we do not expect to see very many participants in the severe category

Table 2. Medical Care Referral Guidelines

Evaluation	Findings	Referral	Comments
Blood Pressure	SBP ≥ 180 or DBP ≥ 110	Urgent*. Seek care as soon as possible if confirmed as a chronic condition. **Based on AHA 2010 guidelines*	HVA to offer to contact 911 or help assist with referral as indicated. HVA / Call Center to follow up with participant by phone ASAP.
	SBP 160 to 179 or	Check-up. See health care	Results provided to participant

Evaluation	Findings	Referral	Comments
	DBP 100 to 109	provider within one month.	during encounter and mailed to participant within one month.
	SBP 140 to 159 or DBP 90 to 99	Check-up. See health care provider within two months.	Results provided to participant during encounter and mailed to participant within one month.
	SBP 120 to 139 or DBP 80 to 89	Routine. Those with slightly high BP advised to discuss need for any additional evaluations of lifestyle changes with HCP.	Results provided to participant during encounter and mailed to participant within one month.
	SBP < 120 AND DPB < 80	No Referral.	Results provided to participant during encounter and mailed to participant within one month.
Resting Heart Rate	HR > 120 bpm	Check-up. See health care provider as soon as possible.	Results provided to participant during encounter and mailed to participant within one month.
	101 ≤ HR ≤ 120 bpm	Check-up. See health care provider within one month.	Results provided to participant during encounter and mailed to participant within one month.
	40 ≤ HR ≤ 59 bpm	Check-up. See health care provider within one month.	Results provided to participant during encounter and mailed to participant within one month.
	HR < 40 bpm	Check-up. See health care provider as soon as possible.	Results provided to participant during encounter and mailed to participant within one month.
Urine Glucose	Glucose > trace OR Trace glucose with specific symptoms* of diabetes. **frequent urination & thirst*	Urgent. See health care provider within one week.	Results provided to participant during encounter and mailed to participant within one month. HVA / Call Center to follow up with participant by phone within two weeks of encounter.
	Negative glucose with symptoms of diabetes OR Trace glucose with no symptoms* of diabetes	Of Potential Concern. See health care provider within one month	Results provided to participant during encounter and mailed to participant within one month.
	Glucose negative, no symptoms* of diabetes,	Normal. No Referral.	Results provided to participant during encounter and mailed to participant within one month.
BMI	Obese (≥ 30) Overweight (25 to 29.9) Normal (18.6 to 24.9) Underweight (< 18.5)	Routine. If overweight or underweight, discuss results and potential lifestyle changes with health care provider.	Results provided to participant during encounter and mailed to participant within one month.

Evaluation	Findings	Referral	Comments
Spirometry	ALERT LEVEL Either FEV_1, FVC, or FEV1/FVC below lower limits of normal AND FEV_1, < 50% predicted	Urgent Referral. See health care provider within one week. HVA / Call Center contacts participant by phone within one week of receiving spirometry evaluation	Participant advised to see HCP within one week of receiving phone call. Results mailed to participant within one month.
	Either FEV_1, FVC, or FEV1/FVC below lower limits of normal AND FEV_1, ≥ 50% predicted	Check-up. See health care provider within one month.	Results mailed to participant within one month.
	FEV_1, FVC, and FEV1/FVC all above lower limits of normal	No Referral.	Results mailed to participant within one month.
CBC **Total White Blood Cell Count**	ALERT LEVEL 1* All: ≤ 1.1 x 10^3	Urgent Referral. HVA / Call Center contacts participant by phone within one week of receiving results.	Participant advised to see HCP within 72 hours of receiving phone call for alert level 1. Letter with results mailed to participant within one month of receipt from lab.
	Results between alert level and normal reference range	Check-up. See health care provider within two months.	Letter with results mailed to participant within one month of receipt from lab.
	Within lab normal reference range	No Referral.	Letter with results mailed to participant within one month of receipt from lab.
CBC **Hemoglobin**	ALERT LEVEL 1* All: ≤ 6.1 ALERT LEVEL 2 Males: > 6.1 to 12 OR >20 Females: > 6.1 to 10 OR >17	Urgent Referral. HVA / Call Center contacts participant by phone within one week of receiving results.	Participant advised to see HCP within 72 hours of receiving phone call for alert level 1. Participant advised to see HCP within two weeks of receiving phone call for alert level 2. Letter with results mailed to participant within one month of receipt from lab.
	Results between alert level and normal reference range	Check-up. See health care provider within two months.	Letter with results mailed to participant within one month of receipt from lab.
	Within lab normal reference range	No Referral.	Letter with results mailed to participant within one month of receipt from lab.
CBC **Hematocrit**	ALERT LEVEL 1* All: ≤ 18.1	Urgent Referral. HVA / Call Center contacts	Participant advised to see HCP within 72 hours of receiving

Evaluation	Findings	Referral	Comments
	ALERT LEVEL 2 Males > 18.1 to 35 OR >53 Females > 18.1 to 30 OR >50	participant by phone within one week of receiving results.	phone call for alert level 1. Participant advised to see HCP within two weeks of receiving phone call for alert level 2. Letter with results mailed to participant within one month of receipt from lab.
	Results between alert level and normal reference range	Check-up. See health care provider within two months.	Letter with results mailed to participant within one month of receipt from lab.
	Within lab normal reference range	No Referral.	Letter with results mailed to participant within one month of receipt from lab.
CBC **Platelets**	ALERT LEVEL <50 x 10^3 OR >500 x 10^3	Urgent Referral. HVA / Call Center contacts participant by phone within one week of receiving results.	Participant advised to see HCP within two weeks of receiving phone call. Letter with results mailed to participant within one month of receipt from lab.
	Results between alert level and normal reference range	Check-up. See health care provider within two months.	Letter with results mailed to participant within one month of receipt from lab.
	Within lab normal reference range	No Referral.	Letter with results mailed to participant within one month of receipt from lab.

** Alert Level 1 for total white blood cell count, hemoglobin, and hematocrit are based on central diagnostic laboratory reference values.*

Note: Other alert levels are based on a combination of central diagnostic laboratory reference values and alert values used for the Jackson Heart Study

If the participant has abnormal test results, the HVA will suggest appropriate follow-up with their healthcare provider. If the participant does not have a healthcare provider, they will receive referrals for medical and mental health care providers, as needed, including those providers that can assist with free or reduced-cost services (see Appendix N for example of Healthcare Provider Resource Information).

For example, Louisiana State Health officials in District 1 have indicated that they are willing and able to help individuals identify and access healthcare providers in their community, if needed, and a growing list of community clinics are available to see participants at little or no cost. Such referral information is being developed on an ongoing basis, in close coordination with state and local health departments, non-governmental organizations, and the local communities to help ensure appropriate medical and mental healthcare referrals. It is anticipated that such information will continue to evolve and require frequent updating. In order to ensure that this task is

being explicitly addressed, Study Coordinators located in the Gulf States will work with health officials and communities in this matter.

Additionally, we are working with state and local public health officials to identify any additional public health information and resources related to weight control, hypertension, diabetes, and other conditions that the HVAs can provide to the study participants for educational and public health benefit.

2.10.5 Abnormal Findings Form

The HVA will document all evaluation findings in the CAPI system while they are conducting the visit. This CAPI module that collects evaluation findings will contain workflow features that prompt the HVA on how to proceed when abnormal findings are obtained. The HVA will review the actions and check the appropriate items on the checklist for cues as to subsequent steps to be taken depending on the findings or situation (Appendix J, Baseline Questionnaire, Section N). Once this information has been uploaded to the central database, selected responses will trigger further actions for the HVA and Coordinating Center staff, such as follow-up phone calls, follow-up letters, and assistance with referrals.

2.10.6 Follow-up Reports & Information

2.10.6.1 Follow-up of Urgent/Emergency Situations During In-person Encounter

If the HVA contacts 911 for an emergency situation, the HVA or Study Center representatives may immediately follow-up, or as soon as possible with respect to the situation, with the participant or their spouse to express our concern, check on their current condition and determine future interest and ability to participate in the study.

2.10.6.2 Follow-up Letters to Summarize Evaluation Findings and Encourage Recommended Actions

Within one month of the home visit, we will mail the participant a follow-up letter with a summary of their evaluation results (see Appendix P and Q). This letter will also contain information reiterating their results and recommended actions.

2.10.6.3 Reporting of CBC Laboratory Tests

For individuals in the Biomedical Surveillance Sub-cohort, selected components of the CBC results and interpretations will be included in the report that accompanies the follow-up letter. Urgent findings identified by the laboratory will be phoned to individuals by the HVAs or Call Center within one week of receipt from the laboratory. HVAs or Call Center staff will also follow-up with participants within two weeks of sharing the results by phone to see if they need additional assistance scheduling an appointment with a health care provider. The date of all follow-up mailings will be recorded in the data system, any returned mailings will be noted, and those that cannot be reached by mail will be contacted by phone, if possible. Results of follow-up phone calls, including dates and times of calls, responses, advice, and referrals given to participants will also be entered into the data system.

2.10.6.4 Reporting of Spirometry Results to Participants

For participants that complete spirometry evaluations, interpretations of their results will be included in the report that accompanies the follow-up letter. Alert Findings identified during evaluation of their measurements will be phoned to individuals by the HVAs or Call Center within one week of receipt from trained pulmonary study reviewers. Urgent Referrals for participants to see their HCPs within one week will have HVAs or Call Center staff follow-up with participants within two weeks of sharing the results by phone to see if they need additional assistance scheduling an appointment with a health care provider. The date of all follow-up mailings will be recorded in the data system, any returned mailings will be noted, and those that cannot be reached by mail will be contacted by phone, if possible. Results of follow-up phone calls, including dates and times of calls, responses, advice, and referrals given to participants will also be entered into the data system.

2.10.6.5 Results Reporting to Physicians

If any of the participants' evaluation findings are abnormal and the participant has a health care provider and consents to sharing evaluation findings, we will mail the health care provider a cover letter explaining the study and a copy of the summary of results and recommended actions that was sent to the participant. This report will be sent to the health care provider within one month of the home visit along with relevant contextual information such as normal value ranges (see Appendix O) so that the physician can provide the appropriate care to their patients.

2.11 Laboratory Biospecimen Processing and Storage

Once the biospecimens have arrived in the Central Processing Laboratory they will undergo additional processing to separate out the various components (serum, plasma, cell fractions) and aliquoting of samples into small volumes for cryostorage, before being transferred to the long-term storage facility.

2.11.1 Central Laboratory Processing

Active Follow-up Sub-cohort Sample Processing: The ACD tube will be cryopreserved with 10% DMSO and aliquotted into cryovials, which will be subjected to programmed cryopreservation and stored in LN2. The Trace Metal and PAXgene samples will be frozen in their original tubes at -20℃. The serum and plasma will be aliquotted into cryovials and stored in LN2. The RBCs/buffy coat (from the 10 mL and 6 mL EDTA tubes) will be aliquotted into cryovials and stored in LN2. The 2 mL EDTA tube will be aliquotted as whole blood into cryovials and stored at -80℃ or LN2. The urine and saliva samples will be aliquotted and stored at -80℃ or LN2. The blood clots will be aliquotted and stored at -80℃ or LN2. The hair samples and dust wipes will be stored at -20℃. Toenail samples will be stored with desiccant, under controlled ambient temperature and humidity.

Biomedical Surveillance Sub-cohort Sample Processing: Samples from persons tagged as eligible for inclusion in this sub-cohort will be processed in the same manner as those of the rest of the Active Follow-up Sub-cohort except that, promptly upon receipt at the central processing laboratory, 1) A portion of the urine sample will be sent to a diagnostic testing laboratory to undergo a more comprehensive dipstick urinalysis, 2) The 2 mL EDTA tube will be analyzed by the diagnostic laboratory for CBC with WBC differential, and 3) The ACD-B tube will undergo discontinuous density gradient

centrifugation in the CPL to isolate the lymphocytes, which will be mixed with 10% DMSO, aliquotted, and subjected to programmed freezing and storage in LN2.

The CPL will prepare the accumulated samples for transport in bulk for archive storage at the NIEHS Repository. All samples will be transferred to the NIEHS Repository for storage in liquid nitrogen or -20℃/-80℃ mechanical freezers, as appropriate for each sample, within one week of receipt.

2.11.2 Study Sample Long-Term Storage at the NIEHS Repository

Environmental Pathology Laboratories (EPL) is the contractor that operates the NIEHS Repository. EPL is located in Keystone Park, in close proximity to the NIEHS campus in the Research Triangle Park in North Carolina.

The EPL Repository is a state of the art storage facility which integrates structural, mechanical, electrical, HVAC, liquid nitrogen (LN2), and backup and monitoring systems to maintain ideal storage temperatures. These systems ensure specimen integrity and long-term preservation while supporting the safe and efficient storage of frozen specimens.

EPL's Repository houses a wide variety of biological and environmental samples and provides storage space for frozen, refrigerated, and room temperature specimens and associated data. The 17,000 square foot facility provides space for ultra-low temperature mechanical and liquid nitrogen freezers, data and specimen storage, and a processing laboratory. Nearly 10,500 square feet of space is dedicated to frozen storage, with a capacity of approximately 185 ultra-low temperature mechanical and liquid nitrogen freezers depending on the types of specimens to be stored. Additionally, the facility has three -20℃ walk-in freezers totaling 675 square feet of space. Currently, EPL has over 3.5 million frozen specimens stored in archival storage.

EPL has over 25 years experience managing and operating archives and repository storage facilities for government and commercial clients. EPL provides qualified professional and technical personnel, materials, equipment and facilities for the receipt and long term, secure storage of samples, packaging of the samples for shipment, processing requests for samples and for aliquoting and labeling new samples, as well as distributing requested data and specimens.

Aliquots of a given type will be divided across liquid nitrogen and -20℃/-80℃ mechanical freezers, as appropriate for each sample, to maximize integrity of the samples during long-term storage and to reduce risk of complete loss due to freezer failure.

2.11.3 Analyses (including future studies)

Subjects targeted for the Biomedical Surveillance Sub-cohort (exposed and unexposed participants) will have their CBC and WBC differentials measured in the 2 mL lavender top tube promptly upon receipt of the tube by the diagnostic testing laboratory. This will allow assessment of these measures among many, if not all, workers with the highest expected benzene exposure (e.g., from exposure to crude oil or burning oil). These sets of samples will be flagged prior to shipping and the lab will be separately notified of these samples. The 2 mL lavender top tubes from all other subjects will be processed in the same manner as the other lavender top tubes. Future analyses performed on

incoming fresh blood specimens in the sub-cohort may also include flow-cytometry to determine changes to specific cell populations, such as CD4 or CD8, CD17, and regulatory T-cells.

Subjects targeted for the Biomedical Surveillance Sub-cohort also will have a portion of their urine samples used for a basic chemistry urinalysis (Multistix Pro 10LS reagent strips) to measure protein, creatinine, blood, leukocytes, nitrite, glucose, ketone, pH, and specific gravity immediately upon receipt of the urine samples at the central laboratory.

All other samples will be processed and banked for future analyses.

Future analyses, to be conducted among targeted subsets of the cohort, may include assessment of DNA damage via assays such as the alkaline comet assay and the micronucleus test on the cryopreserved lymphocytes [Chang, et al. 2006, Zijno, et al. 2007]; global hypomethylation and average telomere length in DNA from buffy coat; liver function tests (LFT) on serum; total immunoglobulins, autoantibodies, and inflammatory markers in the serum; antibodies indicating loss of latency of chronic infections such as Epstein-Barr virus and herpes viruses; gene expression related to exposure to benzene and other VOCs using the sample in the PAXgene tube; N-acetyl-beta-D-glucosaminidase (NAGs), beta-2 microglobulin, microalbuminuria, neutrophil gelatinase-associated lipocalin (NGAL), interleukin-18 (IL-18), kidney injury molecule-1 (KIM-1), liver-type fatty acid binding protein in the urine to assess kidney injury; polymorphisms in genes encoding metabolizing enzymes for benzene, other VOCs, and PAHs. The specific assays and markers listed here are intended only to give an indication of the *types* of test that we may want to perform later and that are being performed now in similar contexts. In order to take best advantage of rapidly emerging technologies, we will determine – and justify – the specific approaches to use around the time that we are ready to undertake such analyses. We have developed our biospecimen collection, processing, and storage protocols to allow as wide a range of analyses as can be anticipated, including those not yet developed.

Exposure markers measured in stored specimens may include arsenic, cadmium, chromium, copper, lead, manganese, mercury, and zinc, in the whole blood (royal blue top tubes, which have been validated for these metals), to be based on toxicological analyses by other agencies of the oil from this spill; more distant exposure to metals in the toe nail clippings; cortisol and more distant exposure to metals in the hair; cortisol and urinary catecholamines in urine specimens.

If any workers are still engaged in clean-up or terminated clean-up within 30 days of enrollment in the cohort, we may also examine more transient markers of exposure, including urinary levels of benzene, toluene, mandelic acid, trans-muconic acid, hippuric acid; and hemoglobin-PAH adducts.

2.12 Supplemental Add-on Studies

Supplemental questionnaires may be developed and administered to address other unique exposure scenarios experienced by subsets of workers. For example, a short supplementary questionnaire module will be administered to up to 200 participants who were exposed to ammonia during an accidental release in August 2010 at a refrigeration facility adjacent to an oil spill clean-up site in Theodore, AL. An Exposure Monitoring Addendum has also been added to the main GuLF STUDY to address ongoing concerns among Gulf state residents about potentially higher levels of exposure to oil-spill related chemicals and implications for current and future health (See Addendum 1). Participants

may receive additional remuneration depending on the level of effort associated with each sub-study.

2.13 Follow-Up of Cohorts

2.13.1 Telephone Questionnaires

Follow-up telephone questionnaires will be administered to a subgroup of participants periodically to assess changes in health status and factors that could confound associations between exposures and outcomes. The initial follow-up interview will take place approximately 2 years after the start of enrollment and will be completed in approximately 18 months. For the first follow-up telephone interview we will attempt contact with all English and Spanish-speaking participants.

Prior to the interview, participants will be mailed an invitational letter encouraging them to complete the follow-up questionnaire. Participants will then be contacted by trained interviewers who will administer the questionnaire using computer assisted telephone interviewing software. The interview will take approximately 30 minutes to complete. Additional mailings may be sent to participants who are hard to reach or who initially decline to participate in the interview to reinforce the importance of their participation.

We also plan to invite ~4,600 individuals from Alabama, Florida, Louisiana, and Mississippi who completed home visits and ~2,000 participants in and out of gulf states who did not complete home visits to complete an additional mental health questionnaire module at the time of their first follow-up telephone interview and again 6, 12, and 24 months later. We hope to collect data for all four waves of mental health follow-up with at least 2,000 participants. We are inviting 6,600 participants to complete the mental health module to account for expected difficulties reaching participants by phone and expected attrition over time. Due to ongoing concerns about the mental health impacts of the disaster, we plan to enrich the sample with participants who showed signs of potential mental health issues at baseline (N~5,100) and randomly sample a “healthy” comparison group (N~1,500) from the remaining cases.

2.13.2 Biomedical Surveillance Sub-cohort Follow-up (Year 1 and 3)

Participants selected for the Biomedical Surveillance Sub-cohort will undergo more extensive testing and follow-up. These exams will be administered through an external contract or contracts run in collaboration with extramural collaborators. Detailed neurobehavioral, neurocognitive, and peripheral neuropathy measures will be collected. More thorough respiratory function testing, including bronchodilator challenge, will be performed. Additional tests and follow-up questionnaires and protocols will be determined with the extramural collaborators and necessary approvals will be obtained through the respective organizations.

2.13.3 Annual Morbidity and Mortality Outcomes (Year 2 and later)

Routine surveillance of GuLF study participants will be conducted beginning in Year 2. Follow-up will include linkage with State Cancer Registries and state vital statistics as

well as linkage with the National Death Index (NDI). We will explore the feasibility of other passive monitoring for changes in health via linkage with other routinely collected surveillance data and electronic medical records that may become available.

2.13.4 Follow-up in Years 6-10

Routine surveillance of all GuLF study participants, using the NDI, potentially available electronic medical records, and state cancer registries (among others), will be conducted to investigate any morbidity and mortality associated with clean-up related activities.

Telephone interviews may be administered to all Active Follow-up Sub-cohort participants in Years 6-7 and 9-10, using questionnaires similar to those used in Years 3 and 4 (see 2.12.1 above), but possibly including additional questions based on the results of follow-up to date.

2.14 Retention Strategies

The strategies outlined in this section are intended to maximize retention, and in some cases recruitment, efforts. These strategies will capitalize on the community outreach and engagement efforts as a core activity of the study design and implementation activities and build on the trust and rapport between the local members of the research team, the target communities and public health leadership across all four states.

A key to high response rates and long-term participation is not to simply contact participants when data are needed but rather to maintain contact in small ways and provide useful information including study results back to participants on a regular basis. We will provide regular feedback about study progress and group results as well as make sure we show our appreciation to the participants for their tremendous commitment to this study. We will also meet regularly as a study team to review progress made on retention efforts and obtain direct feedback to follow-up where necessary.

2.14.1 Annual Update of Contact Information

In order to minimize loss to follow-up, we will send participants emails and letters requesting that they update their contact information through an application on the study website or by contacting the study hotline. Update requests will be sent to participants once they have completed the telephone interview and will be included with all subsequent study mailings for use as needed. The study website will feature an “update contact information” page to securely register changes in contact information through an encrypted server. Thank you letters following the initial visit will include a GuLF STUDY magnet that reminds participants to “keep in touch” and includes pertinent contact information.

In addition, efforts will be made to update contact information annually. Participants will be asked to complete contact information updates annually, whether or not they have had any changes in their contact information. Any mailings that have been “returned to sender” will undergo tracing to identify updated address information. Individuals lost to follow-up will be traced using traditional methods such as internet and other phone-book searches, credit bureaus, and the Social Security Death Index.

2.14.2 Newsletters and Other Mailings

Similar to the study website, annual newsletters will provide information on study progress and findings. Additionally, we will send birthday cards or holiday cards every year to enrolled participants along with small incentives/tokens of appreciation such as pens, notepads, calendars, and magnets with the study logo on them to maintain contact and long-term study interest.

2.14.3 Study Website

We will maintain a website to provide information about the study. The website will be updated regularly with details on recruitment efforts, study findings, and links to other organizations and information resources. Additionally, we will seek to have each of our community partners have a link on their website to the study website. As feasible, the website may contain details on upcoming or ongoing health research studies of oil spill workers. In order to support retention efforts, study participants will also be able to provide study investigators updates to their contact information via a secured web form on the website.

2.14.4 Social Media

Segments of the oil clean-up worker population are active social media users partly due to long trips away from home. Social media such as Facebook can be used to reach these workers to build study credibility, provide more frequent updates, and prompt participation in the out years of the study. However, as we expect web access to be quite incomplete, this approach is not expected to be effective across the cohort. As part of our outreach and retention efforts, we will explore the use of Web 2.0 resources (e.g. Facebook, Twitter, etc.) to encourage awareness and credibility and facilitate follow-up. We will explore the possibility of establishing a presence on a site such as Facebook and maintain study updates as well as other information related to the spill. We envision that study participants can opt to be emailed when updates are provided to the social media site or may even chose to be a “friend” of the site. Additionally, we envision that we will be able to reach out to community organizations and invite them to be a “friend” of the site. Because the social media landscape will undoubtedly change during the study duration, we will continue to monitor for opportunities to utilize this technology for maintaining contact and encouraging retention in study activities. However, we must be assured that participant confidentiality will be maintained and that a significant proportion of participants are actively participating in these media to justify the feasibility of creating and maintaining these resources. We will seek IRB approval for all social media advertising activities. The addition of the use of social media must be reviewed and approved by the IRB in accordance with NIH policy prior to implementation and we will consult with a computer specialist regarding security issues prior to opening any account.

2.14.5 Community Partnerships and Outreach

As described in Section 2.4 - Community Outreach, we will utilize linkages with the communities in all four states to augment recruitment efforts. Similarly, we will utilize community partnerships and relationships with other organizations to support retention efforts. First, we will continue to convene the Community Advisory Group (CAG) on at least a semi-annual basis throughout the life of the project. Subcommittees of the CAG

may be created where necessary to address retention activities and other challenging situations regarding the cohort. We will rely on the leaders within each community to recommend retention strategies best utilized with their constituents. As we continue to develop relationships with communities, we will incorporate these strategies and revise the plans for study retention.

2.15 Remuneration

In addition to non-monetary incentives such as refrigerator magnets, chip clips, stationery, and pens, participants in the Active Follow-up Sub-cohort will receive remuneration for their time and effort in the form of pre-paid gift cards or phone cards. A monetary incentive will be offered to participants at the baseline home visit. Gift cards with a $50 value will be given to participants immediately upon completion. Participants will be asked to acknowledge their receipt of their gift card by completing a form (Appendix V), which will be returned by the HVA to the study office with other study materials. If the Participant also completed the Ammonia Release Survey or provided an additional Quality Control Sample for the study, they will be given an additional gift cards (see Table 3 below), receipt of which will also be acknowledged on this form. The amount of remuneration for each study event is summarized in the table below.

Table 3. Remuneration for Completion of Study Events

Study Event	Active Follow-up Sub-cohort	Passively followed members of full cohort
Baseline Home Visit	$50	N/A
Duplicate Biospecimen Collection at Baseline Home Visit*	$10*	N/A
Ammonia Release Survey**	$20	$20
Exposure Monitoring Supplement***	$10 or $30	N/A
Total	$50 - $110	$20

** Only for the N=300 randomly selected individuals participating in the QA/QC biospecimen collection.*
*** Only for the individuals eligible for the ATSDR Sub-study.*
**** Participants in the Exposure Monitoring Addendum receive $10 for providing an extra blood sample or $30 if also asked to wear a personal air monitoring device.*

Additional incentives for recruitment and participation such as drawings for prizes, sporting event tickets or gift cards, and recruitment events featuring food bank distributions, community health fairs, or other community events will be explored based on feedback from the community and assessment during the run-in phase of the study. We will confer with the appropriate scientific, community, institutional and ethical advisory boards to determine the appropriateness of these additional incentives.

Participants who complete the home visit will be entered into a drawing for a $500.00 gift card. Drawings will be held after every 5,000th participant completes the home visit and three winners will be selected at each drawing. The odds of winning are about 1 in 1650. Similarly, participants who complete the Follow-up Telephone Questionnaire will be entered into a drawing for a $500.00 gift card. One drawing will be held after every 500th participant completes the interview. The odds of winning are about 1 in 500. Early responders who complete the Follow-up Telephone Questionnaire within three weeks of

the release of their invitational mailing will be entered in an additional drawing for a $500.00 gift card. One drawing will be held after every 500th early responder completes the interview. The odds of winning are about 1 in 500. There is no cost associated with entering the drawings or accepting the gift cards.

Participants selected to complete the SAMHSA Extended Mental Health Questionnaire questions during their Follow-up Telephone Questionnaire will receive a $10.00 gift card for their additional time and effort following each interview ($10.00 per interview; $40.00 total).

A separate remuneration schedule will be developed for the more comprehensive activities of the Biomedical Surveillance Sub-cohort.

2.16 Study Timeline

The GuLF STUDY investigators will engage community and scientific leaders during the study design process for input and refinement. A timeline of study activities is presented in Table 4.

Table 4. Study timeline

	Q3 2010	Q4	Q1 2011	Q2	Q3	Q4	Q1 2012	Q2	Q3	Q4	Q1 2013	Q2	Q3	Q4	Q1 2014	Q2	Q3	Q4	Q1 2015	Q2	Q3	Q4
Study Design and Scientific Input	●	●	●																			
Community Outreach	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Study Start			●																			
Subject Recruitment			●	●	●	●	●	●	●													
Enrollment Questionnaires			●	●	●	●	●	●	●													
Home Visits			●	●	●	●	●	●	●	●												
Biomedical Surveillance Sub-Cohort Follow-up									●	●	●	●					●	●	●	●		
Newsletter & Annual Update							●				●				●				●			
Active Sub-cohort Follow-up													●	●	●	●						

3 Evaluation of Benefits and Risks

3.1 Potential Benefits

All study participants may benefit from positive feelings associated with participating in a study of the health effects of the oil spill that may be of value to their community. In addition the knowledge gained from this study may have a significant impact on future public health responses to similar disasters. It is also possible that participants may benefit directly from public health responses that are based on early findings from this study.

Participants in the Active Follow-up Sub-cohort may benefit from receiving results of medical evaluations and health care referrals that they may not otherwise receive (see Section 3.10. - Reports to Participants and Health Care Referrals).

3.2 Potential Risks

The questionnaires and procedures in this observational study present minimal risks to study participants. The questionnaires are based on instruments that are widely used in epidemiological studies. Adverse events associated with study procedures are expected to be uncommon and limited to mild and transient discomforts. In order to minimize risks to participants, all study procedures will be conducted by qualified, experienced, and well-trained field staff.

The main risk in questionnaire administration involves questions about sensitive health topics or personal experiences that may be traumatic. There is economic, legal, and social risk to subjects from breaches of confidentiality with a participant's data. For example, inappropriate release of some personally identifiable information may compromise their employment, insurability, social standing, or subject them to arrest. These risks are minimized by protective data management practices and obtaining a federal Certificate of Confidentiality. Additionally, there is a psychological risk of embarrassment or anxiety while answering questions about sensitive personal matters such as drug use. Staff will monitor subjects' psychological state, evidenced by their statements, questions, or behavioral responses to the screening process when it is appropriate to do so. Participants will be told that they can skip any questions that make them feel uncomfortable or end the interview at any time. Participants will also be warned of the possibility of loss of privacy should their de-identified data distributed through controlled access procedures (see section 11.2a) be linked back to them in ways that cannot be foreseen at present.

Pulmonary function testing is considered safe. The primary risk, which is exceedingly rare, is fainting in older participants with impaired lung function. We minimize the chance that this rare event will occur first through our very conservative exclusions for pulmonary function testing – any heart attack or hospitalization for other heart problem or stroke in the past 3 months. Pregnant women will not undergo pulmonary function testing until at least 3 months post-partum. To further minimize risk of fainting, pulmonary function testing is done in a seated position, and study staff will be trained to look for signs of dizziness or other problems and to stop the maneuver if necessary. The risk of infection is all but eliminated by using disposable mouthpieces (spirettes). These disposable mouthpieces have the additional protection of having a built-in bacterial filter. In the PLATINO [Menezes, et al. 2005] and BOLD [Buist, et al. 2007] studies, home

visits were conducted on 14,000 adults over age 40 by trained technicians only, without physicians present, and no adverse events were associated with in-home spirometry.

There may be some minor discomfort associated with blood collection, including temporary pain, bruising, or swelling at the phlebotomy site. Fainting during blood collection is exceeding rare.

There is also a remote risk of accidental disclosure of study information. Measures that will be taken to guard against accidental disclosures include maintaining complete confidentiality of the questionnaires and laboratory samples, use of secure data systems, and staff training (see Section 10.3 – Participant Confidentiality). Participants will also be warned of the possibility of loss of privacy should their de-identified data distributed through controlled access procedures be linked back to them in ways that cannot be foreseen at present.

4 Adverse Event Reporting

Adverse events associated with this study procedures are expected to occur very infrequently. Most of the potential risks associated with study procedures (see Section 3.2) is limited to mild, transient discomforts of no clinical significance. Only clinically significant adverse events will be reported to the IRB. Examples of clinically significant adverse events include:

- fainting during spirometry or blood collection
- respiratory distress induced by spirometry that requires medical attention
- prolonged bleeding, hematoma formation, or infection associated with blood collection that requires medical attention

Field staff will be trained to detect and respond to clinically significant adverse events. They will also be expected to report clinically significant adverse events to the Coordinating Center immediately. Because some adverse event may not emerge until after the visit, participants will be instructed to call the study hotline if they experience a new or worsening health problem that could be due to a study procedure. The principal investigator will be responsible for reporting all clinically significant adverse events related to study procedures to the IRB within 72 hours of receiving notification that an event occurred.

A clinically significant adverse event related to study procedures will be reported as a serious adverse event if it is life threatening, causes persistent or significant disability, leads to death, or requires medical or surgical intervention to prevent one of these outcomes.

As described in Section 2.10.2, HVAs may encounter participants who report or display symptoms of acute, pre-existing medical or mental health conditions that are not related to participation in the study. HVAs may also observe unusual situations in the home that may suggest the existence of reportable social or abusive behaviors. In addition, the results of study procedures, such as blood pressure measurement, may indicate the need for immediate medical attention for previously undiagnosed or poorly controlled illnesses (see Section 2.10.4.1). Telephone interviewers may also encounter participants who report or display symptoms that are consistent with acute medical, mental health, or social problems. Any pre-existing health problem or social situation that requires a call to 911, local authorities, or social services will be reported to the IRB as an adverse event at the time of continuing review. The report will include information on the outcome of the

actions taken in response to the event. We expect these events to occur in less than 1% of telephone interviews and home visits.

The investigator will report unanticipated problems to the IRB within 72 hours of identifying such an occurrence. Unanticipated problems are defined as any incident, experience, or outcome that meets **all** of the following criteria:

- unexpected in terms of nature, severity, or frequency given (a) the research procedures that are in protocol and informed consent and (b) the characteristics of the subject population being studied;
- related or possibly related to participation in the research;
- suggests that the research places subjects or others at a greater risk of harm (including physical, psychological, economic, or social harm) than was previously known or recognized.

5 Study Oversight

The Principal Investigator will monitor and evaluate the progress of the study, including periodic assessments of data quality and timeliness, participant recruitment, administration of informed consent, accrual and retention, participant risk versus benefit, performance of contractors and other factors that can affect study outcome. This monitoring will also consider factors external to the study when interpreting the data, such as scientific or therapeutic developments that may have an impact on the safety of the participants or the ethics of the study.

The study team, all of whom will contribute to study oversight, has the experience necessary to provide this oversight. We list the investigators and their roles and responsibilities

- Dale Sandler, Ph.D. Principal Investigator NIEHS (Protocol development and overall oversight and responsibility for all parts of the study)
- Richard Kwok, Ph.D., Lead Associate Investigator, NIEHS (Protocol development and oversight over the day-to-day operations of the study, exposure assessment and coordination for all parts of the study)
- Lawrence Engel, Ph.D., Associate Investigator, University of North Carolina at Chapel Hill and NIEHS (Protocol and questionnaire development, and oversight over the neurologic and biologic areas of the study)
- Stephanie London, M.D., Dr.P.H., Associate Investigator, NIEHS (Oversight over the respiratory areas of the study)
- Aubrey Miller, M.D., M.P.H. Associate Investigator, NIEHS (Oversight over the medical and medical alert / referral areas of the study)
- Christine Parks, Ph.D., Associate Investigator, NIEHS (Oversight over the immunologic areas of the study)
- Aaron Blair, Ph.D., Consultant, NCI (Consultation on overall study implementation and design and exposure reconstruction)
- Mark Stenzel, Consultant, Exposure Assessment Applications, LLC. (Consultation on exposure assessment and industrial hygiene)

- Patricia A. Stewart, Ph.D., Consultant, Stewart Exposure Assessments, LLC. (Consultation on exposure assessment and industrial hygiene, development of exposure metrics for study participants)

- Sandro Galea, M.D., M.P.H., Dr.P.H. Consultant, Columbia University (Consultation on mental health assessments, strategies, and assist with analysis of mental health outcomes)

Social & Scientific Systems, Inc. (SSS), a provider of professional research services company, will provide support for this study through an existing contract with the NIEHS. SSS will oversee the day-to-day activities of the study with oversight from the NIEHS investigators. SSS will be responsible for recruiting and enrolling participants, conducting home visits, managing study data, providing laboratory processing services, and completing follow-up telephone interviews. All SSS staff and any SSS subcontractor staff will have the proper education, experience, and training required for their role in the study. Staff members who interact with participants or have access to study data will be trained in human subjects research protections, the study protocol, and study procedures relevant to their role. They will also be required to sign confidentiality agreements. SSS's telephone interviewers are hired and payrolled through staffing agencies, consistent with standard industry practices, but are trained and managed directly by SSS. The responsibilities of SSS's key subcontractors and collaborators are described below.

- ClinForce, a medical research staffing agency, will identify, hire, and payroll home visit agents and regional field managers. SSS will be responsible for training, equipping, and managing the work of all field staff.
- Experimental Pathology Laboratories (EPL) will provide biorepository services under an existing contract with the NIEHS.
- Stewart Exposure Assessment, LLC will provide assessments to characterize possible worker exposure to a number of chemical and physical agents associated with crude oil, dispersants, and other chemicals arising from the spill or used in the clean-up work.

A GuLF STUDY Scientific Advisory Board will be established as a subcommittee of the NIEHS Board of Scientific Counselors to provide additional oversight. This Board will include one or more members of the Board of Scientific Counselors, scientific experts, community representatives and Federal agency representatives. A separate Community Advisory Board, consisting of representatives of key study populations in the affected states, also will be established. Through funding made possible by a Gift to the NIH, the NIH has arranged to have the Institute of Medicine review the initial plans for the study and monitor study progress. The IOM held its first meeting focused on the GuLF STUDY on September 22, 2010. It is expected that the IOM will meet twice a year for several years, and then annually to review study progress and findings. An Interagency working group made up of representatives from each Federal Agency involved in some aspect of the oil spill response met on August 19, and is also expected to meet regularly to provide study oversight.

6 Statistical Analysis Methods

6.1 Treatment of Exposure Status and Health Outcomes

Estimates of quantitative levels for specific exposures will be developed to the extent possible by the industrial hygiene team. Exposure status (e.g. any contact with crude oil, dispersants, or relevant crude oil specific chemicals, e.g., benzene, heavy metals, etc.) will also be defined dichotomously as “exposed” or “unexposed” based on the definitions given above for the study population and an activity-based exposure reconstruction (Sections 3.1.1 and 3.1.3). Similarly, health outcomes will be examined quantitatively where appropriate (e.g., FEV1/FVC, CBC measures), and will also be defined as “present” or “not present” based on the existence of specific endpoints within each disease area of interest (respiratory, cardiovascular, hematologic, dermatologic, neurologic, cancer, reproductive, mental health, immunologic, renal, liver).

We expect that very few workers engaged in clean-up *related* tasks, but not in clean-up *per se,* such as those providing only administrative, logistical, or personnel support, will be enrolled in the cohort because of the initial screening. However, any such workers found to be enrolled in the cohort will be placed in an “unexposed worker” category and excluded from most analyses because their exposure profile will be fundamentally different from that of the other clean-up workers and they are likely to differ in important, potentially unmeasured, respects (e.g., physical activity, socioeconomic status, health care access or quality) from the other clean-up workers. We will revisit this approach after examining results from the mini-pilot to determine whether this should be incorporated into the full study.

6.2 Statistical Methods to Address Study Objectives

The objectives of this study are to evaluate and characterize relationships between exposures to oil, oil byproducts and/or chemical dispersants, and stress associated with the disaster and short- and long-term health effects. General analysis methods to address these objectives are as follows:

- **Descriptive analyses** will be conducted as a precursor to other investigations. Rates and proportions will be estimated and bivariate relationships will be explored using cross tabulations. 95% confidence intervals (CIs) will be estimated where appropriate.
- **Acute- and Short-term Outcomes:** Acute- and short-term health effects that may have been incurred during or immediately following exposure will primarily be assessed during baseline data collection and in the immediate follow-up time-period. Relationships between exposures and these outcomes will be investigated at the most basic level by fitting regression models: logistic regression models for dichotomous outcomes to estimate odds ratios (ORs) and 95% confidence intervals (CIs) for each exposure and least squares regression for continuous outcomes to estimate betas and standard errors (SEs) for each exposure. Relevant demographic variables (e.g., sex, age, race, socioeconomic status indicators) and other exposures will be included in the regression models as covariates and effect modifiers. More refined analyses will incorporate specific characterizations of exposure, such as type of work performed, location, nature, and duration of exposure, protective equipment used, and ultimately a quantitative index of exposures developed by a panel of industrial hygienists and other exposure experts to reflect the risk factors of interest.

Outcomes that will be evaluated include respiratory symptoms, nausea, headaches, dermatitis, depressive symptoms, anxiety, FEV1/FVC, CBC components, WBC differentials, DNA damage, etc.

- **Long-term Outcomes:** Long-term health effects that may be incurred in the years following the exposure will be assessed at regular intervals through follow-up by interview or linkage with disease/mortality registries. Relationships between exposures and dichotomous health outcomes will be investigated by fitting binomial repeated measures models to each outcome, using standard statistical software such as SAS Proc GENMOD and Proc MIXED. Exposure effects will be assessed via ORs for each observation period. Non-dichotomous outcome measures will be investigated using generalized linear models; appropriate transformations will be used to satisfy model assumptions. Relevant demographic variables (e.g., sex, age, race, SES indicators) and other exposures (including ongoing, repeated environmental variables where available) will be included in the repeated measures models as covariates. These outcomes will include cancer, neurological (neurocognitive, neurobehavioral, neurophysiological) deficits, cardiovascular injury, reproductive effects, persistence of early effects, among others.

Various refinements to these basic methods as well as these additional analyses will also be pursued:

- **Confounding and Effect Modification:** Potential confounders and effect modifiers will be introduced into the models to determine the extent to which they might influence any effect. A potential confounder will be retained in the model if its inclusion changes the estimated effect of an exposure or the length of its 95% confidence interval by 10% or more. Stratified analyses will also be used, as appropriate. Information on many of these factors will be obtained by interview, but others may come from analysis of biologic specimens. In addition, we will perform sensitivity analyses to assess the impact of unmeasured confounders, classification errors (for both exposures and outcomes), and selection bias on estimates of exposure-disease association. This will be done in part using probabilistic methods to quantify the likely effects of misclassification of dichotomous measures [Fox, et al. 2005, Chu, et al. 2006] and polytomous measures [Arah, et al. 2008].

- **Repeated measures**: Repeated measurements on individual components of long-term health outcomes (examples: reported numbers of days experiencing asthma symptoms, FEV1/FVC) will be investigated for association with exposure through repeated measures mixed-effect models, while introducing appropriate effect modifiers. In particular, pulmonary function measures provide objective data that complement less objective self-reported symptom data, but are typically quite variable. Results from other studies suggest that, at a given time point, we can expect to detect differences in FEV1 as low as 5% between subgroups of about 250 participants per group with 80% power. Analyses to compare larger subgroups, compare groups across multiple time points, detect changes over time, or investigate the FEV1/FVC ratio all involve more stable measures or comparisons and so will exhibit greater statistical power.

- Non-reversing binary prospective outcomes, such as incident diagnoses, will also be modeled using Cox proportional hazards models.

6.3 Interim and Safety Analyses

Adverse events associated with study procedures such as blood draws and pulmonary function testing are expected to be uncommon and limited to mild and transient discomforts. Such events will be monitored through interim reports. Interim reports will also be used to monitor parameters that characterize the conduct of the study, such as pace of recruitment, completeness of scheduled activities, time lags associated with data entry and laboratory testing, as well as QC reports for issues such as inter-observer variability and inter- and intra-laboratory variability. Study statisticians will develop these and other reports. No early stopping rules are in place for this study since there is no treatment and no anticipated risk to participants. Analyses of short-term health outcomes will be conducted after completion of baseline visits. Other interim analyses may be conducted in a blinded fashion so as not to influence investigators or study staff with respect to the conduct or completion of the study.

6.4 Laboratory QA/QC Analyses

Laboratory QA/QC data will be reviewed for evidence of excessive variability and for trends indicating shifts in process control. Data from blind QC samples submitted to laboratories will be analyzed and within-pair coefficients of variation (CV) for internal (within laboratory) consistency samples will be calculated. Inter-laboratory reliability will be investigated by analysis of results of laboratory same-sample analyses. The duplicate blood and urine samples collected from randomly selected individuals in the study (mentioned in Section 2.9.5) will provide specimens for these QA/QC efforts. These individual and pooled samples will be used for quality control purposes such as assessing long-term storage effects and assay batch variability.

6.5 Sample Size Considerations and Power

6.5.1 Estimated sizes of worker (exposed) and non-worker (unexposed) groups

Based on currently available information, we anticipate that when we merge the PEC list, the NIOSH list, the lists of workers from Federal agencies that may be included in this study (e.g., Coast Guard, Fish and Wildlife Service, US Geologic Survey), and other worker lists, and then remove duplicates, persons who provided no contact information, and persons who indicated that they intended to work on clean-up for less than one week (< 0.2% of the early NIOSH roster, but possibly a larger number; likely to be persons with no intention of engaging in clean-up work), the merged list will contain approximately 90,000 names. Based on early NIOSH information, approximately 92% of these persons will be from one of the four most affected Gulf States. Restriction of the workers, for logistical reasons, to persons from the four Gulf States and to those workers from outside of those states who experienced certain high exposures such as to benzene, burning oil, and dispersants will produce a list of approximately 86,000 persons. It is expected that after loss to follow-up, non-response, and refusal, about

55,000 eligible persons (a 60-65% participation rate) will complete the enrollment questionnaire. These 55,000 persons will comprise the full cohort. Among this group, we estimate that about 43,000 (80%) will have engaged in clean-up activities while the remaining 12,000 (~20%) did not. These 12,000 unexposed persons will include up to several thousand Federal responders who engaged only in response activities such as administrative, oversight, or logistical support that did not involve any contact with spill-related oil, oil byproducts, or dispersants.

There are sufficient eligible persons to recruit 15,000 workers and 5,000 controls into the Active Follow-up Sub-cohort, assuming a 40% ***participation rate*** (after applying sampling probabilities and assuming an 80% response rate for those who have gotten this far) among persons who have already enrolled in the full cohort by participating in the telephone interview. The size of the Active Follow-up Sub-cohort has been capped at 20,000 in light of available funding and statistical power considerations; the base population is large enough that this target is achievable even with a modestly lower participation rate. Based on current information, we estimate that about 26% of the eligible controls are from outside the immediately affected communities. By oversampling these non-local controls, we expect to recruit approximately 1,500 non-local controls and 3,500 local controls, with both groups including Federal controls as described above.

The expected participation rates provided above are reasonable, given anecdotal reports from collaborating federal agencies, media reports, and feedback from community groups and focus groups of clean-up workers that indicate widespread concern about potential health effects from the oil spill among clean-up workers and members of the affected communities. Furthermore, it is possible that the eventual cumulative total of workers will be greater than is currently estimated. We will know the real total only after we have obtained worker lists from other agencies and local communities engaged in clean-up and crossed the lists to identify unique additional workers who did not complete PEC training. *In any case, power calculations indicate that even if actual participation rates turn out to be as much as 20% lower than those indicated above, this study will still be sufficiently powered to achieve its specified aims, with an increase in minimum detectable ORs or differences of less than 10-15%.*

The rest of the full cohort (N~35,000) will comprise individuals to be passively followed who either were not randomly sampled to be part of the Active Follow-up Sub-cohort or who refused to be part of the Active Follow-up Sub-cohort (but participated in the enrollment telephone interview). This represents about 28,000 workers and about 7,000 controls.

Thus, the total size of the full cohort is anticipated to be approximately 55,000 persons (43,000 workers and 12,000 controls), consisting of 20,000 members of the Active Follow-up Sub-cohort (15,000 workers and 5,000 controls [3,500 local and 1,500 non-local, including Federal]) and 35,000 passively followed members of the full cohort (28,000 workers and 7,000 controls).

Based on other prospective observational studies, we anticipate 90% follow-up and participation in telephone interviews after enrollment for the Active Follow-up Sub-cohort. Thus, completed follow-up interviews are expected for approximately 13,500 workers and 4,500 controls in Years 3-4.

6.5.2 Sample Power

This study is designed not around a few narrow *a priori* hypotheses, but rather to allow the investigation of a wide range of potential adverse health effects. The study size and the number of individuals who experienced a given exposure – and the consequent statistical power – have largely been determined by the number of individuals involved in the clean-up operations and their distribution by task/exposure. While this study will have limited power to examine certain rarer exposures or outcomes in the near future, this is the largest study to date of oil spill clean-up workers and it is important that we address, to the extent feasible, the wide range of public health concerns. It is a prospective study and as time passes, if the exposure continues to exert an impact on some health outcomes, power will increase.

Table 3 presents minimum detectable odds ratios across a range of proportions of exposure among the workers and of health outcome among the controls. Estimates are shown separately for analyses of the full cohort and of the Active Follow-up Sub-cohort, including all controls or including only the non-local controls. Estimates are also shown for analyses of the Biomedical Surveillance Sub-cohort. All estimates are based on a two-sided test with α=5% and power=80%. As the table shows, this study has excellent power to detect small risks, except when exposure or outcome is rare. For example, in an analysis of the full cohort, if 10% of the workers received a given exposure (e.g., high exposure to VOCs) and the incidence or prevalence of disease is 1%, this study would have sufficient power to detect an OR of at least 1.56 when using all 12,000 controls and 1.86 when using only the 2,500 non-local controls. In an analysis restricted to the Active Follow-up Sub-cohort, with proportion of exposure of 10% and disease incidence/prevalence of 10%, the minimum detectable OR would be only 1.30 when using the full control group (N=5,000) and 1.38 for the non-local control group (N=1,500). The Biomedical Surveillance Sub-cohort, with 4,500 workers and 500 controls, provides adequate statistical power to detect odds ratios of at least 1.59 when 25% of workers received a given exposure and the incidence or prevalence of disease is 10%. For perspective, estimated relative risks of lower respiratory tract symptoms observed among clean-up workers in previous oil spills ranged from 1.5 to 3.6 [Janjua, et al. 2006, Zock, et al. 2007, Meo, et al. 2009, Sim, et al. 2010]. Thus GuLF STUDY is sufficiently powered to observe such prevalence or relative risks for these outcomes.

Table 3. Minimum detectable odds ratios for a range of proportions of exposure among the workers and for all controls vs. non-local controls, based on a two-sided test with α=5% and power=80%

Size of control group (i.e., all vs. non-local)	**Proportion (N) of workers exposed to a given agent**					
	5%	**10%**	**25%**	**50%**	**75%**	**100%**
Full cohort: 43,000 workers, 12,000 controls:						
	N=2,150	N=4,300	N=10,750	N=21,500	N=32,250	N=43,000
Proportion of controls with outcome=1%						
12,000[a]	1.74	1.56	1.41	1.35	1.33	1.32
2,500[b]	2.02	1.86	1.76	1.72	1.71	1.70

Proportion of controls with outcome=10%						
12,000[a]	1.23	1.17	1.13	1.11	1.10	1.10
2,500[b]	1.30	1.25	1.22	1.21	1.21	1.21
Proportion of controls with outcome=30%						
12,000[a]	1.15	1.11	1.08	1.07	1.07	1.07
2,500[b]	1.19	1.16	1.14	1.14	1.14	1.13

Active Follow-up Sub-cohort: 15,000 workers, 5,000 controls:

	N=750	N=1,500	N=3,750	N=7,500	N=11,250	N=15,000
Proportion of controls with outcome=1%						
5,000[a]	2.33	1.98	1.71	1.59	1.55	1.53
1,500[b]	2.66	2.34	2.11	2.02	1.99	1.97
Proportion of controls with outcome=10%						
5,000[a]	1.40	1.30	1.21	1.18	1.17	1.16
1,500[b]	1.47	1.38	1.31	1.29	1.28	1.28
Proportion of controls with outcome=30%						
5,000[a]	1.26	1.19	1.14	1.12	1.11	1.11
1,500[b]	1.31	1.25	1.20	1.19	1.18	1.18

Biomedical Surveillance Sub-cohort: 4,500 workers, 500 controls:

	N=225	N=450	N=1,125	N=2,250	N=3,375	N=4,500
Proportion of controls with outcome=1%						
500[a]	4.62	3.86	3.32	3.11	3.04	3.00
Proportion of controls with outcome=10%						
500[a]	1.92	1.73	1.59	1.54	1.53	1.52
Proportion of controls with outcome=30%						
500[a]	1.60	1.47	1.38	1.35	1.33	1.33

[a] All controls in cohort/sub-cohort
[b] Non-local controls in cohort/sub-cohort

Minimum detectable differences for continuous outcomes are presented in Table 4. Differences are expressed in standard deviations (SDs) and are based on a two-sided test with α=5% and power=80%. Results are shown separately for analyses of the full cohort and of the Active Follow-up Sub-cohort including all controls or including only the non-local controls. In addition, estimates are shown for analyses of the Biomedical Surveillance Sub-cohort. This table demonstrates that the present study has sufficient

power to detect small differences in continuous outcomes. For example, in an analysis of the full cohort that examines an exposure of 10% prevalence, we will be able to detect minimum differences of less than 0.050 SD for the full cohort and 0.070 SD for the non-local cohort. A similar analysis in the Active Follow-up Sub-cohort will be able to detect minimum differences of less than 0.082 SD when using all 5,000 controls and 0.102 when using the 1,500 non-local controls. Such an analysis in the Biomedical Surveillance Sub-cohort will have sufficient power to detect a minimum difference of 0.182 SD. For perspective, in a study of volunteers involved in the Prestige oil spill clean-up and unexposed controls [Laffon, et al. 2006], results of the comet assay in peripheral blood leukocytes showed differences between the two groups of approximately 4.3 SD in comet tail length. A study of health effects related to the Tasman Spirit oil spill found a difference of about 0.6 SD in symptom scores between coastal residents affected by the spill and persons living away from the site of the spill [Janjua, et al. 2006]. The present study is very well powered to detect such effects.

Table 4. Minimum detectable differences, in standard deviations, for continuous outcomes for a range of proportions of exposure among the workers and for all controls vs. non-local controls, based on a two-sided test with α=5% and power=80%

Size of control group (full vs. non-local)	**Proportion of workers exposed to a given agent**					
	5%	**10%**	**25%**	**50%**	**75%**	**100%**
Full cohort: 43,000 workers, 12,000 controls:						
	N=2,150	N=4,300	N=10,750	N=21,500	N=32,250	N=43,000
12,000[a]	0.066	0.050	0.037	0.032	0.030	0.029
2,500[b]	0.082	0.070	0.062	0.059	0.058	0.058
Active Follow-up Sub-cohort: 15,000 workers, 5,000 controls:						
	N=750	N=1,500	N=3,750	N=7,500	N=11,250	N=15,000
5,000[a]	0.110	0.082	0.061	0.051	0.048	0.046
1,500[b]	0.125	0.102	0.086	0.079	0.077	0.076
Biomedical Surveillance Sub-cohort: 4,500 workers, 500 controls:						
	N=225	N=450	N=1,125	N=2,250	N=3,375	N=4,500
500[a]	0.217	0.182	0.151	0.139	0.134	0.132

[a] All controls in cohort/sub-cohort
[b] Non-local controls in cohort/sub-cohort

Finally, power calculations indicate that even if participation rates turn out to be as much as 20% lower than expected, the minimum detectable ORs or differences will increase by less than 10-15%.

7 Analysis Plan

7.1 Primary Endpoints

Given the very limited health effects research conducted to date on oil spill clean-up workers, the GuLF STUDY is designed not around a particular *a priori* hypothesis, but rather to allow investigation of a wide range of potential adverse health effects, including physical, psychological, and biological effects. These include both short-term and long-term effects focused on, but not limited to, the following areas: respiratory, cardiovascular, hematologic, dermatologic, neurologic, cancer, reproductive, mental health, immunologic, hepatic, and renal. A priori outcomes of greatest interest based on previous studies are respiratory effects, neurological dysfunction, and genotoxic and hematologic effects.

Questionnaire-based exposure information will be examined in relation to outcomes in both prospective and cross-sectional analyses in the full cohort or sub-cohorts. Because many biological and environmental assays are expensive and samples are limited, we also plan to carry out nested case-control or case-cohort studies within the cohort.

Many of the primary exposure measures will be from job-exposure matrices (JEMs), which will be developed by the investigators using time-specific task and exposure data from a range of sources. These will be semi-quantitative (e.g., 5-point scale). They will be treated in statistical analyses as ordinal values or, depending on distribution or scientific considerations, collapsed into fewer categories (e.g., high vs. low).

Endpoints will be identified through several means. First, we will use the self-reported health information provided in the enrollment interview(s) to define case groups or to assign quantitative or semi-quantitative health categories for a given outcome or constellation of outcomes, as appropriate. Self-reported health histories from this interview will be used to identify outcomes with an onset or increase in severity after the subject began clean-up work (i.e., not a pre-existing condition). Some self-reported health information may be validated in sub-studies through subsequent information provided, with participant permission, by the subject's doctor, the subject's medical record, and/or the subject him/herself. Second, we will have clinic information such as the FEV1/FVC results collected at enrollment from all subjects who live within the immediately affected areas and the urinary glucose results obtained at enrollment from all subjects.

We will examine results of a Complete Blood Count (CBC) with white blood cell differentials among members of the Biomedical Surveillance Sub-cohort. Endpoints will include total WBCs, individual WBC components, red cell measures, and platelets. White blood cell and platelet counts have been found to be significantly reduced among workers with low exposure to benzene, with reduced hemoglobin concentration among workers with higher exposure to benzene [Lan, et al. 2004]. To explore potential effects of metals, particulates, and stress, we will examine measures of the acute phase response (C-reactive protein), inflammatory cytokines, as well as anti-nuclear and thyroid antibodies. We will also examine results of the urinalysis (for protein, creatinine, blood, leukocytes, nitrite, glucose, ketone, pH, and specific gravity) among members of the Biomedical Surveillance Sub-cohort.

In subsets of the Active Follow-up Sub-cohort or the Biomedical Surveillance Sub-cohort defined by higher or lower stress exposure and in vulnerable sub-populations, we will also examine antibodies to latent viral infections as indicators of sub-clinical depressed immunity. Antibodies to latent infections have been studied frequently in relation to the physiological impact of stress, and may vary according to socioeconomic factors [Aiello,

et al. 2009, Dowd and Aiello 2009]. We will also examine stress-associated immunosenescence as indicated by average leukocyte telomere length and stress biomarkers [Epel, et al. 2004, Parks, et al. 2009], which along with viral antibodies may be related to a variety of chronic disease outcomes. Such tests may be performed using baseline samples or, for the Biomedical Surveillance Sub-cohort, samples collected at subsequent visits may be utilized.

For a subset of subjects representing high and low exposures to agents known or suspected to be nephrotoxic, including volatile organic compounds and heavy metals, and also unexposed subjects, we will examine urinary markers of kidney injury, including N-acetyl-beta-D-glucosaminidase (NAGs), beta-2 microglobulin, microalbuminuria, neutrophil gelatinase-associated lipocalin (NGAL), interleukin-18 (IL-18), kidney injury molecule-1 (KIM-1), and liver-type fatty acid binding protein.

We will similarly conduct liver function tests using sera from a subset of subjects having either high or low exposures to agents known or suspected to alter liver function, including volatile organic compounds, PAHs, and heavy metals, and also unexposed subjects.

For a subset of subjects representing high and low exposures to agents known or suspected to be genotoxic, including volatile organic compounds, heavy metals, PAHs, and hydrogen sulfide, and also unexposed subjects, we will examine results of DNA damage assays, The specific assays will be determined, based on the current state of the art around the time that we are ready to undertake these analyses, as described above in section 3.11.3. They may include the comet assay and the micronucleus test. Comet assay measures will include the tail moment, defined as the product of the percentage of DNA in the comet tail and the tail length, and the tail intensity, defined as the percentage of DNA in the tail. Micronucleus test measures will consist of the frequency of micronuclei and the frequency of binucleated micronucleated cells.

During follow-up of the cohort, we will identify incident outcomes or changing severity of those outcomes via self-reported health status in follow-up interviews, via linkage with cancer and vital status registries, and via testing of follow-up biospecimens. Our analyses will consider onset or changes in severity relative to both enrollment health status and health history, as appropriate. For some subjects, such as Coast Guard members, we may be able to obtain additional information from electronic medical records.

Continuous outcome measures such as FEV1/FVC will be treated as continuous and/or categorized according to appropriate cutpoints in statistical analyses. They will be log-transformed as needed.

Initial analyses will be largely descriptive, including examination of distributions of jobs, exposures, demographic and lifestyle factors, health history, and recent health outcomes at enrollment. We will quantify and examine patterns of missing data and outliers. We will perform data cleaning as appropriate. To the extent possible, we will explore potential bias in subject selection and reporting.

We will next conduct cross-sectional analyses, consisting primarily of comparisons of prevalence or extent of a given outcome by clean-up task or estimated exposure to a given factor (from the JEM). These will be performed using least squares regression for continuous outcomes or logistic regression for dichotomous outcomes, adjusted for confounders as appropriate. We will explore possible modifiers of effect such as race,

sex, baseline health characteristics, lifestyle factors, and access to health care by also conducting stratified analyses by these factors, as appropriate and as numbers permit.

When follow-up data become available, we will also be able to perform prospective analyses linking clean-up activities/exposures to incident outcomes using Cox proportional hazards regression. We will use logistic regression for nested case-control analyses. Extent of change of outcomes will be assessed using least squares regression. Confounding and effect modification will be addressed as described above.

Clinical protocols for a number of outcomes, including respiratory and neurologic effects, will be developed and carried out in collaboration with local university partners identified through a request for proposals (RFP). Therefore, analysis of these outcomes will be addressed in a later protocol.

8 Training, Quality Control, and Quality Assurance

8.1 Staff Recruitment and Enrollment Process

8.1.1 Telephone Interviewers

Locating and screening tasks will be conducted by approximately 50 trained telephone interviewers working part time over different shifts. Interview staff will be given training on good practices in interviewing—locating, gaining cooperation, overcoming barriers to participation and correctly coding outcomes, and American Association for Public Opinion Research (AAPOR) code of ethics which includes training on confidentiality and non-disclosure, and other training in human subjects research. Trainees also receive interactive cultural competence training. Administrative aspects of the computer-assisted telephone interviewing (CATI) system and time record keeping are practiced.

The training program will be tailored to meet the specific needs of this study, including a discussion of successful approaches for conducting interviews with people facing the continuing life disruptions following Hurricanes Rita/Katrina and now the BP oil spill. Interviewers will learn the best methods for refusal avoidance and conversion techniques, and will receive extensive hands-on training with the Computer-Assisted Interviewing (CAI) questionnaire. They will also learn the most effective ways to explain the importance of participating in the study, and how to best answer questions about the study's purpose and process. Interviewers will be trained to make respondents aware of other sources of information about the study, such as the study website. Training will include sensitivity exercises designed to ensure that interviewers show unconditional positive regard for participants. Interviewers will be trained to use positive rather than patronizing language, use structured probes, check for respondent fatigue, and offer encouragement without leading the respondent to respond in a specific way. The training will focus on the three general challenges in interviews—communication, stamina, and cognitive challenges—and specific recommendations for overcoming these challenges.

Each training topic will be reinforced with group discussion and interaction, trainer demonstrations, and classroom practice and discussion. Role-playing and practice will be used.

Confidentiality safeguards will be maintained throughout the data collection period. All study personnel will be trained in their responsibilities under HIPAA to protect the confidentiality and privacy of each participant's personal health information. The training

will also describe the civil and criminal penalties if an interviewer violates a participant's right to privacy. All interviewing staff will be required to sign a Confidentiality Agreement and an Affidavit of Nondisclosure as part of their training on protecting the privacy and rights of respondents. Training will also include identification of social and mental health issues in need of intervention and appropriate protocols for seeking outside support or making community referrals.

Individual Telephone Interviewer performance will be monitored by Telephone Supervisors using Computer Assisted Telephone Interviewing (CATI) and telephony technology that permits silent monitoring of voice together with key-stroke by key-stroke monitoring within the CATI instrument. The supervisors will systematically select interviewers for monitoring and will formally evaluate performance providing praise or corrective feedback, as appropriate. Evaluations are maintained in individual interviewer performance files and are regularly reviewed by the call center manager for purposes of performance recognition, performance improvement coaching or dismissal.

The call center manager will frequently review recruitment and enrollment statistics in the study database to ensure that participants are being enrolled consistent with the distribution of the various study populations of interest in the selected sampling frame. Weekly reports will summarize recruitment statistics which also will be discussed at weekly project meetings. If it appears that too many or not enough of given subgroups are being enrolled, study staff and investigators will meet with SSS's statistical and programming staff to consider adjusting the calling cue to rebalance the recruitment calls as appropriate. SSS's Director of Survey Activities will closely monitor day-to-day call center activities to ensure that call center staff is closely adhering to recruitment and enrollment quality and productivity goals.

8.1.2 Home Visit Personnel

Home visits will be conducted by as many as 60-80 home visit agents (HVA) and 8-12 Regional Managers (RM). In this study, it will be important to retain HVAs with particular aptitude, skill, and sensitivity in working with persons having experienced natural disaster, life disruption, and probable dislocation.

Training for home visit data collection will start with a Regional Manager training sessions that precede the HVA training. This RM training will focus on data collection procedures, management of HVAs, the importance of data quality and cost containment, and reporting. Following the RM training, training sessions will be held for the HVAs. The field data collection trainings will be conducted both in person and over the internet. The training sessions will consist of large-group exercises, demonstrations, round-robin and dyad mock interviews, and question-and-answer sessions. HVAs will be trained and tested on their mastery of the ethics and protection of human subjects in research, establishing rapport, setting visit dates, obtaining informed consent, and administering questionnaires. They will also be trained in the clinical portion of the study protocol and tested specifically on the clinical protocol components to include setup, preparation and shipping of biological samples. The training will also include practice session. The HVA will practice the complete baseline protocol under the close supervision of the field supervisors and trainers.

Periodically, RMs will accompany the HVA for follow-up assessment of performance. Deviations from protocol evidenced in the receipt of data or specimens will be reported to project management staff at SSS and the RM will follow-up with corrective training or

dismissal of the HVA as appropriate. The investigators and the NIEHS IRB will be informed of all deviations.

Field activities will be closely monitored by SSS's Director of Laboratory Services and the Home Visit Coordinator who will monitor field operations and the Storage Coordinator, who will monitor activities of the central processing laboratory, the testing laboratory and archiving of specimens at the NIEHS Repository, managed by Experimental Pathology Laboratories.

The Home Visit Coordinator will monitor home visit activities to ensure that these are proceeding according to schedule. The Home Visit Coordinator will interact with the RMs on a frequent/near daily basis to ensure that HVAs are receiving home visit assignments and that they are receiving the necessary home visit supplies to complete the visits in a timely manner. The Storage Coordinator will also ensure that HVAs are processing and shipping the collected study specimens immediately upon completion of the visits and closely monitor arrival of collected study specimens at the CPL and will ensure that these are being processed according to the study protocol. The Storage Coordinator will also ensure that processed samples are being routinely transferred to the NIEHS Repository under appropriate transport conditions. The Storage Coordinator will also work closely with the Repository Staff to ensure that study samples are entered into storage and that final storage locations (e.g., freezer, shelf/rack/box/column/row) are sent to SSS for import into the study database.

8.1.3 Monitoring of Recruitment and Field Activities

Recruitment, retention and field operations are a challenge in most studies. SSS will generate routine reports for the investigators that summarize recruitment, enrollment, and retention rates, as well as outcomes of operation processes. Frequent reviews of study status reports will allow the investigators and SSS to identify problems early and make adjustment to keep enrollment and study operations on track. Examples of the types of reports that SSS will generate include:

- Call center reports that monitor telephone questionnaire outcomes, such as call rescheduling (soft refusal) rates, duration of interviews, and points of break-off for incomplete interviews.
- Enrollment reports that present contact and participation rates for the telephone enrollment questionnaire both overall and for different demographic subgroups.
- Home visit reports that monitor outcomes of field activities, such time required to schedule appointments, no-show and reschedule rates, missed procedure rates, and duration of visits.

8.1.4 Personal Safety

During our training sessions for HVAs, we will emphasize the importance of safety during in-home visits and awareness of local laws and regulations. For example, we will instruct the HVAs to stay on main thoroughfares and well-lighted routes as much as possible when traveling and give them the option of terminating a visit if there are safety concerns. The police and sheriff's departments will be informed of the project's presence in their county/parish. Each HVA will be issued a cell phone that they can use to make emergency calls during travel to or from subjects' homes as well as during the visit. SSS is also making provisions for HVAs to request an escort for home visits in

neighborhoods where there may be safety concerns or for home visits during evening hours or to remote locations.

Regional managers will—if not already familiar with their assigned area of operation—consult with local law enforcement officials to determine what, if any, "trouble spots" may exist in their area. When participants who live in these areas are scheduled for home visits, the Regional Managers will share this information with the HVAs so that escorting arrangements can be made and extra travel precautions can be made as necessary. In addition, we will work with local health departments and other community groups to find alternate locations in which to conduct interviews if safety is a major concern.

After training, each HVA will have a fundamental and operational knowledge of the following principles:

- Come prepared for the neighborhood, based on the informal information gathered from the scheduling call, a preview of the neighborhood, and information from your supervisor,
- Always be aware of your environment
- Leave the house and reschedule if you think it is necessary for your safety,
- When concerned about an area or participant, keep your supervisor aware of when you are to arrive and when you expect to leave,
- Call your supervisor when you do leave.
- Emergency telephone numbers are programmed for speed dial into each HVA's cell phone

8.1.5 Mandatory Reporting Requirements

In addition to personal safety training, the HVAs will be trained to detect signs of turmoil and abuse in the homes. Should a HVA witness signs of child, spouse or elder abuse while in the participant's home, the HVA will immediately generate an incident report and transmit this to their Regional Manager and to the Coordinating Center. The Coordinating Center will immediately contact the NIEHS Project Officer and after appropriate consultation will report the situation to local authorities in accordance with applicable laws.

8.1.6 Identifying and Dealing with Mental Health Issues, Domestic Violence, and Acute Physical Illness

Study staff may encounter participants who are experiencing mental health issues, domestic violence, or acute physical illness when they interact with participants over the phone (i.e. on the study hotline or during telephone interviews) or during home visits. Staff will be trained to handle these situations according to standardized procedures that are adapted from approaches developed by the CDC and SAMSHA. In brief, the general approach involves study staff assessing the level of risk and taking appropriate action to prevent harm to the participant or others.

8.1.6.1 Mental Health Issues

Due to the economic, social and potential health impacts of the oil spill, staff may encounter potential recruits and study participants who are experiencing mild to severe psychosocial distress. Call center and field staff will be trained to remain neutral when asking questions or responding to issues related to physical or mental health conditions

and socioeconomic status and to reply with sensitivity. In most situations, mild distresses can be effectively addressed with an empathetic and respectful listening, allowing study activities to continue as planned. When these approaches fail, study staff will offer to provide health care referrals and to continue study activities at a later date. Staff will also be trained to respond to more serious signs of mental health distress, such as suicidal or homicidal thoughts, that require additional interventions. Those who express such thoughts will be assessed for signs of acute distress and asked if they have plans, intentions, and means to act on their thoughts. Based on these assessment findings, study staff will take appropriate action, as summarized in Table 5 below.

Table 5. Action Plan for Responding to Suicidal and Homicidal Thoughts

Individual at Risk	Imminent Danger*	Action
Self	No	• Continue study activities, depending on level of emotional distress • Offer a health care referral • Offer to "hotlink" to National Suicide Prevention Hotline
Self	Yes	• End study activities • Offer to "hotlink" to National Suicide Prevention Hotline • Call 911, if referral to hotline is declined • Escalate to study managers and investigators
Other	No	• Continue study activities, depending on level of emotional distress • Offer a health care referral
Other	Yes	• End study activities • Call 911 • Escalate to study managers and investigators

* Homicidal or suicidal thoughts combined with plans, intention, or means to act on thoughts.

8.1.6.2 Domestic Violence

Study staff may encounter domestic violence situations when interacting with participants over the phone or during home visits. In cases where telephone interactions result in direct evidence (e.g. pleas for help) or indirect signs (e.g. screams, guns shots) of domestic violence, study staff will offer to call 911. If the phone call ends abruptly, study staff will initiate a call to 911. Field staff will be trained to immediately leave the home setting if domestic violence situations arise and to call 911 as soon as they are in a safe location. Study managers and investigators will be informed of these incidents immediately after 911 is notified of the situation.

8.1.6.3 Acute Physical Illness

Study staff will be trained to contact 911 when they encounter potential recruits and study participants who are displaying signs and symptoms of acute physical illness. In addition, field staff will be certified and trained to provide basic first aid and life support, if needed, and will help participants and families access emergency care.

8.1.6.4 Escalation and Documentation

Study supervisors and managers will be immediately notified of all cases involving active suicidal or homicidal thoughts (i.e. thoughts combined with intentions, plans, or means), domestic violence situations, and acute medical emergencies. Upon notification, study managers will notify study investigators and seek advice for any cases that fall outside the standardized response procedures. Study staff will be responsible for completing incident reports to document these situations.

8.1.7 Reporting Individual Results to the Participants

HVAs will be trained to provide participants with appropriate and standard feedback about their individual blood pressure, heart rate and BMI measurements, preliminary pulmonary function test observations, and urine glucose results before departing the participant's home. HVAs will be trained to record all observations and in-home test results in the data management application as well as on participant Test Result Forms that provide the participant with a basic interpretation of the various measurements and test results. HVAs will also be trained to strictly follow scripts when conveying results to participants. The participant Test Result Forms will include scripts that provide recommended actions for participants to take depending on the measured values for each test. For each test result, we provide standard recommendations depending on the result value (see also section 2.11 and the Test Results Forms in Appendix X). **"Normal" results** or expected test values will be relayed as such and the participant will be told that no additional actions are necessary. If test results or measures are **slightly or moderately elevated or abnormal**, the HVA will instruct the participant that he or she should consult with their healthcare provider at an interval defined by the test in question to discuss the significance of these results. If test results or measures are **markedly elevated or abnormal**, the HVA will instruct the participant to seek medical evaluation as soon as possible. HVAs will be trained not to offer any medical advice or to discuss study results in more detail or to engage in general discussions with the participant about any health-related issues.

HVAs will ask the participant if they would like information on healthcare facilities in their local area that can provide medical treatment or care. If they receive an affirmative response, the HVA will use the GuLF STUDY Resource Guide to provide a list of local providers. If the participant declines, the HVA will re-emphasize to the participant that there are local providers available and that they can contact the study helpline at any point to receive information about resources that are available to them.

The HVA will note in the CAPI system which resource contacts were provided to the participant as well as what follow-up recommendations were given. When these data are uploaded to the network, the system will auto-generate reports of participants who should receive follow-up calls to assess whether the participant contacted their healthcare provider or one of the healthcare/mental health resources provided by the HVA (or interviewer).Once specimens from participants who are members of the Biomedical Surveillance Sub-cohort have been transported to and processed by the Central Processing Laboratory, additional test results such as the complete blood count with white blood cell differential and a complete urinalysis will be performed by the diagnostic laboratory and the results will be entered into the study database. Additionally, pulmonologist interpretations of the pulmonary function test results will also be captured in the study database. The data management system will then generate a test result letter and an enclosure with a complete summary of all test findings along with

their interpretations and recommendations for follow-up that will be sent to the participant.

In rare event that the central diagnostic lab identifies clinically significant abnormalities that are not included in results letters for participants, we will contact the participant by phone, present the findings, and encourage the participant to follow-up with their health care provider. We will also mail the participant a copy of the laboratory report with a cover letter encouraging them to see their health care provider. In the event that the participant does not have a health care provider, we will offer a referral to a local clinic that provides care for free or at a reduced cost.

8.2 Data Quality Control

8.2.1 Data Collection Quality Control

At the core of our data collection efforts, we will use a commercially available survey platform. The platform has the following features:

A flexible interface for loading complex sample data initiates and drives study recruitment activities.

A Computer-Assisted Telephone Interview (CATI) component that guides project personnel through the interview process to determine eligibility. This component provides complex branching and algorithm support to collect data, make eligibility determinations, schedule future contact and direct the management of the new recruit's case to regional field supervisors. The CATI system allows data managers to monitor the recruitment process and all call center operations and success metrics. All CATI data are updated and managed in the central data management system. A notification system text-messages all receiving field representatives and managers when new cases are assigned to them.

A CAPI component running on field laptop computers to administer study questionnaires and capture clinical evaluations. The CAPI component guides field personnel through a questionnaire that has complex and conditional branching as well as rostering. The CAPI system provides real-time data validation, ensuring data are valid when captured and the immediate correction of data after an error is detected.

A central management tool ensures that all CAPI and CATI data are collected into a single repository and manages the aggregation of laptop interview data. Field representatives connect to the communications portal (described below) using secure internet technology, and automatically upload collected interview data and download preparatory data for forthcoming interviews. CATI user data are managed via the same software tool that reads and writes data directly to the database.

8.2.2 Data Storage

All study data are housed in a single SQL Server data repository stored in the secure data center. This single database ensures that all system users are accessing the same database; allows for greater control via role-based access privileges; provides a robust architecture to support backup, security, and disaster recovery; and provides the flexibility needed to change the data input mechanisms that could change during a potentially very long study.

8.2.3 Data Management & Communications

The communications portal provides a single access point for all study data, reports, status updates and communications. The communications portal provides the ability to record, track, and analyze information associated with all types of case management activities such as scheduling, field interviews, tracking, and data acquisition. Project field personnel and other authorized project personnel connect to the communications portal over the Internet, go through an authorization process to establish an SSL connection, and have access to a variety of functions that support their work. These functions include the ability to:

- Upload and download interview data
- Update interview schedules; view upcoming workloads for self or field staff (for supervisors)
- View data completeness reports including status of lab data
- Receive updates from project management including updated modules, with training provided
- Transmit laboratory data, receive validations
- Report and track errors or technical support needs and follow them to closure
- Receive warnings about overdue lab data transfers
- Update participant profile information if within user rights
- Keep track of project personnel; review training completeness reports and training records
- Monitor call center performance

Field representatives or managers connect to the Data Management System (DMS) using laptops with real-time, whole-disk encryption. Data will be transferred from the laptop to the DMS over the Internet or using smart phone tethering technology to gain Internet access. The DMS is integrated with email, enabling key events to trigger emails accessible via smart phones, ensuring that our distributed workforce is as current with information as possible. Regular data transmissions are required of all field personnel and phone email messaging prompt field staff to establish a data upload session if overdue.

The communication portal is key to the success of this project as it provides the most timely, accurate information and delivers it to project staff in real-time. For example, it is crucial that supervisors monitor recruitment and enrollment trends, and compare these results against various call center operations to improve overall recruitment success rates. Furthermore, enrollment success measures are compared based on time of day, call center operators, source of telephone number, and ordinal number of call attempts in order to identify trends that suggest necessary modifications.

8.3 Laboratory Procedures

8.3.1 Laboratory Data Quality Control

The study laboratories that will be selected to analyze the study specimens will be evaluated in part based upon their existing performance measures to assure the quality of their testing results. This includes (1) internal and external quality control and proficiency testing programs, (2) testing methodologies *vis à vis* industry standards such as those published by the Clinical Laboratory Standard Institute (CLSI) and the American Industrial Hygiene Association (AIHA), (3) assay standardization to ensure the desired analytical range and sensitivity/specificity, and (4) methodology validation and analytical instrument performance using CLSI standard GP-31A and others, and pre- and post-analytical processes such as specimen receipt and accessioning, sample aliquoting and batching, treatment of out-of-range results, reporting, and electronic data transfer.

A continuing performance review on both external and internal quality control programs will be conducted prior to commencing study data collection. Once home visits have begun and biospecimens and environmental specimens are submitted for analyses, test reproducibility and accuracy will be monitored as follows:

- *Assay Variability/Reproducibility:* Intra-assay (measurement) variability will be assessed through replicate assays conducted on the same day and in the same run. Inter-assay variability will be assessed through replicate assays conducted on different days in different runs.
- *Testing Accuracy:* Assessing the accuracy of test results presumes that there are available “gold standards” for each analyte of interest. While it is possible to quantitatively determine the amount of some analytes present (generally chemical compounds such as cotinine, lead, BFRs, and phthalates), definitively quantifying biological analytes such as IgE allergens, endotoxins, mold, and fungi, or volatile analytes such as formaldehyde and VOCs is more problematic and assay dependent. Biospecimen controls, environmental controls, and split specimens will be implemented for this purpose.

Laboratory testing quality will also be monitored by requiring submission of regular QC results as well as periodic proficiency testing program results. Modifications to testing procedures or sample processing/ extraction procedures will be avoided or minimized to the extent possible.

8.3.2 Quality Control Specimen Collection

To preserve valuable study subject materials, we will collect biospecimens and environmental samples from up to 200 randomly selected anonymous donors to use for quality control. These will be used to create samples that can be inserted blindly for quality control when laboratories process or analyze GuLF STUDY samples, to assess drift over time in laboratory analyses, and to provide a sample source for assay development and testing. These samples will be in addition to the quality control samples that will be collected from a random subset of cohort members and that are essential for analyses requiring serial samples or known representativeness of the study

cohort. The volunteers providing these samples will be selected to be roughly similar to the clean-up worker population. Each person will provide blood, urine, saliva, hair and nail clippings, and household dust samples. Blood will be stored as serum, plasma, and blood clots in cryovials in vapor phase liquid nitrogen. Urine will be stored in cryovials in vapor phase liquid nitrogen. Dust wipes and hair samples will be stored at -20℃. Toenail samples will be stored with desiccant under controlled ambient temperature and humidity. We will collect these samples from anonymous donors under a separate protocol.

8.4 Run-in Period

Study personnel, procedures and forms will need to be tested in order to determine whether planned data collection efforts will yield valid and reliable results in the most time and cost efficient manner. We plan to conduct a 4-5 week run-in period of the study. We aim to recruit N~2,000 participants during the run-in period and schedule as many in-home visits as possible during this time. This will establish a vanguard group of participants to allow us to test the questionnaires and, as the participants move through the phases of the study, the protocols to ensure that the GuLF STUDY data collection efforts will work as planned. We will evaluate the data from the field as it becomes available and any necessary alterations in the study protocol that will need to be made can be identified and adjudicated accordingly based on the results of this vanguard group. The IRB will be notified of any necessary changes to the protocol.

9 Human Subjects Protections

9.1 Institutional Review Board

The investigator will submit the protocol, informed consent form, questionnaires, proposed recruitment materials, and other materials for participants to the NIEHS IRB for review and approval. Subjects will not be enrolled until the submission has been approved in writing by the IRB chair. Once the protocol is approved, the principal investigator will be responsible for obtaining IRB approval during annual Continuing Review for the duration of the study.

The principal investigator will submit and obtain approval from the IRB for all amendments to the protocol, informed consent form, and other study documentation referenced above. Amendments will not be implemented without prior IRB approval, except where necessary to eliminate immediate hazards to participants. The principal investigator will report adverse events, protocol deviations, inadvertent loss or disclosure of data, and loss of samples in accordance with IRB policies.

9.2 Informed Consent Process

Informed consent is an ongoing, interactive process that is initiated when the discussion regarding study participation begins and continues throughout the study. The consent process will begin with a lead letter and study brochure that provides an overview of the study and what it means to participate. During the telephone enrollment call, recruiters will explain the reason for the call, reference the lead letter and brochure that were sent by mail in advance of the call, introduce the study, and seek verbal consent for the initial screening and enrollment process. Participants will be informed that they will receive an

annual Newsletter for the duration of the study and be asked to provide periodic contact information updates. The elements of passive follow-up via linkage with Cancer Registries, Vital Statistics and other data sources will be described and verbal consent will be obtained. They will also be informed about data sharing policies and that they may be contacted for potential participation in related studies but that they would have an opportunity to consent or not consent at that time.

Those who are eligible for participation in the Active Follow-up Sub-cohort will receive additional information about the study and will be invited to schedule a home visit. Field staff will obtain written informed consent from participants prior to conducting any study activities during the home visit. In order to ensure that participants make an informed decision about enrollment, field staff will review the study's purpose, procedures, risks, and benefits, as well as the rights of research participants. Explicit consent will be sought for sharing individual-level data with qualified researchers committing to maintain participant confidentiality and comply with their consent provisions, similar to NIH policies for data sharing in genome-wide association studies (http://grants.nih.gov/grants/gwas/).

Field staff will allow the participant ample time to review the consent, ask questions, and obtain clarifications regarding the study prior to agreeing to enrollment. After voluntarily agreeing to take part in the study, participants will be asked to sign and date a current IRB-approved informed consent form. Field staff will return the signed consent to SSS for storage in the central study file. A copy of the consent form will be provided to the subject along with a summary of the key points in the consent document and a study FAQ document – a series of answers to questions participants may have about aspects of the study.

The consent form will contain contact information (i.e., toll-free phone number) for study staff that will be available to answer questions that may arise after the visit. Questions about study participation will also be addressed at the time of follow-up interviews.

Passively followed participants will receive an enrollment packet after the enrollment call is completed. The packet will contain information that describes the study and provides contact information for study staff, including the toll-free study phone number and address for the study website. They will receive a description of what they agreed to during the telephone call and will be provided with information on how to withdraw from the study if they have changed their mind about long-term passive participation.

Participants who are invited to complete the Follow-up Telephone Questionnaires will receive an advance mailing that provides an overview of the additional telephone interviews. The telephone interviewer will review the purpose of the interview and the participant will provide verbal consent prior to answering any questions.

All participants will receive an annual newsletter that contains updates about study progress and findings (see Section 3.L.ii – Newsletters).

9.3 Participant Confidentiality

All study personnel will be required to complete on-line training in the protection of human research subjects. The investigators and study staff will strictly maintain participant confidentiality. This confidentiality will be extended to cover questionnaire data, clinical assessments, biological samples, and environmental samples.

All study-related information will be stored securely. All study datasets, laboratory specimens, and administrative forms will be identified by a coded number in order to maintain participant confidentiality. All records that contain names or other personal identifiers will be stored separately from study records identified by code number. All databases will be secured behind firewalls with password-protected access systems. Worksheets, lists, logbooks, appointment books, and any other documents that link participant ID numbers to other identifying information will be stored in a separate, locked file in an area with limited access.

A Federal Certificate of Confidentiality will be obtained for this study. The Certificate will help protect against disclosures of study-related information by Federal, State or local civil, criminal, administrative, legislative, or other proceedings, although it will not guarantee that data cannot be released. Participants will be informed about the certificate during the informed consent process.

9.4 Study Discontinuation

Participants may voluntarily withdraw from the study for any reason at any time. Participants will be informed that unless explicit written instructions are received, investigators will continue to use data and samples collected up to the point of withdrawal although no new information will be collected from them. Study staff will effectively destroy all known remaining biologic and environmental samples by anonymizing the samples using a newly assigned ID number and report what was done to both the subject and to the IRB. This decision will not affect the subject's participation in this protocol or any other protocols at NIH. Anonymizing the samples will effectively terminate any association the samples have with the study participant, fulfilling their request, while simultaneously providing samples that can be used for laboratory QA/QC procedures. However, should the subject specifically request it, we will physically destroy all remaining samples.

Study staff will seek feedback from the participant to determine reasons for discontinuation and to identify any barriers that can be addressed to keep the participant in the study. The reasons for all discontinuations will be recorded in the data collection system and routinely monitored by the investigators. Common barriers to ongoing participation may be addressed by changes in retention strategies or study design.

9.5 Research with Subjects who May be Unable to Provide Consent

Follow-up of the entire cohort is initially planned for at least 10 years. As stated in sections 2.13 and 2.14, health outcomes among the GuLF STUDY cohort will be identified through self-report via periodic follow-up interviews. Participants receive annual newsletters with requests to update contact information and are invited to provide detailed information on changes in health and exposures through biennial follow-up questionnaires. Additional outcome information will be obtained from periodic follow-up clinical evaluations (e.g., spirometry, neurological testing) and analysis of follow-up biospecimens (e.g., immunologic parameters, liver function, renal function, DNA damage). Participants in the GuLF STUDY are contacted regardless of whether they completed the previous follow-up. Procedures and materials for these follow-ups have been reviewed and approved by the NIEHS IRB. In addition to identifying adverse health outcomes related to clean-up activities among the Deepwater Horizon responders,

follow-up of the cohort will allow investigators to continue to assemble information that can be used for prevention and intervention of adverse health outcomes in any future similar disasters.

During the course of follow-up, some participants are reported as deceased or permanently incapacitated due to physical or cognitive impairments. Sections 2.13.3 and 2.13.4 describe some of the procedures planned to conduct passive monitoring for health outcomes among the cohort. All cohort members, including those who choose to end their study participation, die, or become permanently incapacitated, have consented to being followed for development of a range of health outcomes through record linkage (cancer, mortality) and if feasible, through linkage with electronic medical records that may become available during the course of follow-up.

Deceased and permanently incapacitated participants are more likely than others to have experienced significant unreported health changes prior to death or prior to or subsequent to incapacitation. These participants are no longer able to participate actively in study follow-ups, although obtaining information about causes of death and antecedent diagnoses is essential for avoiding bias due to loss of follow-up of informative participants. Therefore, when a death or incapacitating event is reported, the GuLF STUDY will attempt to ascertain the cause through participants' next of kin or legally authorized representative and obtain other information (such as a social security number) that may facilitate record linkage. We will also gather contact information to enable possible collections of additional information in the future. These may include requests for missing health and exposure information or requests for authorization for release of medical records. Next of kin and legally authorized representatives will be informed of the purpose of these information collections, that providing information is voluntary, and will be asked if they assent on the participant's behalf. Risks to subjects, their next of kin, and legally authorized representatives from this data collection will be minimal.

In the case of incapacitated persons, it will not be possible to evaluate if the participant has lost the ability to provide on-going consent without gathering health information and details of the illness or injury. To avoid collecting this health or other personal information without surrogate consent by a legally authorized representative, study staff will not make any assumption about the participant's decision-making capacity when permanently incapacitating situations are reported. The GuLF STUDY will determine the relationship to the participant before collecting additional information. If the relationship is not an immediate family member or legal representative, we will seek a more appropriate person who can provide information and an assessment that the participant no longer has the ability to continue active study participation.

10 Data Handling and Record Keeping

10.1 Data Capture Methods

The core of the data capture system will rely on an industry standard field data collection system, using standard technologies. The system platform must allow for:

- A flexible interface for loading complex sample data initiates and drives study recruitment activities.

- A Computer-Assisted Telephone Interview (CATI) component that guides project personnel through the interview process to determine eligibility. This component provides complex branching and algorithm support to collect data, make eligibility determinations, schedule future contact and direct the management of the new recruit's case to regional field supervisors. The CATI system allows data managers to monitor the recruitment process and all call center operations and success metrics. All CATI data are updated and managed in the central data management system. A notification system alerts all receiving field representatives and managers when new cases are assigned to them.
- A Computer-Assisted Personal Interview (CAPI) component running on field laptop computers to administer study questionnaires and capture clinical evaluations. The CAPI component guides field personnel through a questionnaire that has complex and conditional branching as well as rostering. The CAPI system provides real-time data validation, ensuring data are valid when captured and the immediate correction of data after an error is detected. SSS will prepare all CAPI systems, ship them to kickoff training, train personnel to use the system, and support the laptop PCs and CAPI applications via a toll-free and email helpdesk function.
- A central management tool that ensures that all CAPI and CATI data are collected into a single repository. The centralized data management and aggregation tool will manage the matriculation of data from field interview data platforms to the centralized data repository. Field representatives will connect to the communications portal (described below) using internet SSL technology, and automatically upload collected interview data and download preparatory data for forthcoming interviews.

10.2 Data Management Responsibilities

The captured data will be stored in a comprehensive data management system (DMS) that centralizes study information into an integrated solution. From the time that participants become part of the potential sample to the time they are complete, all project data are managed and tracked in the DMS. Project personnel will have an appropriate "view" into the data using role-based access control. The DMS will support the full scope of study data management activities, including management of study sampling; collection of field and laboratory data; management of participant activities (case management); reporting of all data collection efforts and status; and preparation of analysis datasets.

The heart of the DMS will be the database server. The database server will be configured for 24/7 operation, and provide the capability of offsite backups.

The DMS also includes a communications portal which provides a single access point for all study data, reports, status updates and communications. The communications portal serves as the gateway between users and the data repository. The portal enables the ability to record, track, and analyze information associated with all types of case management activities such as scheduling, field interviews, tracking, and data acquisition. Project field personnel and other authorized project personnel connect to the communications portal over the Internet, go through an authorization process to

establish an SSL connection, and have access to a variety of functions that support their work. These functions include the ability to:

- Upload and download interview data
- Update interview schedules; view upcoming workloads for self or field staff (for supervisors)
- View data completeness reports including status of lab data and abstracted medical records
- Receive updates from project management including updated modules, with training provided
- Transmit laboratory data, receive validations
- Report and track errors or technical support needs and follow them to closure
- Receive warnings about overdue lab data transfers
- Update participant profile information if within user rights
- Track project personnel; review training completeness reports and training records
- Monitor call center performance

Field representatives or managers connect to the DMS using laptops over the Internet or using smart phone tethering technology to gain Internet access. The DMS is integrated with email, enabling key events to trigger emails accessible via smart phones, ensuring that our distributed workforce is as current with information as possible. Regular data transmissions are required of all field personnel, and field staff are prompted to establish a data upload session if overdue.

The communication portal is key to the success of this project as it provides the most timely, accurate information and delivers it to project staff in real-time. For example, it is crucial that supervisors monitor recruitment and enrollment trends, and compare these results against various call center operations to improve overall recruitment success rates. Furthermore, enrollment success measures are compared based on time of day, call center operators, source of telephone number, and ordinal number of call attempts in order to identify trends that suggest necessary modifications.

10.3 Data Access and Sharing

Given the public health importance of research on the health effects of the Deepwater Horizon disaster and its aftermath, results from the GuLF STUDY will be made available for research use by any interested and qualified investigator or organization, within the limits of providing appropriate protection of research participants and compliance with their informed consent. Policies for data access will build on NIH established policies for controlled access to individual-level data in genome-wide association studies, as described at http://grants.nih.gov/grants/gwas/ and open-access data sharing policies developed for other NIH sponsored longitudinal studies. Researchers interested in obtaining controlled-access GuLF data will agree to keep the data secure, use the data only for the approved research purposes, and not to attempt to identify individual study participants. In recognition of the rights and intellectual contributions of the GuLF

investigators to publish data within a reasonable timeframe, outside researchers will also agree to observe a twelve month moratorium on submitting abstracts and publications using the data. Data and documentation will be made publicly available soon after collection along with information on all data that have been or will be collected. Typically (e.g. as currently practiced on dbGaP, protocols, descriptions of data and files, and counts of responses are available online. Summary descriptive tables may also be posted. In order to prevent accidental disclosure of individual participant data, de-identified datasets are separately provided to qualified requesters; individual level data are not posted online. Access to the data will be granted by an NIH Data Access Committee which will ensure that these conditions are met initially and monitor subsequent compliance during the study.

10.3.1 Access to Biospecimens and Use of Cohort for Add-on Studies

Additionally, other investigators (both at NIH and outside) may wish to study the stored biologic and/or environmental samples or propose add-on studies that generate new data and/or involve direct participant contact. In that case, NIEHS IRB approval must be sought prior to any sharing of samples. Any clinical information shared about the sample would similarly require prior NIEHS IRB approval. Procedures and guidelines for proposing new assays or add-on studies will be established and posted. An independent committee will be established to review proposals for scientific merit, feasibility, and impact on the study cohort.

10.4 Study Records Retention

All study records will be retained indefinitely. Study records that will be retained include IRB approvals and correspondence, signed informed consent forms, tracking logs, contact information update forms, and other study documentation that may be developed during the course of the study. To protect against accidental or premature destruction of these documents, the records will be maintained in a secure, locked storage areas that are only accessible to study staff.

All study data will be housed in a single data repository. This single database ensures that all system users are accessing the same database; allows for greater control via role-based access privileges; provides a robust architecture to support backup, security, and disaster recovery; and provides the flexibility needed to change the data input mechanisms that could change during a potentially long study.

Any loss or unanticipated destruction of samples or data (for example, due to freezer malfunction) that meets the NIH Intramural Protocol Violation definition or results in a violation that compromises the scientific integrity of the data collected for the study; will be reported to the NIEHS IRB.

At the completion of the protocol (termination), samples and data will either be destroyed, or after IRB approval, transferred to another existing protocol where they will be maintained in a repository as applicable.

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Addendum 1: Current Environmental Exposures in GuLF STUDY Participants Exposure Monitoring Addendum

I. Overview

The Exposure Monitoring (EM) Addendum is designed to address ongoing concerns among Gulf state residents about potentially higher levels of exposure to oil-spill related chemicals and implications for current and future health. Since the half-life in blood of relevant volatile organic compounds (VOCs) is short (12-24 hours), reports of high levels of chemicals such as benzene, toluene, ethylbenzene, and xylene (BTEX) in blood from Gulf area residents should be due to ongoing environmental, lifestyle, and occupational exposures rather than to the oil spill per se. Yet concern that these reportedly high levels are a direct result of exposure to the oil spill persist, fanned by periodic reports in the media. It is important to determine both the factors that contribute to these potentially higher levels of oil spill chemicals and to explore any relationship between chemical levels and symptom reporting. This information will aid in future interpretation of the larger GuLF STUDY data. The EM Addendum will take advantage of the ongoing GuLF STUDY to cost-effectively collect the needed samples and data to assess current levels of oil-related chemicals and metabolites in blood and identify potential sources and consequences of exposure. The EM Addendum will:

1. Describe current exposure levels in GuLF STUDY participants who are residents in the four states most affected by the Deepwater Horizon disaster – Alabama, Florida, Louisiana, and Mississippi.

    - Compare current exposure levels with data from a national sample of US adults
    - Assess current exposure levels of GuLF STUDY participants in relation to proximity to the Gulf of Mexico, taking into account behavioral and other determinants of exposure

2. Identify factors associated with current exposure levels of GuLF STUDY participants, including potential determinants of exposure and any associations between current exposure levels and health measures.

3. Evaluate correlations between current personal air monitoring data and biological measures for a subset of participants in the EM Addendum.

Measured blood VOC levels will be evaluated in relation to behaviors, environmental and occupational exposures, lifestyle, and oil-spill clean-up experiences as ascertained in the GuLF STUDY baseline questionnaires and additional surveys specific to the EM Addendum. The association between measured levels of biological and environmental exposures and self-reported symptoms and health conditions will be evaluated to address questions of concern to GuLF STUDY communities.

The EM Addendum will take advantage of the operational efficiencies of the ongoing GuLF STUDY by sampling from the GuLF STUDY population - oil-spill clean-up workers and volunteers who reside in communities affected by the April 2010 Gulf of Mexico oil spill and have already agreed to a home visit for the GuLF STUDY. GuLF STUDY participants who reside in Alabama, Florida, Louisiana, and Mississippi will be recruited for biomonitoring and, for a subset of EM Addendum participants, 24-hour personal air monitoring. The EM Addendum will take advantage of ongoing home visits for the GuLF STUDY to enroll participants and collect biological samples and personal monitoring data. Participants will be identified at either the completion of the GuLF STUDY telephone interview or afterwards if the telephone interview is completed and they are selected for a home visit. Those individuals who have completed the telephone interview and are selected for a home visit will receive a recruitment call asking them to complete the EM Addendum during their scheduled home visit.

Approximately 1,000 participants will provide additional blood samples and answer some additional questions during their normal GuLF STUDY home visit. Of those ~1,000 participants, approximately 200 will be asked to also participate in the personal monitoring portion of the EM Addendum which will require participants to wear a personal air monitoring badge for 24-hours prior to the GuLF STUDY home visit.

II. Background

The Deepwater Horizon disaster resulted in the release of over 4.9 million barrels of crude oil into the Gulf of Mexico. During the course of the oil-spill clean-up response, over 150,000 workers and volunteers participated in oil-spill clean-up activities. Community groups have expressed ongoing concerns about exposures and health outcomes they believe to be associated with components of oil and dispersants used to clean-up the oil spill [1]. Reported symptoms among clean-up workers and volunteers included headaches, coughing, dizziness, nausea, exhaustion, and heat stress symptoms [2]. Such symptoms continue to be reported by GuLF STUDY participants, with the frequency of symptoms higher in Gulf than non-Gulf communities (unpublished GuLF STUDY data).

Of particular concern among residents and clean-up workers have been oil-related chemicals such as heavy metals and VOCs. VOCs are aromatic hydrocarbons that occur naturally in crude oil and evaporate quickly (<24 hours) after oil reaches the water surface. VOCs were examined in the Gulf oil plume at 1.5 km depth in June 2010 [3]. Although benzene, toluene, ethylbenzene, and xylenes (BTEX) made up a significant portion of the oil plume, most airborne breathing zone measurements of BTEX collected between April 2010 and October 2010 indicated that BTEX concentrations did not exceed Occupational Exposure Limits during the Gulf cleanup activities [4]. Additionally, heavy metals found in crude oil, including cadmium, chromium, manganese, copper, nickel, and lead, have a range of adverse health effects, including neurotoxicity and carcinogenicity, renal and immunotoxicity[5-12]. However, even at the time of the oil spill, exposures were reported to be very low due to weathering and other properties of the oil. Nonetheless, there is still a high level of community concern about these exposures and resulting health effects.

In other studies, significant associations have been reported between selected VOCs in air (benzene, chloroform, 1,4-dichlorobenzene, ethylbenzene, methyl tert-butyl ether, tetrachloroethane, toluene, m-/p-xylene, and o-xylene) and VOCs in blood [13]. The half-life of VOCs in blood is 24-hours in adults with no ongoing occupational exposure, and blood levels in the U.S. population range from parts per trillion to parts per billion with concentrations elevated among smokers [14-17]. Occupational studies have demonstrated positive associations between personal exposure to VOCs and blood VOC concentrations. In a study of VOC exposure among Mexico City workers, passive VOC monitors were used to assess personal exposures during a work shift and blood samples were drawn immediately after the work shift [18]. Significant associations were observed between job category, personal monitoring VOC concentrations, and blood VOC concentrations. Outside of the occupational setting, environmental exposures to VOCs are predominantly due to emissions from industrial sources, mobile sources, landfill sites, personal time-activity patterns, and building characteristics [19, 20].

Exposures resulting from the Deepwater Horizon Disaster were generally reported to be low for most communities, with the majority of area and breathing zone measurements below the limits of detection in assays designed to measure occupational threshold-level exposures. Government and industry measurement data are mistrusted by some community members, with concern that tests were insufficiently sensitive or not focused to detect exposures related to the spill. Although current levels cannot plausibly be linked to exposures that took place at the time of the spill, case reports of residents and workers with elevated levels of BTEX chemicals in blood continue to appear in the media and to draw attention at community meetings related to the oil spill. Residents of the Gulf region may have ongoing opportunities to be exposed to oil and oil-related constituents through their occupation (e.g. working with degreasers and cleaning agents), recreational and lifestyle behaviors (e.g. smoking), or by residing near industrial facilities. The Exposure Monitoring Addendum will systematically characterize current exposures to oil-related constituents in a sample of approximately 1,000 GuLF STUDY participants.

III. Objectives

The Exposure Monitoring (EM) Addendum aims to investigate exposure to selected metals and volatile organic compounds (VOCs, including benzene, toluene, ethylbenzene, and xylenes) among a subset of GuLF STUDY participants. The following are the objectives of the EM Addendum:

1. To characterize current environmental exposures among participants during the course of their normal daily activities.
2. To describe associations of behavioral, residential, and socioeconomic characteristics with measured levels of heavy metals and VOCs among participants.
3. To explore associations between EM Supplement measured exposures and health outcomes reported in the GuLF STUDY questionnaires.

IV. Population

Participants will be recruited for the EM Addendum from among those completing the GuLF STUDY telephone interview and agreeing to the home visit. For those individuals who have already completed the telephone questionnaire but not the home visit, we will place recruitment calls to invite them to complete the EM Addendum in addition to their home visit. The goal is to have 1,000 participants complete the EM Addendum, including providing the additional blood samples and answering the extra questionnaire items. Due to operational challenges and participant preferences, we anticipate that some participants will provide either the blood samples or the questionnaire data, but not both. In these incomplete cases, we plan to keep the data or samples that are obtained. Thus, we will invite approximately 1,200 GuLF STUDY participants to achieve a sample size of approximately1,000 fully compliant cases for the EM Addendum.

We will recruit participants from Alabama, Florida, Louisiana, and Mississippi (from any home-visit eligible GuLF STUDY county or parish) prospectively at completion of the telephone interview as well as from among those who have already completed the telephone interview but have not yet completed their home visit.

We plan to enroll a sample that includes participants across a range of distances from the Gulf of Mexico (Gulf and Adjacent counties, as defined in the GuLF STUDY protocol, and the rest of the state) and that includes sufficient numbers of women and nonsmokers for analysis. Based on data from the first 2,500 home visit participants, 75% reside in Gulf counties or parishes, 8% in adjacent counties, and 17% are from more distant locations. Since the bulk of the concern about ongoing exposures is concentrated in the Gulf counties, this distribution of participants will allow us to address local concerns as well as to include sufficient numbers of non-Gulf county participants to have a natural comparison group of persons less proximate to the Gulf of Mexico.

Both active and passive exposure to tobacco smoke are strongly associated with increased levels of metals and VOCs in blood. Approximately 38% of GuLF STUDY participants who have agreed to a Home Visit are current smokers (active smokers). Non-active smokers will be over-sampled in order to examine the potential contributions of non-tobacco sources to personal exposures. Although we now collect information on passive smoking during the telephone interview, until late February 2012, this information was collected only from those completing a home visit. Table 1, therefore, shows information on active and passive smoking for individuals who completed the home visit as of May 15, 2012. Approximately 35% of GuLF STUDY participants who are not active smokers report they are currently exposed to tobacco smoke in their home.

When selecting participants for the EM Addendum, we will apply sampling weights so that at least 80% of the participants are not active smokers. Thus based on current rates of passive exposure, we expect that 20 percent will be active smokers and 28% will be passive smokers (0.8*.35) for a total of 48% with smoke exposure and 52% unexposed.

Table 1. Active and Passive Smoking Status among GuLF STUDY participants

		Passive Smokers *Currently Exposed to Tobacco Smoke in the Home*					
		Yes		No		Total	
Active Smokers		N	%	N	%	N	%
Currently Smoke	Yes	966	63.8%	549	36.2%	1515	100%
	No	858	34.9%	1600	65.1%	2458	100%

Currently about 20% of those eligible for a home visit are women. We will also apply sampling weights in order to target a sample that is at least 30% women.

A. Selection of Participants for EM Addendum (Phase I)

Beginning with participants who agree or tentatively agree to a home visit (about 83% of GuLF STUDY participants), we will invite 1,200 (300 per state) to provide the additional samples for the EM Addendum to achieve a final sample size of approximately 1,000 participants with complete data and samples (83% participation). This accounts for the loss of participants between agreement and final completion (currently 15%) and allows for some additional losses due to inability to obtain the extra blood samples or secondary refusals.

B. Selection of Participants for Personal Environmental Monitoring (Phase II)

A subset of participants will be randomly selected and asked to wear a personal environmental sampler to collect corresponding information on BTEX and other VOC's for cross comparisons with blood measures and comparison with external environmental data (Phase II). There will be no environmental monitoring of metals. Allowing for a combined rate of 80% for response and compliance (e.g., using the badge correctly), we will invite approximately 250 participants to wear the exposure monitor in order to achieve a final sample of approximately 200 compliant participants, including badge and questionnaire data and blood samples. Participants in this phase of the EM Addendum will be selected from among EM participants in just two states (Louisiana and Alabama) to maximize the number of participants per state.

Because the exposure opportunities may differ for men and women and because there are fewer women than men in the GuLF STUDY overall, we will also oversample women for this phase of the EM Addendum. We anticipate approximately 250 participants per state in the full EM Addendum, among whom 75 are expected to be women, and an expected 80% response/compliance rate. For the personal environmental monitoring portion of the EM Addendum, we will attempt to account for drop outs and no shows by recruiting approximately 63 women per state (84% of those available) for a target sample of 100 women and 100 men total (50 each per state).

Participants selected for personal monitoring will be sent an environmental monitoring kit via commercial overnight courier 2-3 days before the scheduled home visit. Each monitoring kit will include a personal VOC monitor and customized pictorial and written instructions for personal monitor use during the 24 hours prior to the home visit. Two days before the scheduled home visit, the

HVA will place a reminder phone call to the participant to confirm receipt of the monitoring kit, review EM Addendum instructions, and answer any questions that the EM Addendum participant may have. There will be a second call made approximately 24 hours before the GuLF STUDY Home Visit to remind the participant and confirm that they are able to deploy and wear the VOC monitor.

During the normal Gulf STUDY Home Visit, the HVA will collect the additional blood samples from the EM Addendum participants and collect additional information about exposure opportunities in the past 24 hours (behavioral, dietary, occupational and environmental). Information on current exposures collected for the EM Addendum will addendum data collected from the GuLF STUDY to characterize the current environmental exposures among participants during the course of normal daily activities. The HVA will also retrieve the VOC monitor from those selected for the monitoring phase of the EM Addendum and review compliance with regard to wearing the monitor.

C. Informed Consent

Verbal consent will be obtained from potential EM Addendum participants during the GuLF STUDY baseline enrollment telephone questionnaire or from a follow-up recruitment call for those recruited from the home visit back-log. The Home Visit Agent (HVA) will schedule a GuLF STUDY Home Visit after obtaining verbal consent from EM Addendum participants. Written informed consent for the EM Addendum will be obtained by the HVA during the normal GuLF STUDY Home Visit.

D. Remuneration

EM Addendum participants who contribute only the additional blood samples for the EM Addendum will receive an additional $10 for their EM Addendum participation ($60 total, including the normal GuLF STUDY remuneration). Participants who also complete personal air monitoring will receive an extra $30 for their EM Addendum-related efforts ($80 total, including the normal GuLF STUDY remuneration).

Figure 1. Overview of Exposure Monitoring Addendum

	Phase I	Phase II
Baseline Enrollment Telephone Questionnaire		
EM Addendum recruitment and consent	●	●
Personal Air Monitoring Setup		
Personal monitoring equipment mailed to EM Addendum participant		●
Personal monitoring reminder phone calls		●
Home Visit		
Collect personal monitoring equipment		●
Collect blood samples	●	●
Administer EM Addendum forms	●	●
Administer parent GuLF STUDY questionnaires	●	●
Additional Remuneration		
	$10	$30

V. Data Collection

During the Gulf STUDY Home Visit, the HVA will collect the additional blood samples from EM Addendum participants in addition to information about exposure opportunities in the past 24 hours.

A. Addendumal Residential, Lifestyle, and Behavioral Data

The HVA will collect additional information from EM Addendum participants to help identify potential sources of heavy metals and VOCs that may contribute to personal exposures. The HVA will query participants about residential, dietary, and occupational characteristics and personal behaviors. Three forms will be used to collect additional information about EM Addendum participants, residential characteristics, and recent activities:

- The *Residence Exposure Form* includes questions about building characteristics, residential exposures, ventilation, and water use (Appendix W_I - Form is adapted from the CDC NHANES 2007-2008 questionnaires and the EPA DEARS surveys).
- The *Twenty-Four Hour Activities Form* includes questions about selected activities during the previous 24 hours (Appendix W_II - Form is adapted from the CDC NHANES 2007-2008 questionnaires and the EPA DEARS surveys) to aid in interpretation of blood sample results and identify factors contributing to measured exposure levels.

- The *Current Occupation Addendum* includes questions about current employment in specific industries, commuting practices, and occupational exposures (Appendix W_III - Addendum is adapted from the CDC NHANES 2007-2008 questionnaires and the EPA DEARS surveys).

B. Local Ambient Source Mapping

GuLF STUDY investigators will use geographic information system (GIS) technology to map potential area and mobile sources within 300m of the each participant's residence. These GIS analyses will be used to characterize a participants' potential exposure to the following data sources:

The Toxics Release Inventory (TRI) database, compiled annually by EPA, contains county-level emissions data on all manufacturing facilities (with ≥ 10 full-time employees) that process > 25,000 lb in aggregate or use > 10,000 lb of any one of 600+ TRI chemicals [21]. The TRI database includes chemical data by industry, facility address, on-site disposals, and off-site disposals.
Facility data from state and county agencies, including information on the address and/or GPS coordinates of local facilities that may emit VOCs.

C. Biomonitoring

The Division of Laboratory Sciences, National Center for Environmental Health (NCEH), Centers for Disease Control and Prevention will provide biomonitoring technical assistance and oversight. NCEH laboratories will provide supplies and instructions for collecting blood samples and analyze samples for selected heavy metals and VOCs. NCEH will also help to interpret analytical results and provide a comparison data set (The National Health and Nutrition Examination Survey, NHANES). All records associated with biological samples will be labeled with a coded identification number that contains no personal identifiers

During the GuLF STUDY Home Visit, the HVA will collect an additional 13mL of blood for metals (3mL) and VOCs (10 mL) analyses. After sample collection, the HVA will ship the samples to the central GuLF STUDY processing laboratory for temporary storage before shipment in batches to the testing laboratory for VOC and metals analysis. Samples will be analyzed for selected VOCs (including but not limited to benzene, toluene, ethylbenzene, and xylenes) and metals (including but not limited to cadmium, lead, manganese, mercury, and selenium). Participants in the EM addendum will not be asked to provide blood or other samples for quality assurance purposes in the main study.

D. Personal Air Monitoring

A qualified lab will provide technical assistance and oversight for environmental VOC monitoring. Environmental monitoring kits will include a passive air sampler and customized pictorial and written instructions on proper sampler deployment and use. Passive sampling badges for measurements of VOCs (Assay Technology 521 Organic Vapor Monitor or similar type badge) will be used to collect 24-hour air samples of BTEX and possibly other VOCs. Passive diffusive samplers are inexpensive personal monitors that are easy to use, small and unobtrusive, and studies have shown that the performance of passive air sampling is comparable to

canister-based methods [22]. Environmental monitoring kits and all records associated with environmental samples will be labeled with a coded identification number that contains no personal identifiers.

During the reminder phone calls, the HVA will instruct EM Addendum participants on personal monitoring equipment use and compliance. Briefly, each participant will be instructed to carry the VOC sampler on their person for the 24 hour time period prior to the GuLF STUDY Home Visit. The participants will be instructed that while sleeping, showering, or bathing, the sampler should be removed and placed in a location that represents their breathing zone. Participants will be instructed to place the sampler in a dry location if they engage in other activities with a high likelihood of the participant/sampler getting wet. However, because some of the workers may be fishermen or boat captains and we want do not want to exclude exposures during those activities, they will be advised on approaches to keep the detector dry and be asked to remove the VOC monitor as needed to avoid submersion under water. If the participant is unable to wear the VOC monitor during the sampling period because of the potential for underwater submersion or employer objection, the duration of time without the monitor will be noted in the Twenty-Four Hour Activities Form (Appendix W_II, Question 29). Participants who deploy the monitor but are unable to wear it because of circumstances such as employer objection or underwater submersion will still receive the additional $30 remuneration, regardless of duration of monitor use as long as it was deployed. Participants who do not deploy the monitor at all will not receive remuneration for wearing a monitor. After 24 hours of sampling, the HVA will collect and package the samplers for FedEx shipment to the analysis laboratory.

VI. Data Analysis

Descriptive analyses, stratified by gender, state of residence and smoking status, will be conducted to describe the EM Addendum population in terms of demographic, smoking, behavioral, residential, and socioeconomic characteristics. Descriptive analyses will include frequencies for categorical variables and means for continuous variables. Correlations between environmental and biological exposure measurements will be evaluated.

Multivariable analyses will include multiple linear regression to explore demographic, behavioral, residential, socioeconomic, and self-reported Gulf clean-up characteristics as predictors of personal exposure concentrations. Multiple logistic regression analyses will be performed to explore associations between measured exposure levels and health outcomes.

VII. Statistical Power

Power calculations were based on reported mean concentrations and standard deviations from existing literature. Geometric means and selected percentiles of blood concentrations for the U.S. population are presented in Tables 2-4 [23, 24].

Table 2. Volatile Organic Compounds in Blood – Less-than-daily Smokers (ng/mL)

	Geometric Mean (95% conf. interval)	*Selected percentiles (95% conf. interval)*		*Sample Size*
		50th	*95th*	
Benzene	<0.024 Neg. Control	<0.024 Neg. Control	0.063 (0.051-0.070)	859
2,5-Dimethylfuran	<0.011 Neg. Control	<0.011 Neg. Control	<0.011 Neg. Control	880
Ethylbenzene	0.028 (0.026-0.031)	0.028 (0.026-0.031)	0.071 (0.056-0.083)	827
Toluene	0.082 (0.071-0.096)	0.076 (0.065-0.091)	0.330 (0.240-0.520)	854
o-Xylene	<0.021 Neg. Control	<0.021 Neg. Control	0.081 (0.066-0.083)	877
m- p-Xylene	0.122 (0.109-0.137)	0.120 (0.097-0.130)	0.280 (0.240-0.330)	861

Table 3. Volatile Organic Compounds in Blood – Daily Smokers (ng/mL)

	Geometric Mean (95% conf. interval)	*Selected percentiles (95% conf. interval)*		*Sample Size*
		50th	*95th*	
Benzene	0.138 (0.126-0.151)	0.140 (0.120-0.150)	0.450 (0.380-0.510)	289
2,5-Dimethylfuran	0.074 (0.067-0.082)	0.076 (0.067-0.088)	0.260 (0.210-0.280)	290
Ethylbenzene	0.068 (0.064-0.072)	0.065 (0.061-0.069)	0.160 (0.012-0.018)	278
Toluene	0.327 (0.294-0.364)	0.330 (0.290-0.370)	0.940 (0.690-1.300)	285
o-Xylene	0.048 (0.045-0.051)	0.044 (0.035-0.052)	0.090 (0.083-0.099)	289
m- p-Xylene	0.212 (0.197-	0.220 (0.200-0.230)	0.460 (0.400-	287

Table 3. Volatile Organic Compounds in Blood – Daily Smokers (ng/mL)

Geometric Mean (95% conf. interval)	*Selected percentiles (95% conf. interval)*		*Sample Size*
	50th	*95th*	
0.228)		0.500)	

Power was calculated using the POWER procedure in SAS (Version 9.2, SAS Institute, Cary, NC). All power analyses assumed alpha = 0.05. Under a sample size of 1000 allocated equally between comparison groups, the EM Addendum will have sufficient power to detect a 21% difference in geometric mean blood lead concentrations (Table 4). Under a 1:2 between-group sample size allocation, a 22% difference will be detectable.

Table 4. Detectable between-group ratio of geometric mean blood lead concentration, based on 80% power for a two-sided test, at significance level 0.05

Total Sample Size	**Detectable Ratio of Geometric Means**	
	1:1 Allocation[1]	**1:2 Allocation[2]**
100	1.82	1.89
500	1.31	1.33
1000	1.21	1.22
1500	1.17	1.18
2000	1.15	1.15

[1] Equal sample sizes in each comparison group, as anticipated for comparisons based on smoking status groups.
[2] Sample size allocation of one-third-to-two-thirds, as anticipated for comparisons based on current exposure or occupational groups.

VIII. Reporting of Results

At the conclusion of the EM Addendum, NIEHS will provide confidential reports to each EM Addendum participant that will summarize results. Reports will be developed in collaboration with the CDC and be vetted with community leaders and health departments as well as the IRB before being distributed. The EM Addendum report will include a cover letter that describes overall results along with individualized reports of biological and environmental sampling results. The EM Addendum report will provide findings in the context of study, regional, and national results. For biological sampling results, results will be compared to levels reported in CDC's National Report on Human Exposure to Environmental Chemicals, a population-based assessment of exposure to environmental chemicals in blood and urine. Environmental sampling results will be compared to national recommended standards.

During the consent process, participants will be asked if they would like the GuLF STUDY to send their blood and environmental monitoring results (if available) from the EM Addendum to their health care provider. The GuLF STUDY already includes options for referral to low or no cost health care. State-specific results will be shared with state and local health department officials and with other community leaders. Community meetings will be held to present results and discuss resulting concerns.

IX. Timeline

HVA training is currently scheduled to begin in July 2012 and pilot testing of the EM procedures will occur shortly thereafter followed by the full EM Addendum enrollment to coincide with the GuLF STUDY recruitment and home visit schedule until the EM Addendum enrollment goals have been attained. Figure 2 indicates the approximate times for the primary EM Addendum tasks:

Figure 2. EM Addendum **Timeline (June 2012 – June 2013)***

	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
HVA training		●											
Pilot testing		●											
Participant recruitment		●	●	●	●	●	●	●					
Equipment setup and Home visits			●	●	●	●	●	●					
Laboratory analyses			●	●	●	●	●	●	●				
Data analysis									●	●	●	●	●
Dissemination of individual test results to participants													●
Preparation of reports and manuscripts												●	●

*** Note:** The EM Addendum timeline may be extended to coincide with the end of enrollment and study visits for the GuLF STUDY so that we can maximize the enrollment into the EM Addendum.

X. Evaluation and Qualitative Interviews

A. Background

As described above, personalized results will be sent to participants at the conclusion of the exposure monitoring study. We will evaluate the effectiveness of the individualized reports and our communications with this subgroup about the results.

B. Rationale

Few studies have evaluated the effectiveness of reporting individual results to biomonitoring study participants. There is limited information about the impact of the report-back process on study participants, specifically –

1. how study participants perceive biomonitoring results when information about health effects are uncertain and

2. the behavioral modifications, if any, that participants undertake as a consequence of their results report.

All GuLF STUDY EM participants will be asked to complete a brief evaluation rating the report-to-participants. To further examine participants' perceptions of the GuLF EM study results (both overall and individual results), a subset of EM study participants will be purposively sampled for a follow-up qualitative evaluation interview. Results of these evaluations will be used to inform the design and content of future GuLF STUDY communications.

C. Objective

The objective of the evaluations and qualitative interviews is to assess the effectiveness of the GuLF STUDY's report-back process in communicating study results and exposure reduction strategies to biomonitoring study participants.

D. Methods

1. Evaluation Form

As previously described in the exposure monitoring study addendum, GuLF STUDY participants will receive a personalized results report. Along with the report, they will receive a brief evaluation that will include questions about current perceptions about chemical exposures and the information presented in the report-to-participants. Participants will be given a postage-paid return envelope and asked to return the evaluation to the GuLF STUDY office. If a study participant does not return the evaluation within three months of distribution, we will assume that the study participant has declined to complete the evaluation. Without any follow-up reminders, we anticipate that a minimum of 10% (n~100) of the EM study population will return the evaluation.

2. Qualitative Interviews

Inclusion Criteria

GuLF STUDY exposure monitoring participants who return a completed evaluation will be deemed eligible for a follow-up qualitative interview. Follow-up telephone interview participants will be sampled from the eligible population by study investigators using the purposive sampling approach, maximum variation method [25]. Briefly, in order to capture the variety of perspectives and experiences among biomonitoring study participants, potential telephone interview participants will be sampled according to education level, smoking status, biomonitoring results, and self-rated health.

Table 5. Recruitment minimums for telephone interview by participant characteristics

	High School or less		Greater than High School	
	Smoker	**Nonsmoker**	**Smoker**	**Nonsmoker**
Follow-Up sample minimum	5	5	5	5
any blood BTEX above 95th pctl	2	2	2	2
Fair or Poor self- rated health	2	2	2	2

Approximately 20-50 study participants will be recruited for qualitative interviews, with a minimum of 5 each in strata defined by education level and current smoking. We expect that education level will influence how well materials are understood. Smoking is a key stratification variable because it is a contributor to high levels of BTEX chemicals and summary results are presented separately for smokers and nonsmokers in personalized results reports. No attempt will be made to fully stratify on all four variables (including elevated results and/or self-rated health status) so long as there are at least 2 individuals with these characteristics in each of the four selection strata. When the maximum number of participants (n = 50) has been reached or when data saturation occurs (i.e., interviews do not yield any additional data), recruitment will cease.

Sample Recruitment
Potential interview participants will be recruited by telephone by study investigators. Using established GuLF STUDY confidentiality procedures, password protected datasets with participant contact information will be created.

Telephone contact with potential qualitative interview participants will follow the procedures described previously. Recruitment calls will be staggered over morning, afternoon, evening, and weekend periods to maximize chances of establishing contact. Participants will be recruited every 2 weeks.

Data Collection
Telephone interviews will be conducted using standardized scripts. The interviewer will obtain verbal assent to audio record the interview prior to the interview. The interviewer will use a semi-structured interview guide that will allow the interviewer to open new lines of inquiry, when appropriate. The interview guide will include questions that address 1) GuLF STUDY perceptions and 2) interpretations of a) individual exposure results, b)

uncertainty about health outcomes associated with exposures, c) population-based reference value comparisons, d) health-based reference value comparisons, and e) exposure reduction strategies.

The interviewer will also take notes during the interview. We anticipate that the time length of the telephone interview will be approximately 30 minutes.

Remuneration
Study participants who complete the follow-up qualitative telephone interview will receive an additional $10 for their participation.

Data Analysis
After the interview, the audio recording will be transcribed and the transcripts will be stored in password-protected files. Personal identifiers will not be transcribed. The interviewer will review the transcript and interview notes for accuracy. After the transcripts have been reviewed for accuracy, the audio recording will be destroyed.

A coding team will consist of the investigator and no more than three additional trained personnel. Members of the coding team will independently code interview data using the qualitative analysis software package, Atlas.ti. A thematic analysis approach [26] will be used to identify themes related to the interview guide topics (GuLF STUDY perceptions, individual exposure results, uncertainty about health outcomes associated with exposures, population-based reference value comparisons, health-based reference value comparisons and exposure reduction strategies). Members of the coding team will meet regularly discuss their results and identify additional codes or themes that emerge during data analysis.

XI. Styrene Exposure Follow-back Interviews

A. Background
As described above, personalized results were sent to participants in the exposure monitoring addendum. For most who participated, the levels of BTEX, other VOCs, and metals measured in blood were similar to those measured in the general U.S. population although some Gulf Coast residents had higher levels of styrene than are usually found in the US. We plan to conduct follow-up interviews with approximately 100 exposure monitoring sub-study participants to better understand sources of styrene.

B. Rationale
Over 12 billion pounds of styrene are produced annually in the US and used in a wide range of building materials and consumer products. However, the human health effects from environmental styrene exposure in the general population are unknown. Studies in animals and highly exposed workers indicate that styrene exposure may be associated with neurotoxicity, immune dysfunction, and increased risk of lymphohematopoietic tumors. The general population is exposed to styrene primarily via off-gassing of building materials and consumer products in homes and offices, tobacco smoke, motor vehicle emissions, and proximity to industrial facilities. Styrene-exposed workers in

boat building and manufacture of plastics, rubber, and polystyrene products have average blood levels 25 times higher than those of the general population. In a cross-sectional study of over 1,000 GuLF STUDY participants, conducted 1-3 years after the Deepwater Horizon oil spill and reflecting ambient (not cleanup-related) exposures, we observed average blood levels of styrene 2-3 times higher than the US general population, though substantially lower than among styrene-exposed workers. Health effects at this level of exposure have not been studied. Although participants were asked at the time of blood collection about their potential sources of exposure to volatile organic compounds, only a small portion of these questions focused on styrene-related sources. Thus, the sources of these modestly elevated blood styrene levels remain largely unexplained, but warrant investigation for future health studies.

C. Objective

The objectives of the follow-back interviews are to identify potential sources of styrene that resulted in individuals' elevated blood levels at the time of the home visit, to determine, to the extent possible, whether the levels at the time of the home visit are representative of the individuals' usual levels and to identify possible point sources of styrene that may be relevant to the larger GuLF STUDY population.

D. Methods

100 participants in the exposure monitoring addendum will be invited to participate in styrene follow-back interviews, including those with and without elevated levels. The interview asks about occupational, recreational and environmental exposures, (e.g., plastic manufacturing and repair, boat manufacturing and repair, construction, fiberglass manufacturing and repair, tire manufacturing or disposal, etc.) as well as the use of personal protective equipment during times of potential exposure.

Interviews will be conducted by telephone using standardized scripts. The interviewer will obtain verbal assent to participate prior to the interview. Telephone contact with potential participants will follow the procedures described previously. Calls will be staggered over morning, afternoon, evening, and weekend periods to maximize chances of establishing contact.

XII. Exposure Monitoring Addendum Appendices

Appendix W_I. Residence Exposure Form
Appendix W_II. Twenty-Four Hour Activities Form
Appendix W_III. Current Occupation Addendum
Appendix W_IV. TraceAir Monitor Instructions
Appendix W_V. Additional Scripts
Participant Notification Letter and Sample Report-to-Participant
Chemical Factsheets
Evaluation Survey
Qualitative Interview Scripts
Styrene Exposure Questionnaire

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Addendum 2: Pilot Study to Estimate Contact Rates for GuLF Follow-up Interviews

Purpose:

Test a variety of approaches to collecting updated contact information to estimate contact rates for follow-up telephone interviews under different pre-notification scenarios

Eligible Participants:

Random sample of participants in the first wave of annual re-contact; select a sample large enough to test conditions below

Approaches:

Approach	E-mail 1[1]	E-mail 2[2]	Letter[3]	Phone[4]
1	Yes	No	Yes	Yes
2	Yes	Yes	No	Yes
3	No	No	Yes	Yes
4	No	No	No	Yes

[1]*Email* – send once and use text planned for mail re-contact effort

[2]*Email* – send a follow-up email once, approximately 1 week after sending Email 1 and use text planned for mail re-contact effort

[3]*Letter* – send once and use letter planned for main re-contact effort

[4]*Phone* – call participants to request phone, address, email updates, and secondary contact information; use current data system for main re-contact effort for data collection; call all numbers on file for each participant using current calling rules and call disposition codes

Note: All participant contact information will be submitted to a locating service for batch tracing; however, contact information obtained through locating efforts will only be used for participants who do not respond to the initial contact approach

Sample Size and Related Design Considerations:

The table illustrates the proportion of successful recontacts using email or telephone (method B) that can be detected with at least 80% power, based upon different sample sizes (N, in each of four arms) and different underlying recontact rates (method A). As shown in the last line of the table which reflects a worst-case underlying rate of 0.5, with a sample size of N=1,000 per arm, or 4,000 total, we can detect a 5% difference in the recontact rate.

	Proportion of successful recontacts		
N per group	Recontacted using method A	Recontacted using method B	Power achieved
250	0.3	0.398	0.803
500	0.3	0.368	0.801

	Proportion of successful recontacts		
N per group	Recontacted using method A	Recontacted using method B	Power achieved
750	0.3	0.355	0.809
1000	0.3	0.347	0.817
250	0.4	0.500	0.801
500	0.4	0.470	0.809
750	0.4	0.457	0.810
1000	0.4	0.449	0.806
250	0.5	0.598	0.801
500	0.5	0.570	0.804
750	0.5	0.557	0.803
1000	0.5	0.549	0.814

Note that the sample size analysis is based on Fisher's Exact Test in a 2x2 factorial design in which we have two factors: Letter and Email, as in Approaches 1-4 above (noting that Phone is present in all approaches). Thus the test for a "Letter" vs "No Letter" effect involves a test of combined approaches 1 & 3 (method B) vs approaches 2 & 4 (method A). Similarly a test for the "Email" effect involves 1 & 2 (method B) vs 3 & 4 (method A). We assume a two-sided test and, to account for multiple testing, we use a Bonferroni adjustment and conduct each test at significance level 0.05/2=0.025. For sample size purposes we do not seek sufficient power to support a formal test of interaction which would require significantly higher numbers.

The pilot sample will be drawn across multiple waves of recontacting in order to assure inclusion of a diverse population of workers, some of which are only minimally represented in early study waves (e.g., Coast Guard, workers from TRG file, rig workers). We will also oversample active cohort participants with a target of 50% representation, so as to support more precise estimates from which to project likely follow-up interview participation rates. It is also possible that the pilot sample might somewhat exceed the target sample size of 4,000 if needed to accommodate operational constraints.

Approximately 500 participants who are eligible for the Biomedical Surveillance Subcohort clinical exams may be invited to participate in an additional pilot study to examine factors that may influence participation in the exam. These additional questions will be administered after their contact information is confirmed or updated. The questionnaire will take approximately 5-10 minutes to complete.

Operational Plans:

In-bound calls in response to emails and letters – handle as we would in the main re-contact effort and end additional follow-up for those in approach 1, 2, and 3 at the time the update is completed

Time between emails, letters and phone calls – one week between each form of contact

Addendum 3: GuLF STUDY Biomedical Surveillance Clinical Examination

1 Study Objectives & Background

A. Objectives

The Deepwater Horizon (DWH) disaster resulted in the release of over 4.9 million barrels of crude oil into the Gulf of Mexico [1]. In the ensuing oil-spill clean-up response, 150,000 workers and volunteers participated in in some aspect of oil-spill clean-up. Community groups across the Gulf region have expressed ongoing concerns about oil-spill exposures and health outcomes they believe to be associated with components of oil and dispersants used in the DWH clean-up efforts [2]. Reported symptoms among clean-up workers and volunteers at the time of the spill included headaches, cough, dizziness, nausea, exhaustion, and heat stress [3]; media reports and preliminary data collected as part of ongoing studies of the health of workers and community members suggest that such symptoms continue to be reported.

The potential long-term health effects of participation in this and other clean-up efforts are largely unknown. The few previous studies examining health consequences of oil spills have reported respiratory, neurological, hematologic, and psychological or mental health related outcomes (see “Background” section below). Workers involved in the DWH oil spill have not only been exposed to the constituents of the oil but also to dispersants and oil & dispersant mixtures as well as to extended uncertainty and unemployment due to the long-term nature of the spill and its impact on the region. Thus they offer a unique opportunity to further understand exposure-response relationships and mental health outcomes associated with oil spills in general and this event, specifically. In response to concerns about potential health impact of the Deepwater Horizon oil spill, a cohort of nearly 33,000 persons involved in some aspect of oil spill clean-up has been surveyed regarding clean-up experiences and current health. A subgroup of 11,200 participants from Gulf states have completed brief clinical examinations at home during which lung function and blood pressure were measured and biological samples (blood, urine, toenails, hair) and environmental samples (dust wipes) were collected. The ***GuLF STUDY Biomedical Surveillance Clinical Examination (BSCE)*** which will be carried out among a subset of GuLF STUDY participants is designed to more thoroughly investigate the following questions related to potential health effects of this environmental disaster.

1. Are worker exposures to constituents of oil, dispersants, and oil & dispersant mixtures associated with adverse effects on respiratory and neurological function?
2. Are worker exposures or experiences related to the DWH oil spill resulting in measurable and sustained psychological or mental health related outcomes?
3. Are there biomarkers of potentially adverse biologic effects associated with oil spill-related exposures?

The proposed BSCE extends the work of the GuLF STUDY among a subgroup of participants who completed home visits (Active Surveillance Follow-up Cohort) by undertaking more intensive clinical testing and mental health evaluations (hereafter referred to as "clinical examinations"). These additional clinical examinations will allow for a much more in-depth understanding of pulmonary, neurological, and mental health outcomes that may be associated with the DWH oil spill exposures and experiences.

B. Background

The Deepwater Horizon disaster resulted in the release of over 4.9 million barrels of crude oil into the Gulf of Mexico [1]. In the ensuing oil-spill clean-up response, over 150,000 workers and volunteers participated in some aspect of oil-spill clean-up, including just completing safety training in hopes of being hired. The potential long-term health effects of participation in this and other clean-up efforts are largely unknown. The few studies that have evaluated the human health consequences of oil spills have primarily focused on acute physical effects and psychological sequelae.

Previous Oil Spill Health Studies

Prior 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 [4]. Most of these studies were cross-sectional, though two spills (the Prestige and Heibei Spirit oil spill in Korea) have been the focus of small follow-up studies after several years. Several studies reported respiratory symptoms, including cough and shortness of breath [5-8]. In a follow-up study among clean-up workers from the Prestige oil spill, Zock et al. [9] observed that lower respiratory tract symptoms persisted up to 2 years after exposure had ended, although the excess risk decreased with increasing time from last exposure. Some symptoms showed exposure-response patterns in relation to number of exposed days, exposed hours per day, and number of activities. Elevated levels of 8-isoprostane, vascular endothelial growth factor, and basic fibroblast growth factor in the exhaled breath condensate (EBC) were found among workers involved in the Prestige oil spill clean-up, with evidence of increasing levels with increasing intensity of exposure to the clean-up two years after the oil spill [10]. Among those exposed to the oil, evidence of increased non-specific bronchial responsiveness and increased levels of 8-isoprostance and growth factors in EBC persisted five years after the oil spill [11]. Studies of other petroleum-exposed groups have also observed adverse health effects associated with petroleum exposures including increased respiratory symptoms, increased exhaled nitric oxide, and decreased FEV1/FVC [12]. Meo et al. reported a reduction in forced vital capacity (FVC), forced expiratory volume in first second (FEV1), and forced expiratory flow and maximum voluntary ventilation (MVV), including exposure-response trends, in a small study of workers involved in the clean-up of the Tasman Spirit oil spill [13, 14]. Other commonly reported symptoms from previous oil spill studies include itchy eyes, nausea/vomiting, dizziness, headaches [5, 6, 8, 14-17], and skin irritation/dermatitis [6, 8, 15].

Other Hydrocarbon Exposure Health Studies

Neurotoxic effects of hydrocarbon and hydrocarbon constituents have been observed in both occupational groups and laboratory studies on human volunteers [18-22]. These include significant effects on intellectual capacity, psychomotor and visuomotor function, immediate and delayed memory, and increased proportionate mortality ratio for mental and psychoneurotic conditions [22-24]. In laboratory studies on human volunteers, inhalation exposure to xylene at 90 ppm caused deleterious effects on reaction time, manual dexterity, body balance, and memory span [25, 26]. Toluene exposure at 100 ppm was associated with altered short term memory, visual memory, locomotion, poorer manual dexterity performance, and mood [27, 28]. In addition, the Agency for Toxic Substances and Disease Registry has identified several heavy metals found in crude oil as neurotoxic in humans or in animal models [29-35]. These findings suggest effects on the central nervous system functioning in the absence of clinical disease diagnosis.

Mental Health Studies

In addition to health effects induced by chemical and physical exposures, physical and mental health may be adversely affected through pathways involving physiological and psychological responses to acute and chronic stressors related to the disaster. Adverse psychological consequences have frequently been linked to previous oil spills. Excess prevalence of generalized anxiety disorder, post-traumatic stress disorder (PTSD), and depressive symptoms were observed among communities affected by the Exxon Valdez oil spill approximately one year after the spill occurred [36]. Similar patterns of higher anxiety and depression scores and worse mental health were observed among communities near the Sea Empress spill [16]. The Braer spill was associated with increased somatic symptoms, anxiety, and insomnia, but not personal dysfunction or severe depression [37]. Worse mental health scores were related to closer proximity to the Prestige spill [38].

2 Study Overview

Approximately 6,500 cohort members from Louisiana, Mississippi, Alabama, and Florida will be invited to take part in the clinical examinations. We will invite all cohort members who were previously identified as a potential participant in the ***Biomedical Surveillance Sub-cohort*** during the baseline phase of the study (and for whom additional baseline laboratory tests were performed) to participate in a clinic visit, provided they live within 60 miles of a study clinic. We will augment this sample with additional cohort members who live within driving distance of one of two clinics in New Orleans, Louisiana and Mobile, Alabama. The clinical examinations will be performed in controlled clinical settings under the direction of health professionals from the University of South Alabama (USA) and Louisiana State University (LSU) Health Sciences Center. The clinic exams and procedures are described below, but briefly these research exams will include anthropometric measurements, biological sample collection, neurobehavioral evaluations, pulmonary function testing, and mental health questionnaires. The exams are for research purposes only and are not intended as delivery of primary or specialty health care services. Referral networks such as those developed for Phase 1 of the GuLF STUDY will be developed/

augmented to help those participants who wish to pursue clinical follow-up find appropriate services. The exam is expected to take between 3.75 and 4.0 hours and participants will be compensated for their time and travel costs as described below.

Study Oversight

The Principal Investigator will monitor and evaluate progress of the study, including periodic assessment of accrual, administration of informed consent, data quality and timeliness of data collection, participant risk versus benefit, performance of contractors and other factors that can affect study outcome. This monitoring will also consider factors external to the study, such as scientific findings that may have an impact on the safety of the participants or the ethics of the study.

Social & Scientific Systems, Inc. (SSS), a company that provides professional research services and supports the overall GuLF STUDY, will serve as the coordinating center for BSCE phase of the study through an existing contract with the NIEHS. SSS will coordinate with the clinical collaborators at USA and LSU to oversee the day-to-day activities of the clinical examinations with additional oversight from the NIEHS investigators. SSS will be responsible for data management, laboratory sample management, and the performance of subcontractors who support ancillary research activities.

In accordance with NIEHS requirements, an independent study monitor will visit the coordinating center and each clinical site at least once a year to ensure compliance with the protocol, NIEHS research policies, and federal regulations for the protection of human subjects. During the visits, the monitor will review informed consent forms, central and local study files, data management procedures, and laboratory sample storage conditions. The monitor will document findings in a formal monitoring report that will be shared with the NIEHS Office of Human Subjects Protection, the Principal Investigator, the coordinating center, and the clinical site directors. The coordinating center and clinical sites will be responsible for responding to and resolving any issues identified in the report.

The clinical examinations will be carried out by collaborators at the University of South Alabama and Louisiana State University Health Sciences Center. Clinical directors at each site will be responsible for overseeing day-to-day activities at their sites.

The study team, all of whom will contribute to study oversight, has the experience necessary to provide this oversight. We list the roles and responsibilities of the investigators and key collaborators below.

- Dale Sandler, Ph.D., Principal Investigator, NIEHS (Protocol development and overall oversight and responsibility for all parts of the study)

- Richard Kwok, Ph.D., Lead Associate Investigator, NIEHS (Protocol development and oversight over the day-to-day operations of the study and coordination for all parts of the study)

- Lawrence Engel, Ph.D., Associate Investigator, University of North Carolina at Chapel Hill and NIEHS (Protocol and questionnaire development, and oversight over the neurologic and biologic areas of the study)

- Aubrey Miller, M.D., M.P.H., Associate Investigator, NIEHS (Oversight over the medical and medical alert / referral areas of the study)

- Stephanie London, M.D., Dr.P.H., Associate Investigator, NIEHS (Consultation on the respiratory areas of the study)

- Robert L. Jensen, Ph.D., Consultant, University of Utah (Consultation on pulmonary function testing quality control and interpretation)

- Christine Parks, Ph.D., Associate Investigator, NIEHS (Consultation on the immunologic areas of the study)

- Aaron Blair, Ph.D., Consultant, NCI (Consultation on overall study implementation and design)

- David A. Welsh, MD., Associate Investigator, Louisiana State University (Louisiana Clinical Site Director)

- Errol D. Crook, M.D., Associate Investigator, University of Southern Alabama (Alabama Clinical Site Director)

- Sandro Galea, M.D., M.P.H., Dr.P.H., Consultant, Columbia University (Consultation on mental health assessment strategies, and assist with analysis of mental health outcomes)
- Fredric Gerr, M.D., Consultant, University of Iowa (Consultation and oversight over the neurobehavioral and neurological areas of the study)

- Diane Rohlman, M.A., Ph.D., Consultant, University of Iowa (Consultation and oversight over the neurobehavioral and neurological areas of the study)

The GuLF STUDY Scientific Advisory Board, a subcommittee of the NIEHS Board of Scientific Counselors, will provide additional oversight. The board is comprised of scientific experts, community representatives, and federal agency representatives. A separate Community Advisory Board, consisting of representatives of key study populations in the affected states, has also been established.

3 Training, Certification, and Quality Control

Study staff members will have the necessary education, qualifications and experience to conduct study activities. Staff members who interact with participants or have access to study data will be trained in human subjects research protections, the study protocol, and study procedures relevant to their role. All will be required to sign confidentiality agreements. Staff will be required to complete web-based, self-study, and centralized in-person training programs

specific to their roles in the project. The study coordinating center (SSS) will provide study-specific training to all clinical site staff in collaboration with the study PIs, clinical site directors, and expert consultants.

Study manuals and job aids will be developed to ensure the standardized administration/implementation of procedures. Staff members will be required to pass proficiency testing and receive certification prior to conducting study procedures. Study coordinators at each site will conduct periodic quality control assessments of staff performance using standardized quality control checklists and will provide feedback to staff. Study managers at the coordinating center will monitor accrual and weekly procedural completion data, review site coordinator QC assessment forms quarterly, and conduct site monitoring visits as part of the overall quality control process. Data managers at the coordinating center will also generate data QC reports that will allow the study investigators and coordinating center staff to identify problems with missing, inconsistent, or implausible data so that any problems with data quality can be identified and corrected in a timely manner. Corrective actions for unsatisfactory performance will include coaching, retraining, or termination.

4 Eligibility and Selection of Participants

Approximately 6,500 cohort members will be identified for invitation to take part in the clinical examination, with about 4,000 expected to complete the examination (anticipated participation rate ~62%).

All cohort members who were tagged for inclusion in the Biomedical Surveillance Sub-cohort on the basis of residence within 60 miles of USA or LSU and completed the baseline home visit will be eligible to complete an exam (N ~ 4,000). In addition to completing the home visit, persons who had been selected for this Sub-cohort had Complete Blood Count (CBC) evaluation at baseline and lymphocytes were extracted and cryopreserved for later functional assays.

In addition, we will augment the sample with ~2,500 participants who completed a home examination and live within ~60 miles of a study clinic, but were not initially tagged for inclusion in the Biomedical Surveillance Sub-cohort. To reach this target, we will invite all clean-up workers and a 75% random sample of non-workers who meet these criteria, to achieve a final sample comprised of ~23% non-workers as a comparison group.

Based on response rates after the first few months of clinic operation and experience gained with recruiting participants living far from the clinic sites, we may modify the criteria for selecting supplemental participants (e.g., by expanding or contracting the distance requirement) for the clinic exam – with the goal of completing 4,000 exams.

For reasons of logistics, cost, and procedure standardization, we will have only two main clinical sites, one in Mobile, AL and the other in New Orleans, LA. However, reluctance of cohort members to travel long distance to get to a clinical site may lower participation rates. We will provide reimbursement for travel

expenses, lodging and meals, as needed, to accommodate participants who live further away from the two main clinical sites in Mobile, AL and New Orleans, LA.

5 Visit Scheduling

Eligible cohort members will receive a letter from the GuLF STUDY Principal Investigator and the director of the clinical site closest to their home inviting them to participate in the clinical exam. The letter will be on GuLF STUDY letterhead and will contain the logos of both the GuLF STUDY and the clinical site closest to the subject's home. This letter will explain the purpose and components of the exam, and how to contact the study coordinating center to schedule the exam. Coordinating center staff will contact eligible cohort members who do not respond to the letter within one week and attempt to schedule a clinic visit. Clinical site staff will place visit reminder calls to eligible cohort members who agree to participate.

Study coordinating center staff will flag eligible cohort members who cannot be reached with existing primary and secondary contact information. The study coordinating center will send their names and other personally identifiable information (when available) to a commercial tracing service. All information exchanges will be encrypted using standard computer security and encryption protocols. If the commercial tracing service returns contact information, the coordinating center will attempt to contact the eligible cohort member. If contact is made and the eligible cohort member is willing to schedule the exam, the coordinating center will schedule the appointment at a date and time convenient for the cohort member. If updated contact information is not obtained, the coordinating center may deploy field staff to visit the eligible cohort member's last known address to obtain updated contact information and to schedule the visit. For eligible cohort members who cannot be reached by these methods, the coordinating center may also send emails and letters to their last known email or mailing address to encourage participation, and may telephone the alternate contacts provided by participants when they enrolled or last updated their contact information to confirm or update contact information.

A confirmation letter will be sent to the selected participant 4 to 5 days in advance of the scheduled visit along with preparatory materials, which include pre-visit instructions, a list of answers to frequently asked questions, a one-page summary of key information in the consent form, and directions to the clinical site. The study coordinating center will serve as the first point of contact for selected participants for questions about the exam and for cancellations and rescheduling.

The clinic site staff will place reminder calls to the participants. The first call will occur 2 weeks prior to the exam. Additional reminder calls will be placed 1 to 2 days before the scheduled exam. If the participant contacts the clinic for cancellations and rescheduling, the clinic staff will update the appointment in the scheduling system.

In order to promote the clinical examinations more generally, we will engage eligible cohort members and their local communities through our community

advisory group (CAG), the study website, and social media (e.g. Facebook, Twitter).

6 Components of the Clinical Examination

Table 1 below summarizes the components of the clinical exam and the time required to complete each component. Additional details about the clinical exam are provided in the sections that follow.

We plan to administer all of the components listed below to all participants, with the exception of components that will be performed on a subset of participants, as per the design of the study. However, we recognize that some participants may perceive the exam as burdensome when they are invited to take part. In those cases, the study coordinating staff will offer an abbreviated exam after attempting refusal conversion strategies. The clinic site will also offer the abbreviated exam to participants who state that they cannot stay for the entire exam after arrival at the clinic. The abbreviated exam will last approximately two hours and consist of a subset of the procedures below. Remuneration for the abbreviated exam will be half that of the full clinical exam. The abbreviated exam will only be offered after approval has been obtained from the study coordinating center. The study coordinating center will monitor the percentage of scheduled and completed abbreviated exams to prioritize full exams. Should the administration time of the clinical exam substantially exceed our estimates and/or prove unacceptable to a substantial proportion of participants during the run-in period or afterward, we will modify the administration of each exam to reduce burden for all participants.

Table 1. Clinical Visit Overview

Activity	Time	Notes
Visit Scheduling†	N/A	• Initiation mailing • Scheduling calls • Pre-visit procedural eligibility assessment • Confirmation letter and visit preparation materials mailed
Arrival and Greeting†	5 min.	• Greetings and introduction to study staff
Informed Consent†	10 min.	• Review and obtain informed consent
Clinic Visit Questionnaire†	15 min.	• Clinic Visit Questionnaire
Physiological Measures†	5 min.	• Resting Blood Pressure and Heart Rate
Anthropometric Measures	10 min.	• Height, Weight, Waist and Hip Circumference

Activity	Time	Notes
Biological Specimen Collection †	15 min.	• Hair, Toenail Clippings* and Urine Collection • Provide training and materials for serial saliva samples (for a subset) and collect baseline saliva sample • Venous blood collection, (including quality control collections for a subset) and finger stick for Hemoglobin A1c and lipid testing
Peripheral Nervous System Tests†	25 min.	• Visual Acuity • Visual Contrast Sensitivity • Handgrip Strength • Vibrotactile Threshold Testing • Standing Steadiness (Postural Stability) • Single Leg Stance • Long Distance Corridor Walk (400m) • Trailmaking
Neurobehavioral Tests	50 min.	• Finger Tapping • Symbol-Digit • Simple Reaction Test • Digit Span • Match to Sample • Continuous Performance • Progressive Ratio
eNO	10 min.	• Exhaled Nitric Oxide
Pulmonary Function Testing**†	30 min.	• Pre/post-bronchodilator spirometry
Mental Health Assessment	40 min.	• Questionnaire administration and referral, if needed
Substance Abuse Questionnaire	10 min.	• Self-administered computer-based questionnaire
Biological Specimen Processing †	N/A	• Process, aliquot, label, and temporarily store specimens
Report of Findings†	10 min.	• Handout provided with clinically relevant findings and recommendations for seeking additional care, if indicated • Referral provided, if needed
Check-Out and Remuneration†	5 min.	• Remuneration

Activity	Time	Notes
Clean-up and Specimen Shipping†	N/A	• Samples packed and shipped in batches by clinical staff
Total time	**4hrs. 0 min.**	

** If toenail specimens cannot be collected during the visit, the participant will receive toenail collection instructions and a prepaid self-addressed envelope to return toenail samples to the central processing laboratory.*
*** Pulmonary measures will be collected in the order of eNO, then spirometry because spirometry may affect eNO measurements. [39]*
† Exam components that will be included in the abbreviated exam.

6.1 Informed Consent

Informed consent will be obtained before any visit activities are conducted. A one-page consent form summary will be used to guide the informed consent process. Clinic staff will allow the participant ample time to review the consent, ask questions, and obtain clarifications prior to agreeing to enrollment. After voluntarily agreeing to take part in the study, participants will be asked to sign and date a current IRB-approved version of the informed consent form. The consent form will contain contact information for clinical site staff, the study center, and the NIEHS IRB in the event that questions or concerns emerge after the visit. A copy of the signed consent form will be provided to the participant. The original copy of the consent will be stored at clinical sites until the conclusion of the study, at which time they will be shipped to the coordinating center for long-term storage. Random review of consent forms will be included in the study's clinical monitoring plan.

6.2 Clinic Visit Questionnaire

Clinical staff will administer a 15-minute questionnaire to participants using Computer Assisted Personal Interview software (CAPI) to screen for exclusion criteria for exam components. These include factors such as recent chest surgery, which is an exclusion criterion for the pulmonary function testing, and need for walking aids or assistive devices, which is an exclusion criterion for the long distance corridor walk. We will also collect information on factors that may impact performance on the neurobehavioral or peripheral nervous system tests, on pulmonary function testing, or that might affect biological specimens. These factors are not exclusion criteria, but will be considered as potential confounders or to use for sub-selection for sensitivity analyses, as appropriate, when analyzing the results of the clinical tests.

6.3 Heart Rate and Blood Pressure Measurement

Clinic staff will take three measurements of resting heart rate and blood pressure using standard clinical oscillometric equipment after the participant has rested in a seated position for at least five minutes. The second and third readings will be used to calculate average values for reporting results to participants.

6.4 Anthropometric Measures

Clinic staff will take three measurements of weight (kg), height (cm) and hip and waist circumference (cm). Height will be measured with a wall-mounted stadiometer, and weight will be measured with digital scales. Height and weight (converted from metric to English) will be used to calculate BMI for participant reports. Hip and waist circumference will be measured with a vinyl measuring tape. The measuring tape will be inspected daily for defects / stretching and will be replaced as needed should any defects be identified.

6.5 Biological Samples

Clinic staff will collect a variety of biological samples, including blood, urine, hair, toenail clippings, and saliva, as described in the sections below. All samples will be processed as described below until shipment to the Central Processing Laboratory (CPL) for any final processing and transfer to the biorepository for long-term storage. The participant will not be asked to fast before the biological samples are taken. A recent community based cross-sectional analysis has shown that measuring blood lipid levels when a participant has not fasted will yield acceptable results. [40]

6.5.1 Hair

Clinic staff will collect a small nape hair sample as close to the participant's scalp as possible. Clinic staff will clip and mark hair samples to indicate which end was closest to the scalp. The clinics will temporarily store collected hair samples at ambient temperature with a desiccant prior to shipping samples for long-term storage and future analysis. A hair sample will be collected only if it is at least 1 cm long.

6.5.2 Toenails

During the examination, clinic staff will ask participants to collect toenail clippings from each toe, unless participant has a medical or physical condition (e.g., poorly controlled diabetes) that would contraindicate collection. Sites will temporarily store toenail clippings at ambient temperature prior to shipping samples for long-term storage and future analysis. Clinic staff will advise participants in advance of their scheduled clinic visit not to clip their toenails before the visit. If toenail specimens cannot be collected, the clinic staff will provide the participant with toenail collection instructions and a prepaid self-addressed envelope to ship the toenails to the CPL at a later date.

6.5.3 Urine Specimen

Participants will be asked to provide a random ("spot") urine specimen in a sterile container using the mid-stream catch technique. The sample will be analyzed by

local clinical site laboratory personnel who will perform a 10-parameter urinalysis (glucose, bilirubin, ketone, specific gravity, occult blood, pH, protein, urobilinogen, nitrite, leukocyte esterase) using a commercially available dipstick and a CLIA-waived testing device.

6.5.4 Saliva

A sample of ~1,000 participants at the University of South Alabama will be asked to provide serial saliva samples for the measurement of salivary cortisol, following an in-home sample collection protocol used successfully in other studies [41]. Sampling probability will be modified as necessary, in order to achieve balanced sampling on gender (i.e., 50% males, 50% females). Participants will be asked to produce five samples on two different days during a one-week period following their exam. The samples will be collected to allow for measurement of diurnal patterns in cortisol levels: 1) upon waking, 2) about 45 minutes after waking, 3) 4 hours after waking, 4) 10 hours after waking, and 5) before bed time.

To ensure the participants understand the collection process, clinical site staff will train participants to collect samples at the time of their exams and ask participants to produce one sample as part of the training. The practice sample will be stored at the clinic site and shipped to the CPL for processing. Clinical site staff will also provide participants with a collection kit that includes instructions, collection containers, return shipping materials, and a collection log. The collection log will capture the days and times of sample collection, as well as information about factors that may influence cortisol levels. Participants will be instructed to refrigerate samples from the time of collection until shipment. Clinical site staff will contact participants 3-4 days after their exam to remind them to collect the samples and return them in the self-addressed, stamped mailer. Study staff will make another reminder call if samples are not received within 8 days of their exam. No further reminder calls will be made. Participants will be asked to return samples directly to the CPL for processing.

6.5.5 Venous Blood Collection

Clinic staff will use a “butterfly” blood collection set to collect a total of 54.5 mL of blood at USA and 60.5 mL of blood at LSU by venipuncture into seven or eight Becton-Dickinson brand Vacutainer™ blood collection tubes. Blood specimens will be collected in the following order of priority:

- **Red Top Serum Tubes**: Two 10 mL red top tubes, with no additives and no separator gel to provide aliquotted serum and clotted blood cells for future analyses.
- **Lavender Top EDTA Tubes**: Two 10 mL lavender-top tubes with lyophilized K_2EDTA anticoagulant to provide plasma and packed cells for future analyses.
- **Yellow Top ACD-B Tube**: At USA one 6 mL yellow topped tube with Acid/Citrate/Dextrose Solution B tube for future lymphocyte analyses. As

described in Section 6.12.1 below, clinic personnel at LSU will collect two yellow topped ACD tubes from participants for comparison testing.

- **Royal Blue Top EDTA Tube**: One 6 mL royal blue top tube with lyophilized K_2EDTA anticoagulant for future trace metals analyses. The tubes have been validated by the manufacturer to be free of the following trace metals: antimony, arsenic, cadmium, calcium, chromium, copper, iron, lead, magnesium, manganese, mercury, selenium, and zinc.
- **PAXgene RNA Tube**: One 2.5 mL PAXgene blood RNA tube will be collected to obtain stabilized whole blood for future mRNA isolation for analyses.

In the rare event that a partial blood tube is collected due to a temporary interruption of the blood collection procedure, we will retain the partially filled tube. In the event that a participant has poor venous access, clinic staff will attempt to draw blood up to three times if the participant agrees.

6.5.6 Quality Control (QC) Specimens

We anticipate that future researchers will require substantial volumes of biospecimens for quality control and assay validation purposes, but that the results of these procedures will not directly contribute to addressing the specific aims of this study. These specimens will be critical when serial samples or samples known to be from the source population are required.

To meet this need, we will store an additional 40 mL of urine and collect four additional tubes of blood, consisting of one 10 mL red top, one 10 mL lavender top, one 6 mL yellow top and one 6 mL royal blue top, (i.e., an additional 32 mL blood) from a total of 200 participants. We will request these QC samples of all participants who provided QC samples at baseline (maximum of 200). We will supplement these with a random sample of other clinical exam participants to achieve a total sample size of 200. The extra QC urine (40 mL) will be taken from the sample already collected because participants provide samples in a large cup that contains more sample than needed for long-term storage. Site staff will aliquot the QC urine and blood QC specimens in the same manner as their corresponding study samples (above) and ship them with the study samples to the CPL for long-term cryo-storage. A subset of the cohort will provide a QC saliva sample that will be shipped to the CPL for long-term cryo storage.

6.5.7 Capillary Blood Collection

Clinic personnel will perform a finger stick to obtain approximately 250 µL of capillary blood for the immediate point-of-care measurement of Hemoglobin A1c and a standard lipid panel (Total Cholesterol, HDL Cholesterol, LDL Cholesterol, and Triglyceride) and analyzed at the clinical sites using a CLIA-waived testing device.

6.6 Peripheral Nerve Testing

Direct assessment of physical performance has become standard practice in epidemiologic observational studies of health and disease processes. The most commonly used assessments were initially designed to differentiate function in older adults [42, 43], but modifications in administration and scoring[44] can improve the utility of these assessments to discriminate meaningful differences and change in functional capacity in most middle-age persons, as well. Although the measurement ceiling of these tests may be low for young and some middle-age adults (i.e., they can easily achieve the maximum possible performance on all tests), they provide useful comparative measures to other study populations such as the NIA-sponsored Baltimore Longitudinal Study of Aging (BLSA).[45] Furthermore, repeat assessment following standardized procedures over subsequent visits can aid in identifying the approximate point at which meaningful loss of functional capacity begins to emerge. The following protocol constitutes a modification of the physical performance battery originally used in the Established Populations for Epidemiologic Studies of the Elderly (EPESE)[43] and Women's Health and Aging Study (WHAS), developed for and used in the Health, Aging and Body Composition (Health ABC) study. [44]

6.6.1 Visual Acuity

Visual Acuity is the measurement of clarity or sharpness of vision. We will use the standard Snellen chart to determine visual acuity with and without current correction (if applicable) at 20 feet.

6.6.2 Visual Contrast Sensitivity

Visual contrast sensitivity will be evaluated with the Functional Assessment of Contrast Sensitivity test using a standard testing instrument, the Optec 1000 (Optec, Inc. USA). Circular stimuli consisting of alternating light and dark bars will be presented. Nine stimuli of decreasing contrast will be presented at each of 5 spatial frequencies, i.e., 1.5, 3, 6, 12, and 18 cycles per degree. The index of the weakest contrast correctly identified (i.e., threshold) will be recorded for each spatial frequency.

6.6.3 Handgrip Strength

Measurement of grip strength provides information about the functional integrity of the voluntary motor system from the brain's motor cortex to the peripheral skeletal muscles. Impulses for voluntary contraction of skeletal muscles are carried on large, myelinated nerve fibers with cell bodies located in the anterior horn of the spinal cord. In occupational and environmental health settings, the most common disorder affecting grip strength is distal sensory-motor axonopathy.

Grip strength and pinch strength will be assessed with the baseline digital hydraulic hand dynamometer. It is a self-contained mechanical/hydraulic device that records on a dial the maximum force exerted by the participant's "power" or

whole-hand grip. It is equipped with a "tell-tale" that retains the maximum excursion of the force indicator needle. It is commonly used by physical medicine and rehabilitation specialists for evaluation of patients with motor abnormalities.

The device is manually operated. It requires no set-up and is relatively robust, but may be damaged or lose calibration if dropped. We will perform one set of three grip strength measures of the dominant hand followed by one set of three grip strength measures of the non-dominant hand. The mean of the three measures for each hand are the summary metrics for the handgrip measure. A full set of grip strength measurements requires approximately 2 minutes.

6.6.4 Vibrotactile Threshold Testing

The measurement of cutaneous vibrotactile threshold is used to diagnose peripheral neuropathy. Cutaneous vibratory stimuli are carried on large myelinated sensory nerve fibers. These fibers are believed to be more sensitive to both diffuse and focal insult than are small myelinated and unmyelinated fibers carrying other sensory information such as pain or temperature. Thus, large fiber function abnormalities can be an early indicator of peripheral neurological disease in an individual at risk. Many occupational and environmental hazards, including heavy metals and organic solvents, can affect these fibers. Testing large fiber function may allow for early detection of neurotoxicity due to these and other agents.

The Vibratron II is a simple and widely used electromechanical vibrometer consisting of a controller unit and two identical transducer units that cause plastic posts protruding from their housings to vibrate at a frequency of 120 Hz. The intensity (amplitude) of the Vibration is controlled by the OUTPUT knob on the face of the controller unit. The amplitude is provided in "Vibration Units" on a digital display on the face of the controller. The Vibratron is a manually operated device and does not require computer interface for operation. It is relatively physically robust and readily portable. Data will be manually entered into the data system by the examiner. Set-up requires about 5 minutes. Each threshold requires about two minutes to obtain. We will obtain five threshold values (three descending and two ascending values) for each great toe, requiring a total of about 10 minutes. The vibration threshold for each toe is the median value obtained from values 2-5 (value 1 is discarded).

6.6.5 Standing Steadiness (Postural Stability)

The Advanced Mechanical Technology, Inc. (AMTI) force platform assesses postural stability by measuring the forces applied to the platform through the participant's feet. The device uses strain gauges in the metal platform and a computer interface to record the forces applied to it. The signals from these strain gauges are amplified, digitized, and stored in the computer. From these forces, a times series of locations of the participant's center of pressure can be collected. The path of these center of pressure locations is plotted on the computer screen and the length and velocity of the sway path over a standard time period (e.g., 60 seconds) is recorded. Other summary measures such as

the average deviation in the lateral and anterior-posterior directions can also be calculated. We will repeat the test two times with the participant's eyes open and two times with eyes closed. A complete test session requires approximately 8 minutes.

6.6.6 Single Leg Stance

Measurement of postural stability allows for assessment of the integrated function of several components of the nervous system, including the vestibular apparatus, cerebellum, and proprioceptive system. Loss of functional integrity of any of these systems secondary to disease or toxic exposure may affect postural stability.

We will measure the single leg stance by asking the participant to stand on one leg and maintain balance for 30 seconds. If the participant is unable to maintain their balance for the entire 30 seconds, then the procedure will be repeated up to two additional times

6.6.7 Long Distance Corridor Walk (LDCW)

Insufficient cardiovascular fitness may be a major mechanism through which different behaviors and diseases contribute to functional decline; a key landmark on the pathway from independence to disability. As substantial decline in exercise tolerance may precede recognition of mobility-related difficulty, particularly in sedentary individuals, low exercise tolerance may be an early indicator of impending functional limitation.

The LDCW, a walking-based test of exercise tolerance and fitness level, developed for use in the Health ABC study, was designed to minimize shortcomings associated with self-paced walking tests. [46] The participant is asked to walk four hundred meters at their normal pace and the time to accomplish this task is recorded. Four hundred meters is the approximate distance an average healthy older adult can cover in 6 minutes and is comparable to the reference distance (1/4 mile) of a commonly used self-report measure of mobility-related difficulty. [46] Participants are told that they will be timed but are advised to walk as quickly as they can, without running, at a pace they can maintain over the 400 meters. The LDCW will not be performed with participants whose systolic blood pressure is greater than or equal to 180, diastolic blood pressure greater than or equal to 110, heart rate less than or equal to 40 beats per minute, or heart rate greater than or equal to 120 beats per minute. Participants who report recent (within last three months) heart attack or myocardial infarction, angioplasty or stent placement, or heart surgery will also be excluded from the LDCW. Further, participants are excluded if they are not comfortable walking long distances without assistive devices or if they are wearing shoes that make walking difficult.

6.6.8 Trail Making

The trail making test is a paper and pencil test that measures multiple domains, including visual search, scanning, speed of processing, mental flexibility and executive functions. The test consists of two tasks. In Task A, participants are asked to draw lines sequentially connecting 25 encircled numbers distributed on a sheet of paper. Task B is similar to ask Task A, except the participant must alternate between numbers and letters (e.g., 1, A, 2, B, 3, C).

6.7 Neurobehavioral Examination

We will use the Behavioral Assessment and Research System (BARS) to measure neurobehavioral function. The purpose of the examination is to determine whether exposures to oil and oil dispersants are associated with brain or nervous system dysfunction. Individual components of the neurobehavioral exam are summarized in Table 2 and described in detail below.
We selected BARS for testing in this study because it was specifically designed for use in populations with limited levels of educational attainment and minimal experience using computers. The same design features that were implemented to improve ease of test administration – step-by-step spoken and written instructions, practice exercises, and a simple 9-button keyboard – have the added benefit of reducing staffing effort for examiners and variability in test administration. Our examiners will be trained and monitored by Fred Gerr and Diane Rohlman, collaborators at the University of Iowa who are experts in the field of neurobehavioral assessment and supported by the central study coordinator.

Table 2. Components of the Neurobehavioral Exam in Order of Presentation

Test	Function	Measurements
Finger Tapping	Response speed, coordination	• Number of taps completed in a fixed time
Symbol-Digit	Complex function/Information Processing Speed	• Latency to complete the matrices • Errors
Simple Reaction Time	Response speed	• Response latency or reaction time
Digit Span	Attention, memory	• Longest span forward and backward
Match-to-Sample	Visual memory	• Number correct • Correct response latency
Continuous Performance	Sustained attention	• Reaction time • Number of hits • Errors of omission • Errors of commission

Test	Function	Measurements
Progressive Ratio	Motivation	• Number of ratios completed • Longest ratios completed

6.7.1 Finger Tapping

The tapping test measures response speed and coordination. The participant is instructed to tap as rapidly as possible with the right hand, the left hand and alternating hands over a 20 second period. Taps increase the height of a dark bar to suggest progress to the participant.

6.7.2 Symbol Digit

The symbol digit test, an assessment of complex scanning and visual tracking, is one of the most widely used and sensitive measures of neurotoxicity. The test presents nine symbols that are paired with a number between one and nine. The symbol-digit pairs are arranged in a 2 x 9 table at the top of the screen. A similar table at the bottom of the screen contains the symbols but not the digits. The participant is instructed to type the missing numbers that correspond with symbols in the bottom table as quickly as possible.

6.7.3 Simple Reaction Time

The simple reaction time test measures response speed. The participant is instructed to respond by pressing a response button as quickly as possible after seeing a stimulus on the screen or when a response button becomes backlighted. Fifty trials are presented and the latency for each button press is recorded.

6.7.4 Digit Span

The digit span test measures attention and memory. A series of numbers between one and nine is presented sequentially on the computer screen. The participant is instructed to reproduce the sequence of numbers by pressing the numbered response buttons in either the same or reverse order in which they were presented. The number of digits increases, starting from three numbers, until a failure criterion is met.

6.7.5 Match to Sample

The match to sample test measures visual memory. A 10 × 10 matrix of blocks is followed by three choices, among which one is the same as the sample stimulus. Participants are asked to select the sample stimulus.

6.7.6 Continuous Performance

The continuous performance test measures sustained visual attention. A series of stimuli are presented one at a time and in an unpredictable order for approximately 5 minutes. Participants are instructed to press a response button as quickly as possible after a cue-target (plus sign followed by a circle) is presented. Three hundred stimuli are presented; 20% of them are target stimuli.

6.7.7 Progressive Ratio

The progressive ratio test measures motivation. Participants are instructed to press a button multiple times and receive a “reinforcer” (smiley face) for completing the task. The criterion for earning a reinforcer increases with each successive trial. The total number of button presses or taps in two minutes is recorded.

6.8 Fractional Exhaled Nitric Oxide (FeNO)

eNO will be measured according to ATS/ERS standards, using a Sievers analyser (NOA-2080i) a with chemoluminsecent sensor. Clinical staff will conduct measurements with the participant in a seated position. The participant will place the mouth piece in their mouth, inhale for two to three seconds to total lung capacity, then exhale immediately at a constant flow rate (50mL/s) for ten seconds. The participant will be allowed to perform up to 8 maneuvers in order to achieve two measurements that agree within 5%. If the participant cannot perform two reproducible 10-second maneuvers, two 6-second maneuvers will be considered acceptable. FeNO will be collected immediately *prior* to the pulmonary function testing

6.9 Pulmonary Function Testing (PFT)

Pre and post-bronchodilator pulmonary function testing (PFT) will be conducted according to ATS/ERS guidelines [48]. Bronchodilation will be achieved through the administration of 4 metered doses of albuterol (90 µg per actuation, 4 puffs) through a spacer, with 30 seconds between puffs. Post-bronchodilator spirometry will take place 10-15 minutes after bronchodilator administration.

PFT will be performed using a portable, ultrasound transit-time based spirometer (EasyOn; NDD Medical Technologies, Chelmsford MA, USA, or a comparable model). A full Forced Vital Capacity maneuver will be conducted. We will obtain three ATS acceptable forced expiratory maneuvers out of a maximum of eight attempts before and after bronchodilator administration. Spirometry will be conducted with the participant seated and wearing a disposable nose clip. We will use new individually packaged, disposable mouthpieces for each subject and

a new spacer for each subject. All spirometers will undergo standard quality control checks each day they are used.

To the extent possible, we will ask participants to not use their asthma inhalers on the day of the examination. We will record the timing and dosage of all asthma medications over the preceding seven days.

Participants who answer yes to any of the following questions will not undergo spirometry during the visit:

- In the past three months, have you had any surgery to your chest or abdomen?
- In the past three months, have you had a heart attack or stroke?
- In the past three months, have you had a detached retina or have you had eye surgery?
- In the past three months, have you been hospitalized for any other heart problem?
- Are you pregnant?
- Are you currently taking medication for tuberculosis?

In addition, participants with a blood pressure > 180 mmHg systolic or > 110 mmHg diastolic, or with a heart rate > 100 or < 40 beats per minute will not be tested.

Our exclusion questions include those used in BOLD [49] and PLATINO [50], multinational studies that enrolled over 14,000 adults over age 40 years for pre and post bronchodilator spirometry with only trained technicians. No adverse events occurred in either the BOLD or PLATINO studies. These exclusions are considered very conservative and these questions are not generally asked before spirometry is done in clinical practice.

Study staff conducting PFT will be required to take a web-based, NIOSH-approved spirometry course prior and to attend an in-person training session. Following training, staff will be required to submit 10 practice tests that are judged as acceptable by a PFT expert in order to receive certification of proficiency. During the run-in phase, our PFT expert will review PFTs on a weekly basis and will send findings to clinical site directors, along with suggested corrective actions. Clinical site directors or another staff member experienced in PFT will work with study staff to improve performance. If necessary, additional training and practice sessions will be provided by the coordinating center in conjunction with the study PFT expert consultant. All tests will be over-read by a PFT quality control expert. We will re-train staff and continue to over-read all tests until 90% of scores meet quality standard and stabilize at that level of quality.

6.10 Mental Health Assessment

The clinical exam will include a more comprehensive assessment of mental health status, mental health needs, and resiliency than the telephone interview. This assessment allows for a more focused examination of complex interactions between mental and physical health status and will also cover domains that cannot be well-covered in a telephone interview, such as suicidal ideation and substance abuse. The assessment will repeat certain measures included in the telephone interview and will obtain information on participants' access and utilization of local mental health services. Participants will be administered the Patient Health Questionnaire-9 (PHQ-9), which measures current depressive symptoms, with an emphasis on depressed mood, the Primary Care PTSD Screen (PC-PTSD), a four item screener designed for use in medical settings, and the Positive and Negative Affect Scale-Short Form, (PANAS-SF) which, as its name suggests, measures levels of both positive and negative affect. We will also administer instruments based on the Generalized Anxiety Disorder 7-item (GAD-7) scale, the Connor-Davidson Resiliency Scale, the Traumatic Life Events Questionnaire, and the Financial Events Scale, which have previously been used in studies of the general population. This mental health assessment will be conducted near the end of the clinical exam.

Staff may encounter study participants during the clinic visit who are experiencing mild to severe psychosocial distress and will be trained to remain neutral when asking questions or responding to issues related to mental health conditions and to reply with sensitivity. In most situations, mild distress can be effectively addressed with an empathetic and respectful listening, allowing study activities to continue as planned. While the purpose of the exam is not to provide mental health diagnosis, counseling or care, every attempt will be made to connect participants in need with mental health services available in their community (lists of such services have been compiled (and will be updated as needed) with the assistance of other State and Federal Agencies and has been actively used throughout the GuLF STUDY.

Mental health referrals will be based on responses to the PHQ-9, the PC-PTSD, and the GAD-7. We will use validated cutoff points to systematically assess mental health distress and provide real-time referrals. Follow-up calls will be placed to all participants who receive a mental health referral to available mental health services in their area to determine if services were obtained and to provide additional information regarding health services, if necessary.

Staff will also be trained to respond to more serious signs of mental health distress, such as suicidal or homicidal thoughts, that require additional interventions. Participants who express such thoughts will be assessed for signs of acute distress and asked if they have plans, intentions, and means to act on their thoughts. Based on these assessment findings, study staff will take appropriate action, as summarized in Table 3 below.

Table 3. Action Plan for Responding to Suicidal and Homicidal Thoughts

Individual at Risk	Imminent Danger*	Action
Self	No	• Continue study activities, depending on level of emotional distress • Offer a mental health care referral and follow-up call for all referrals
Self	Yes	• End study activities • Refer to emergency care at local community services if available, or through national Hotline • Escalate to study managers and investigators • Follow-up call for all referrals
Other	No	• Continue study activities, depending on level of emotional distress • Offer a health care referral and follow-up call for all referrals
Other	Yes	• End study activities • Call 911 • Escalate to study managers and investigators • Follow-up call for all referrals

* Homicidal or suicidal thoughts combined with plans, intention, or means to act on thoughts.

6.11 Substance Abuse Questionnaire

Participants will be asked about their use of illicit drugs and prescription pain killers, tranquilizers, stimulants and sedatives. The questions will be self-administered using computer-assisted interviewing software. To protect the participant's privacy, the questionnaire administration software will be designed so that the participant's answers are no longer visible to clinical staff once the questionnaire is submitted. The questions come from the National Survey on Drug Use and Health, and will be conducted near the end of the clinical exam.

6.12 Biospecimen Processing and Shipment

Once specimens are collected by clinic personnel, they must be processed for short-term storage at the clinics, transport to the Central Processing Laboratory and for long-term storage in the NIEHS Biorepository.

6.12.1 Biospecimen Processing by the Clinic Laboratories

After collection, clinic personnel will bring the collected biospecimens to the clinic laboratory for processing.

- **Red Top Serum Tubes and Lavender Top EDTA Tubes**: Laboratory personnel will allow the red- and lavender-topped tubes (including QC tubes) to sit for approximately 30 minutes to allow blood to clot in the red top tubes. Laboratory staff will then centrifuge both tube types for 15 minutes at 1,300 x g to separate serum from the clots in the red top tubes and plasma from packed cells in the lavender-topped tubes. Serum, plasma and packed cells will be divided into barcode labeled 1.0 mL aliquots in cryovials and the red cell clots will be decanted into barcode labeled 7 mL storage tubes. The aliquotted specimens will be all frozen at -80℃ for storage until shipment.
- **Yellow Top ACD-B Tube**: Clinic laboratory personnel will process the yellow-topped ACD tubes differently at each location:
  - At the University of South Alabama Clinic in Mobile, laboratory personnel will mix the unseparated whole blood in the yellow-topped tubes with the cryoprotectant dimethyl sulfoxide (15% DMSO). USA laboratory personnel will then aliquot and freeze the cryopreserved specimens at a controlled rate of approximately -1℃ per minute to -80℃, at which temperature the specimen will be stored for future use. QC ACD tubes at USA will be processed in the same manner.
  - At Louisiana State University in New Orleans, laboratory personnel will process the yellow top specimens in two different ways. These procedures will us to compare the efficacy of lymphocyte recovery from specimens processed by both methods:
    - ***First yellow top ACD-B tube***: LSU clinic laboratory personnel will process the first ACD tube by cryopreserving the whole blood specimen in 15% DMSO without lymphocyte separation. The cryoprotected whole blood specimens will then be aliquotted and frozen at a controlled rate of -1℃ per minute to -80℃ for storage at that temperature prior to shipment.
    - ***Second yellow top ACD-B tube***: LSU Clinic personnel will collect an additional 6 mL ACD yellow top tube from participants. Laboratory personnel will isolate polymorphonuclear cells/lymphocytes from the whole blood specimen using a discontinuous gradient separation media (Histopaque) in Greiner Leukosep® porous barrier centrifugation tubes. Separated cells will be washed three times with a buffer (Hank's Balance Salt Solution with 5% fetal bovine serum) and then cryopreserved in 15% DMSO at a controlled rate of approximately -1℃ per minute to -80℃ for storage at that temperature prior to shipment. QC ACD tubes at LSU will be processed in this manner. If blood is collected in the morning, lymphocytes will be isolated at midday and cryopreservation will be completed the same day as collection. For blood collected in the afternoon, lymphocyte isolation will begin the day of collection but the process, including cryopreservation, will be completed the following morning.
- **Royal Blue Top EDTA Tube and PAXgene RNA Tube**: These specimens (including QC tubes) will not be aliquotted but left in their

original containers to avoid specimen contamination. Since these blood tubes are glass, they will be frozen at only -20℃ to prevent tube breakage due to ice expansion.

- **Capillary Blood Sample**: Laboratory personnel will not need to process the capillary blood samples as the clinic staff will analyze them immediately using the CLIA-waived point of care testing devices.
- **Urine Samples**: Clinic laboratory personnel will receive these samples (including QC samples) and enter them into the data management system. Urine samples will be separated into 2 mL and 7 mL aliquots and stored at -80℃.
- **Hair, Toenail, and Baseline Saliva Samples**: Clinic laboratory personnel will receive these samples (including QC samples) and enter them into the data management system. However, no additional processing is required except to store them at the proper temperature while awaiting shipment to the Central Processing Laboratory. Hair will be frozen at -20℃, toenails will be stored at ambient temperature, and saliva will be refrigerated at +4°C.

6.12.2 Short-Term Storage at the Clinic Laboratories

Collected and processed biospecimens will be held in interim storage in the clinic laboratories pending shipment to the Central Processing Laboratory. Specimens will be held at one of four storage temperatures:

- **Ambient temperature:** Toenail samples are stored with desiccant packets at room temperature prior to shipment.
- **+4℃**: Baseline saliva samples will be stored +4℃ in the laboratory refrigerator until shipment.
- **Frozen at -20℃**: The unopened royal blue topped tubes and PAXgene RNA tubes as well as collected hair samples will be stored at -20℃ in the clinic laboratory's combination refrigerator/freezer until shipment.
- **Frozen at -80℃**: All remaining aliquots of serum, red cell clots, plasma, anticoagulated packed cells, cryopreserved whole blood, isolated lymphocytes (at LSU only), and urine will be stored -80℃ in the laboratory deep freezer until shipment.

6.12.3 Biospecimen Shipment to Central Processing Laboratory

As storage boxes of processed and stored biospecimens are filled, clinic laboratory personnel will prepare these storage containers for shipment to the Central Processing Laboratory. To minimize the potential of specimen loss or damage, we will split each participant's specimens across two shipments that are mailed on different days.

The clinic laboratories will prepare three separate types of shipments based on the storage temperature of the biospecimens to be shipped.

- ***Dry Ice Shipments***: All specimen aliquots that are stored at -80℃ will be packaged and shipped to the Central Processing Laboratory via overnight carrier (FedEx) on dry ice in accordance with DOT and IATA hazardous shipping requirements.

- ***Frozen Gel Pack Shipments:*** The royal blue top trace metal specimens, PAXgene RNA specimens, and collected hair samples that have been stored on-site at -20℃ will be shipped to the Central Processing Laboratory via overnight carrier (FedEx) in a well-insulated shipping container with several ice bricks that have been frozen for at least 48 hours at -20℃. Boxes of stored saliva samples will be placed in the top of the shipping container, but not in contact with the ice bricks, thereby maintaining a temperature of approximately +1℃ to +8℃ during transit.

- ***Ambient Temperature Shipments:*** Filled boxes of stored toenail samples will periodically be shipped to the Central Processing Laboratory via overnight carrier (FedEx) at ambient temperature in an insulated shipping container to protect the specimens from external temperature extremes during transit.

Clinical laboratory personnel will make weekly biospecimen shipments to the Central Processing Laboratory on either a Monday or Tuesday for priority/next day delivery to minimize the possibility of shipments arriving in the CPL on weekends or holidays. All biological samples will be shipped according to local, state, and federal requirements governing shipment of exempt biological specimens (UN3373).

6.12.4 Biospecimen Processing at the Central Processing Laboratory

With the exception of saliva samples, the Central Processing Laboratory will need to process biospecimens received from the clinic laboratories only minimally. Saliva samples received from sites and from participants will be separated into 0.5 mL aliquots and stored at -80°C. After all other samples are received and registered in the NIEHS Biospecimen Inventory System at the central processing lab, they will be held in short-term storage under the same conditions as above until they are shipped to the NIEHS biorepository.

6.12.5 Long-Term Storage in the NIEHS Biorepository

Once the CPL transfers study specimens to the NIEHS biorepository, the serum, plasma, packed red cells, and cryopreserved whole blood aliquots will be stored in LN2. The blood clots and saliva will be stored at -80℃. The trace metal tubes and PAXgene RNA tubes and hair samples will be stored at -20℃. The urine aliquots will be split between LN2 and -80℃. Toenail samples will be stored with desiccant, under controlled ambient temperature and humidity.

6.13 Reports to Participants and Health Care Referrals

During each clinical exam visit, clinical staff will measure height and weight to calculate BMI, blood pressure, spirometry, and hemoglobin A1c and lipid levels.

The participant will receive a form with the results of these tests/measurements, standardized clinical interpretations, and advice for seeking care. In addition to providing the participant form and recommended actions (see Table 4), participants who do not have a primary care provider or who cannot afford to pay for care will be referred to a local clinic that provides care for services based on a sliding scale.

Table 4. Recommendations for Action based on Medical Findings

Evaluation	Findings	Recommended Actions
Blood Pressure	SBP ≥ 180 or DBP ≥ 110	Seek care **as soon as possible** as this is a potential emergency health condition. Emergency Care Needed. A hypertensive crisis exists when blood pressure reaches levels of 180 or higher for the systolic (top) number OR 110 or higher for the diastolic (bottom) number. There is no safe duration for blood pressure to remain in this range.
	SBP 160 to 179 or DBP 100 to 109	See a health care provider **within the next month** to have your blood pressure rechecked and managed.
	SBP 140 to 159 or DBP 90 to 99	See a health care provider **within the next two months** to have your blood pressure rechecked and managed.
	SBP 120 to 139 or DBP 80 to 89	Find out from a health care provider if any additional evaluations or lifestyle changes are indicated.
	SBP < 120 AND DPB < 80	No recommendation.
Resting Heart Rate	HR > 120 bpm	You should see a health care provider **as soon as possible**. A very high heart rate can be a sign of a heart problem or other medical conditions.
	101 ≤ HR ≤ 120 bpm	A high heart rate may be due to a medical problem or other causes. You should see a health care provider **within the next month**.
	40 ≤ HR ≤ 59 bpm	A low heart rate may be normal for some individuals. In others, it may be due to a medical problem. You may want to share this report with your health care provider at your next visit.
	HR < 40 bpm	You should see a health care provider **as soon as possible**. A very low heart can be a sign of a heart problem or other medical conditions.
	60 ≤ HR ≤ 100	No recommendation.
BMI	Obese (≥ 30)	People who are obese are at higher risk for chronic conditions such as high blood pressure, diabetes, and high cholesterol.
	Overweight (25 to 29.9)	People who are overweight are at higher risk for chronic conditions such as high blood pressure, diabetes, and high cholesterol. You may want to consult a health care provider about your weight and ways to stay healthy.

Evaluation	Findings	Recommended Actions
BMI	Normal (18.6 to 24.9)	Maintaining a healthy weight may reduce the risk of chronic diseases associated with overweight and obesity.
	Underweight (< 18.5)	Being very underweight, especially if weight loss has been sudden, may indicate health problems. Talk with your health care provider to discuss these findings and any need for additional evaluation or consultation.
Pre-Bronchodilator Spirometry	Either FEV_1, FVC, or FEV1/FVC below lower limits of normal AND FEV_1, < 50% predicted	An abnormal lung function test result is not a diagnosis of disease; that determination can only be made by a health care provider following a complete medical examination. Based on these results, we recommend that you see your physician **within the next week** to discuss these findings.
	Either FEV_1, FVC, or FEV1/FVC below lower limits of normal AND FEV_1, ≥ 50% predicted	An abnormal lung function test result is not a diagnosis of disease; that determination can only be made by a health care provider following a complete medical examination. Based on these results, we recommend that you see your physician **within the next month** to discuss these findings.
	FEV_1, FVC, and FEV1/FVC all above lower limits of normal	No recommendation.
Post-Bronchodilator Spirometry (If FEV_1 > 1.67 l, use 12% threshold)	(POST-BD FEV_1 – PRE-BD FEV_1) / PRE-BD * 100 < 12%	Unchanged
	(POST-BD FEV_1 – PRE-BD FEV_1) / PRE-BD * 100 ≥ 12%	Significantly improved
Hemoglobin A1c	≤ 5.7%	No recommendation.
	≥5.8%	You should see a health care provider **within one month**. A high A1c level can be a sign of pre-diabetes or increased risk of diabetes complications.
Total Cholesterol	< 200 mg/dL	No recommendation
	200 – 239 mg/dL	You may be able to modify your cholesterol with specific diet and lifestyle changes such as increasing exercise level or weight loss. **You should share your test results with your health care provider to discuss the best way to change your cholesterol**.

Evaluation	Findings	Recommended Actions
Total Cholesterol	≥ 240 mg/dL	You may be able to modify your cholesterol with specific diet and lifestyle changes such as increasing exercise level or weight loss. **You should share your test results with your health care provider to discuss the best way to change your cholesterol**..
HDL Cholesterol	Less than 40 mg/dL (for men) Less than 50 mg/dL (for women)	You may be able to modify your cholesterol with specific diet and lifestyle changes such as increasing exercise level or weight loss. **You should share your test results with your health care provider to discuss the best way to change your cholesterol**.
	≥ 60 mg/dL	No recommendation
LDL Cholesterol	<130 mg/dL	No recommendation
	130 – 159 mg/dL	You may be able to modify your cholesterol with specific diet and lifestyle changes such as increasing exercise level or weight loss. **You should share your test results with your health care provider to discuss the best way to change your cholesterol**.
	160 – 189 mg/dL	You may be able to modify your cholesterol with specific diet and lifestyle changes such as increasing exercise level or weight loss. **You should share your test results with your health care provider to discuss the best way to change your cholesterol**.
	≥ 190 mg/dL	You may be able to modify your cholesterol with specific diet and lifestyle changes such as increasing exercise level or weight loss. **You should share your test results with your health care provider to discuss the best way to change your cholesterol**.
Triglyceride	< 150 mg/dL	No recommendation
	150 – 199 mg/dL	You may be able to modify your cholesterol with specific diet and lifestyle changes such as increasing exercise level or weight loss. **You should share your test results with your health care provider to discuss the best way to change your cholesterol**.
	200 – 499 mg/dL	You may be able to modify your cholesterol with specific diet and lifestyle changes such as increasing exercise level or weight loss. **You should share your test results with your health care provider to discuss the best way to change your cholesterol**.

Evaluation	Findings	Recommended Actions
Triglyceride	≥ 500 mg/dL	You may be able to modify your cholesterol with specific diet and lifestyle changes such as increasing exercise level or weight loss. **You should share your test results with your health care provider to discuss the best way to change your cholesterol**.

6.14 Remuneration

Participants who complete the Biomedical Surveillance Sub-cohort clinic visit will receive $100 for their time and effort. Participants who complete the saliva collection and return their samples will receive an additional $20. If the participant is unable to complete the full clinical exam, but completes the abbreviated 2-hour exam, they will receive $50. Participants will also receive reimbursement for travel costs based on the table below. A reimbursement for lodging and meals will be provided, if needed, to participants who travel long distances for early morning or later afternoon visits. All participants will be offered recovery sustenance during the exam, consistent with what would typically be available in a medical setting given procedures of this nature.

Table 5. Travel Reimbursement

Approximate Distance from the Clinic	Amount
≤ 30 miles	$25
≥31 miles	$50

7 Data Collection

Study computers with whole-disk encryption will be issued to clinical sites, as required by the security plan in effect for the GuLF STUDY. A clinical data management and scheduling system will be utilized to standardized data collection and centralize the storage of study data. The system will be accessible only to project team members at the coordinating center and clinical sites, via an encrypted, secure connection to GuLF STUDY central servers (VPN or Secure-Socket-Layer). Thus, no project data will be archived on remote computers for long-term storage. Study data recorded on the neurobehavioral and PFT computers will be uploaded weekly and stored in a secured, password protected database at the study coordinating center. The system has user access rights designed to ensure site personnel have access only to participants assigned to their site, and cannot see data collected elsewhere. Any ancillary data collected using 3rd party software (e.g., pulmonary function data) will not contain personally identifying information when possible. All clinical data management systems will be programmed in order to minimize the risk of errors. For example, real-time data validation and consistency checks will be performed as data are being collected, in order to preserve the integrity of the data. Study computers will be returned to the central office at the closure of clinical data collection efforts.

8 Record Retention

Paper documents will be kept in locked filing cabinets, to which only authorized personnel and study staff will have access. Electronically stored information and materials will be on password protected access systems, computers and devices with various safeguards (i.e. firewalls) put in place to address privacy and security concerns.

All records that contain names or other personal identifiers will be stored separately from study records identified by code number. Worksheets, lists, logbooks, appointment books, and any other documents that link participant ID numbers to other identifying information will be stored in a separate, locked file in an area with limited access. At the end of enrollment, consent forms and all other study related materials will be transferred to the coordinating center for long term storage.

9 Data Analysis

Descriptive analyses, stratified by gender, state of residence and smoking status, will be conducted to characterize the demographic, lifestyle, behavioral, residential, and socioeconomic profiles of participants. We will also investigate these factors in relation to the nature and extent of subjects' participation in the oil spill clean-up effort. In addition, to assess selection bias, we will compare these profiles among those invited to participate in the exam compared to those who actually participated. Descriptive analyses will include frequencies for categorical variables and means for continuous variables.

We will use least squares regression and logistic regression to examine self-reported and measured outcomes in relation to cleanup-related activities and exposures, as well as demographic, lifestyle, and other factors. Measured outcomes include measures of neurobehavioral function, peripheral nerve function, pulmonary function, and mental health. Statistical methods will be appropriate to the outcomes. For example, in addition to using least squares regression to investigate the association between selected factors and continuous outcome measures, we will employ, when appropriate, logistic regression to examine these factors in relation to outcomes categorized according to clinical criteria.

10 Statistical Power

Consistent with the overall aims of the GuLF STUDY, the clinical exam is designed to allow us to measure the effects of varying levels of exposures to oil and oil dispersants across a wide range of physical and mental health outcomes. As demonstrated in Table 6, we are powered to detect relatively small differences in the prevalence of outcomes between exposed and unexposed participants when the frequency of the outcome is not rare among the unexposed. Similarly, as shown in Table 7, we also have power to detect small differences in continuous outcomes. Even if participation is as much as 25%

lower than expected, our power calculations (not shown) indicate that the minimum detectable ORs or mean differences will increase by less than 10-15%.

For subgroup analyses, power will be adequate (80%) to detect moderate odds ratios (OR) when the proportion not exposed with the outcome is not rare and the prevalence of exposure is between 25 and 75 percent. For example, assuming an N of 700 for the EBC analyses, when the proportion of those unexposed with the outcome is at least 10 percent and the prevalence of exposure is between 25 and 75% there will be adequate power to detect an OR between 1.6 and 2.1. When the prevalence of the outcome is lower among the unexposed and/or the proportion with the exposure is less than 10% or greater than 75%, larger ORs will be needed to attain adequate power.

Table 6. Minimum detectable odds ratios (OR) for a range of proportions of exposure and outcome frequencies, based on a two-sided test with alpha=5%, power=80%, and N = 4,000

Frequency of outcome among unexposed	Proportion of cohort exposed to a given agent					
	5%	10%	25%	50%	75%	90%
	200	400	1,000	2,000	3,000	3,600
1%	3.72	2.88	2.26	2.12	2.39	3.34
5%	2.11	1.78	1.52	1.46	1.55	1.85
10%	1.79	1.55	1.37	1.32	1.38	1.59
30%	1.53	1.37	1.24	1.21	1.25	1.37

Table 7. Minimum detectable mean differences for a range of proportions of exposure, based on a two-sided test with alpha=5%, standard deviation=1, power=80%, and N = 4,000

Proportion of cohort exposed to a given agent	Mean Difference
5% or 95%	0.203
10% or 90%	0.148
25% or 75%	0.102
50%	0.089

11 Institutional Review Board

The investigator and clinical site directors will submit the protocol, informed consent form, questionnaires, and other materials for participants to the NIEHS IRB and local site IRBs for review and approval. Clinical exams will not commence until the submission has been approved in writing by all IRBs. Once the protocol is approved, the principal investigator and clinical site directors will be responsible for obtaining IRB approval during annual Continuing Review for the duration of the study. Amendments will not be implemented without prior IRB approval, except where necessary to eliminate immediate hazards to participants. The principal investigator will report adverse events, protocol deviations, inadvertent loss or disclosure of data, and loss of samples in accordance with the policies of all IRBs.

12 Evaluation of Risks and Benefits

12.1 Potential Benefits

Study participants may benefit from the positive feelings associated with participating in a study of the health effects of the oil spill that may be of value to their community. In addition, the knowledge gained from this study may have a significant impact on future public health responses to similar disasters. It is also possible that participants may benefit directly from public health responses that are based on early findings from this study. Finally, participants may benefit from receiving results of medical evaluations and health care referrals that they may not otherwise receive.

12.2 Potential Risks

The questionnaires and study procedures associated with the clinical exam study present minimal risks to study participants. Adverse events associated with study procedures are expected to be uncommon and limited to mild and transient discomforts. In order to minimize risks to participants, all study procedures will be conducted by qualified, experienced, and well-trained research staff.

The questionnaires are based on instruments that are widely used in epidemiological studies and administered in the baseline enrollment effort. The main risk in questionnaire administration involves questions about sensitive health topics or personal experiences that may be traumatic. Participants will be told that they can skip any questions that make them feel uncomfortable or end the interview at any time. Questions related to mental health and distress and drug abuse may be more stressful than other questions, but as described above, staff will be appropriately trained and systems have been put in place to deal with any issues that may arise. Participants will also be warned of the possibility of loss of privacy should their de-identified data distributed through controlled access procedures be linked back to them in ways that cannot be foreseen at present.

Pulmonary function testing is considered safe. The primary risk, which is exceedingly rare, is fainting in older participants with impaired lung function. We minimize the chance that this rare event will occur by using very conservative exclusions for pulmonary function testing. To further minimize risk of fainting, pulmonary function testing is done in a seated position, and study staff will be trained to look for signs of dizziness or other problems and to stop the maneuver if necessary. We will also exclude participants from testing who have extremely high blood pressure or rapid pulse rates. The risk of infection is all but eliminated by using disposable mouthpieces (spirettes). These disposable mouthpieces have the additional protection of having a built-in bacterial filter.

The only other health risk is associated with the use of albuterol, a bronchodilator, which may cause some jitteriness and increased heart rate. In order to minimize these risks, participants with abnormal blood pressure or heart rate will not undergo spirometry testing, and all participants will be observed for spirometry-related adverse events prior to discharge from the clinic.

There may be some minor discomfort associated with blood collection, including temporary pain, bruising, or swelling at the phlebotomy site. Fainting during blood collection is exceedingly rare.

13 Adverse Event Reporting

Adverse events that are related to clinical procedures and that require clinical intervention are expected to be very uncommon and occur in less than 1% of the study population. Any clinically-significant, procedural-related adverse events requiring medical attention will be reported to the IRBs during the annual continuing review.

Study staff may encounter participants who report or display symptoms of acute, pre-existing medical or mental health conditions that are not related to participation in the study. The results of study procedures, such as blood pressure measurement, may indicate the need for immediate medical attention for poorly controlled or previously undiagnosed illness. Clinic personnel may also observe signs that suggest the existence of reportable social or abusive behaviors or encounter participants who are experiencing mental health distress, suicidal ideation, or homicidal thoughts. Any pre-existing health problem, mental health distress, or social situation that requires a call to 911, local authorities, or social services will also be reported to the NIEHS IRB and local site IRBs as an adverse event at the time of continuing review. The report will include information on the outcome of the actions taken in response to the event.

A clinically significant adverse event related to study procedures will be reported as a serious adverse event if it is life threatening, causes persistent or significant disability, leads to death, or requires medical or surgical intervention to prevent one of these outcomes. The principal investigator will be responsible for reporting all clinically significant serious adverse events related to study procedures to the NIEHS and clinical site IRBs within 24 hours of receiving notification that an event occurred.

Unanticipated problems are defined as any incident, experience, or outcome that meets all of the following criteria:

- unexpected in terms of nature, severity, or frequency given (a) the research procedures that are in the protocol and informed consent and (b) the characteristics of the subject population being studied;
- related or possibly related to participation in the research;
- suggests that the research places subjects or others at a greater risk of harm (including physical, psychological, economic, or social harm) than was previously known or recognized

Serious unanticipated problems and serious protocol deviations will be reported to the NIEHS and CD as soon as possible but not more than seven days after the Principal Investigator first learns of the event. Not-serious unanticipated problems will be reported to the IRB and CD as soon as possible but not more than 14 days after the Principal Investigator first learns of the event. Not serious protocol deviations will be reported to the IRB as soon as possible but not more than 14 days after the Principal Investigator first learns of the event. Sites will report these events to their IRBs according to local requirements.

14 Timeline

We plan to initiate clinical examinations in May 2014. The initiation phase will begin with a run-in period to assess the feasibility of operational plans. The run-in will last for approximately four months and will be followed by ramp-up in visit rates that will allow us to complete all exams within approximately18 months of start-up.

During the four month run-in phase, we will pilot test all aspects of the study, as currently planned, including study procedures, data collection systems, and operational plans. In addition, we will monitor participation rates, implementation of procedures, and overall timing of the clinic visit. We also aim to gain a more accurate reflection of how distance and remuneration impact cohort members' willingness to be involved, as well as overall participant motivation to complete the exam. We will seek IRB approval for any protocol changes that need to be made based on our experience during the run-in phase.

We plan to ramp up the study in August 2014 to ensure that all visits are completed over the next 12-14 months. Depending on when we obtain final IRB approval from all participating sites, we will adjust the launch and ramp-up dates as necessary. However, we anticipate that the run-in phase and study ramp-up will take 4 months and 12-14 months respectively. We will implement any necessary changes during the ramp-up phase in response to our experience during the run-phase. We may ramp up the study sooner, if we find that operational activities stabilize more quickly than current anticipated.

15 Practice Exams

To improve the quality of exams, we will test Biomedical Surveillance Clinical Examination procedures with a small number of adult volunteers who are not enrolled in the GuLF STUDY. About 20 participants age 21 or older will be invited to take part in practice exams to test and evaluate instructions and procedures for clinical examinations.

Volunteers will be asked to come to one of the two study clinic sites. Exams will be conducted using the procedures described above. However, for practice exams, minimal personal contact information will be recorded. Contact information will be destroyed upon completion of the practice exam and the stored data and samples will be anonymized. Information collected during the practice exam will be used to help interpret the results of any tests that are performed. All samples will be linked to the information that is collected by an ID number only.

We will store samples using the storage methods described above. At a later date, we will use the anonymous data and samples to develop future tests or for laboratory quality control measures. Samples provided may be used for quality control of specimen collection, handling, storage and testing for the GuLF STUDY. These samples may also be used to understand the effects of long-term storage, to serve as a comparison or as quality control samples and to evaluate the feasibility and reliability of specific studies and laboratory tests. Analyses of samples may be done at laboratories at the National Institutes of Health or in the laboratories of research collaborators or contractors at other institutions. Samples may be kept indefinitely and analyzed for other tests at a later date. They may also be disposed at any time at the discretion of the investigators or shared with other researchers.

Staff at each site will recruit volunteers using word of mouth. Staff will schedule appointments, administer the informed consent, collect data and specimens, administer exam tests, and provide participants with reports, referrals and remuneration. Participants for practice exams will receive a copy of the consent form and a staff member and witness will sign that the consent was explained and agreed to by the participant. Consent forms will be marked with a participant ID so that forms, data and samples can be linked. Up to twenty-five practice exams will be completed at each site.

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Addendum 4: Pilot to Test Strategies for Increasing Retention and Follow-up among Hard to Reach Participants

1 Purpose:

Based on our experience enrolling participants and completing the first follow-up telephone interview, we believe that more intense efforts to reach participants are necessary to retain the cohort, due in large part to residential mobility and the use of "pay as you go" mobile phones among participants facing financial difficulties. The purpose of this pilot is to assess strategies that may increase participation in the first follow-up telephone interview.

2 Eligible Participants:

New strategies to increase retention and follow-up will be tested among participants who have not been reached for follow-up telephone interviews after exhausting standard attempts to reach them by mail or phone. Initially, we will test each strategy with small samples of approximately ~50 participants per approach, but may expand approaches to much larger subgroups and possibly all previously unreached participants, depending on the results of early testing outcomes.

3 Methods:

Participants selected for the initial pilot test will be randomized into three groups. Strategies being tested are summarized in the table below and explained in detail in the text that follows.

Strategy	Gift Card [a]	Mailed Pre-paid Phone [b]	Locating + Pre-paid Phone [c]
1	Yes	No	No
2	No	Yes	No
3	No	Yes	Yes

a. *Gift cards* – Participants assigned to Strategy 1 one will be offered a $20 gift card for completing the follow-up interview. The gift card will be mailed to responders after the interview is completed. The purpose of the gift card is to offset costs and effort associated with completing the interview among hard-to-reach participant who may not have reliable and convenient access to a telephone.

b. *Pre-paid phones* – Participants assigned to Strategy 2 will be mailed a pre-paid mobile that contains 60 minutes of pre-paid call time, along with a letter encouraging them to contact the study center to complete their follow-up interview. Participants will be allowed keep the phone whether they complete the follow-up interview or not. The approximate retail value of this phone and pre-paid minutes is $30.

c. *Locating and pre-paid phones* – Field staff will be deployed to the homes of participants assigned to Strategy 3. Up to three attempts will be made to locate participants. If participants are not reached, field staff will attempt to obtain updated contact information from household members at the last known address. In these cases, staff will indicate that they are trying to reach the participant to

talk to them about the GuLF STUDY, but will not disclose that they are enrolled. Participants who are reached will be asked to update or confirm their contact information, and they will be offered a pre-paid mobile phone to contact the study center and complete their interview. If the phone is accepted, the participant will be allowed to keep it.

4 Evaluation of Results and Continued Efforts:

Results from the pilot will be reviewed and will inform the selection of a standard methodology to be used for remaining participants whom we were unable to contact for the follow-up telephone interview. These contacting approaches may also be used for future telephone follow-up interviews.

Addendum 5: Event Characterization and Reporting to the IRB, Clinical Director (CD)

Adverse events, protocol deviations, unanticipated problems (UP), serious adverse events, and serious protocol deviations, are defined as described in NIH HRPP SOP 16 ("Reporting Requirements for Unanticipated Problems, Adverse Events and Protocol Deviations."). All adverse events occurring during the study, including those observed by or reported to the research team, will be recorded.

The principal investigator and other key research personnel (KRP) are responsible for investigating and documenting adverse events (AEs) associated with specimen collection and other clinical procedures. No other AEs, as defined in NIH HRPP SOP 16 ("Reporting Requirements for Unanticipated Problems, Adverse Events and Protocol Deviations"), are expected for this study, as the study does not involve any medical interventions. AEs associated with specimen collection and other clinical procedures will not be reported in an expedited manner to the IRB unless they exceed the expected rate of less than 1% of the study population or meet the definition of an unanticipated problem, but will be provided in summary at Continuing Review.

Some subjects participating in this study may die as a result of natural courses of disease or other causes not related to study participation. Additionally the protocol does not mandate immediate notification of deaths; therefore, deaths may not be known unless family members or others notify the study during periodic study communications by mail, telephone, or email. Deaths will be considered "anticipated" and will not be reported to the Clinical Director (CD). If the Principal Investigator or other KRP become aware of a study participant's death that is possibly related to the study, the death will be reported to the CD within seven days after the Principal Investigator first learns of the event.

Serious unanticipated problems and serious protocol deviations will be reported to the IRB and CD as soon as possible but not more than seven days after the Principal Investigator first learns of the event. Not-serious unanticipated problems will be reported to the IRB and CD as soon as possible but not more than 14 days after the Principal Investigator first learns of the event. Not serious protocol deviations will be reported to the IRB as soon as possible but not more than 14 days after the Principal Investigator first learns of the event.