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Federally Sponsored Research on Gulf War Veterans' Illnesses for 2011

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Deployment Health Working Group Research Subcommittee

Annual Report to Congress – 2011

Federally Sponsored Research on Gulf War Veterans' Illnesses for 2011

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*****Totals for FY '02 -'11 do not include funds obligated in FY 1992 -2001

Status: C=Complete; O=Ongoing

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EXECUTIVE SUMMARY

I. INTRODUCTION

Section 707 of Public Law 102-585, as amended by section 104 of Public Law 105-368 and section 502 of Public Law 111-163, requires that an annual report be submitted to the Senate and House Veterans' Affairs Committees on the results, status, and priorities of research activities related to the health consequences of military service in the Gulf War (GW) in Operations Desert Shield and Desert Storm; August 2, 1990 – July 31, 1991. The Research Subcommittee of the interagency Deployment Health Working Group (DHWG) prepared this *2011 Annual Report to Congress*, which is the eighteenth report on Federal research and research activities. The DHWG tracks all federally funded research projects related to Gulf War Veterans' illnesses (GWVI).

As in previous *Annual Reports to Congress*, the material presented is divided into six sections and three appendices. Section I is an introduction; Section II summarizes the research priorities and organization of the Federal GW research portfolio; Section III highlights and summarizes research progress published since the last *Annual Report to Congress*; Section IV summarizes Federal funding trends for GW research during the ten-year period from FY 2002 through FY 2011; Section V highlights new research projects and initiatives since the last report; Section VI contains literature references; and the Appendices contain listings of federally-funded research projects.

II. RESEARCH PRIORITIES

The research priorities remain unchanged from last year. The 19 Research Topics (2 of the original 21 topics were eliminated in the 2006 *Annual Report to Congress*) are grouped into five major Research Focus Areas. These Research Focus Areas are used to organize Sections III and V, as well as Appendix B (Project Listing by Research Focus Area). In November 2005, at the request of the Secretary of Veterans Affairs (VA), the VA Office of Research and Development (ORD) developed a set of criteria for inclusion of VA-funded projects in the GW research portfolio and then evaluated the entire VA research portfolio for projects meeting those criteria. The criteria used as the basis for the review are presented in Section II.

III. PUBLISHED RESULTS AND STATUS OF THE FIELD IN 2011

Section III provides brief summaries of research articles on the health problems of GW Veterans published during calendar year 2011 or in 2010 after the previous *Annual Report to Congress* was submitted. Research results are grouped according to the five Research Focus Areas used to organize the 19 Research Topics (see Section II): Brain and Nervous System Function, Environmental Toxicology, Immune Function, Reproductive Health, and Symptoms and General Health Status. In this section, published research results are described followed by specific study abstracts taken from PubMed.

IV. RESEARCH FUNDING TRENDS

VA, Department of Defense (DoD), and Department of Health and Human Services (HHS) funded 400 distinct projects from FY 1992 through FY 2011 related to health problems affecting GW Veterans. The scope of the Federal research portfolio is broad, from small pilot studies to large-scale epidemiology studies involving large populations and major center-based research programs. Federal funding for research on GWVI totaled approximately $230 million for the period from FY 2002 through FY 2011. As of September 30, 2011, 339 projects (85 percent of the 400 projects) were completed, and 61 projects (15 percent) were new or ongoing.

V. NEW RESEARCH PROJECTS AND INITIATIVES

Thirteen new projects were funded through the FY 2010 appropriation for the Gulf War Illness Research Program (GWIRP) managed by the Congressionally Directed Medical Research Program (CDMRP) at DoD, but did not start until FY 2011. These projects focused on Brain and Nervous System Function (3), Environmental Toxicology (1), and Symptoms and General Health (9). VA funded six new projects in FY 2011. Four of these projects focused on Brain and Nervous System Function, one focused on Environmental Toxicology, and four focused on Symptoms and General Health.

*****Totals for FY '02 -'11 do not include funds obligated in FY 1992 -2001

I. INTRODUCTION

The Secretary of VA is required by section 707 of Public Law 102-585, as amended by section 104 of Public Law 105-368 and section 502 of Public Law 111-163, to submit an annual report on the results, status, and priorities of research activities related to the health consequences of military service in the Gulf War to the Senate and House Committees on Veterans' Affairs. The Research Subcommittee of the interagency Deployment Health Working Group (DHWG) prepared this *2011 Annual Report to Congress*, which is the 18th report on research and research activities (DHWG, 2004; DHWG, 2005; DHWG, 2006a; DHWG, 2006b; DHWG, 2007; DHWG, 2008; DHWG, 2009; DHWG, 2010; MVHCB, 2001; MVHCB, 2002; PGVCB, 1995; PGVCB, 1996b; PGVCB, 1997; PGVCB, 1998; PGVCB, 1999; PGVCB, 2001). The DHWG tracks all federally funded research projects related to GWVI.

As in previous *Annual Reports to Congress*, the material presented is divided into six sections and three appendices. Section I is an introduction. Section II summarizes the research priorities and organization of the Federal GW research portfolio. Section III highlights and summarizes published research progress since the last report. Section IV summarizes Federal funding trends for GW research during the ten-year period from FY 2002 through FY 2011. Section V highlights new research projects and initiatives since the last *Annual Report to Congress*. Section VI contains literature references, and the Appendices contain listings of federally-funded research projects.

II. RESEARCH PRIORITIES

A. Nineteen Research Topics

The Persian Gulf Veterans Coordinating Board (PGVCB) was created in 1994 to coordinate research from VA, DoD, and HHS on GWVI. In 1995, the PGVCB devised a contextual framework for the results of completed and ongoing studies and also to develop an approach for the interpretation of research results. To that end, the PGVCB identified 19 major research questions and subsequently added two additional questions in 1996 (PGVCB, 1996a), to bring the total to 21. The comprehensive GW research portfolio has addressed each of these 21 questions, and relevant results have been published on each one. The Military and Veterans Health Coordinating Board (MVHCB), the successor organization to the PGVCB, conducted a comprehensive assessment of the progress made on each of these 21 questions in the *2000 Annual Report to Congress*. The Research Subcommittee of the DHWG, which was established to address a broader range of deployment health issues, reviewed the 21 questions and replaced them with a corresponding list of 21 Research Topics for the *2004Annual Report to Congress* (DHWG, 2006a).

The original list of 21 questions has been reduced to 19. Based on the Institute of Medicine of the National Academies (IOM) review of the scientific literature on infectious diseases (Institute of Medicine, 2006b) and the state of our current scientific knowledge, the conclusion was reached in the *2006 Annual Report to Congress* (DHWG, 2007) that there is no rationale to continue inclusion of infectious diseases as an area of research that will provide answers to the causes or cure for these symptoms. Questions 2 and 19 have, therefore, been removed from the original list of 21 Questions and the third Research Focus Area has been refocused from Immune Function and Infectious Diseases to just Immune Function. Projects originally identified as "GW research" under these two questions will continue to be listed in Appendices A and B, but no funding amounts will be shown for FY 2007 or beyond.

Similarly, projects related to post-traumatic stress disorder (PTSD) that were originally included in the Federal GW research portfolio were closed as of FY2007 (i.e., no funds listed in Appendix C) if they did not directly study a population of ill GW Veterans or were not investigating treatments that may prove beneficial for ill GW Veterans.

The IOM report reviewing the available literature on amyotrophic lateral sclerosis (ALS) in Veterans (Institute of Medicine, 2006a) concluded there is limited and suggestive evidence of an association between military service and later development of ALS. This strengthens the decision to include ALS as a relevant topic in the Federal portfolio of GW research (DHWG, 2006b). ALS projects included in the GW portfolio are primarily focused on epidemiologic studies in GW Veterans and the development of new methodologies to identify and treat ALS.

The organization of the remaining 19 Research Topics into five major categories is described in Section B below.

B. Research Portfolio Descriptors

VA maintains a research database of federally sponsored research on GWVI. This includes research conducted by Federal scientists, as well as that by non-Federal scientists supported by Federal research funds through grants, contracts, and cooperative agreements. It is not possible to accurately track research efforts that fall within the private sector or otherwise outside of the purview of the Federal government.

Nonetheless, the Research Subcommittee of the DHWG attempts to stay abreast of all research relevant to GWVI. This is accomplished by monitoring peer-reviewed published scientific literature, attending scientific meetings, and even using newspaper reports and personal accounts of researchers.

Appendix A lists the projects that VA, DoD, and HHS have funded to date. Research projects are grouped according to the department that is responsible for funding. Dual-funded projects are listed under both departments.

Appendix B lists all federally funded GW research projects, regardless of the agency providing the funding. Three descriptors are used to categorize each funded project.

The first descriptor is the primary **Research Focus Area** of the project. The five Research Focus Areas are also used to organize the 19 Research Topics (see Section A, above).

- Brain and Nervous System Function (e.g., studies on neurological or psychological deficits and/or alterations)
  - Organic neuropsychological and neurological deficits (original Question 16)
  - Psychological symptoms and/or diagnoses (original Question 18)
- Environmental Toxicology (e.g., studies focused on specific environmental exposures such as pesticides, oil well fires, jet fuel, vaccines, medical prophylactic agents, etc.)
  - Petroleum products and combustion products (original Question 3)
  - Occupational/environmental hazards (original Question 4)
  - Organophosphorus nerve agent and/or sulfur mustard from bombing at Muhammadiyat or weapons bunker at Khamisiyah (original Question 5)
  - Chemical agents, other than at Khamisiyah (original Question 6)
  - Pyridostigmine bromide (PB) and other medical prophylaxes (e.g., vaccines and anti-malarials) (original Question 7)
  - Psychophysiological stressors (original Question 8)
  - Short term, low level exposures to pyridostigmine bromide, N,N-diethyl-m-toluamide (DEET), or permethrin, alone or in combination as a cause of short-term and/or long-term neurological effects (original Question 17)
- Immune Function (e.g., studies on alterations in immune function or host defenses)
  - Altered immune function or host defense (original Question 10)
- Reproductive Health (e.g., studies on sexual and/or reproductive dysfunction)
  - Birth defects in offspring (original Question 11)
  - Lower reproductive success (original Question 12)
  - Sexual dysfunction (original Question 13)
- Symptoms and General Health (e.g., studies on mortality, pulmonary disease, cancer, chronic multisymptom illnesses, etc.)
  - Increased prevalence or severity of symptoms and/or illnesses (original Question 1)
  - Nonspecific symptoms and symptom complexes (e.g., chronic multisymptom illnesses) (original Question 9)
  - Changes in lung function or airway reactivity (original Question 14)
  - Smaller baseline lung function or greater degree of nonspecific airway reactivity (original Question 15)
  - Development of cancers of any type (original Question 20)
  - Mortality rates (original Question 21)

Secondary and/or tertiary Research Focus Areas from the above list may also be assigned. Two additional Research Focus Areas may be used for secondary and tertiary assignments. This permits accounting for projects that cover multiple focus areas.

- Chemical weapons (e.g., sarin, sulfur mustard, etc.)
- Pyridostigmine bromide and other medical prophylaxes (e.g., vaccines, pyridostigmine bromide, antimalarials, etc)

The second descriptor is the **Project Focus**, categorized as follows:

- Diagnosis: studies that will improve the ability to diagnose previously unexplained conditions, or to better refine diagnoses with new tools
- Exposure: studies that examine individual exposures and/or interactions of exposures (chemical, biological, pharmacological, physiological, etc.)
- Interactions: interactions of combined exposures (chemical, biological, pharmacological, physiological, etc.)
- Prevention: studies that will produce knowledge that could lead to disease prevention strategies
- Symptoms: prevalence and risk factors for symptoms and alterations in general health status
- Treatment: development or testing of new therapies

Each project is assigned up to three Project Focus areas as categorical descriptors. This allows accounting for projects that cover multiple focus areas. For example, a project on the neurophysiological effects of exposure to sarin in animals would have a focus on the brain and nervous system, and a focus on chemical weapons. The number of focus areas (between one and three) assigned to a project depends on the project itself.

The third descriptor for each project is **Research Type**. Each research project on GWVI uses a method of approach to test a specific research hypothesis. Although precise categorization of research types can be difficult because of overlapping methodologies, research projects can be divided into the following general types:

MECHANISTIC: Research into underlying mechanisms of diseases and illnesses using in vitro and in vivo models.

CLINICAL: Application of an intervention, such as in a controlled drug trial, or use of methodologies such as case-control studies to define risk factors for disease.

EPIDEMIOLOGY: Study of the distribution and determinants of disease in human populations. It includes population-based studies focused on outcomes such as mortality, symptoms, hospitalizations, etc., using devices such as postal surveys, telephone interviews, and reviews of medical records.

DEVELOPMENT: In addition to tracking research on GWVI, the DHWG also tracks development activities. In general, development is the systematic use of the knowledge or understanding gained from research directed toward the production of materials; devices; systems; or methods, including design, development, and improvement of prototypes and new processes. Within the context of GWVI, the DHWG categorizes activities as development as an activity that satisfies the general definition of development described above, and is directed toward new biologically based prevention, intervention, and treatment measures.

The research database on GWVI catalogs only research and development activities that either directly involve GW Veterans or answer specific questions about risk factors. An example of the latter is a research project using animal models to determine health effects of low-level chemical warfare agents. The database does not account for the vast accumulated knowledge derived from the Nation's investment in more generalized biomedical research over the past 50 years.

C. Portfolio Criteria

In November 2005, at the request of the Secretary of VA, the VA Office of Research and Development (ORD) developed a set of criteria for inclusion of VA-funded projects in the GW research portfolio. The criteria and relevant references from that analysis are presented below. These criteria are now routinely used to identify relevant research projects. New projects selected for funding must meet these criteria and are presented in Section V.

1. Studies of chronic multisymptom illnesses (CMI) affecting GW Veterans, including case definitions for CMI in GW Veterans and the general population.
    a) Case definitions of multisymptom illnesses affecting GW Veterans
    (Fukuda et al., 1998; Haley et al., 1997a; Haley et al., 1997b; Haley et al., 2002; Wolfe et al., 2002)
    b) Chronic fatigue syndrome
    (Dunphy et al., 2003; Eisen et al., 2005; Gray et al., 2002; The Iowa Persian Gulf Study Group, 1997; Unwin et al., 1999)
    c) Fibromyalgia
    (Eisen et al., 2005; The Iowa Persian Gulf Study Group, 1997)
    d) Irritable bowel syndrome
    (Dunphy et al., 2003; Gray et al., 2002; The Iowa Persian Gulf Study Group, 1997)
    e) Multiple chemical sensitivity (MCS)
    (Fiedler et al., 2004; Gray et al., 2002; The Iowa Persian Gulf Study Group, 1997)

2. Conditions and/or symptoms occurring with higher prevalence in GW Veterans
    a) Fatigue
    (CDC, 1995; Coker et al., 1999; Doebbeling et al., 2000; Fukuda et al., 1998; Gray et al., 1999; Haley et al., 1997b; The Iowa Persian Gulf Study Group, 1997; Unwin et al., 1999; Wolfe et al., 2002)
    b) Joint and muscle pain
    (CDC, 1995; Coker et al., 1999; Fukuda et al., 1998; Gray et al., 1999; Haley et al., 1997a; Haley et al., 1997b; Haley, 2003; Kang et al., 2000; Pierce, 1997; Proctor et al., 1998; The Iowa Persian Gulf Study Group, 1997; Wolfe et al., 2002)
    c) Gastrointestinal complaints (dyspepsia, gastritis, diarrhea, etc.)
    (Blanchard et al., 2006; CDC, 1995; Coker et al., 1999; Eisen et al., 2005; Fukuda et al., 1998; Gray et al., 2002; Haley et al., 1997b; Kang et al., 2000; Proctor et al., 1998)
    d) Cognitive dysfunction (memory, attention, etc.)
    (CDC, 1995; Coker et al., 1999; Fukuda et al., 1998; Gray et al., 1999; Haley et al., 1997b; Kang et al., 2000; Knoke et al., 2000; Proctor et al., 1998; The Iowa Persian Gulf Study Group, 1997; Wolfe et al., 2002)
    e) Sleep disturbances
    (CDC, 1995; Coker et al., 1999; Gray et al., 1999; Haley et al., 1997b; Kang et al., 2000; Knoke et al., 2000; Pierce, 1997; Proctor et al., 1998; Unwin et al., 1999; Wolfe et al., 2002)
    f) Central Nervous System disorders (ALS, glioblastoma, imaging studies, etc.) Headaches
    (Bullman et al., 2005; Haley, 2003; Horner et al., 2003; Weisskopf et al., 2005)
    g) Headaches
    (CDC, 1995; Coker et al., 1999; Fukuda et al., 1998; Gray et al., 1999; Haley et al., 1997b; Kang et al., 2000; Knoke et al., 2000; Proctor et al., 1998; Unwin et al., 1999; Wolfe et al., 2002)
    h) Dermatologic conditions
    (CDC, 1995; Coker et al., 1999; Eisen et al., 2005; Fukuda et al., 1998; Gray et al., 1999; Kang et al., 2000; Knoke et al., 2000; Pierce, 1997; Proctor et al., 1998; Wolfe et al., 2002)
3. Long-term health effects of potentially hazardous substances, alone and in combination, to which GW Veterans may have been exposed to during deployment.
    a) Pyridostigmine bromide
    b) DEET
    c) Permethrin
    d) Oil well fire smoke
    e) Petroleum products (e.g., jet fuels) and combustion products
    f) Multiple vaccinations and other medical prophylaxes

4. Other topics from the 19 Topics forming the framework for the *Annual Report to Congress on Federally Sponsored Research on GW Veterans' Illnesses:*

    a) Altered immune function and/or host defense
    b) Physiological responses to biological stress
    c) Sexual and/or reproductive dysfunction

III. PUBLISHED RESULTS AND STATUS OF THE FIELD IN 2011

Since the last *Annual Report to Congress*, numerous research studies have provided new and detailed information on the health problems of GW Veterans. A PubMed search retrieved 59 relevant articles published in English in calendar year 2011 or in 2010 after the last report was submitted. These articles include federally and non-federally funded research, as well as international research. This section provides brief highlights of the published research divided into the five Research Focus Areas described in Section II. B., above, followed by the PubMed abstracts.

A. Brain and Nervous System Function

Studies relevant to Veterans of the1990-1991 Gulf War are presented in this section if they are related to brain and nervous system function. In 2011, most of these studies focused on psychological health and neuroinflammation, with a smaller number of studies investigating the long-term effects of nerve gas/organophosphate exposure primarily on the cholinergic system, learning and memory deficits, PTSD, and general long-term health of GW Veterans.

General Brain Function and Exposure Research

There is growing evidence that chronic inflammation from exposure to chemicals or to injury can lead to progressive secondary damage. A recent report indicated that nerve gas exposure results in the chronic reduction in size in certain brain structures related to executive function and memory using functional magnetic resonance imaging (fMRI) and diffusion tensor imaging (DTI) methods (Chao et al., 2011). A study using MRI-based arterial spin labeling (ASL) and phase-contrast techniques confirmed and extended previous findings that patients with GWVI have an abnormal response to an inhibitory cholinergic challenge (physostigmine infusion) compared to age-gender-education matched control Veterans (Liu et al., 2011; Li et al., 2011b).

Mice exposed to pyridostigmine bromide and permethrin displayed increased anxiety, psychomotor problems, and cognitive impairment. Proteomic analysis revealed changes in proteins related to the endocrine and immune systems and to lipid metabolism and molecular transport in the brain (Abdulla et al., 2011).

Amyotrophic Lateral Sclerosis (ALS)

Sta and colleagues examined the extent of the immune activation in ALS by measuring the expression and cellular distribution of components of innate and adaptive immunity in spinal cord and motor cortex from patients with rapid and slow sporadic ALS and controls. Their findings demonstrated a persistent and prominent activation of both innate and adaptive immunity in ALS (Sta et al., 2011).

Neuropsychological Functioning and Stress Response

The most common psychological health issue to arise from the Gulf War was post-traumatic stress disorder (PTSD). A magnetic resonance imaging study of 244 Gulf War Veterans indicated that the hippocampal volume in the brain is smaller in Veterans with active PTSD symptoms. Volumes are not smaller in Veterans who previously suffered with PTSD or depression (Apfel et al., 2011). In an attempt to repeat earlier magnetic resonance studies of Gulf War Veterans with and without GWVI, Weiner and coworkers measured N-acetylaspartate (NAA, a neuronal marker) in the basal ganglia and pons. No differences in NAA concentrations were found in the two groups of Veterans, but the group with GWVI had a higher frequency of PTSD (Weiner et al., 2011). In a group of 1381 Australian Gulf War Veterans, those suffering with PTSD were found to be over seven times more likely to have high blood pressure than those without PTSD (Abouzeid et al., 2012).

A comparison of combat Veterans who served in Vietnam and the 1990-1991 Gulf War demonstrated that the adverse effects of combat on mental health were larger for Veterans of the Gulf War versus Vietnam (Gade and Wenger, 2011). In a study of the hypothalamic-pituitary-adrenal (HPA) axis in Gulf War and Vietnam Veterans, it was found that

adrenocorticotropic hormone (ACTH) was elevated in the PTSD-positive Veterans of the Gulf War only. These data suggest that dysregulation of the HPA axis in Gulf War Veterans requires additional study (Golier et al., 2012). A study of Vietnam and Gulf War Veterans indicates that the catechol-O-methyltransferase gene which influences dopamine inactivation is involved with the effects of PTSD on the frontal lobe of the brain in both Veteran groups (Schulz-Heik et al., 2011).

Sexual harassment of deployed women was found not to affect general health after returning, but sexual assault was linked to post-traumatic stress symptomatology (PSS) and gastrointestinal, genitourinary, musculoskeletal, and neurological problems (Smith et al., 2011). A review of survey instruments designed to evaluate combat stress indicated that very few of the available surveys can be reliably applied to women Veterans (Sternke, 2011).

B. Environmental Toxicology

Environmental agents potentially toxic to GW Veterans in theater were the topics of numerous scientific reports in 2010. These agents can be grouped into three areas: (1) depleted uranium, which is used in armor-piercing munitions; (2) chemical and anti-nerve agents (e.g., mustard gas and pyridostigmine bromide); and (3) insecticides (e.g., permethrin, chlorpyrifos).

Depleted Uranium (DU)

In a longitudinal study of 35 Veterans exposed to DU, urine uranium levels were elevated in patients with embedded fragments, but there were no apparent cellular toxicity or changes in renal function, although there was a decrease in serum parathyroid hormone and increases in urine calcium and sodium excretion in the group with higher urine uranium levels (McDiarmid, Engelhardt, et al., 2011).

Bakhmutsky and coworkers studied the genotoxic effects (measured as number of micronuclei in peripheral blood lymphocytes) of DU in GW Veterans enrolled in a long-term health surveillance program at the Baltimore VAMC. Urinary uranium (uU) levels were used to separate Veterans into low and high exposure groups. There was no measureable difference in genotoxic effect between the two groups (Bakhmutsky et al., 2011). In a follow-up study, four biomarkers (micronuclei, chromosome aberrations, mutant frequencies of hypoxanthine-guanine phosphoribosyl transferase (HGPT MFs), and phosphatidylinositol N-acetylglucosaminyltransferase subunit A (PIGA)) were measured, but there were no differences between the high- and low-uranium groups. This reinforces the notion that there can only be a weak link between DU exposure and genotoxicity, although there might be a threshold effect for HPRT MFs (McDiarmid, Albertini, et al., 2011).

The p53 tumor suppressor protein is activated by certain toxic metals, but a series of cytotoxicity tests indicate that there is no p53 response to uranyl acetate and uranyl nitrate (Heintze et al., 2011). Skin patches containing uranyl acetate were used to check skin reactivity to the metal, but there was no reaction. The authors concluded that dermatitis observed in some veterans was not likely due to DU exposure (Shvartsbeyn et al., 2011).

Since some metals are linked to Alzheimer's disease, there was interest in determining if DU could have a similar effect. Acetylcholine and cholesterol metabolisms in the cerebral cortex were tested on a transgenic mouse model, but there was no evidence that exposure to DU had a significant effect on amyloid precursor protein (Lestaevel et al., 2011). The effects of DU on the activity of 1α-hydroxylase in the kidney was tested by implanting DU fragments in rats. The activity decreased after three months but was back to normal after six and twelve months of exposure. However, it was concluded that kidney damage occurred and that the synthesis of vitamin D was inhibited (Yan et al., 2011). Pourahmad and coworkers demonstrated that a ß-(1→3)-D-glucan can serve as an antioxidant and radical scavenger to prevent lysis of rat hepatocytes due to reactive oxygen species after exposure to DU. They suggest this material as prophylaxis or treatment for DU exposure (Pourahmad et al., 2011).

The ability of chitooligosaccharides to selectively chelate uranium in DU-exposed human renal proximal tubule epithelial cells has also been demonstrated (Zhang et al., 2011).

Environmental samples from southern Iraq were tested for a number of materials including uranium. Water from the Euphrates River and soils from the surrounding area had concentrations of uranium and U-235/U-238 ratios in expected ranges (Riccobono et al., 2011). In another study near Fallujah, Iraq, hair samples from the parents of children with congenital anomalies along with soil and water samples were tested for uranium and other metals. Even though lead, mercury, uranium, vanadium, and other toxic metals were found, the authors concluded that their findings suggested that uranium exposure was the cause of certain health problems in the area (Alaani et al., 2011).

Nerve and Chemical Agents

Soman (pinacolyl methylphosphonofluoridate), a warfare nerve agent, almost completely (>95%) inhibits acetylcholinesterase activity in human intercostals muscle fibers. If the muscle fibers are pretreated with pyridostigmine bromide, only 80% inhibition was observed (Maselli et al., 2011).

Insecticides and Pesticides

Individual pesticides and combinations of pesticides and other chemical species have been considered to be important in many of the medical problems exhibited by Gulf War Veterans. After exposing mice to low levels of chlorpyrifos, and organophosphate pesticide, for five days, it was found that hippocampal synaptic transmission in the brain decreased by 50% after three months, thus demonstrating that there was long-term brain damage even though there were no short-term problems (Speed et al., 2012). The effects of organophosphates on dopamine and glutamatergic neurotransmission in the brain were studied by exposing mice to chlorpyrifos pesticide, diisopropyl fluorophosphates (a nerve agent simulant), pyridostigmine bromide (PB, a nerve agent protectant), and N,N-diethyl-m-toluamide (DEET, an insect repellent). In all cases where an organophosphate was used, there were changes in brain function that would be associated with neurological disorders (Torres et al., 2011). Chlorpyrifos and its metabolite Chlorpyrifos-oxon were tested in rat cortical neurons to see if they have an effect on mitochondria. It was concluded that organophosphates act by altering mitochondrial dynamics and transport in axons (Middlemore et al., 2011). In a study utilizing bovine red blood cell acetylcholinesterase, it was found that pyridostigmine bromide provides protection against pesticides like chlorpyrifos-oxon, diazinon-oxon, and paraoxon, but does not protect against malaoxon (Henderson et al., 2011).

Wille and coworkers investigated the interactions among low levels of DEET, PB, and pesticides with human cholinesterases in vitro, and determined that these compounds do not have a synergistic effect on cholinesterase activity (Wille et al., 2011a; 2001b). Other researchers disagree with this conclusion (Moss, 2011).

Oil Well Spills

While the Kuwaiti oil well fires were burning in 1991, a model was developed to estimate environmental exposures to US troops. The model was based on combustion products from crude oil, wind patterns, and air dispersion calculations. The resulting health risk assessment was able to determine the relative risk of the oil fires and other possible environmental exposures (Heller, 2011). During the same period, a US Army unit was being monitored for adverse health effects. Blood and urine were collected for laboratory analyses, questionnaires were administered, and other activities were conducted before deployment, during deployment, and after deployment. The challenges associated with obtaining useful medical surveillance information during deployment was discussed (Deeter, 2011). The health effects of oil spills were studied after millions of gallons of crude oil escaped into the Gulf of Mexico. Acute and chronic conditions affecting people in the region were described (Levy and Nassetta, 2011).

C. Immune Dysfunction and Infectious Diseases

Broderick and colleagues examined the patterns of immune markers and their evolution during exercise in ill GW Veterans. Cortisol was measured in saliva and other body fluids before and after an exercise test, and immune cell populations were surface-stained for a panel of nine immune cell markers. The results suggested that there may be an autoimmune component in the etiology of GWVI (Broderick et al., 2011).

Immunoexcitotoxicity is a term used to explain pathological and neurodevelopmental changes in autism and GWVI. It is described as an interaction between immune receptors in the central nervous system and excitatory glutamate receptors, and it was suggested to be involved in a number of neurodegenerative conditions (Blaylock and Maroon, 2011).

Shoenfeld and Agmon-Levin reviewed the current data on the role of adjuvants in the pathogenesis of immune-mediated diseases with special interest in siliconosis, GWVI, macrophagic myofasciitis syndrome and post-vaccination phenomena. They suggested that these four conditions be grouped together and referred to as “autoimmune (or autoinflammatory) syndrome induced by adjuvants” (ASIA) (Shoenfeld and Agmon-Levin, 2011; Perricone et al., 2011).

D. Reproductive Health

As indicated above, hair samples from the parents of children with congenital anomalies were tested for metals. Even though lead, mercury, uranium, vanadium, and other toxic metals were found, the authors concluded that their findings suggested that uranium exposure might be the cause of the congenital problems (Alaani et al., 2011).

E. Symptoms and General Health

General Health

The UK Defence Analytical Services and Advice, in the Ministry of Defence, published summary statistics on the causes of deaths that occurred among the UK Veterans of the 1990-1991 Gulf War. The mortality rates of 53,409 U.K. GW Veterans were analyzed along with those of a comparison group, consisting of 53,143 U.K. Armed Forces personnel of similar age, gender, Service, regular/reservist status and rank who were in Service on 1 January 1991 but did not deploy to the Persian Gulf (Defence Analytical Services and Advice, 2011).

A symposium and workshop was held to review environmental exposures and health risks to military personnel. Exposures during the Gulf War were discussed at length, and suggestions were made for improving the US military strategy for dealing with these issues in the future (DeFraites and Richards, 2011). A description of the unique environments and exposures in battlefield situations from World War II to the 1990-1991 Gulf War were presented along with strategies for dealing with these problems after the conflicts (Richards, 2011). Changes in environmental health surveillance initiated by the DoD after the Gulf War were described and discussed (Batts and Parzik, 2011; Kirkpatrick, 2011; Martin et al., 2011) as were recommendations from the Institute of Medicine (Joellenbeck, 2011).

Alcohol use and drinking patterns were the focus of a study that found a correlation between problem drinking and PTSD, major depressive disorder, unexplained multisymptom illness, and chronic fatigue syndrome-like illness (Coughlin et al., 2011a). Similarly, a study of overweight and obese Gulf War Veterans found that obesity was correlated with PTSD and other chronic conditions not associated exclusively with the Gulf War (Coughlin et al., 2011b).

In a 10-year follow-up study of the health of Gulf War Veterans, it was found that deployed Veterans were more likely to have persistent poor health and more likely to experience new adverse health conditions than their Gulf-era counterparts (Li et al., 2011a). A comparison of the health status of US and UK Gulf War Veterans showed similar scores on standard surveys, but the variations between the two groups may be due to cultural differences in the way health results are reported (Ismail et al., 2011). Environmental epidemiological studies, including illnesses among Gulf War Veterans, conducted by the Centers for Disease Control and Prevention (CDC) were recently summarized (Falk and Briss, 2011).

GWVI, Chronic Fatigue Syndrome, and Fibromyalgia

Amin and coworkers found that Veterans with GWVI had a significantly increased frequency of arousals related to apneas, hypopneas, and mild inspiratory airflow limitation, suggesting the possibility that treating these sleep disorders might significantly improve their quality of life (Amin et al., 2011a). In a subsequent small pilot study (n=17) they found that Veterans receiving continuous positive airway pressure (CPAP) treatments experienced improvements in pain (34 percent), fatigue (38 percent), cognitive function (33 percent), sleep quality (41 percent), physical health (34 percent) and mental health (16 percent); larger clinical trials will be required to replicate these findings and establish the utility of this intervention (Amin et al., 2011b).

A previously-developed case definition for GWVI based on factor analysis was validated by applying it to a new cohort of 8,020 Gulf War Veterans (Iannacchione et al., 2011). In a comment about the article by Iannacchione and coworkers, it was pointed out that case definitions are essential even in a situation like the one facing Gulf War Veterans where it is difficult to connect symptoms to specific exposures (Sharma, 2011).

The prevalence of chronic multisymptom illness in deployed Gulf War Veterans appears to be related to a Veteran's location in the Kuwait theater of operations. For Veterans who were in Iraq and Kuwait multisymptom illness was most strongly correlated with the use of PB tablets or being within one mile of an exploding SCUD missile. For personnel in support areas, the most significant correlation was with pesticides (Steele et al., 2012).

In a small study of Gulf War Veterans with GWVI, a treatment based on hormone replacement was conducted. All five patients who qualified for the trial reported improvements in symptoms, but additional research with a larger cohort is required to determine if such a treatment is widely applicable (Wakil et al., 2011).

A clinical trial using Rituximab (an anti-CD20 antibody) or placebo to treat patients with chronic fatigue syndrome (CFS) resulted in improvement in 67% of the Rituximab patients and only 13% in the placebo group after the 12-month follow-up. The delayed response to Rituximab has prompted the authors to suggest that CFS is an autoimmune disease

(Fluge et al., 2011). Since headaches are more frequent in CFS patients, a study was designed to characterize the types and severities of headaches. Migraine headaches were found in 84% of CFS patients (5% of healthy controls), and tension headaches in 81% of CFS patients (45% in controls). Of the CFS patients with migraine headaches, 24% had migraines with aura while 60% had migraines without aura. The patients without aura, however, also had lower pain thresholds and higher rates of fibromyalgia (Ravindran et al., 2011).

F. Abstracts from Published Research

Abdullah L, Crynen G, Reed J, Bishop A, Phillips J, Ferguson S, Mouzon B, Mullan M, Mathura V, Mullan M, Ait-Ghezala G, Crawford F (2011) Proteomic CNS profile of delayed cognitive impairment in mice exposed to Gulf War agents. Neuromolecular Med 13:275-288. (Epub 2011 Oct 11.)
Abstract: Gulf War Illness (GWI) is a chronic multisymptom condition with a central nervous system (CNS) component, for which there is no treatment available. It is now believed that the combined exposure to Gulf War (GW) agents, including pyridostigmine bromide (PB) and pesticides, such as permethrin (PER), was a key contributor to the etiology of GWI. In this study, a proteomic approach was used to characterize the biomolecular disturbances that accompany neurobehavioral and neuropathological changes associated with combined exposure to PB and PER. Mice acutely exposed to PB and PER over 10 days showed an increase in anxiety-like behavior, psychomotor problems and delayed cognitive impairment compared to control mice that received vehicle only. Proteomic analysis showed changes in proteins associated with lipid metabolism and molecular transport in the brains of GW agent-exposed mice compared to controls. Proteins associated with the endocrine and immune systems were also altered, and dysfunction of these systems is a prominent feature of GWI. The presence of astrogliosis in the GW agent-exposed mice compared to control mice further suggests an immune system imbalance, as is observed in GWI. These studies provide a broad perspective of the molecular disturbances driving the late pathology of this complex illness. Evaluation of the potential role of these biological functions in GWI will be useful in identifying molecular pathways that can be targeted for the development of novel therapeutics against GWI.

Abouzeid M, Kelsall HL, Forbes AB, Sim MR, Creamer MC (2012) Posttraumatic stress disorder and hypertension in Australian veterans of the 1991 Gulf War. J Psychosom Res 72:33-38. (Epub 2011 Sep 21.)
Abstract: OBJECTIVE: Military veterans experience a high prevalence of psychopathologies such as posttraumatic stress disorder (PTSD). Relationships between physical and psychological health are increasingly recognised. This study investigated associations between PTSD and hypertension in male Australian Gulf War veterans. METHODS: In 2000-02, 1456 veterans underwent medical and psychological assessments. Medical practitioners rated self-reported medical conditions as probable diagnoses, possible, unlikely or non-medical. The Composite International Diagnostic Interview (CIDI) assessed psychological symptomatology present in the 12 months preceding evaluation, and lifetime prevalence. Odds of hypertension among those with and without PTSD were calculated for each timeframe using logistic regression. RESULTS: Analysis was restricted to the 1381 veterans for whom CIDI and medical data were available. Hypertension was considered probable in 100 subjects (7.2%). Adjusted odds ratios of hypertension were 2.90 (95% CI 1.19-7.09) amongst veterans with PTSD in the past 12 months and 2.27 (95% CI 1.01-5.10) for lifetime prevalence, compared with those without PTSD. Hypertension was over seven times more likely amongst veterans with PTSD alone than those with no mental illness in the past 12 months. CONCLUSIONS: Veterans with a history of PTSD had increased odds of having hypertension. Given the array of disabling psychosocial associations of PTSD, and the numerous potential clinical sequelae of hypertension, co-existence of these conditions may have implications for prevention and management at the individual, clinical, and public health policy and practice level. Early identification of PTSD in military samples may help to ameliorate longer-term adverse physical health outcomes.

Alaani S, Tafash M, Busby C, Hamdan M, Blaurock-Busch E (2011) Uranium and other contaminants in hair from the parents of children with congenital anomalies in Fallujah, Iraq. Confl Health 5:15.
Abstract: BACKGROUND: Recent reports have drawn attention to increases in congenital birth anomalies and cancer in Fallujah Iraq blamed on teratogenic, genetic and genomic stress thought to result from depleted Uranium contamination following the battles in the town in 2004. Contamination of the parents of the children and of the environment by Uranium and other elements was investigated using Inductively Coupled Plasma Mass Spectrometry. Hair samples from 25 fathers and mothers of children diagnosed with congenital anomalies were analysed for Uranium and 51 other elements. Mean ages of the parents was: fathers 29.6 (SD 6.2); mothers: 27.3 (SD 6.8). For a sub-group of 6 women, long locks of hair were analysed for Uranium along the length of the hair to obtain information about historic exposures. Samples of soil and water were also analysed and Uranium isotope ratios determined. RESULTS: Levels of Ca, Mg, Co, Fe, Mn, V, Zn, Sr, Al, Ba, Bi, Ga, Pb, Hg, Pd and U (for mothers only) were significantly higher than

published mean levels in an uncontaminated population in Sweden. In high excess were Ca, Mg, Sr, Al, Bi and Hg. Of these only Hg can be considered as a possible cause of congenital anomaly. Mean levels for Uranium were 0.16 ppm (SD: 0.11) range 0.02 to 0.4, higher in mothers (0.18 ppm SD 0.09) than fathers (0.11 ppm; SD 0.13). The highly unusual non-normal Fallujah distribution mean was significantly higher than literature results for a control population Southern Israel (0.062 ppm) and a non-parametric test (Mann Whitney-Wilcoxon) gave p = 0.016 for this comparison of the distribution. Mean levels in Fallujah were also much higher than the mean of measurements reported from Japan, Brazil, Sweden and Slovenia (0.04 ppm SD 0.02). Soil samples show low concentrations with a mean of 0.76 ppm (SD 0.42) and range 0.1-1.5 ppm; (N = 18). However it may be consistent with levels in drinking water (2.28 μgL-1) which had similar levels to water from wells (2.72 μgL-1) and the river Euphrates (2.24 μgL-1). In a separate study of a sub group of mothers with long hair to investigate historic Uranium excretion the results suggested that levels were much higher in the past. Uranium traces detected in the soil samples and the hair showed slightly enriched isotopic signatures for hair U238/U235 = (135.16 SD 1.45) compared with the natural ratio of 137.88. Soil sample Uranium isotope ratios were determined after extraction and concentration of the Uranium by ion exchange. Results showed statistically significant presence of enriched Uranium with a mean of 129 with SD5.9 (for this determination, the natural Uranium 95% CI was 132.1 < Ratio < 144.1). CONCLUSIONS: Whilst caution must be exercised about ruling out other possibilities, because none of the elements found in excess are reported to cause congenital diseases and cancer except Uranium, these findings suggest the enriched Uranium exposure is either a primary cause or related to the cause of the congenital anomaly and cancer increases. Questions are thus raised about the characteristics and composition of weapons now being deployed in modern battlefields.

Amin MM, Belisova Z, Hossain S, Gold MS, Broderick JE, Gold AR (2011a) Inspiratory airflow dynamics during sleep in veterans with Gulf War illness: a controlled study. Sleep Breath 15:333-339.
Abstract: PURPOSE: To determine whether veterans with Gulf War Illness (GWI) are distinguished by sleep-disordered breathing, we compared inspiratory airflow dynamics during sleep between veterans with GWI and asymptomatic veterans of the first Gulf War. METHODS: We recruited 18 male veterans with GWI and 11 asymptomatic male veterans of the first Gulf War by advertisement. The two samples were matched for age and body mass index. Each participant underwent a first full-night polysomnogram (PSG) while sleeping supine using standard clinical monitoring of sleep and breathing. A second PSG was performed measuring airflow with a pneumotachograph in series with a nasal mask and respiratory effort with a supraglottic pressure (Psg) catheter to assess the presence of inspiratory airflow limitation during supine N2 sleep. We determined the prevalence of flow-limited breaths by sampling continuous N2 sleep and plotting inspiratory flow against Psg for each breath in the sample. We expressed the prevalence of flow-limited breaths as their percentage in the sample. RESULTS: Compared to controls, veterans with GWI had an increased frequency of arousals related to apneas, hypopneas, and mild inspiratory airflow limitation. During supine N2 sleep, veterans with GWI had 96 ± 5% (mean ± SD) of their breaths flow-limited while controls had 36 ± 25% of their breaths flow limited ($p < 0.0001$). CONCLUSIONS:
Veterans with GWI experience sleep-disordered breathing that may distinguish them from asymptomatic veterans of the first Gulf War.

Amin MM, Gold MS, Broderick JE, Gold AR (2011b) The effect of nasal continuous positive airway pressure on the symptoms of Gulf War illness. Sleep Breath 15:579-587.
Abstract: PURPOSE: We performed a pilot study to determine whether nasal continuous positive airway pressure (CPAP) alleviates the symptoms of veterans with Gulf War illness (GWI) and sleep disordered breathing (SDB). METHODS: Eighteen male veterans with GWI and SDB recruited by advertisement, participated in a randomized, single-masked, sham-controlled treatment trial. Participants received 3 weeks of treatment during sleep with either therapeutic nasal CPAP or sham nasal CPAP. Using validated questionnaires, pain, fatigue, cognitive function, sleep disturbance, and general health were assessed by self-report before and after treatment. One of the participants assigned to therapeutic CPAP was excluded from the trial before starting treatment, leaving 17 participants. RESULTS: Compared to the nine sham nasal CPAP recipients, the eight participants receiving therapeutic nasal CPAP experienced improvements in pain (34%; $p = 0.0008$), fatigue (38%; $p = 0.0002$), cognitive function (33%; $p = 0.004$), sleep quality (41%; $p = 0.0003$), physical health (34%; $p = 0.0003$), and mental health (16%; $p = 0.03$). CONCLUSIONS: Our findings in this pilot study suggest that nasal CPAP may greatly improve symptoms in veterans with GWI and SDB.

Apfel BA, Ross J, Hlavin J, Meyerhoff DJ, Metzler TJ, Marmar CR, Weiner MW, Schuff N, Neylan TC (2011) Hippocampal Volume Differences in Gulf War Veterans with Current Versus Lifetime Posttraumatic Stress Disorder Symptoms. Biol Psychiatry 69:541-548.

Abstract: BACKGROUND: Decreased hippocampal volume is described in posttraumatic stress disorder (PTSD) and depression. However, it is not known whether it is a risk factor for the development of PTSD or a consequence of PTSD. We sought to determine the effects of PTSD and depressive symptoms on hippocampal volume. METHODS: Clinical and magnetic resonance imaging data were collected in a cross sectional study of 244 Gulf War veterans. Measures included lifetime and current Clinician Administered PTSD Scale, Hamilton Depression Scale, Life Stressor Checklist, and Lifetime Drinking History. Magnetic resonance imaging data were acquired with a 1.5-T scanner and analyzed with automated and semiautomated image processing techniques. RESULTS: Eighty-two veterans had lifetime PTSD, 44 had current PTSD, and 38 had current depression. In the linear regression analysis, current PTSD symptoms (standardized coefficient $\beta = -.25$, $p = .03$) but neither lifetime PTSD symptoms nor current depression were associated with smaller hippocampal volume. Gender, age, history of early life trauma, education, lifetime and current alcohol use, current marijuana use, and treatment with antidepressants did not have independent effects. Participants with chronic PTSD had, on average, a smaller hippocampus compared with those with remitted PTSD. CONCLUSIONS: The finding that current but not lifetime PTSD symptom severity explains hippocampal size raises two possibilities: either a small hippocampus is a risk factor for lack of recovery from PTSD (trait) or PTSD effects on hippocampal volume are reversible once PTSD symptoms remit and the patient recovers (state).

Bakhmutsky MV, Oliver MS, McDiarmid MA, Squibb KS, Tucker JD (2011) Long term depleted uranium exposure in Gulf War I veterans does not cause elevated numbers of micronuclei in peripheral blood lymphocytes. Mutat Res 720:53-57.
Abstract: Depleted uranium (DU) is a high density heavy metal that has been used in military munitions since the 1991 Gulf War. DU is weakly radioactive and chemically toxic. Long term exposure can cause adverse health effects. This study assessed genotoxic effects in DU exposed Gulf War I veterans as a function of uranium (U) body burden. Levels of urine U were used to categorize the cohort into low and high exposure groups. Exposure to DU occurred during friendly fire incidents in 1991 involving DU munitions resulting in inhalation and ingestion exposure to small particles of DU and soft tissue DU fragments from traumatic injuries. All of these Veterans are enrolled in a long term health surveillance program at the Baltimore Veterans Administration Medical Center. Blood was drawn from 35 exposed male veterans aged 36-59 years, then cultured and evaluated for micronuclei (MN) using the cytokinesis block method. The participants were divided into two exposure groups, low and high, based on their mean urine uranium (uU) concentrations. Poisson regression analyses with mean urine U concentrations, current smoking, X-rays in the past year and donor age as dependent variables revealed no significant relationships with MN frequencies. Our results indicate that on-going systemic exposure to DU occurring in Gulf War I Veterans with DU embedded fragments does not induce significant increases in MN in peripheral blood lymphocytes compared to MN frequencies in Veterans with normal U body burdens.

Batts R, Parzik D (2011) Panel 3: Conducting environmental surveillance sampling to identify exposures. Mil Med 176(7 Suppl):101-104.
Abstract: Environmental sampling technology has improved significantly since Operations Desert Shield and Storm (Gulf War I, August 6, 1990-February 27, 1991). Deployment of U.S. Forces overseas and Joint Service operations have increased, and large numbers of troops are currently deployed for long periods of time. Concerns of adverse health effects from environmental exposures, similar to the concerns about exposures to oil well fires in Gulf War I, continue to occur today. Although progress has been made in developing Joint Service policies for training and conducting environmental sampling, the military doctrine that drives this training and allows for the purchase of updated sampling equipment has been slow to respond to changes, thus resulting in conflicts between current technology and assets available in the field. The military needs to remain flexible to new technology and new requirements, and must standardize doctrine and training across the services, and acquire standardized, state-of-the-art sampling equipment to improve field assets.

Blaylock RL, Maroon J (2011) Immunoexcitotoxicity as a central mechanism in chronic traumatic encephalopathy-A unifying hypothesis. Surg Neurol Int 2:107. (Epub 2011 Jul 30.)
Abstract: Some individuals suffering from mild traumatic brain injuries, especially repetitive mild concussions, are thought to develop a slowly progressive encephalopathy characterized by a number of the neuropathological elements shared with various neurodegenerative diseases. A central pathological mechanism explaining the development of progressive neurodegeneration in this subset of individuals has not been elucidated. Yet, a large number of studies indicate that a process called immunoexcitotoxicity may be playing a central role in many neurodegenerative diseases including chronic traumatic encephalopathy (CTE). The term immunoexcitotoxicity was first coined by the lead author to explain the evolving pathological and neurodevelopmental changes in autism and the Gulf War Syndrome, but it can

be applied to a number of neurodegenerative disorders. The interaction between immune receptors within the central nervous system (CNS) and excitatory glutamate receptors trigger a series of events, such as extensive reactive oxygen species/reactive nitrogen species generation, accumulation of lipid peroxidation products, and prostaglandin activation, which then leads to dendritic retraction, synaptic injury, damage to microtubules, and mitochondrial suppression. In this paper, we discuss the mechanism of immunoexcitotoxicity and its link to each of the pathophysiological and neurochemical events previously described with CTE, with special emphasis on the observed accumulation of hyperphosphorylated tau.

Broderick G, Kreitz A, Fuite J, Fletcher MA, Vernon SD, Klimas N (2011) A pilot study of immune network remodeling under challenge in Gulf War Illness. Brain Behav Immun 25:302-313.
Abstract: Gulf War Illness (GWI) is a complex disorder affecting nervous, endocrine and immune regulation. Accordingly, we propose that GWI presents with a distinct pattern of immune signaling. To explore this we compared interaction patterns linking immune markers and their evolution during exercise. Blood was collected from 9 GWI and 11 control subjects prior to a Graded eXercise Test (GXT) (t_0), at peak effort (t_1) and 4 h post-exercise (t_2). Salivary cortisol and plasma, serum or culture supernatants were analyzed for concentrations of neuropeptide Y (NPY), IL-1α, IL-5, IL-6, IL-10, TNF-α, IFN-γ and soluble CD26 (sCD26). Immune cell populations were surface stained for CD19, CD2, CD3, CD4, CD8, CD26, CD56, CD16, and CD11a. Mutual information (MI) networks linking these immune markers were generated in each group at each time point. Graph theory was used to describe the evolution of each network's structure and identify potential nucleating points. Distinct in topology, GWI networks had more abundant connections but were less organized. NPY, IL-1α, TNF-α and CD2+/CD26+ nodes were better integrated in the GWI network at rest. Under effort (t_1) these differences were replaced by significant restructuring around nodes for CD19+ B cell population, IL-5, IL-6 and soluble CD26 concentrations. This pattern subsided post-exercise. Further analysis indicated that IL-1α and CD2+/CD26+ nodes strongly influenced this characteristic modulation of B and T cell network motifs. This potentially heightened lymphocyte and HPA axis responsiveness to IL-1 stimulation in the context of a mixed Th1:Th2 immune signature supports an autoimmune component in GWI etiology.

Chao LL, Abadjian L, Hlavin J, Meyerhoff DJ, Weiner MW (2011) Effects of low-level sarin and cyclosarin exposure and Gulf War Illness on brain structure and function: a study at 4T. Neurotoxicology 32:814-822. (Epub 2011 Jun 29.)
Abstract: BACKGROUND: More than 100,000 US troops were potentially exposed to chemical warfare agents sarin (GB) and cyclosarin (GF) when an ammunition dump at Khamisiyah, Iraq was destroyed during the 1991 Persian Gulf War (GW). We previously found reduced total gray matter (GM) volume in 40 GW veterans with suspected GB/GF exposure relative to 40 matched, unexposed GW veterans on a 1.5T MR scanner. In this study, we reexamine the relationship between GB/GF exposure and volumetric measurements of gross neuroanatomical structures in a different cohort of GW veterans on a 4T MR scanner. METHODS: Neuropsychological and magnetic resonance imaging (MRI) data from a cross sectional study on Gulf War Illness performed between 2005 and 2010 were used in this study. 4T MRI data were analyzed using automated image processing techniques that produced volumetric measurements of gray matter (GM), white matter (WM) and cerebrospinal fluid (CSF). RESULTS: Binary comparisons of 64 GB/GF exposed veterans and 64 'matched', unexposed veterans revealed reduced GM ($p=0.03$) and WM ($p=0.03$) volumes in the exposed veterans. Behaviorally, exposed veterans committed more errors of omission ($p=0.02$) and tended to have slower responses ($p=0.05$) than unexposed veterans on the Continuous Performance Test (CPT), a measure sustained and selective attention. Regression analyses confirmed that GB/GF exposure status predicted GM ($\beta=-0.11$, $p=0.02$) and WM ($\beta=-0.14$, $p=0.03$) volumes, and number of CPT omission errors ($\beta=0.22$, $p=0.02$) over and above potentially confounding demographic, clinical, and psychosocial variables. There was no dose-response relationship between estimated levels of GB/GF exposure and brain volume. However, we did find an effect of Gulf War Illness/Chronic Multisymptom Illness on both GM and WM volume in the GB/GF exposed veterans. CONCLUSIONS: These findings confirm previous reports by our group and others of central nervous system pathology in GW veterans with suspected exposure to low levels of GB/GF two decades after the exposure.

Coughlin SS, Kang HK, Mahan CM (2011a) Alcohol use and selected health conditions of 1991 gulf war veterans: survey results, 2003-2005. Prev Chronic Dis 8:A52. (Epub 2011 Feb 15.)
Abstract: INTRODUCTION: A sizable literature has analyzed the frequency of alcohol consumption and patterns of drinking among veterans. However, few studies have examined patterns of alcohol use in veterans of the first Gulf War or factors associated with problem drinking in this population. We examined the frequency and patterns of alcohol use in male and female veterans who served in the 1991 Gulf War or during the same era and the relationships between alcohol use and selected health conditions. METHODS: We analyzed data from a follow-up survey of health

information among population-based samples of 15,000 Gulf War and 15,000 Gulf Era veterans. Data had been collected from 9,970 respondents during 2003 through 2005 via a structured questionnaire or telephone survey. RESULTS: Posttraumatic stress disorder (PTSD), major depressive disorder (MDD), unexplained multisymptom illness (MSI), and chronic fatigue syndrome (CFS)-like illness were more frequent among veterans with problem drinking than those without problem drinking. Approximately 28% of Gulf War veterans with problem drinking had PTSD compared with 13% of Gulf War veterans without problem drinking. In multivariate analysis, problem drinking was positively associated with PTSD, MDD, unexplained MSI, and CFS-like illness after adjustment for age, sex, race/ethnicity, branch of service, rank, and Gulf status. Veterans who were problem drinkers were 2.7 times as likely to have PTSD as veterans who were not problem drinkers. CONCLUSION: These findings indicate that access to evidence-based treatment programs and systems of care should be provided for veterans who abuse alcohol and who have PTSD and other war-related health conditions and illnesses.

Coughlin SS, Kang HK, Mahan CM (2011b) Selected Health Conditions Among Overweight, Obese, and Non-Obese Veterans of the 1991 Gulf War: Results from a Survey Conducted in 2003-2005. Open Epidemiol J 4:140-146.

Abstract: BACKGROUND: Several health conditions and concerns have been reported to be increased among Gulf War veterans including post-traumatic stress disorder (PTSD), chronic fatigue syndrome (CFS), CFS-like illness, and unexplained multi-symptom illness (MSI). As the cohort of Gulf War veterans advance in age, they are likely to be at risk of not only certain deployment-related health conditions but also chronic diseases associated with lifestyle factors. METHODS: To clarify relationships between PTSD, CFS-like illness, MSI, and obesity, we analyzed data from a cross-sectional survey of health information among population-based samples of 15,000 Gulf War veterans and 15,000 veterans who served during the same era. Data had been collected from 9,970 respondents in 2003-2005 via a structured questionnaire or telephone survey. RESULTS: Based upon body mass index (BMI) estimated from self-reported information about height and weight, the percentages of Gulf War and Gulf Era veterans who were overweight (BMI 25 to $\leq$ 29.9), were 46.8% and 48.7%, respectively. The percentages who were obese (BMI $\geq$ 30) were 29.6% and 28.3%, respectively. Without adjustment for Gulf deployment status (Gulf War vs Gulf Era), age, sex, or other factors, PTSD, MSI, CFS-like illness, and other chronic health conditions were more common among obese veterans than those who were normal weight (BMI 18.5 to $\leq$ 24.9). In multivariate analyses, PTSD was positively associated with obesity after adjustment for age, sex, Gulf deployment status, rank, income, education, and current smoking. In the model for PTSD, the adjusted odds ratio for obesity was 1.5 (95% CI 1.2-1.8). No associations were observed between BMI categories and CFS-like illness or MSI in multivariate analysis. CONCLUSIONS: Gulf War and Gulf Era veterans who were obese were more likely to have certain chronic health conditions including PTSD. Associations between Gulf status and CFS-like illness and MSI identified in the 2003-2005 follow-up survey were not accounted for by group differences in the prevalence of overweight or obesity.

Deeter DP (2011) The Kuwait Oil Fire Health Risk Assessment Biological Surveillance Initiative. Mil Med 176(7 Suppl):52-55.

Abstract: An important environmental concern during the first Gulf War (Operation Desert Storm) was assessing exposures and potential health effects in U.S. forces exposed to the Kuwait oil fires. With only 3 weeks for planning, a Biological Surveillance Initiative (BSI) was developed and implemented for a U.S. Army unit. The BSI included blood and urine collections, questionnaire administration, and other elements during the predeployment, deployment, and post-deployment phases. Many BSI objectives were accomplished. Difficulties encountered included planning failures, loss of data and information, and difficulty in interpreting laboratory results. In order for biological surveillance initiatives to provide useful information for future deployments where environmental exposures may be a concern, meaningful, detailed, and realistic planning and preparation must occur long before the deployment is initiated.

Defence Analytical Services and Advice (2011) 1990-1991 Gulf Conflict-UK Gulf Veterans Mortality Data: Causes of Death. DASA, Bath, UK, December 31, 2011. (Accessed at http://www.dasa.med.uk/20120328GulfVets2011.pdf)

The purpose of this Statistical Notice is to compare the mortality rates of 53,409 UK Armed Forces personnel that deployed to the 1990/91 Gulf Conflict to those of a comparison group, the Era cohort. The Era cohort consists of 53,143 UK Armed Forces personnel of similar age, gender, Service, regular/reservist status and rank who were in Service on 1 January 1991 but did not deploy to the Gulf. The findings include deaths that occurred to personnel whilst in service and deaths that occurred after personnel had left the UK Armed Forces.

DeFraites RF, Richards EE (2011) Assessing potentially hazardous environmental exposures among military populations: 2010 symposium and workshop summary and conclusions. Mil Med 176(7 Suppl):17-21.
Abstract: From May 19 to May 21, 2010, the Armed Forced Health Surveillance Center and the Uniformed Services University cosponsored an educational symposium and workshop on the assessment of potentially hazardous environmental exposures among military populations. Symposium participants reviewed and analyzed historical exposure events, from herbicides in Vietnam to the 1991 Gulf War oil well fires and World Trade Center dust exposure in 2001, using the framework that the Institute of Medicine developed for addressing environmental exposures and their possible impact on military populations. Historical exposures were critically assessed in terms of methods used to identify and define harmful exposures, to prevent or limit exposures, and to define the health risks to exposed people. The lessons learned were then used during small group discussions to deliberate on the current scientific approach for dealing with hazardous environmental exposures. This article summarizes the major conclusions and proceedings of the symposium and provides suggestions to improve the U.S. military's current strategy on identifying and assessing potentially hazardous environmental exposures.

Falk H, Briss P (2011) Environmental- and injury-related epidemic-assistance investigations, 1946-2005. Am J Epidemiol 174(11 Suppl):S65-79.
Abstract: This paper summarizes environmental investigations (n = 458) conducted during the first 60 years of the epidemic-assistance investigation program at the Centers for Disease Control and Prevention. These investigations were grouped into 10 categories: toxic chemicals (n = 102), indoor air quality and outdoor air toxics (n = 21), new or rare epidemic diseases and unexplained syndromes (n = 29), natural disasters (n = 81), terrorism and unintentional human-made disasters (n = 9), substance use and abuse (n = 13), environmental aspects of infectious disease (n = 132), those affecting neonates and infants (n = 11), violence and injuries (n = 51), and miscellaneous (n = 9). Among the most important or prominent were studies of lead and arsenic toxicity at smelters, mercury in paint and beauty creams, dioxin in waste oil in Missouri, polychlorinated biphenyls and multiple other toxic chemicals, global pesticide poisoning outbreaks, hepatic angiosarcoma among vinyl chloride workers, toxic oil syndrome in Spain, eosinophilia-myalgia syndrome from contaminated L-tryptophan, diethylene glycol poisoning in Haiti, aflatoxicosis in Kenya, Gulf War illness among veterans, impact and needs assessments during natural disasters (e.g., Hurricane Katrina (2005) and the Mount St. Helens volcano eruptions (1980)), risk factors for heat-related mortality, domestic and international terrorist attacks, Parkinsonism related to 1-methyl-4-phenyl-1,2,3,6-tetrahydropyridine in California, and unintentional injury- and violence-related events.

Fluge Ø, Bruland O, Risa K, Storstein A, Kristoffersen EK, Sapkota D, Næss H, Dahl O, Nyland H, Mella O (2011) Benefit from B-lymphocyte depletion using the anti-CD20 antibody rituximab in chronic fatigue syndrome. A double-blind and placebo-controlled study. PLoS One 6:e26358. (Epub 2011 Oct 19.)
Abstract: BACKGROUND: Chronic fatigue syndrome (CFS) is a disease of unknown aetiology. Major CFS symptom relief during cancer chemotherapy in a patient with synchronous CFS and lymphoma spurred a pilot study of B-lymphocyte depletion using the anti-CD20 antibody Rituximab, which demonstrated significant clinical response in three CFS patients. METHODS AND FINDINGS: In this double-blind, placebo-controlled phase II study (NCT00848692), 30 CFS patients were randomised to either Rituximab 500 mg/m(2) or saline, given twice two weeks apart, with follow-up for 12 months. Xenotropic murine leukemia virus-related virus (XMRV) was not detected in any of the patients. The responses generally affected all CFS symptoms. Major or moderate overall response, defined as lasting improvements in self-reported Fatigue score during follow-up, was seen in 10 out of 15 patients (67%) in the Rituximab group and in two out of 15 patients (13%) in the Placebo group ($p=0.003$). Mean response duration within the follow-up period for the 10 responders to Rituximab was 25 weeks (range 8-44). Four Rituximab patients had clinical response durations past the study period. General linear models for repeated measures of Fatigue scores during follow-up showed a significant interaction between time and intervention group ($p=0.018$ for self-reported, and $p=0.024$ for physician-assessed), with differences between the Rituximab and Placebo groups between 6-10 months after intervention. The primary end-point, defined as effect on self-reported Fatigue score 3 months after intervention, was negative. There were no serious adverse events. Two patients in the Rituximab group with pre-existing psoriasis experienced moderate psoriasis worsening. CONCLUSION: The delayed responses starting from 2-7 months after Rituximab treatment, in spite of rapid B-cell depletion, suggests that CFS is an autoimmune disease and may be consistent with the gradual elimination of autoantibodies preceding clinical responses. The present findings will impact future research efforts in CFS.

Gade DM, Wenger JB (2011) Combat exposure and mental health: the long-term effects among US Vietnam and Gulf war veterans. Health Econ 20:401-416.

Abstract: Using a random sample of more than 4000 veterans, we test the effects of combat exposure on mental health. We focus on two cohorts of veterans: those who served in Vietnam (1964-1975) and the Gulf War (1990-1991). Combat exposure differed between these groups in intensity, duration and elapsed time since exposure. We find that combat exposure generally, and exposure to dead, dying, or wounded people, specifically, is a significant predictor of mental health declines as measured by an individual's Mental Component Summary score. Under our general specifications, the negative effects of combat on mental health were larger for Gulf war veterans than for Vietnam veterans as of 2001. These effects persist after controlling for demographic characteristics, insurance coverage, income and assets. Using discrete factor, nonparametric maximum likelihood (DFML) estimation we controlled for unobserved heterogeneity as well as the factors above. In the DFML specifications we find a negative impact of exposure to dead, wounded or dying people for both Gulf and Vietnam veterans, but find no statistically significant effect for combat exposure overall for Vietnam veterans as of 2001. Based on our Gulf war parameters, we estimate that the costs of mental health declines to be between $87 and $318 per year for each soldier with combat service and exposure to dead, dying and wounded people.

Golier JA, Caramanica K, Yehuda R (2012) Neuroendocrine response to CRF stimulation in veterans with and without PTSD in consideration of war zone era. Psychoneuroendocrinology 37:350-357. (Epub 2011 Aug 2).
Abstract: BACKGROUND: Alterations in hypothalamic-pituitary-adrenal (HPA) axis activity have been observed in Gulf War veterans with posttraumatic stress disorder (PTSD) which differ from those observed in other veteran groups, raising the possibility that there is a unique neuroendocrine profile in this group of veterans. This study seeks to further characterize the effects of PTSD, military cohort (Vietnam, 1991 Gulf War, Operations Enduring Freedom/Iraqi Freedom (OEF/OIF)), and their interaction on the neuroendocrine response to synthetic corticotrophin-releasing factor (CRF) stimulation. METHODS: 51 male veterans were studied consisting of 21 from the Vietnam era, 16 from the Gulf War era, and 14 from the OEF/OIF era. 16 of these veterans were deployed to a war zone and had chronic PTSD (PTSD+), 25 were deployed to a war zone and did not have chronic PTSD (PTSD-), and 10 were not deployed to a war zone and did not have PTSD (non-exposed). The participants underwent the CRF stimulation test in the afternoon (approximately 2:00 p.m.), which measures the integrity and sensitivity of the pituitary-adrenal axis. Plasma cortisol and adrenocorticotropic hormone (ACTH) were measured at baseline and at intervals over a 2h period following intravenous administration of 1 μg/kg of ovine CRF (o-CRF, max 100 μg). In a small subset of participants, dehydroepiandrosterone (DHEA) and cortisol binding globulin (CBG) were also assessed. RESULTS: There was a significant group by era interaction in the response of ACTH to CRF, in addition to a main effect of group (PTSD+, PTSD-, non-exposed). The interaction reflected that group differences were only evident in the Gulf War cohort; among Gulf War era veterans, the PTSD+ group had higher elevations in ACTH levels following CRF than the PTSD- group and the non-exposed group. Additionally, the peak change in ACTH was associated with a self-reported environmental exposure (pyridostigmine bromide ingestion) which has been found to be linked to the excess morbidity found in Gulf War veterans. Self-reported childhood trauma was greater in veterans of the Gulf War than Vietnam or OEF/OIF, but did not account for the observed differences. There was a significant effect of group on the cortisol response to CRF, reflecting greater responsivity in both of the deployed groups (PTSD+ and PTSD-) compared to the non-exposed group which could be accounted for by baseline differences in cortisol levels; unlike the ACTH response, the cortisol response did not differ by era. There were no effects of group, era, or their interaction on the DHEA and CBG response to CRF. CONCLUSIONS: A uniform pattern of PTSD-related alterations in the response to intravenous CRF was not found. Rather, PTSD-related alterations were found only in veterans of the 1991 Gulf War, and were characterized by an enhanced pituitary response to CRF which may reflect increased sensitivity of pituitary corticotrophs or CRF hyposecretion. Together with previous neuroendocrine findings, the data suggest the HPA axis is dysregulated in Gulf War veterans in unique ways which may reflect the long-term effects of environmental exposures in addition to disease effects. Further work is needed to characterize these effects and their impact on long-term psychological and medical outcomes.

Heintze E, Aguilera C, Davis M, Fricker A, Li Q, Martinez J, Gage MJ (2011) Toxicity of depleted uranium complexes is independent of p53 activity. J Inorg Biochem 105:142-148. (Epub 2010 Oct 29.)
Abstract: The p53 tumor suppressor protein is one of the key checkpoints in cellular response to a variety of stress mechanisms, including exposure to various toxic metal complexes. Previous studies have demonstrated that arsenic and chromium complexes are able to activate p53, but there is a dearth of data investigating whether uranium complexes exhibit similar effects. The use of depleted uranium (DU) has increased in recent years, raising concern about DU's potential carcinogenic effects. Previous studies have shown that uranyl acetate and uranyl nitrate are capable of inducing DNA strand breaks and potentially of inducing oxidative stress through free radical generation, two potential mechanisms for activation of p53. Based on these studies, we hypothesized that either uranyl acetate or uranyl nitrate

could act as an activator of p53. We tested this hypothesis using a combination of cytotoxicity assays, p53 activity assays, western blotting and flow cytometry. All of our results demonstrate that there is not a p53-mediated response to either uranyl acetate or uranyl nitrate, demonstrating that any cellular response to uranium exposure likely occurs in a p53-independent fashion under the conditions studied.

Heller JM (2011) Oil well fires of Operation Desert Storm--defining troop exposures and determining health risks. Mil Med 176(7 Suppl):46-51.
Abstract: During Operation Desert Storm, in February 1991, Iraqi troops began burning Kuwaiti oil wells. Almost immediately there was concern about possible adverse health effects in U.S. personnel exposed to crude oil combustion products. Combustions products were predicted from the known composition of Kuwaiti crude oil. Monitoring sites were established in Saudi Arabia and Kuwait; about 5,000 environmental samples were studied. Data collected were used to develop health risk assessments for the geographic areas sampled. This initial approach to assessing risk had to be greatly expanded when Congress passed Public Law 102-190, requiring development of means to calculate environmental exposures for individual U.S. service members. To estimate daily exposure levels for the entire area over 10 months for all U.S. troops, air dispersion modeling was used in conjunction with satellite imagery and geographic information system technology. This methodology made it possible to separate the risk caused by oil fire smoke from the total risk from all sources for each service member. The U.S. military responses to health concerns related to the oil well fires and to Public Law 102-190 were reviewed. Consideration was given to changes in technology, practices, and policies over the last two decades that might impact a similar contemporary response.

Henderson JD, Glucksman G, Leong B, Tigyi A, Ankirskaia A, Siddique I, Lam H, DePeters E, Wilson BW (2012) Pyridostigmine bromide protection against acetylcholinesterase inhibition by pesticides. J Biochem Mol Toxicol 26:31-34. (Epub 2011 Oct 3.)
Abstract: Pyridostigmine bromide (PB) has been used to protect soldiers from the toxic effects of soman, a chemical warfare agent. Recent research shows that pyridostigmine bromide protects a significant percentage of acetylcholinesterase in isolated human intercostal muscle. Findings presented here indicate that red blood cell acetylcholinesterase is similarly protected by pyridostigmine bromide from the action of diisopropyl fluorophosphate and several organophosphate pesticides including chlorpyrifos-oxon, diazinon-oxon, and paraoxon, but not malaoxon, using the bovine red blood cell as a subject. These findings suggest that pretreatment with PB may protect growers, farmworkers, first responders, and the public, in general, from the effects of selected pesticides.

Iannacchione VG, Dever JA, Bann CM, Considine KA, Creel D, Carson CP, Best H, Haley RW (2011) Validation of a research case definition of Gulf War illness in the 1991 US military population. Neuroepidemiology 37:129-140. (Epub 2011 Oct 7.)
Abstract: BACKGROUND: A case definition of Gulf War illness with 3 primary variants, previously developed by factor analysis of symptoms in a US Navy construction battalion and validated in clinic veterans, identified ill veterans with objective abnormalities of brain function. This study tests prestated hypotheses of its external validity. METHODS: A stratified probability sample (n = 8,020), selected from a sampling frame of the 3.5 million Gulf War era US military veterans, completed a computer-assisted telephone interview survey. Application of the prior factor weights to the subjects' responses generated the case definition. RESULTS: The structural equation model of the case definition fit both random halves of the population sample well (root mean-square error of approximation = 0.015). The overall case definition was 3.87 times (95% confidence interval, 2.61-5.74) more prevalent in the deployed than the deployable nondeployed veterans: 3.33 (1.10-10.10) for syndrome variant 1; 5.11 (2.43-10.75) for variant 2, and 4.25 (2.33-7.74) for variant 3. Functional status on SF-12 was greatly reduced (effect sizes, 1.0-2.0) in veterans meeting the overall and variant case definitions. CONCLUSIONS: The factor case definition applies to the full Gulf War veteran population and has good characteristics for research.

Ismail K, Fear N, Flanagan M, Doebbeling B, Wessely S (2011) A US-UK comparison of health in 1990-1991 Gulf War veterans. Occup Med (Lond). 61:483-489.
Abstract: BACKGROUND: UK and US military personnel appear to have different health profiles yet direct comparisons of health status and deployment exposures between US and UK military populations have never been performed. AIMS: To compare US and UK military personnel deployed to the 1991 Persian Gulf War (PGW) for rates of symptom reporting, medical conditions and health status [Short Form-36 general health perception (GHP) and physical functioning (PF) subscales] and self-report military exposures. METHODS: We analysed representative cross-sectional samples of military personnel from the Iowa Persian Gulf Study (n = 3626) and the UK Health Survey of Military Personnel (n = 5573) that included directly comparable measures and stratified by those who had been

deployed to PGW and those who had not been deployed to PGW. RESULTS: Although UK veterans had similar mean PF scores as US veterans (mean differences in PGW: 0.86, 95% CI -0.36 to 2.07 and in non-deployed -0.61, 95% CI -1.84 to 0.62), they had worse mean GHP scores (mean differences in PGW: -5.62, 95% CI -7.44 to -3.80 and in non-deployed -3.83, 95% CI -5.40 to -2.27). UK PGW veterans were more likely to report Gulf specific exposures, and this was associated with worse GHP (UK mean difference -9.05, 95% CI -11.49 to -6.61 versus US mean difference -4.30, 95% CI -6.62 to -1.98). CONCLUSIONS: This study observed transatlantic variations in health status in military populations that may reflect cultural differences in the reporting of health.

Joellenbeck LM (2011) Medical surveillance and other strategies to protect the health of deployed U.S. forces: revisiting after 10 years. Mil Med. 176(7 Suppl):64-70.
Abstract: Following the first Gulf War (Operations Desert Shield and Desert Storm, 1990-1991), medically unexplained symptoms and illnesses reported by many returning veterans proved frustrating to veterans, care providers, and military planners. The Department of Defense (DoD) sought an independent, proactive effort to learn from the lessons of the Gulf War and other deployments and the development of a strategy to better protect the health of the troops. DoD engaged the Institute of Medicine and National Research Council to provide input in four areas: assessment of health risks during deployments; technologies and methods for detection and tracking of exposures; physical protection and decontamination; and medical protection, health consequences and treatment, and medical record keeping. In a third year, a committee emphasized and extended the recommendations from the four interim reports to describe a long-term strategy for health protection. This article notes salient recommendations from the report on medical protection and record keeping and from the final report that still bear emphasis a decade after the reports were published.

Kirkpatrick JS (2011) The impact of U.S. military operations in Kuwait, Bosnia, and Kosovo (1991-2000) on environmental health surveillance. Mil Med 176(7 Suppl):41-45.
Abstract: Deployments of U.S. Forces to the Persian Gulf (1991), Bosnia and Herzegovina (1995), and Kosovo (1999) were associated with diverse, potential environmental exposures. Health effects possibly associated with these exposures were cause for concern among service members, veterans, and military and civilian leaders. A need for the military to effectively respond to these exposures, and more importantly, to assess and mitigate exposures before deployments and to conduct environmental surveillance during deployments was identified. The Department of Defense encountered many obstacles in dealing with the exposures of 1991. Even though these obstacles were being identified, and in some cases, addressed, responses to historical exposure concerns continued to be reactive. In 1996, efforts were intensified to improve policy and doctrine, field sampling equipment, risk assessment processes, geographic information systems, and other tools needed to effectively identify and reduce the impact of exposures before troops deploy and to conduct environmental surveillance while deployed. Success in these efforts resulted in a comprehensive, planned approach being implemented to address environmental health concerns during the 1999 Kosovo deployment.

Lestaevel P, Bensoussan H, Racine R, Airault F, Gourmelon P, Souidi M (2011) Transcriptomic effects of depleted uranium on acetylcholine and cholesterol metabolisms in Alzheimer's disease model. C R Biol 334:85-90. (Epub 2011 Jan 26.)
Abstract: Some heavy metals, or aluminium, could participate in the development of Alzheimer disease (AD). Depleted uranium (DU), another heavy metal, modulates the cholinergic system and the cholesterol metabolism in the brain of rats, but without neurological disorders. The aim of this study was to determine what happens in organisms exposed to DU that will/are developing the AD. This study was thus performed on a transgenic mouse model for human amyloid precursor protein (APP), the Tg2576 strain. The possible effects of DU through drinking water (20 mg/L) over an 8-month period were analyzed on acetylcholine and cholesterol metabolisms at gene level in the cerebral cortex. The mRNA levels of choline acetyl transferase (ChAT) vesicular acetylcholine transporter (VAChT) and ATP-binding cassette transporter A1 (ABC A1) decreased in control Tg2576 mice in comparison with wild-type mice (respectively -89%, -86% and -44%, $p < 0.05$). Chronic exposure of Tg2576 mice to DU increased mRNA levels of ChAT (+189%, $p < 0.05$), VAChT (+120%, $p < 0.05$) and ABC A1 (+52%, $p < 0.05$) compared to control Tg2576 mice. Overall, these modifications of acetylcholine and cholesterol metabolisms did not lead to increased disturbances that are specific of AD, suggesting that chronic DU exposure did not worsen the pathology in this experimental model.

Levy BS, Nassetta WJ (2011) The adverse health effects of oil spills: a review of the literature and a framework for medically evaluating exposed individuals. Int J Occup Environ Health 17:161-167.
Abstract: In April 2010, an explosion on an oil rig in the Gulf of Mexico killed 11 workers, injured 17 workers, and spilled an estimated 185 million gallons of crude oil into the Gulf. Adverse effects on the health of cleanup workers,

fishermen, and others as well as on the ecosystem are being studied. This paper reviews published studies of the adverse health effects due to previous oil spills. Acute effects have included: respiratory, eye, and skin symptoms; headache; nausea; dizziness; and tiredness or fatigue. Chronic effects have included: psychological disorders, respiratory disorders, genotoxic effects, and endocrine abnormalities. We also present a systematic approach to evaluating individuals exposed to oil spills.

Li B, Mahan CM, Kang HK, Eisen SA, Engel CC (2011a) Longitudinal Health Study of US 1991 Gulf War Veterans: Changes in Health Status at 10-Year Follow-up. Am J Epidemiol 174:761-768. (Epub 2011 Jul 27.)
Abstract: The authors assessed changes in the health status of US 1991 Gulf War-era veterans from a 1995 baseline survey to a 2005 follow-up survey, using repeated measurement data from 5,469 deployed Gulf War veterans and 3,353 nondeployed Gulf War-era veterans who participated in both surveys. Prevalence differences in health status between the 2 surveys were estimated for adverse health indices and chronic diseases for each veteran group. Persistence risk ratios and incidence risk ratios were calculated after adjustment for demographic and military service characteristics through Mantel-Haenszel stratified analysis. At 10-year follow-up, deployed veterans were more likely to report persistent poor health, as measured by the health indices (functional impairment, limitation of activities, repeated clinic visits, recurrent hospitalizations, perception of health as fair or poor, chronic fatigue syndrome-like illness, and posttraumatic stress disorder), than nondeployed veterans. Additionally, deployed veterans were more likely to experience new onset of adverse health (as measured by the indices) and certain chronic diseases than were nondeployed veterans. During the 10-year period from 1995 to 2005, the health of deployed veterans worsened in comparison with nondeployed veterans because of a higher rate of new onset of various health outcomes and greater persistence of previously reported adverse health on the indices.

Li X, Spence JS, Buhner DM, Hart J Jr, Cullum CM, Biggs MM, Hester AL, Odegard TN, Carmack PS, Briggs RW, Haley RW (2011b) Hippocampal Dysfunction in Gulf War Veterans: Investigation with ASL Perfusion MR Imaging and Physostigmine Challenge. Radiology 261:218-225. (Epub 2011 Sep 13.)
Abstract: PURPOSE: To determine, with arterial spin labeling (ASL) perfusion magnetic resonance (MR) imaging and physostigmine challenge, if abnormal hippocampal blood flow in ill Gulf War veterans persists 11 years after initial testing with single photon emission computed tomography and nearly 20 years after the 1991 Gulf War. Materials and Methods: The local institutional review board approved this HIPAA-compliant study. Veterans were screened for contraindications and gave written informed consent before the study. In a semiblinded retrospective protocol, veterans in three Gulf War illness groups-syndrome 1 (impaired cognition), syndrome 2 (confusion-ataxia), and syndrome 3 (central neuropathic pain)-and a control group received intravenous infusions of saline in an initial session and physostigmine in a second session, 48 hours later. Each infusion was followed by measurement of hippocampal regional cerebral blood flow (rCBF) with pulsed ASL. A mixed-effects linear model adjusted for age was used to test for differences in rCBF after the cholinergic challenge across the four groups. Results: Physostigmine significantly decreased hippocampal rCBF in control subjects ($P < .0005$) and veterans with syndrome 1 ($P < .05$) but significantly increased hippocampal rCBF in veterans with syndrome 2 ($P < .005$) and veterans with syndrome 3 ($P < .002$). The abnormal increase in rCBF was found to have progressed to the left hippocampus of the veterans with syndrome 2 and to both hippocampi of the veterans with syndrome 3. Conclusion: Chronic hippocampal perfusion dysfunction persists or worsens in veterans with certain Gulf War syndromes. ASL MR imaging examination of hippocampal rCBF in a cholinergic challenge experiment may be useful as a diagnostic test for this condition.

Liu P, Aslan S, Li X, Buhner DM, Spence JS, Briggs RW, Haley RW, Lu H (2011) Perfusion deficit to cholinergic challenge in veterans with Gulf War Illness. Neurotoxicology 32:242-246.
Abstract: A highly plausible etiology for Gulf War Illness (GWI) is that the neural damage and cognitive deficits are associated with excessive exposure to cholinesterase-inhibiting cholinergic stimulants. Our previous SPECT study provided strong indication that cerebral blood flow (CBF) in veterans with GWI may be different from those of unaffected control veterans. The present study confirmed and extended previous findings that patients with GWI have abnormal response to an inhibitory cholinergic challenge, physostigmine infusion, when compared to age-gender-education matched control veterans. The MRI-based arterial spin labeling (ASL) and phase-contrast techniques have several key advantages over SPECT, including shorter experiment duration, complete non-invasiveness, and higher spatial and temporal resolutions, and therefore may provide a cost-effective biomarker for characterization of GWI.

Martin NJ, Richards EE, Kirkpatrick JS (2011) Exposure science in U.S. military operations: a review. Mil Med 176(7 Suppl):77-83.

Abstract: Since 1991, the U.S. Department of Defense has conducted deployment occupational and environmental health surveillance activities in the geographic combatant commands for major conflicts, military exercises, and humanitarian and peace-building missions. The DoD has made significant improvements in documenting and assessing deployment environmental hazards and threats since 1991, illustrated by accomplishments in Bosnia, Kosovo, and Operations Noble Eagle (following the September 11, 2001 terrorist attacks); Enduring Freedom-Afghanistan; and Iraqi Freedom (2003-2010). Sampling is now recommended as part of the DoD Exposure Assessment Method, a dynamic process that is performed during all phases of military operations: I--Predeployment, II--Mobilization, III--Conflict, and IV-Postdeployment. From 2001 to 2009, deployed personnel collected over 24,500 air, water, soil, and bulk samples during operations. These efforts have lead to the creation of an environmental health surveillance database that has been used to investigate public health issues. However, gaps exist, especially in the assessment of individual exposures during deployment.

Maselli RA, Henderson JD, Ng J, Follette D, Graves G, Wilson BW (2011) Protection of human muscle acetylcholinesterase from soman by pyridostigmine bromide. Muscle Nerve 4:591-595.
Abstract: INTRODUCTION: Pretreatment with pyridostigmine bromide (PB) of human intercostal muscle fibers exposed to the irreversible acetylcholinesterase (AChE) inhibitor soman was investigated. METHODS: Muscles were pretreated with 3 × 10(-6) M PB or saline for 20 minutes, then exposed to 10(-7) M soman for 10 minutes. RESULTS: AChE of muscles treated with soman alone was inhibited >95%. In contrast, PB pretreatment of soman-exposed bundles protected 20% of AChE activity. AChE of bundles exposed to PB alone recovered after 4 hours, but bundles exposed to both PB and soman did not. Soman-induced reduction of resting membrane potentials and increment of amplitudes and decay times of miniature endplate potentials (MEPPs) were partially corrected by PB pretreatment. CONCLUSIONS: In vitro pretreatment of human muscles with PB protected up to 20% of muscle AChE and ameliorated some deleterious effects on endplate physiology induced by soman.

McDiarmid MA, Albertini RJ, Tucker JD, Vacek PM, Carter EW, Bakhmutsky MV, Oliver MS, Engelhardt SM, Squibb KS (2011) Measures of genotoxicity in Gulf war I veterans exposed to depleted uranium. Environ Mol Mutagen 52:569-581. (Epub 2011 Jul 4).
Abstract: Exposure to depleted uranium (DU), an alpha-emitting heavy metal, has prompted the inclusion of markers of genotoxicity in the long-term medical surveillance of a cohort of DU-exposed Gulf War veterans followed since 1994. Using urine U (uU) concentration as the measure of U body burden, the cohort has been stratified into low-u (<0.10 μg U/g creatinine) and high-u groups (≥ 0.10 μg U/g creatinine). Surveillance outcomes for this cohort have historically included markers of mutagenicity and clastogenicity, with past results showing generally nonsignificant differences between low- vs. high-U groups. However, mean hypoxanthine-guanine phosphoribosyl transferase (HPRT) mutant frequencies (MFs) have been almost 50% higher in the high-U group. We report here results of a more comprehensive protocol performed in a 2009 evaluation of a subgroup (N = 35) of this cohort. Four biomarkers of genotoxicity [micronuclei (MN), chromosome aberrations, and MFs of HPRT and PIGA] were examined. There were no statistically significant differences in any outcome measure when results were compared between the low- vs. high-U groups. However, modeling of the HPRT MF results suggests a possible threshold effect for MFs occurring in the highest U exposed cohort members. Mutational spectral analysis of HPRT mutations is underway to clarify a potential clonal vs. a threshold uU effect to explain this observation. This study provides a comprehensive evaluation of a human population chronically exposed to DU and demonstrates a relatively weak genotoxic effect of the DU exposure. These results may explain the lack of clear epidemiologic evidence for U carcinogenicity in humans.

McDiarmid MA, Engelhardt SM, Dorsey CD, Oliver M, Gucer P, Gaitens JM, Kane R, Cernich A, Kaup B, Hoover D, Gaspari AA, Shvartsbeyn M, Brown L, Squibb KS (2011) Longitudinal health surveillance in a cohort of gulf war veterans 18 years after first exposure to depleted uranium. J Toxicol Environ Health A 74:678-691.
Abstract: As part of a longitudinal surveillance program, 35 members of a larger dynamic cohort of 79 Gulf War I veterans exposed to depleted uranium (DU) during combat underwent clinical evaluation at the Baltimore Veterans Administration Medical Center. Health outcomes and biomonitoring results were obtained to assess effects of DU exposure and determine the need for additional medical intervention. Clinical evaluation included medical and exposure histories, physical examination, and laboratory studies including biomarkers of uranium (U) exposure. Urine collections were obtained for U analysis and to measure renal function parameters. Other laboratory measures included basic hematology and chemistry parameters, blood and plasma U concentrations, and markers of bone metabolism. Urine U (uU) excretion remained above normal in participants with embedded DU fragments, with urine U concentrations ranging from 0.006 to 1.88 μg U/g creatinine. Biomarkers of renal effects showed no apparent evidence of renal

functional changes or cellular toxicity related to U body burden. No marked differences in markers of bone formation or bone resorption were observed; however, a statistically significant decrease in levels of serum intact parathyroid hormone and significant increases in urinary calcium and sodium excretion were seen in the high versus the low uU groups. Eighteen years after first exposure, members of this cohort with DU fragments continue to excrete elevated concentrations of uU. No significant evidence of clinically important changes was observed in kidney or bone, the two principal target organs of U. Continued surveillance is prudent, however, due to the ongoing mobilization of uranium from fragment depots.

Middlemore-Risher ML, Adam BL, Lambert NA, Terry AV Jr (2011) Effects of chlorpyrifos and chlorpyrifos-oxon on the dynamics and movement of mitochondria in rat cortical neurons. J Pharmacol Exp Ther 339:341-349. (Epub 2011 Jul 28.)
Abstract: Organophosphate (OP)-based pesticides have been used extensively for decades, and as a result, they have become almost ubiquitous in our environment. There is clinical and animal evidence to suggest that chronic exposures to OPs can lead to cognitive dysfunction and other neurological abnormalities, although the mechanism for these effects is unknown. We previously reported that repeated, subthreshold exposures (defined as doses not associated with signs of acute toxicity) to the commonly used OP chlorpyrifos (CPF) resulted in protracted impairments in the performance of attention and memory-related tasks in rodents as well as deficits in axonal transport ex vivo (in the sciatic nerve). Here, we investigated the effects of CPF and its active metabolite CPF oxon (CPO) on the dynamics and movement of mitochondria in rat primary cortical neurons using time-lapse imaging techniques. Exposure to CPF (1.0-20.0 μM) or CPO (5.0 nM-20.0 μM) for 1 or 24 h resulted in a concentration-dependent increase in mitochondrial length, a decrease in mitochondrial number (indicative of increased fusion events), and a decrease in their movement in axons. The changes occurred at concentrations of CPF and CPO that did not inhibit acetylcholinesterase activity (the commonly cited mechanism of acute OP toxicity), and they were not blocked by cholinergic receptor antagonists. Furthermore, the changes did not seem to be associated with direct (OP-related) effects on mitochondrial viability or function (i.e., mitochondrial membrane potential or ATP production). The results suggest that an underlying mechanism of organophosphate-based deficits in cognitive function might involve alterations in mitochondrial dynamics and/or their transport in axons.

Moss JI (2011) Chemical interactions and Gulf War illnesses. Chem Biol Interact 193:107. (Comment on: In vitro kinetic interactions of DEET, pyridostigmine and organophosphorus pesticides with human cholinesterases. Chem Biol Interact. 2011;190:79-83.)
Summary: The interactions between DEET and the acetylcholinesterase inhibitor pyridostigmine bromide on whole organisms have been synergistic as first demonstrated in insects, then in rats, chicken, and mice. This synergistic effect that is conserved from insects to vertebrates is likely to be present in humans, whether or not there is a synergistic effect in an isolated enzyme assay.

Perricone C, Alessandri C, Valesini G (2011) 'ASIA' - Autoimmune/inflammatory syndrome induced by adjuvants: even and odd. Reumatismo 63:63-66.
Abstract: Recently, Shoenfeld and Agmon-Levin described a potential new syndrome, namely ASIA - autoimmune/inflammatory syndrome induced by adjuvants, that comprises four medical conditions: siliconosis, the Gulf war syndrome, the macrophagic myofasciitis syndrome and post-vaccination phenomena, characterized by hyperactive immune responses accompanied by a similar complex of signs and symptoms. Most relevantly, these conditions share a linkage represented by adjuvants. This common soil may possibly induce autoimmune or auto-inflammatory diseases in humans as it was demonstrated in different animal models. Reconsidering under a unified umbrella this apparently detached condition is not only intriguing, but also provocative, and may help in unraveling novel pathogenetic mechanisms, preventive measures, and therapeutic targets.

Pourahmad J, Shaki F, Tanbakosazan F, Ghalandari R, Ettehadi HA, Dahaghin E (2011) Protective effects of fungal β-(1→3)-D-glucan against oxidative stress cytotoxicity induced by depleted uranium in isolated rat hepatocytes. Hum Exp Toxicol 30:173-181. (Epub 2010 Jun3)
Abstract: Previous reports suggested that certain carbohydrate polymers, such as β-(1→3)-D-glucan, may possess free radical scavenging activity. The present study examined the free radical scavenging activity of a carbohydrate polymer, β-(1→3)-D-glucan against oxidative stress induced by depleted uranium in isolated rat hepatocytes. Addition of U (VI) (uranyl acetate) to isolated rat hepatocytes results in reactive oxygen species (ROS) formation, rapid glutathione depletion, mitochondrial membrane potential collapse and lysosomal membrane rupture before hepatocyte lysis occurred. Our results showed that quite similar to silymarin, which is a known antioxidant and radical scavenger, tiny

concentration of β-glucan (138 nM) very successfully protected the hepatocytes against cell lysis and all oxidative stress cytotoxicity endpoints caused by depleted uranium including ROS formation, glutathione depletion, decreased mitochondrial membrane potential, lysosomal membrane rupture and caspase 3 activity increase. In conclusion, our results confirmed the antioxidant and radical scavenging activity of β-(1→3)-D-glucan and suggested this compound and silymarin as possible drug candidates for prophylaxis and treatment against depleted uranium toxic effects.

Ravindran MK, Zheng Y, Timbol C, Merck SJ, Baraniuk JN (2011) Migraine headaches in chronic fatigue syndrome (CFS): comparison of two prospective cross-sectional studies. BMC Neurol 11:30.
Abstract: BACKGROUND: Headaches are more frequent in Chronic Fatigue Syndrome (CFS) than healthy control (HC) subjects. The 2004 International Headache Society (IHS) criteria were used to define CFS headache phenotypes. METHODS: Subjects in Cohort 1 (HC = 368; CFS = 203) completed questionnaires about many diverse symptoms by giving nominal (yes/no) answers. Cohort 2 (HC = 21; CFS = 67) had more focused evaluations. They scored symptom severities on 0 to 4 anchored ordinal scales, and had structured headache evaluations. All subjects had history and physical examinations; assessments for exclusion criteria; questionnaires about CFS related symptoms (0 to 4 scale), Multidimensional Fatigue Inventory (MFI) and Medical Outcome Survey Short Form 36 (MOS SF-36). RESULTS: Demographics, trends for the number of diffuse "functional" symptoms present, and severity of CFS case designation criteria symptoms were equivalent between CFS subjects in Cohorts 1 and 2. HC had significantly fewer symptoms, lower MFI and higher SF-36 domain scores than CFS in both cohorts. Migraine headaches were found in 84%, and tension-type headaches in 81% of Cohort 2 CFS. This compared to 5% and 45%, respectively, in HC. The CFS group had migraine without aura (60%; MO; CFS+MO), with aura (24%; CFS+MA), tension headaches only (12%), or no headaches (4%). Co-morbid tension and migraine headaches were found in 67% of CFS. CFS+MA had higher severity scores than CFS+MO for the sum of scores for poor memory, dizziness, balance, and numbness ("Neuro-construct", $p = 0.002$) and perceived heart rhythm disturbances, palpitations and noncardiac chest pain ("Cardio-construct"; $p = 0.045$, t-tests after Bonferroni corrections). CFS+MO subjects had lower pressure-induced pain thresholds (2.36 kg [1.95-2.78; 95% C.I.] n = 40) and a higher prevalence of fibromyalgia (47%; 1990 criteria) compared to HC (5.23 kg [3.95-6.52] n = 20; and 0%, respectively). Sumatriptan was beneficial for 13 out of 14 newly diagnosed CFS migraine subjects. CONCLUSIONS: CFS subjects had higher prevalences of MO and MA than HC, suggesting that mechanisms of migraine pathogenesis such as central sensitization may contribute to CFS pathophysiology.

Riccobono F, Perra G, Pisani A, Protano G (2011) Trace element distribution and 235U/238U ratios in Euphrates waters and in soils and tree barks of Dhi Qar province (southern Iraq). Sci Total Environ 409:3829-3838. (Epub 2011 Jul 19.)
Abstract: To assess the quality of the environment in southern Iraq after the Gulf War II, a geochemical survey was carried out. The survey provided data on the chemistry of Euphrates waters, as well as the trace element contents, U and Pb isotopic composition, and PAH levels in soil and tree bark samples. The trace element concentrations and the (235)U/(238)U ratio values in the Euphrates waters were within the usual natural range, except for the high contents of Sr due to a widespread presence of gypsum in soils of this area. The trace element contents in soils agreed with the common geochemistry of soils from floodplain sediments. Some exceptions were the high contents of Co, Cr and Ni, which had a natural origin related to ophiolitic outcrops in the upper sector of the Euphrates basin. The high concentrations of S and Sr were linked to the abundance of gypsum in soils. A marked geochemical homogeneity of soil samples was suggested by the similar distribution pattern of rare earth elements, while the (235)U/(238)U ratio was also fairly homogeneous and within the natural range. The chemistry of the tree bark samples closely reflected that of the soils, with some notable exceptions. Unlike the soils, some tree bark samples had anomalous values of the (235)U/(238)U ratio due to mixing of depleted uranium (DU) with the natural uranium pool. Moreover, the distribution of some trace elements (such as REEs, Th and Zr) and the isotopic composition of Pb in barks clearly differed from those of the nearby soils. The overall results suggested that significant external inputs occurred implying that once formed the DU-enriched particles could travel over long distances. The polycyclic aromatic hydrocarbon concentrations in tree bark samples showed that phenanthrene, fluoranthene and pyrene were the most abundant components, indicating an important role of automotive traffic.

Richards EE (2011) Responses to occupational and environmental exposures in the U.S. military--World War II to the present. Mil Med 176(7 Suppl):22-28.
Abstract: Since the Civil War, a proportion of U.S. service members continues to return from war with new health problems and continues to reference battlefield exposures as the cause. Hence, one of the most pressing public health debates in military policy, the determination of causality and linking of battlefield exposures to health outcomes in veterans, continues. The advances in military environmental and occupational epidemiologic research and Department

of Defense policy concerning battlefield exposures are summarized and examples from World War II through the first Gulf War are provided. The limitations associated with the unique battlefield environment, multiple environmental exposures, and the inherent stresses of war, beget challenges for researchers responsible for determining causality. In light of these difficulties, six strategies for addressing environmental exposures and their possible impact on veterans were recommended by the Institute of Medicine post Operation Desert Storm. These strategies, along with their respective progress and remaining gaps, are addressed.

Schulz-Heik RJ, Schaer M, Eliez S, Hallmayer JF, Lin X, Kaloupek DG, Woodward SH (2011) Catechol-O-methyltransferase Val158Met polymorphism moderates anterior cingulate volume in posttraumatic stress disorder. Biol Psychiatry 70:1091-1096. (Epub 2011 Jul 23.)
Abstract: BACKGROUND: Posttraumatic stress disorder (PTSD) is associated with structural and functional compromise of the anterior cingulate cortex (ACC), which may in turn be associated with impairment of its ability to regulate the amygdala. The Val158Met polymorphism in the catechol-O-methyltransferase gene, which substantially influences dopamine inactivation in the frontal lobe in general and in ACC in particular, may moderate ACC integrity in PTSD. METHODS: We tested this hypothesis in a sample of Vietnam and Persian Gulf War veterans who experienced substantial military operational stress, including 51 who met criteria for PTSD and 48 matched controls who did not. RESULTS: Participants with PTSD were previously reported to have smaller ACC volumes than controls in this sample. A novel repeated-measures analysis of variance was conducted with PTSD diagnosis, Val158Met genotype, and their interaction predicting left and right ACC volume. Genotype was not directly related to ACC volume, but it did significantly interact with the PTSD diagnosis. The difference in ACC volume between the participants without PTSD and participants with PTSD was greater among individuals homozygous for the Val allele than among carriers of the Met allele. This finding was driven largely by the right ACC. Analyses of Caucasian-only, non-Caucasian-only, and male-only subsamples indicated similar patterns. CONCLUSIONS: Our findings suggest Val158Met genotype moderates the effect of PTSD-related processes on right ACC volume.

Sharma SK (2011) Importance of case definition in epidemiological studies. Neuroepidemiology 37(2):141-142. (Epub 2011 Oct 7.)
(Comment on: Validation of a research case definition of Gulf War illness in the 1991 US military population. Neuroepidemiology. 2011;37:129-140.)
Summary: In the absence of a case definition, the value of [research] studies is questionable. It is important, therefore, to estimate the size of the sample that would be required to have a reasonable expectation of detecting differences between deployed and nondeployed veterans or exposures to hazardous substances. Many variables are involved in such calculations, for example, the size of the investigated exposure's expected impact on health (consistent lethal effects can be detected in a smaller sample rather than more subtle problems) and the prevalence of exposure, some of which were unknown at the time federal [research] studies were planned.

Shoenfeld Y, Agmon-Levin N (2011) 'ASIA' - autoimmune/inflammatory syndrome induced by adjuvants. J Autoimmun 36:4-8. (Epub 2010 Aug 13.)
Abstract: The role of various environmental factors in the pathogenesis of immune mediated diseases is well established. Of which, factors entailing an immune adjuvant activity such as infectious agents, silicone, aluminium salts and others were associated with defined and non-defined immune mediated diseases both in animal models and in humans. In recent years, four conditions: siliconosis, the Gulf war syndrome (GWS), the macrophagic myofasciitis syndrome (MMF) and post-vaccination phenomena were linked with previous exposure to an adjuvant. Furthermore, these four diseases share a similar complex of signs and symptoms which further support a common denominator.Thus, we review herein the current data regarding the role of adjuvants in the pathogenesis of immune mediated diseases as well as the amassed data regarding each of these four conditions. Relating to the current knowledge we would like to suggest to include these comparable conditions under a common syndrome entitled ASIA, "Autoimmune (Auto-inflammatory) Syndrome Induced by Adjuvants".

Shvartsbeyn M, Tuchinda P, Gaitens J, Squibb KS, McDiarmid MA, Gaspari AA (2011) Patch Testing with Uranyl Acetate in Veterans Exposed to Depleted Uranium during the 1991 Gulf War and the Iraqi Conflict. Dermatitis 22:33-39.
Abstract: BACKGROUND: The Depleted Uranium Follow-Up Program is a clinical surveillance program run by the Baltimore Veterans Affairs Medical Center since 1993 for veterans of the Gulf and Iraqi wars who were exposed to depleted uranium (DU) as a result of "friendly-fire" incidents. OBJECTIVES AND METHODS: In 2009, 40 veterans from this cohort were screened for skin reactivity to metals by patch-testing with extended metal series and uranyl

acetate (0.25%, 2.5%, and 25%). A control arm comprised 46 patients without any known occupational exposures to DU who were seen at the University of Maryland Dermatology Clinic for evaluation of allergic contact dermatitis. RESULTS: Excluding irritant reactions, no patch-test reactions to uranyl acetate were observed in the participants. Irritant reactions to DU were more common in the clinic cohort, likely reflective of the demographic differences between the two arms of the study. Biologic monitoring of urine uranium concentrations in the DU program participants with 24-hour urine samples showed evidence of percutaneous uranium absorption from the skin patches. CONCLUSION: We conclude that dermatitis observed in a subset of the veterans was unrelated to their military DU exposure. Our data suggest that future studies of skin testing with uranyl acetate should utilize 0.25%, the least irritating concentration.

Smith BN, Shipherd JC, Schuster JL, Vogt DS, King LA, King DW (2011) Posttraumatic stress symptomatology as a mediator of the association between military sexual trauma and post-deployment physical health in women. J Trauma Dissociation 12:275-289.
Abstract: This study examined posttraumatic stress symptomatology (PSS) as a mediator of the association between military sexual trauma and post-deployment physical health. Relationships were examined in a sample of 83 female veterans of the first Gulf War (1990-1991) approximately 10 years post-deployment. Participants reported on the frequency of sexual harassment and sexual assault experienced during deployment. Physical health was measured using participants' self-reports of pre-deployment and post-deployment symptoms within 7 body systems. Sexual harassment exposure was not found to be associated with PSS-mediated associations with physical health symptoms. However, sexual assault during deployment was found to be associated with PSS and 4 of the 7 health symptom clusters assessed: gastrointestinal, genitourinary, musculoskeletal, and neurological symptoms. Furthermore, PSS was found to be a significant mediator of the sexual assault-physical health relationship in each of these domains, with the indirect path accounting for 74% to 100% of the relationship. The findings from the current study indicate that sexual assault has detrimental associations with physical health and that PSS plays a primary role in that relationship.

Speed HE, Blaiss CA, Kim A, Haws ME, Melvin NR, Jennings M, Eisch AJ, Powell CM (2012) Delayed reduction of hippocampal synaptic transmission and spines following exposure to repeated subclinical doses of organophosphorus pesticide in adult mice. Toxicol Sci 125:196-208. (Epub 2011 Sep 26.)
Abstract: Agricultural and household organophosphorus (OP) pesticides inhibit acetylcholinesterase (AchE), resulting in increased acetylcholine (Ach) in the central nervous system. In adults, acute and prolonged exposure to high doses of AchE inhibitors causes severe, clinically apparent symptoms, followed by lasting memory impairments and cognitive dysfunction. The neurotoxicity of repeated environmental exposure to lower, subclinical doses of OP pesticides in adults is not as well studied. However, repeated exposure to acetylcholinesterase inhibitors, such as chlorpyrifos (CPF), pyridostigmine, and sarin nerve agent, has been epidemiologically linked to delayed onset symptoms in Gulf War Illness and may be relevant to environmental exposure in farm workers among others. We treated adult mice with a subclinical dose (5 mg/kg) of CPF for 5 consecutive days and investigated hippocampal synaptic transmission and spine density early (2-7 days) and late (3 months) after CPF administration. No signs of cholinergic toxicity were observed at any time during or after treatment. At 2-7 days after the last injection, we found increased synaptic transmission in the CA3-CA1 region of the hippocampus of CPF-treated mice compared with controls. In contrast, at 3 months after CPF administration, we observed a 50% reduction in synaptic transmission likely due to a corresponding 50% decrease in CA1 pyramidal neuron synaptic spine density. This study is the first to identify a biphasic progression of synaptic abnormalities following repeated OP exposure and suggests that even in the absence of acute cholinergic toxicity, repeated exposure to CPF causes delayed persistent damage to the adult brain in vivo.

Sta M, Sylva-Steenland RM, Casula M, de Jong JM, Troost D, Aronica E, Baas F (2011) Innate and adaptive immunity in amyotrophic lateral sclerosis: Evidence of complement activation. Neurobiol Dis 42:211-220.
Abstract: Increasing evidence suggests a role for the immune system in amyotrophic lateral sclerosis (ALS). To determine the extent of the immune activation in ALS we analyzed the expression and cellular distribution of components of innate and adaptive immunity in spinal cord (SC) and motor cortex (MCx) from patients with rapid and slow sporadic ALS and controls. High levels of mRNA and protein of classical complement pathway, C1q and C4, as well as the downstream complement components C3 and C5b-9 were found in all ALS samples. Furthermore, we found higher numbers of activated microglia, reactive astrocytes, dendritic cells (DCs) and $CD8^+$ T-cells in ALS than in control tissue. Rapid ALS cases had more dendritic cells than slow ALS cases, whereas slow ALS cases had more activated microglia than rapid cases. Our findings demonstrate a persistent and prominent activation of both innate and adaptive immunity in ALS. We propose a complement-driven immune response which may contribute to the progression of the inflammation and ultimately lead to even more motor neuron injury.

Steele L, Sastre A, Gerkovich MM, Cook MR (2012) Complex Factors in the Etiology of Gulf War Illness: Wartime Exposures and Risk Factors in Veteran Subgroups. Environ Health Perspect 120:112-118. (Epub 2011 Sep 19.)

Abstract: BACKGROUND: At least one-fourth of U.S. veterans who served in the 1990-1991 Gulf War are affected by the chronic symptomatic illness known as Gulf War illness (GWI). Clear determination of the causes of GWI has been hindered by many factors, including limitations in how epidemiologic studies have assessed the impact of the complex deployment environment on veterans' health. OBJECTIVE: We sought to address GWI etiologic questions by evaluating the association of symptomatic illness with characteristics of veterans' deployment. METHODS: We compared veteran-reported wartime experiences in a population-based sample of 304 Gulf War veterans: 144 cases who met preestablished criteria for GWI and 160 controls. Veteran subgroups and confounding among deployment variables were considered in the analyses. RESULTS: Deployment experiences and the prevalence of GWI differed significantly by veterans' location in theater. Among personnel who were in Iraq or Kuwait, where all battles took place, GWI was most strongly associated with using pyridostigmine bromide pills [odds ratio (OR) = 3.5; 95% confidence interval (CI): 1.7, 7.4] and being within 1 mile of an exploding SCUD missile (OR = 3.1; 95% CI: 1.5, 6.1). For veterans who remained in support areas, GWI was significantly associated only with personal pesticide use, with increased prevalence (OR = 12.7; 95% CI: 2.6, 61.5) in the relatively small subgroup that wore pesticide-treated uniforms, nearly all of whom also used skin pesticides. Combat service was not significantly associated with GWI. CONCLUSIONS: Findings support a role for a limited number of wartime exposures in the etiology of GWI, which differed in importance with the deployment milieu in which veterans served.

Sternke LM (2011) Measurement of military combat exposure among women: analysis and implications. Womens Health Issues 21(4 Suppl):S160-168.)

Abstract: PURPOSE: To examine combat exposure measurement instruments utilized since the Vietnam War, determine how these instruments were developed and psychometrically tested, and if they are appropriate for use with women veterans exposed to combat. METHODS: A literature search for articles concerning combat exposure instruments, their development, and their psychometric properties in relation to women was conducted in several electronic databases. Limited MeSH subject headings required keyword searches with terms such as combat stress, war trauma, and deployment stressors. Instruments were selected for analysis based on their inclusion of combat and combat-related traumatic event measures. RESULTS: Eight instruments were retained for critical appraisal. The majority of instruments were developed and validated based on male veterans' combat experiences from the Vietnam War through the Gulf War. Located instruments explained their methodological development and indicated the type of exposure being measured. Reliability measures for the majority were acceptable, and validity was established to varying degrees and with different methods. Limitations of all instruments included retrospective self-reporting, potential recall error, and the inability to validate individual exposure objectively. CONCLUSION: Women veterans are substantially under-represented in the development and psychometric testing of combat exposure instruments, indicating a male gender bias in most combat measures. Only two instruments utilized women veterans in their validation samples, and six instruments used gender-neutral terminology. Instruments developed and validated with male veterans for specific military conflicts may not reflect the combat experiences of women.

Torres-Altoro MI, Mathur BN, Drerup JM, Thomas R, Lovinger DM, O'Callaghan JP, Bibb JA (2011) Organophosphates dysregulate dopamine signaling, glutamatergic neurotransmission, and induce neuronal injury markers in striatum. J Neurochem 119:303-313.

Abstract: The neurological effects of organophosphate (OP) pesticides, commonly used on foods and in households, are an important public health concern. Furthermore, subclinical exposure to combinations of organophosphates is implicated in Gulf War illness. Here, we characterized the effects of the broadly used insecticide chlorpyrifos (CPF) on dopamine and glutamatergic neurotransmission effectors in corticostriatal motor/reward circuitry. CPF potentiated protein kinase A (PKA)-dependent phosphorylation of the striatal protein dopamine- and cAMP-regulated phosphoprotein of M(r) 32 kDa (DARPP-32) and the glutamate receptor 1 (GluR1) subunit of α-amino-3-hydroxy-5-methyl-4-isoxazolepropionic acid (AMPA) receptors in mouse brain slices. It also increased GluR1 phosphorylation by PKA when administered systemically. This correlated with enhanced glutamate release from cortical projections in rat striatum. Similar effects were induced by the sarin congener, diisopropyl fluorophosphate, alone or in combination with the putative neuroprotectant, pyridostigmine bromide and the pesticide N,N-diethyl-meta-toluamide (DEET). This combination, meant to mimic the neurotoxicant exposure encountered by veterans of the 1991 Persian Gulf War, also induced hyperphosphorylation of the neurofibrillary tangle-associated protein tau. Diisopropyl fluorophosphate and pyrodostigmine bromide, alone or in combination, also increased the aberrant activity of the protein kinase, Cdk5, as

indicated by conversion of its activating cofactor p35 to p25. Thus, consistent with recent findings in humans and animals, organophosphate exposure causes dysregulation in the motor/reward circuitry and invokes mechanisms associated with neurological disorders and neurodegeneration.

Wakil A, Sathyapalan T, Atkin SL (2011) Pituitary hypophysitis and gulf war syndrome: a case series and hypothesis. Clin Endocrinol (Oxf) 75:272-274.
Summary: Although the cause of GWS remains unidentified, recent studies have hypothesized that permanent psychogenic stress coupled with high antigen loading leading to gradual depletion of HPA axis, which is manifested by the reduction of stress-induced cortisol response. The explanation for the high frequency of abnormal anterior pituitary function in our series could be offered by the above hypothesis of chronic stress, although our findings were not exclusive to the HPA axis, perhaps indicating a more diffuse effect on the anterior pituitary than originally hypothesized. Furthermore, in the five subjects who tolerated the hormonal replacement therapy, the administered health questionnaire showed a significant improvement in the scores after replacement, although this improvement was not substantial which indicates that there could be other causesfor the multitude of symptoms encountered by GWV. In conclusion, our case series shows unusually high clustering of abnormal pituitary dynamic tests in GWV with the GWS possibly related to immunogenic hypophysitis. This may help explain some of the complex and multiple symptoms experienced by those afflicted by GWS.

Weiner MW, Meyerhoff DJ, Neylan TC, Hlavin J, Ramage ER, McCoy D, Studholme C, Cardenas V, Marmar C, Truran D, Chu PW, Kornak J, Furlong CE, McCarthy C (2011) The relationship between Gulf War illness, brain N-acetylaspartate, and post-traumatic stress disorder. Mil Med 176:896-902.
Abstract: A previous study (Haley RW, Marshall WW, McDonald GG, Daugherty MA, Petty F, Fleckenstein JL: Brain abnormalities in Gulf War syndrome: evaluation with 1H MR spectroscopy. Radiology 2000; 215: 807-817) suggested that individuals with Gulf War Illness (GWI) had reduced quantities of the neuronal marker N-acetylaspartate (NAA) in the basal ganglia and pons. This study aimed to determine whether NAA is reduced in these regions and to investigate correlations with other possible causes of GWI, such as psychological response to stress in a large cohort of Gulf War veterans. Individuals underwent tests to determine their physical and psychological health and to identify veterans with (n=81) and without (n=97) GWI. When concentrations of NAA and ratios of NAA to creatine- and choline-containing metabolites were measured in the basal ganglia and pons, no significant differences were found between veterans with or without GWI, suggesting that GWI is not associated with reduced NAA in these regions. Veterans with GWI had significantly higher rates of post-traumatic stress disorder, supporting the idea that GWI symptoms are stress related.

Wille T, Thiermann H, Worek F (2011a) In vitro kinetic interactions of DEET, pyridostigmine and organophosphorus pesticides with human cholinesterases. Chem Biol Interact 190:79-83. (Epub 2011 Feb 25.)
Abstract: The simultaneous use of the repellent DEET, pyridostigmine, and organophosphorus pesticides has been assumed as a potential cause for the Gulf War Illness and combinations have been tested in different animal models. However, human in vitro data on interactions of DEET with other compounds are scarce and provoked the present in vitro study scrutinizing the interactions of DEET, pyridostigmine and pesticides with human acetylcholinesterase (hAChE) and butyrylcholinesterase (hBChE). DEET showed to be a weak and reversible inhibitor of hAChE and hBChE. The IC(50) of DEET was calculated to be 21.7mM DEET for hAChE and 3.2mM DEET for hBChE. The determination of the inhibition kinetics of pyridostigmine, malaoxon and chlorpyrifos oxon with hAChE in the presence of 5mM DEET resulted in a moderate reduction of the inhibition rate constant k(i). The decarbamoylation velocity of pyridostigmine-inhibited hAChE was not affected by DEET. In conclusion, the in vitro investigation of interactions between human cholinesterases, DEET, pyridostigmine, malaoxon and chlorpyrifos oxon showed a weak inhibition of hAChE and hBChE by DEET. The inhibitory potency of the tested cholinesterase inhibitors was not enhanced by DEET and it did not affect the regeneration velocity of pyridostigmine-inhibited AChE. Hence, this in vitro study does not give any evidence of a synergistic effect of the tested compounds on human cholinesterases.

Wille T, Thiermann H, Worek F (2011b) In vitro kinetic interactions of DEET, pyridostigmine and organophosphorus pesticides with human cholinesterases - Response to the letter to the editor. Chem Biol Interact 193:108.
Summary: No convincing mechanism for the postulated synergistic effect of pyridostigmine, DEET and other compounds in animal studies could be defined and the results of our investigation suggest that no synergism at human cholinesterases exists.

Yan M, Zhong G, Gao L, Xia X, Wang L, Hu H, Weng S (2011) Effects of uranium depletion on 1α-hydroxylase in kidney of rats. Hum Exp Toxicol 30:786-790.

Abstract: This study was designed to evaluate the effects of depleted uranium (DU) on 1α-hydroxylase in the kidney of rats and to delineate the mechanism of damage to kidneys and bones by DU. Male Sprague-Dawley rats were surgically implanted with DU fragments at three dose levels (0.1 g, 0.2 g and 0.3 g). After 3, 6 or 12 months, the concentration of 1α,25(OH)(2)D(3) in the kidney was measured by radioimmunoassay. The activity of 1α-hydroxylase was shown by the production of 1α,25(OH)(2)D(3) after incubation. The results showed that the 1α-hydroxylase activity in the kidney was decreased after 3 months (27.2% at the medium dose DU group, $p < 0.05$; 33.4% at the high dose DU group, $p < 0.01$). In contrast, at 6 months and 12 months after implantation of DU, the activity of renal 1α-hydroxylase in DU-treated animals was not decreased significantly in comparison with the controls ($p > 0.05$). On the other hand, the activity of renal 1α-hydroxylase was decreased by 33.1% ($p < 0.05$) and 34.4% ($p < 0.01$) in blank control groups at 6 and 12 months, respectively, when compared with the blank control group at 3 months. In conclusion, this study showed that chronic DU exposure could induce renal damages and inhibit the synthesis of biologically active form of vitamin D, which may be the underlying mechanism of bone metabolic disorder caused by renal injury after DU exposure.

Zhang XF, Ding CL, Liu H, Liu LH, Zhao CQ (2011) Protective effects of ion-imprinted chitooligosaccharides as uranium-specific chelating agents against the cytotoxicity of depleted uranium in human kidney cells. Toxicology 286:75-84. (Epub 2011 May 27.)

Abstract: Occupational internal contamination with depleted uranium (DU) compounds can induce radiological and chemical toxicity, and an effective and specific uranium-chelating agent for clinical use is urgently needed. The purpose of this study was to investigate whether a series of synthesized water-soluble metal-ion-imprinted chitooligosaccharides can be used as uranium-specific chelating agents, because the chitooligosaccharides have excellent heavy metal ion chelation property and the ion-imprinting technology can improve the selective recognition of template ions. DU-poisoned human renal proximal tubule epithelium cells (human kidney 2 cells, HK-2) were used to assess the detoxification of these chitooligosaccharides. The DU-chelating capacity and selectivity of the chitooligosaccharides were determined by inductively coupled plasma-mass spectrometry (ICP-MS). Cell viability, cellular accumulation of DU, membrane damage, DNA damage, and morphological changes in the cellular ultrastructure were examined to assess the detoxification of these chitooligosaccharides. The results showed that the Cu^{2+}-imprinted chitooligosaccharides, especially the Cu^{2+}-imprinted glutaraldehyde-crosslinked carboxymethyl chitooligosaccharide (Cu-Glu-CMC), chelated DU effectively and specifically, and significantly reduced the loss of cell viability induced by DU and reduced cellular accumulation of DU in a dose-dependent manner, owing to their chelation of DU outside cells and their prevention of DU internalization. The ultrastructure observation clearly showed that Cu-Glu-CMC-chelated-DU precipitates, mostly outside cells, were grouped in significantly larger clusters, and they barely entered the cells by endocytosis or in any other way. Treatment with Cu-Glu-CMC also increased the activity of antioxidant enzymes, and reduced membrane damage and DNA damage induced by DU oxidant injury. Cu-Glu-CMC was more effective than the positive control drug, diethylenetriaminepentaacetic acid (DTPA), in protection of HK-2 cells against DU cytotoxicity, as a result of its chelation of UO_2^{2+} to prevent the DU internalization and its antioxidant activity.

IV. RESEARCH FUNDING TRENDS

This section provides a quantitative overview of the current research portfolio on GWVI and the evolution of the portfolio since 1999. Topics that are covered include research expenditures by VA, DoD, and HHS from FY 2002-2011, and the number of research projects in which the Federal Government has invested.

The appropriated funds for FY 2002 through 2011, centrally obligated to each project, are shown in Appendix C and summarized in Table IV-1. Federal funding for GW research totaled approximately $230 million during this period. Funds obligated for these projects prior to FY 2002 are not shown in either Table IV-1 or Appendix C. Since many projects are multi-year efforts for which funds are obligated at the beginning of the project period, projects that received all of their funds prior to FY 2002 are listed with no associated obligation ($0) in Appendix C. Federal funds for these earlier projects were reported in prior *Annual Reports to Congress*.

Table IV-1. 10-Year (FY 2002-2011) Funding Trends for GW Research in Millions of Dollars

Department	FY '02	FY '03	FY '04	FY '05	FY '06	FY '07	FY '08	FY '09	FY '10	FY '11	Total Costs FY '02-'11
DoD	$ 18.8	$ 16.4	$ 11.1	$ 10.1	$ 10.1	$ 3.4	$ 11.7	$ 10.4	$ 10.4	$ 3.3	**$ 105.7**
HHS	$ 0.8	$ 1.0	$ 0.5	$ 0.5	$ 0.4	$ 0.4	$ 0.4	$ 0	$ 0	$ 0	**$ 4.0**
VA	$ 4.5	$ 5.7	$ 7.6	$ 9.5	$13.0	$22.1	$ 21.9	$ 16.6	$ 13.9	$ 5.6	**$ 120.4**
Total	**$ 24.1**	**$ 23.1**	**$19.2**	**$ 20.1**	**$ 23.5**	**$ 25.9**	**$ 34.0**	**$ 27.0**	**$ 24.3**	**$ 8.9**	**$ 230.1**

The funding level for FY 2010 in the table above differs from the value reported in the *2010 Annual Report to Congress* due to the delayed start of thirteen projects funded through the FY 2010 appropriation for the Gulf War Illness Research (GWIRP) managed by the Congressionally Directed Medical Research Programs (CDMRP) at DoD. The DoD funding for FY2011 is $3.3M for the same reason and will be updated in the 2012 *Annual Report to Congress* after the projects have begun.

VA, DoD, and HHS sponsored a total of 400 distinct research projects on GWVI during the period of FY 1992 through FY 2011. Appendix A lists all of the research and development projects and programs supported now or in the past by each of the three Federal agencies (DoD, HHS, and VA). Nine projects have been dual-funded by VA and DoD, and each agency has given the project its own unique project number (DoD-115/VA-062; DoD-116/VA-063; DoD-116A/VA-063A; DoD-116B/VA-063B; D0D-118/VA-061; DoD-119/VA-055; DoD-125/VA-074; DoD-143/VA-078; and DoD-154/VA-088). In prior *Annual Reports to Congress*, the total number of funded projects was corrected for the number of dual funded projects. Starting with the 2005 *Annual Report to Congress*, this practice has been discontinued since VA and DoD may start or end funding of their portion of these projects independent of each other. Each dual-funded project is, therefore, treated as two distinct projects.

The numbers of new, ongoing and completed projects for FY 2002 - FY 2011 are shown in Figure IV-1. As of September 30, 2011, 339 projects (85 percent of the 400 projects) were completed, and 61 projects (15 percent) were new or ongoing; the numbers of new, ongoing, and completed projects for each fiscal year are shown in Figure IV-1.

The annual distribution of new and ongoing projects within the five major Research Focus Areas is shown in Figure IV-2. From FY 2002 through 2011 new and ongoing research assigned to the Brain and Nervous System Function, Environmental Toxicology and General Health and Symptoms categories has represented 96.3 ± 1.0 percent of all new and ongoing projects.

Figure IV-1. Cumulative Number of Funded Projects (FY 2002 – FY 2011)

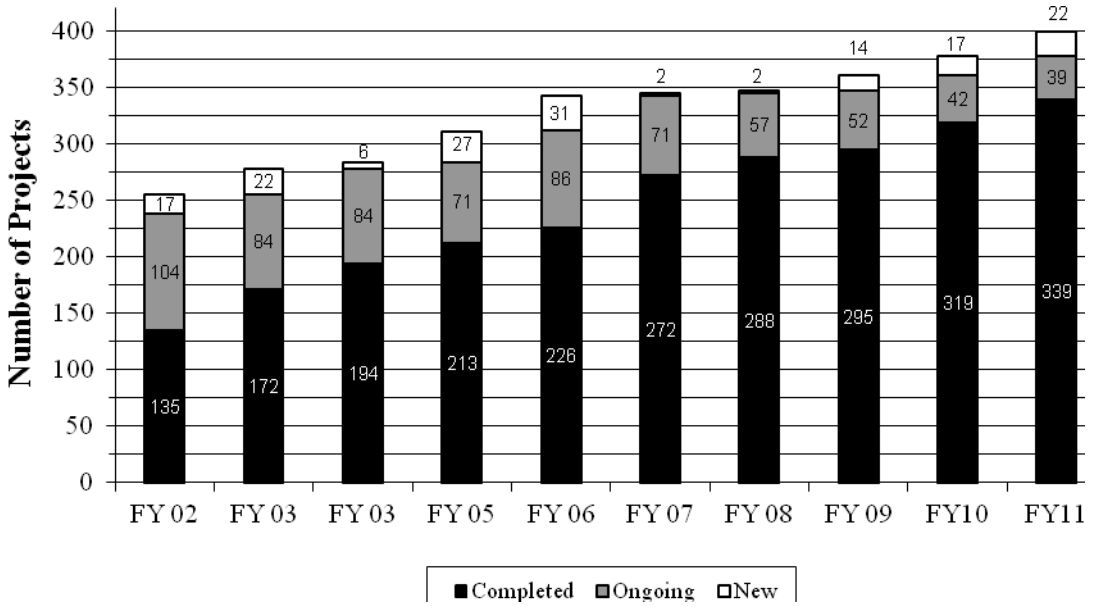
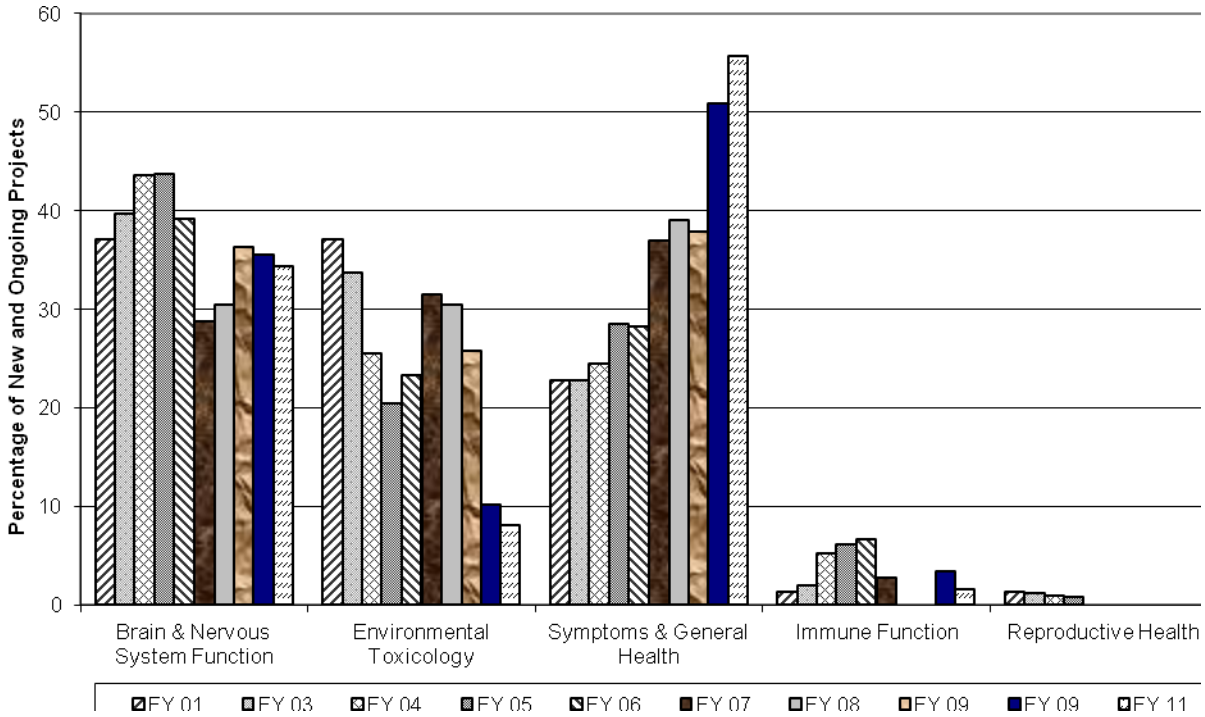


Figure IV-2. Annual Distribution of Topic Areas for New and Ongoing Projects



V. NEW RESEARCH PROJECTS AND INITIATIVES

A. New Initiatives

Requests for Applications (RFAs) were issued by both CDMRP and VA in FY 2011. Proposals received for review in response to these RFAs will be reviewed, and projects selected for funding will begin in FY 2012.

VA began the process of creating a Gulf War Research Strategic Plan to map the direction of research for the next five years, with the focus on converting promising research results into clinical treatments and determining genetic links to Veterans' symptoms. Considerable effort is also focused on increasing the number of investigators involved in Gulf War research. In the short term, a meeting of active VA Gulf War researchers will encourage collaborations and mentoring of young investigators, and special RFAs will supplement existing RFAs to target specific new research areas. Longer term plans include posting videos on VA websites which contain research presentations for interested investigators to review. With more researchers and more projects, more progress can be made in developing treatments and diagnostic capabilities. VA and DoD will work more closely to foster Gulf War research, and Gulf War researchers will meet regularly to build collaborative relationships.

VA has also initiated programs to facilitate researchers' access to Veterans who are willing to participate in research studies. The Gulf War Era Cohort and Biorepository began collecting medical information and a blood sample from Veteran volunteers who can subsequently be contacted by researchers and invited into a research study. Similarly, the Million Veteran Program creates access to Veterans from all conflicts and all time periods (including the Gulf War era). Providing researchers access to these Veteran databases allows them to select a study group which enables them to target specific symptoms or conditions as they investigate diagnostic markers or develop treatments.

B. Portfolio Review

VA and DoD each review their portfolios of Gulf War research on a regular basis in order to determine research gaps and to expand successful research topic areas. The Federal Gulf War research portfolio is increasingly focused on identifying potential new treatments (clinical trials, including complementary medicine approaches) for ill GW Veterans and identifying new diagnostic markers of disease and potential therapeutic targets to develop new therapies. VA and DoD continue to share information regarding funded Gulf War research projects and coordinate activities, whenever possible, to maximize combined program impact. To facilitate this process, the Gulf War research programs will also be integrated into the on-going department-wide VA-DoD Joint Program Reviews.

C. New Projects

This section highlights the new research projects that have been approved since last year's *2010 Annual Report to Congress*. Projects preceded by an asterisk (*) were either funded using funds appropriated in prior years or approved for funding in prior fiscal years, but not identified in previous *Annual Reports to Congress*. They are described below and incorporated into the tables in Appendices A, B and C.

Among these projects are exciting new approaches to treating and diagnosing Gulf War Veterans. Several studies address the management of chronic pain. Alternative methods, such as mindfulness training, are being used to deal with chronic pain as are the more traditional pharmaceutical treatments although innovations in rapid delivery procedures may be able to target the pain more effectively. Exercise training for chronic pain is being coupled to magnetic resonance imaging to determine how the brain responds to the treatments. With regard to the health effects of environmental exposures, genomic and epigenetic studies are underway to investigate the genetic factors that make some Veterans more susceptible to the various materials that they were exposed to in the Persian Gulf, and some research is still aimed at the exposures themselves. Sleep apnea is a common problem which is being addressed in studies including investigations of the neurobiology of the condition, better breathing apparatuses for minimizing the effects of sleep apnea, and complementary and alternative medicine (CAM) methods of reducing sleep disturbances.

Department of Defense (DoD)

Thirteen projects were funded through the FY 2010 appropriation for the Gulf War Illness Research Program (GWIRP) managed by the CDMRP, but did not start until FY 2011. These projects focused on Brain and Nervous System Function (3), Environmental Toxicology (1), and Symptoms and General Health (9).

*DoD-200, "XMRV and GWI: Is There an Association?" has shifted from a focus on XMRV to look for the presence of any infectious pathogen by performing a transcriptome and genome analysis on archived peripheral blood mononuclear cell samples from ill Gulf War Veterans.

*DoD-201, "Synergistic Actions of Pyridostigmine Bromide and Insecticides on Muscle and Vascular Nociceptors" will examine whether the pyridostigmine bromide (which was taken for protection against nerve agents) and insecticides that Gulf War Veterans were exposed to act in a synergistic way to cause musculoskeletal pain. The study will further test the capacity of pharmaceutical agents to reverse neurotoxicant-dependent pain.

*DoD-202, "Brain-Immune Interactions as Basis of Gulf War Illness: Consortium Development" will plan to create a consortium of researchers investigating the pathobiological mechanisms of chronic multisymptom illness in Gulf War Veterans and identify biomarkers that can be translated into future clinical treatment trials. Studies will also target suspected brain-immune signaling alterations in chronic multisymptom illness in Gulf War Veterans.

*DoD-203, "Redefining Gulf War Illness Using Longitudinal Health Data: The Devens Cohort" will examine the current health status of Gulf War Veterans from Ft Devens, who were also surveyed shortly after the war, to capture the remitting, relapsing, and consistent nature of the conditions which are specific to Gulf War Veterans and to better understand the causes driving these symptoms (i.e., genetic predisposition, environmental exposures, prior treatment efficacy).

*DoD-204, "Nasal Irrigation for Chronic Rhinosinusitis and Fatigue in Patients with Gulf War Syndrome" will investigate whether nasal irrigation with saline solutions and therapeutic drugs can reduce the occurrence of chronic sinusitis and thereby reduce the level of fatigue in Gulf War Veterans affected with this problem.

*DoD-205, "The HPA Axis and Metabolic Outcomes in Gulf War Veterans" is designed to further characterize the nature and extent of hypothalamic-pituitary-adrenal (HPA) axis alterations associated with chronic multisymptom illness in GW veterans and the relationship of these HPA axis alterations to adverse metabolic outcomes.

*DoD-206, "Investigating Clinical Benefits of a Novel Sleep-Focused, Mind-Body Program on Gulf War Illness Symptoms: An Exploratory Randomized Controlled Trial" will examine the extent to which two sleep-targeted interventions, Mind Body Bridging (MBB) and Supportive Education (SED) can be used to improve the general health, physical function, and functional impairment in ill Gulf War Veterans.

*DoD-207, "Gulf War Illness Research Development Consortium (GWIC)" will develop and plan a multi-disciplinary and multi-institutional consortium focused on discovering the key mediators and pathophysiology underlying chronic multisymptom illness in Gulf War Veterans and further translating those discoveries into innovative treatments.

*DoD-208, "Genome-Wide Association Study of a Validated Case Definition of Gulf War Illness in a Population-Representative Sample" will perform a whole genome gene-expression study of a validated case definition of chronic multisymptom illness in Gulf War Veterans in a population-representative sample of Gulf War veterans to identify new targets for rational development of new diagnostic and treatment approaches.

*DoD-209, "Proteomic Immune Profiling for the Therapeutic Modulation of Cognitive Impairment in a Novel GWI Mouse Model" will measure concentrations of specific proteins related to cognitive function in mice to determine if any of them can serve as a biomarker for diagnosing or treating chronic multisymptom illness in Gulf War Veterans.

*DoD-210, "Assessment of Diverse Biological Indicators in Gulf War Illness: Are They Replicable? Are They Related?" will utilize a case-control design to evaluate diverse biological measures in a single, well-characterized sample of 120 Gulf War era veterans. Analyses will determine which measures significantly distinguish ill Gulf War

Veterans from controls and will explore the extent to which biological findings are interrelated or are associated with identifiable veteran subgroups.

*DoD-211, "Detection of Xenotropic Murine Leukemia Virus-Related Virus (XMRV) in Gulf War Illness: Role in Pathogenesis or Biomarker?" has expanded the original focus from XMRV-only and will conduct lymphocyte transcriptome analysis of Gulf War Veterans diagnosed with chronic multisymptom illness and compare the results to the same analysis of healthy control subjects. These analyses will provide a better understanding of the innate immune system and potential associated opportunistic pathogens affecting Gulf War Veterans.

*DoD-212, "Integrative Physiology of Gulf War Illness: Role of Autonomic Function, Central Neural Processing, and Sleep" will develop and plan a research consortium to study specific physiological changes in brain-based pain-regulatory or sleep-regulatory problems, autonomic nervous system (ANS) impairment, and immune dysfunction and to develop treatments for Gulf War Veterans based on those changes.

Department of Veterans Affairs (VA)

VA initiated funding for nine new projects during FY 2011. These nine projects focused on Brain and Nervous System Function (4), Environmental Toxicology (1), and Symptoms and General Health (4).

VA-165, "A Pilot Study of CPAP Adherence Promotion by Peer Buddies with Sleep Apnea" is designed to assess the feasibility and acceptability of having members of a peer group assist one another in using their continuous positive airway pressure (CPAP) devices to alleviate the problems associated with sleep apnea.

VA-166, "A Randomized Controlled Trial of a Mindfulness-Based Intervention for Gulf War Syndrome" will use an 8-week group-based class called Mindfulness-Based Stress Reduction (MBSR) to determine if the treatment can affect general health, physical function, fatigue and functional impairment related to pain in ill Gulf War Veterans.

VA-167, "Neuroprotection and Myelin Repair Mechanisms in Multiple Sclerosis" will use a mouse model to evaluate the role of AMP-activated protein kinase (AMPK) in protecting neurons from inflammatory damage and in promoting myelin repair. Understanding this process should lead to improved treatment and management of neurodegenerative diseases like MS.

VA-168, "Sleep Neurobiology and Circuitry" will use a gene transfer method to repair the network of neurons that controls waking, REM sleep, and non-REM sleep in mouse models. It is hypothesized that targeted deletions in the hypocretin gene will help to correct sleep disorders.

VA-169, "Prevention of Hippocampal Neurodegeneration Due to Age and Apnea" will examine pharmaceutical approaches to minimizing adverse changes in the hippocampus as Veterans age and deal with sleep apnea. Changes in the hippocampus have been implicated in cognitive illnesses in Gulf War Veterans.

VA-170, "Epigenetic Mechanisms Relevant to the Pathogenesis of ALS" will use a mouse model to determine whether LSD1 (an enzyme which regulates protein methylation) induces the degeneration of neurons similar to that observed in ALS. The effects of LDS1 inhibitors on the process will also be studied. Epigenetic control of enzyme activity is a possible method for modifying the progression of ALS.

VA-171, "Nanoparticle Coupled Antioxidants for Respiratory Illness in Veterans" will involve *in vitro* and *in vivo* (animal) studies to determine whether antioxidants can be attached to nanoparticles applied to the lining of the upper respiratory tract to deactivate reactive chemicals in smoke and on diesel exhaust particles, as encountered in SWA.

VA-172, "Understanding Pain of Gastrointestinal Origin in Women that Serve in OEF/OIF" will study the mechanisms responsible for the gender-related differences in intestinal sensitivity that lead to chronic abdominal pain in female Veterans. Results for OEF/OIF will be compared to those for Gulf War Veterans.

VA-173, "Impact of Exercise Training on Pain and Brain Function in Gulf War Veterans" will examine whether resistance exercise training (RET) is a useful treatment of Gulf War Veterans suffering from chronic musculoskeletal pain and if neuroimaging techniques can determine how the brains of Veterans respond to musculoskeletal pain.

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Appendices

Federally Funded Research Projects

Appendix A

Project Index By Department

DEPARTMENT OF DEFENSE PROJECTS

DoD-001	Naval Health Study Program
DoD-001A	Epidemiologic Studies of Morbidity Among Gulf War Veterans: A Search for Etiologic Agents and Risk Factors; A Study of Symptoms Among 1500 Seabees
DoD-001B	Epidemiologic Studies of Morbidity Among Gulf War Veterans: A Search for Etiologic Agents and Risk Factors; Study 2: A Comparative Study of Hospitalizations among Active-Duty Personnel Who Participated in the Gulf War and Similar Personnel Who Did Not
DoD-001C	Epidemiologic Studies of Morbidity Among Gulf War Veterans: A Search for Etiologic Agents and Risk Factors; Study 3: A comparative study of pregnancy outcomes among Gulf War Veterans and other active-duty personnel
DoD-001D	Epidemiologic Studies of Morbidity Among Gulf War Veterans: A Search for Etiologic Agents and Risk Factors; Study 4: Infertility and Miscarriage in Gulf War Veterans
DoD-001E	Epidemiologic Studies of Morbidity Among Gulf War Veterans: A Search for Etiologic Agents and Risk Factors; Study 5: Seabee Health Study
DoD-001F	Epidemiologic Studies of Morbidity Among Gulf War Veterans: A Search for Etiologic Agents and Risk Factors; Study 6: A Comparison of Nonfederal Hospitalization Experience Among Veterans in California who have separated from active service: GWV vs. NDV
DoD-001G	Epidemiologic Studies of Morbidity Among Gulf War Veterans: A Search for Etiologic Agents and Risk Factors; Study 7: Prevalence of Congenital Anomalies Among Children of Persian Gulf War Veterans
DoD-002	Physiological and Neurobehavioral Effects in Rodents from Exposure to Pyridostigmine, Fuels, and DEET
DoD-004	The General Well-Being of Gulf War Era Service Personnel from the States of Pennsylvania and Hawaii: A Survey
DoD-007A	Health Risk Assessment of Embedded Depleted Uranium: Behavior, Physiology, Histology, and Biokinetic Modeling
DoD-007B	Carcinogenicity of Depleted Uranium Fragments
DoD-008A	Serologic Diagnosis of Viscerotropic Leishmaniasis (VTL)
DoD-008B	Development of a Leishmania Skin Test Antigen (LSTA)
DoD-009	Identification of the Genetic Factors Which Control Tropism in Leishmania
DoD-010	Pyridostigmine Synergistic Toxicity Study
DoD-011	Male/Female Differential Tolerances to Pyridostigmine Bromide
DoD-013	Effects of Persian Gulf War Service on Military Working Dogs
DoD-014	Risk Factors Among US Army Soldiers for Enrolling on the Department of Veterans Affairs Gulf War Registry
DoD-015	Comparative Mortality Among US Military Personnel Worldwide During Operations Desert Shield and Desert Storm

DoD-016	Kuwait Oil Fire Health Risk Assessment
DoD-017	Retrospective Studies Involving Military Use of Pyridostigmine as a Pretreatment for Nerve Agent Poisoning
DoD-018	Kuwait Oil Fires Troop Exposure Assessment Model (TEAM)
DoD-019	Persian Gulf Veterans Health Tracking System
DoD-021	Study of Variability in Pyridostigmine Inhibition of Blood Cholinesterases in Healthy Adults and Individuals with Symptoms Following Participation in Operation Desert Storm
DoD-022	Chronic Organophosphorus Exposure and Cognition
DoD-023	Acute and Long-Term Impact of Deployment to Southwest Asia on the Physical and Mental Health of Soldiers and their Families
DoD-030	Epidemiological Studies Persian Gulf War Illnesses, PG Women's Health Linkage Study
DoD-031	Dysregulation of the Stress Response in the Persian Gulf Syndrome
DoD-032	Neuropsychological Functioning in Persian Gulf Era Veterans
DoD-033	Effects of Pyridostigmine in Flinders Line Rats Differing in Cholinergic Sensitivity
DoD-034	Characterization of Emissions from Heaters Burning Leaded Diesel Fuel in Unvented Tents
DoD-035	Feasibility of Investigating Whether There is a Relationship Between Birth Defects and Service in the Gulf War
DoD-036	Fatigue in Persian Gulf Syndrome-Physiologic Mechanisms
DoD-037	Neurobehavioral and Immunological Toxicity of Pyridostigmine, Permethrin, and DEET in Male and Female Rats
DoD-038	Diagnostic Antigens of Leishmania tropica
DoD-039	A Controlled Epidemiological and Clinical Study into the Effect of Gulf War Service on Servicemen and Women of the United Kingdom Armed Forces
DoD-040	Psychological and Neurobiological Consequences of the Gulf War Experience
DoD-041	Evaluation of Muscle Function in Persian Gulf Veterans
DoD-042	The Symptomatic Persian Gulf Veterans Protocol: An Analysis of Risk Factors with an Immunologic and Neuropsychiatric Assessment
DoD-044	Investigation of Seminal Plasma Hypersensitivity Reactions
DoD-045	Air Force Women's Health Surveillance Study
DoD-046	Exploratory Data Analysis with the CCEP Database
DoD-047	Study of Mycoplasmal Infections in Gulf War Veterans

DoD-048	Assessment of Genomic Instability via Chromosome 7 Inversion Frequency in a Gulf-War Syndrome Cohort vs. Selected Control Groups
DoD-049	Diagnosis and Dosimetry of Exposure to Sulfur Mustard: Development of Standard Operating Procedures and Exploratory Research on Protein Adducts
DoD-050	Toxicokinetics of 0-Ethyl S-(2-Diisopropylaminoethyl) Methylphosphonothioate [(+)-VX] in Rats, Hairless Guinea Pigs and Marmosets - Identification of Metabolic Pathways
DoD-051	Transgenic Engineering of Cholinesterases: Tools for Exploring Cholinergic Responses
DoD-052	Female Gender and Other Potential Predictors of Functional Health Status Among Persian Gulf War Veterans
DoD-053	Long-Term Effects of Subclinical Exposures to Sarin
DoD-054	Assessment of Subchronic Neurobehavioral and Neuropathologic Effects in Rats Following Low-Level Sarin Exposure
DoD-055	Low-Level Exposure to GB Vapor in Air: Diagnosis/Dosimetry, Lowest Observable Effect Levels, Performance-Incapacitation, and Possible Delayed Effects
DoD-056	Low-Level Sarin Neurotoxicity and Its Modulation by Pyridostigmine
DoD-057	Physiologic Effects of Stress in Gulf War Veterans
DoD-058	Illness Among Persian Gulf War Veterans: Case Validation Studies
DoD-059	Pyridostigmine-induced Neurodegeneration: Role of neuronal Apoptosis
DoD-060	Butyrylcholinesterase Genetic Variants in Persons with Gulf War Illness
DoD-061	Neurophysiologic and Neuropathologic Effects in Monkeys of Low Level Exposures to Sarin, Pyridostigmine, Pesticides, and Botulinum Toxoid
DoD-062	Sarin and Pyridostigmine Interaction under Physical Stress: Neurotoxic Effects in Mice
DoD-063	PGW Veterans: Epidemiological and Clinical Evidence for Residual Organophosphate Neurotoxicity
DoD-064	Individual Differences in Neurobehavioral Effects of Pyridostigmine
DoD-065	Multi-disciplinary Pathophysiologic Studies of Neurotoxic Gulf War Related Syndromes Leading to Diagnosis and Treatment
DoD-066	Testing for mycoplasmal infection replicability of nucleoprotein gene tracking and forensic polymerase chain reaction
DoD-067	Antibacterial Treatment Method Based Upon the Excretion of Dead and Decaying Spherical Bacteria
DoD-069	Five-Year Follow-Up of Army Personnel Exposed to Chemical Warfare Agents
DoD-070	War Syndromes from 1900 to the Present: Symptom Patterns and Long-term Health Outcomes

DoD-071	A Comparison of Post Deployment Hospitalization Between Vietnam and Gulf War Veterans
DoD-072	Long-term Effects of Subchronic Exposure to Sarin, Alone and with Stress or Other Chemicals
DoD-073	Post-deployment Morbid Stress, Behavior and Health: Developing a Model for Predicting Morbidity, Mortality, and other Adverse Outcomes
DoD-074	Relationship of Stress Exposures to Health in Gulf War Veterans
DoD-075	Toxic Interactions of Prophylactic Drugs and Pesticides
DoD-076	Evaluations of Immunotoxicity due to Concurrent Exposure to DEET, Pyridostigmine, and JP-8 Jet Fuel
DoD-077	Percutaneous Absorption of Chemical Mixtures Relevant to the Gulf War
DoD-078	Experimental Models of Gulf War Syndrome
DoD-079	Time Course of Stress-induced Impairment of Blood Brain Barrier
DoD-080	Molecular Regulation of Corticosteroid Receptor Expression in Stress-Responsive Cells
DoD-081	Immunotoxicity due to Coexposure to DEET, Pyridostigmine, and Stress
DoD-082	Feasibility of Developing a Registry of PTSD Affected Veteran Sib Pairs
DoD-083	Risk for Stress-related Substance Abuse: the Effects of Family History of Alcoholism
DoD-084	Psychobiologic Alterations in Persian Gulf War Veterans with and without PTSD
DoD-085	CNS Cytokines and CRH in Gulf War Veterans with Multiple Unexplained Symptoms
DoD-086	Effects of Combat Stress on Structure and Function of the Hippocampus
DoD-087	Measurement and Validation of Psychosocial Risk and Resilience Factors Accounting for Physical and Mental Health and Health-Related Quality of Life among PGWVs
DoD-088	Clinical Relevance of Novel Immunological Markers in PTSD
DoD-089	Limbic Blood Flow and Opiate Receptor PET in Posttraumatic Stress Disorder
DoD-090	SPECT Benzodiazepine Receptor and MR Imaging in PTSD
DoD-091	Neurological and Circadian Substrates of PTSD-like Behaviors
DoD-092	Traumatic Experiences Persistently Enhance Cue-dependent Learning: Toward an Animal Model of Chronic Stress and Posttraumatic Stress Disorder
DoD-093	Troops Exposed to Nerve Agents at Aberdeen Proving Ground: Follow-Up
DoD-094	Combined Analysis of the VA and DoD Gulf War Clinical Registries: A Study of Clinical Findings from Systematic Medical Examinations of 100,000 U.S. Gulf War Veterans
DoD-095	Development of Diagnostic tools and alternative treatment drugs for Leishmania
DoD-096	Deployment Health Center

DoD-097	Surveillance of B. pertussis among Military Trainees with Respiratory Disease: Development and Validation of a Highly Sensitive PCR and Beacon Probe based Method for Diagnosis of Pertussis
DoD-098	Investigation of a Baseline Medical Database to Evaluate the Health of Military Forces and Veterans
DoD-099	DoD-wide Medical Surveillance for Potential Long-Term Adverse Events associated with Anthrax Immunization in Active Duty Service Members, Proposal 1: Hospitalizations
DoD-100	Antibodies to Squalene
DoD-101	Mechanisms in Chronic Multisymptom Illnesses
DoD-102	Case-Control Study of Fatal Motor Vehicle Crashes Among Gulf War and Non-Deployed Veterans
DoD-103	Human Metabolism and Interactions of Deployment-related Chemicals
DoD-104	Clinical Evaluation of a Proposed New Gulf War Syndrome
DoD-105	Neuroplasticity and Calcium Signaling in Stressed Rat Amygdala
DoD-106	The Role of Th1/Th2 cytokine balance in Gulf War-related illness
DoD-107	Stress, Organophosphates and Blood Brain Barrier Integrity
DoD-108	Health Status of Current National Guard Members
DoD-109	Disordered Responses to Orthostatic Stress in the Pathogenesis of Gulf War Syndrome Symptoms
DoD-110	Predictors of Career and Family Dysfunction in Young Adults Enlisting in the United States Navy
DoD-111	Autonomic Dysfunction in Gulf War Veterans
DoD-112	Role of Respirable Saudi Arabian Sand and Pyridostigmine in the Gulf War Syndrome: An Autoimmune Adjuvant Disease?
DoD-113	Interactions of Subsymptomatic Doses of Sarin with Pyridostigmine: Neurochemical, Behavioral, and Physiological Effects
DoD-114	A Re-examination of Neuropsychological Functioning in Persian Gulf War Veterans
DoD-115	A Randomized, Multi-Center, Controlled Trial of Multi-Model Therapy in Veterans with Gulf War Illnesses (EBT) (See also VA-62; formerly VA/DoD 1D)
DoD-116	VA/DoD Core Funding of the Medical Follow-Up Agency (See also VA-63; formerly VA-DoD-2D/2V)
DoD-116A	Follow-Up Investigation of Troops Exposed to Nerve Agents at Aberdeen Proving Ground (Pilot Study) (See also VA-63A; formerly VA/DoD-2DA)
DoD-116B	Patterns of Pre-Persian Gulf War Illness and Health Care Seeking, Pilot Study (See also VA-63B; formerly VA/DoD- 2DB)
DoD-117	Patterns of Pre-Persian Gulf War Illness and Health Care Seeking
DoD-118	An Epidemiological Investigation into the Occurrence of Amyotrophic Lateral Sclerosis (ALS) Among Gulf War Veterans (See also VA-61)

DoD-119	Antibiotic Treatment of Gulf War Veterans' Illnesses (ABT) (See also VA-55)
DoD-120	Assessing the Potential Health Impact of the Gulf War on Saudi Arabia National Guard Members and Their Dependents
DoD-121	Evaluation of the Health Risks of Embedded Depleted Uranium Shrapnel During Pregnancy and Offspring Development
DoD-122	Carcinogenic Potential of Depleted Uranium and Tungsten Alloys
DoD-123	Immunotoxicity of Depleted Uranium and Heavy Metal Tungsten Alloys
DoD-124	Randomized, Controlled Trial for Combination Treatment with Pyridostigmine, DEET, and Permethrin
DoD-125	A Randomized Clinical Trial of Cognitive-Behavioral Treatment for PTSD in Women (See VA-74)
DoD-126	Blood-Brain Barrier Transport of Uranium
DoD-127	Depleted Uranium Fragment Carcinogenicity: Extrapolation of Findings in Rodents to Man
DoD-128	Multifactorial Assessment of Depleted Uranium Neurotoxicity
DoD-129	Inhalation of Uranium Oxide Aerosol: CNS Deposition, Neurotoxicity, and Role in Gulf War Illness
DoD-130	Carcinogenicity and Immunotoxicity of Embedded Depleted Uranium and Heavy-Metal Tungsten Alloys in Rodents
DoD-131	Magnetic Resonance and Spectroscopy of the Human Brain in Gulf War Illnesses
DoD-132	Impaired Auditory Sensory Gating, Acoustic Startle Response: Effects of Long and Short Deployments on Army Combat Readiness
DoD-133	Odors, Deployment Stress, and Health: A Conditioning Analysis of Gulf War Syndrome
DoD-134	Identification and Development of Biological Markers of Human Exposure to the Insecticide Permethrin
DoD-135	Biochemical Markers for Exposure to Low Doses of Organophosphorus Exposure
DoD-136	A Mechanism-Based, Molecular Fingerprint Strategy for Detecting Biomarkers of Organophosphate Exposure
DoD-137	Low Level Exposure to Sulfur Mustard: Development of a SOP for Analysis of Albumin Adducts and of a System for Non-Invasive Diagnosis on Skin
DoD-138	Improving Blood Monitoring of Enzymes as Biomarkers of Risk from Anticholinergic Pesticides and Chemical Warfare Agents
DoD-139	Assessment of the Role of Stress-Activated Kinase in the Pathogenesis of Gulf War Illnesses
DoD-140	US Department of Defense Surveillance for Neoplasms in Infancy
DoD-141	Physical, Mental, Social, and Family Health Outcomes of Gulf War Veterans
DoD-142	Illnesses Among Persian Gulf War Veterans: Case Validation Studies (Iowa / Great Britain)

DoD-143	Millennium Cohort Study (See also VA-78)
DoD-144	Psychological Health Screening: Methods and Metrics for Deployed Forces
DoD-145	Early Intervention Research Program to Enhance Soldier Resilience
DoD-146	Assessment of Toxicology Assays Methods & Chemical Exposures Among a Cohort of US Marines
DoD-147	Development and Validation of the Automated Neuropsychological Assessment Metric (ANAM) for Deployment Health Monitoring Applications
DoD-148	Predicting operational readiness for deployed Army National Guard and Army Reserve soldiers and families
DoD-149	Longitudinal Health Study of Gulf War Veterans
DoD-150	Validation Study of Gulf War Deployment Files
DoD-151	Mechanisms and Consequences of Vaccine Effects on Th1/Th2 Balance in Gulf War Veterans
DoD-152	Characterization of Intracellular Signaling Pathways Activated by Nerve Agents
DoD-153	Gulf War Illness Research
DoD-154	Prospective Assessment of Neurocognition in Future Gulf-deployed and Gulf-nondeployed Military Personnel: A Pilot Study (See also VA-88)
DoD-155	Neuropsychological Functioning in Gulf War Veterans Exposed to Pesticides and Pyridostigmine Bromide
DoD-156	The Effects of Diesel Exhaust and Stress on the Acute Phase Response and Symptoms in the Chemically Intolerant
DoD-157	Novel Leishmania and Malaria Potassium Channels: Candidate Therapeutic Targets
DoD-158	Preconceptional Paternal Exposure to Embedded Depleted Uranium Fragments: Transmission of Genetic Damage to Offspring
DoD-159	Neurotoxicity from Chronic Exposure to Depleted Uranium
DoD-160	Characterization of the Reproductive Toxicity of Depleted Uranium
DoD-161	Glutamate Receptor Aptamers and ALS
DoD-162	Evaluation of the Effects of Multiple Immunizations Administered in a Stressful Environment on Immunologic Function
DoD-163	Neuroimmune Effects of Inhaling Low Dose Sarin
DoD-164	Efficacy of Adjunct Sleep Interventions for PTSD (EASI-PTSD)
DoD-165	Biomarkers for Amyotrophic Lateral Sclerosis in Active Duty Military – BALSAM
DoD-166	A Placebo-Controlled Trial of Prazosin vs. Paroxetine in Combat Stress-Induced PTSD Nightmares and Sleep Disturbance

DoD-167	Mass Spectrometry to Identify New Biomarkers of Nerve Agent Exposure
DoD-168	Developing Biomarkers for Fibromyalgia
DoD-169	Development of Novel Therapy for Chronic Neuropathic Pain
DoD-170	Structural MRI and Cognitive Correlates in Pest-Control Personnel from Gulf War I
DoD-171	Q10 for Gulf War Veterans
DoD-172	CNDP1 Polymorphisms and Carnosine Therapy in GWI
DoD-173	A Randomized, Double-Blind, Placebo-Controlled, Crossover Trial of Mifepristone in Gulf War Veterans with Chronic Multisymptom Illness
DoD-174	Autonomic Biomarkers and Treatment for Gulf War Illness
DoD-175	Novel Pharmacological Approaches for Treatment of Neurotoxicity Induced by Chronic Exposure to Depleted Uranium
DoD-176	Studies on Axonal Transport in an Animal Model for Gulf War Syndrome
DoD-177	Randomized Trial of an Environmental Medicine Approach to Gulf War Veterans' Illness
DoD-178	Analysis of Paraoxonase Status among US Navy Gulf War Veterans with Increased Postwar Symptoms, Psychological Morbidity and Medical Conditions
DoD-179	Mechanisms of Mitochondrial Defects in Gulf War Syndrome
DoD-180	Exercise-Induced Cerebrospinal Fluid Proteomic Biomarkers of Fatigue
DoD-181	Effectiveness of Acupuncture in the Treatment of Gulf War Illness
DoD-182	Trial of Naltrexone and Dextromethorphan for Gulf War Veterans' Illness
DoD-183	Biomarkers of Gulf War Veterans' Illnesses: Tissue Factor, Chronic Coagulopathy, and Inflammation
DoD-184	Treatment of Memory Impairment and Sensorimotor Deficits in an Animal Model for the Gulf War Veterans' Illnesses
DoD-185	Neuroinflammatory Pathobiology in Gulf War Illness: Characterization with an Animal Model
DoD-186	Small Intestinal Microbial Community in Gulf War Illness
DoD-187	The Use of Comprehensive Molecular Profiling with Network and Control Theory to Better Understand GWI and Model Therapeutic Strategies
DoD-188	Epithelial Cell TRPV1-Mediated Airway Sensitivity as a Mechanism for Respiratory Symptoms Associated with Gulf War Illness
DoD-189	Discovery of AMPA Receptor Potentiating Aptamers as Cognitive Enhancers
DoD-190	Identification of Biological Pathways Implicated in Hippocampal Dysfunction and Cognitive Impairment in Gulf War Illness

DoD-191	Neuroimmune Interactions, Low-Dose Sarin Inhalation, and Gulf War Syndrome
DoD-192	Exhaled Gas Frequency Comb Spectroscopy Distinguishing Biomarkers in Gulf War Illness Syndrome
DoD-193	Genome Instability: A Common Link in Gulf War Illness Patients
DoD-194	Homeostatic and Circadian Abnormalities in Sleep and Arousal in Gulf War Syndrome
DoD-195	Theory-Driven Models for Correcting "Fight or Flight" Imbalance in Gulf War Illness
DoD-196	Probiotic (Bifidobacterium Infantis) for Gulf War Illness
DoD-197	Undiagnosed Small Fiber Polyneuropathy: Is It a Component of Gulf War Illness?
DoD-198	Oxidative Stress
DoD-199	Gulf War Illness: Evaluation of an Innovative Detoxification Program
DoD-200	XMRV and GWI: Is There an Association?
DoD-201	Synergistic Actions of Pyridostigmine Bromide and Insecticides on Muscle and Vascular Nociceptors
DoD-202	Brain-Immune Interactions as Basis of Gulf War Illness: Consortium Development
DoD-203	Redefining Gulf War Illness Using Longitudinal Health Data: The Devens Cohort
DoD-204	Nasal Irrigation for Chronic Rhinosinusitis and Fatigue in Patients with Gulf War Syndrome
DoD-205	The HPA Axis and Metabolic Outcomes in Gulf War Veterans
DoD-206	Investigating Clinical Benefits of a Novel Sleep-Focused, Mind-Body Program on Gulf War Illness Symptoms: An Exploratory Randomized Controlled Trial
DoD-207	Gulf War Illness Research Development Consortium (GWIC)
DoD-208	Genome-Wide Association Study of a Validated Case Definition of Gulf War Illness in a Population-Representative Sample
DoD-209	Proteomic Immune Profiling for the Therapeutic Modulation of Cognitive Impairment in a Novel GWI Mouse Model
DoD-210	Assessment of Diverse Biological Indicators in Gulf War Illness: Are They Replicable? Are They Related?
DoD-211	Detection of Xenotropic Murine Leukemia Virus-Related Virus (XMRV) in Gulf War Illness: Role in Pathogenesis or Biomarker?
DoD-212	Integrative Physiology of Gulf War Illness: Role of Autonomic Function, Central Neural Processing, and Sleep

DEPARTMENT OF HEALTH AND HUMAN SERVICES PROJECTS

HHS-001	Health Assessment of Persian Gulf War Veterans from Iowa
HHS-002	Disease Cluster in a Pennsylvania Air National Guard Unit, EPI-AID 95-18
HHS-003	Biomarkers of Susceptibility and Polycyclic Aromatic Hydrocarbon (PAH) Exposure in Urine and Blood Cell DNA from U.S. Army Soldiers Exposed to Kuwaiti Oil Well Fires
HHS-004	Suspected Increase of Birth Defects and Health Problems Among Children Born to Persian Gulf War Veterans in Mississippi
HHS-005	Cognitive Function and Symptom Patterns in Persian Gulf Veterans
HHS-006	Defining Gulf War Illness
HHS-007	Immunotoxicity of Dermal Permethrin and Cis-Urocanic Acid
HHS-008	Strategy to Identify Non-Additive Response to Chemical Mixtures
HHS-009	Improving Health Risk Communications to Prevent Unexplained Illnesses Related to Military Deployments
HHS-010	Health-e Voice: Optimized Implementation of a Stepped Clinical Risk Communications Guideline
HHS-011	Deployment to the Gulf War and the Subsequent Development of Cancer
HHS-012	Genetic Epidemiology of ALS in Veterans

DEPARTMENT OF VETERANS AFFAIRS PROJECTS

VA-001	Mortality Follow-up Study of Persian Gulf Veterans
VA-002	National Health Survey of Persian Gulf Veterans
VA-002A	VA National Survey of Persian Gulf Veterans - Phase I
VA-002B	VA National Survey of Persian Gulf Veterans - Phase II
VA-002C	VA National Survey of Persian Gulf Veterans - Phase III
VA-003	Use of Roster of Veterans Who Served in Persian Gulf Area
VA-004	Boston Environmental Hazards Research Center Program
VA-004A	Evaluation of Cognitive Functioning of Persian Gulf Veterans
VA-004B	Evaluation of Neurological Functioning in Persian Gulf Veterans
VA-004C	Gulf War and Vietnam Veterans Cancer Incidence Surveillance
VA-004D	Evaluation of Respiratory Dysfunction Among Gulf War Veterans
VA-004E	The Aromatic Hydrocarbon Receptor (AhR) as a Biomarker of Susceptibility
VA-004F	Validity of Computerized Tests
VA-005	East Orange Environmental Hazards Research Center Program
VA-005A	Health and Exposure Survey of Persian Gulf Veterans
VA-005B	Physiological and Psychological Assessments of Persian Gulf Veterans
VA-005C	Effects of Exertion and Chemical Stress on Persian Gulf Veterans
VA-005D	Effects of Genetics and Stress on Responses to Environmental Toxins
VA-006	Core Program: Portland Environmental Hazards Research Center: Environment, Veterans Health and the Gulf War Syndrome. Core Project for Clinical and Epidemiology Research
VA-006A	Psychosocial, Neuropsychological and Neurobehavioral Assessment (Project I)
VA-006B	Clinical and Neuroendocrine Aspects of Fibromyalgia (Project II)
VA-006C	Neurotoxicity of Environmental Pollutants and Warfare Agents (Project III)
VA-006D	DNA Damage from Chemical Agents and Its Repair (Project IV)
VA-006E	Clinical and Epidemiology Leishmania Research
VA-007	Desert Storm Reunion Survey
VA-008	Psychological Test Data of Gulf War Veterans Over Time

VA-009	Evaluation of Cognitive Functioning in Persian Gulf War Veterans Reporting War-related Health Problems
VA-010	Memory and Attention in PTSD
VA-011	Neuropsychological Functioning in Veterans
VA-012	Psychological Assessment of Operation Desert Storm Returnees
VA-013	Neurobehavioral Aspects of Persian Gulf Experiences: A Pilot Study
VA-015	Vaccine-Mediated Immunity Against Leishmaniasis
VA-016	Protective Immunity in Experimental Visceral Leishmaniasis
VA-017	Immunological Evaluation of Persian Gulf Veterans
VA-018	Chronic Gastrointestinal Illness in Persian Gulf Veterans
VA-020	Psychological Adjustment in Operation Desert Shield/Storm Veterans
VA-021	A Comparison of PTSD Symptomatology among Three Army Medical Units Involved in ODS
VA-036	Stress Symptoms and Their Causal Attribution in Desert Storm Veterans
VA-040	Musculoskeletal Symptoms in Gulf War Syndrome
VA-046	Diarrhea in Persian Gulf Veterans: An Irritable Bowel-Like Disorder
VA-047	Retrospective Verification of Mustard Gas Exposure
VA-048	Cross-Sensitization as a CNS Model for Gulf War Chemical Intolerance
VA-049	Sensitivity to Pyridostigmine Bromide: Persistent Neural Dysfunction
VA-050	Neuropsychological findings in a sample of Operation Desert Storm Veterans
VA-051	Psychobiological Assessment of Desert Storm Veterans
VA-053	Spouses and Children Program
VA-054	Follow-up of Psychological and Neurocognitive Gulf War Outcome: Relation to Stress
VA-055	Antibiotic Treatment of Gulf War Veterans' Illnesses (ABT) (See also DoD-119)
VA-056	Birmingham's Gulf War Veterans' Illness Demonstration Clinic (13)
VA-057	Case Management and Residential Rehabilitation for Persian Gulf War Veterans (13)
VA-058	Implementation and Evaluation of Gulf War Veterans' Demonstration Project (13)
VA-059	Demonstration Treatment Program for Gulf War Veterans with Unexplained Physical Symptoms (13)
VA-060	Identification and Management of Sleep Disorders in Gulf War Veterans

VA-061	An Epidemiological Investigation into the Occurrence of Amyotrophic Lateral Sclerosis (ALS) Among Gulf War Veterans (See also DoD-118)
VA-062	A Randomized, Multi-Center, Controlled Trial of Multi-Model Therapy in Veterans with Gulf War Illness (EBT) (See also DoD-115; formerly VA/DoD 1V)
VA-063	VA/DoD Core Funding of the Medical Follow-Up Agency (See also DoD-116; formerly VA/DoD-2V/2D)
VA-063A	Follow-Up Investigation of Troops Exposed to Nerve Agents at Aberdeen Proving Ground (Pilot Study) (See also DoD-116A; formerly VA/DoD-2VA/2DA)
VA-063B	Patterns of Pre-Persian Gulf War Illness and Health Care Seeking Pilot Study (See also DoD-116B; previously VA/DoD-2VB)
VA-064	Boston Environmental Hazards Research Center
VA-064A	Functional Neuroimaging in Lead Exposed Adults
VA-064B	Quantification and Validation of Structure-Function Relationships Through Visuospatial Test Performance
VA-064C	Development of a Structured Neurotoxicant Assessment Checklist (SNAC) for Clinical use in Veteran Populations
VA-065	San Antonio Environmental Hazards Research Center
VA-065A	Does a Variant of the Human SOD2 Gene Increase Sensitivity to Hazards?
VA-065B	The Contribution of FEN-1 to Genetic Integrity Subsequent to Oxidative Stress
VA-065C	The Importance of Hydrogen Peroxide Detoxification in Cellular Protection
VA-065D	Do Defective Gpx1 and ALDH2 Genes Increase Sensitivity to Environmental Hazards?
VA-066	Physiological Responding in Posttraumatic Stress Disorder
VA-067	Olfactory Functioning in Gulf War Veterans
VA-068	Family Study of Fibromyalgia
VA-069	Cardiovascular Hyporeactivity and Fatiguing Illness in Gulf War Veterans
VA-070	A Clinical Evaluation of the Health Status of Persian Gulf War Veterans in VISN 8
VA-071	Central Nervous System Modulation of Visceral Pain in the Persian Gulf Syndrome
VA-072	Roles of Paraoxonase, Butyrylcholinesterase and Stress in Unexplained Illnesses
VA-073	Pain Sensitivity in Gulf War Veterans with Medically Unexplained Musculoskeletal Pain
VA-074	A Randomized Clinical Trial for Cognitive-Behavioral Treatment for PTSD in Women (See DoD-125)
VA-075	ALS and Veterans: Are Veterans at Increased Risk?
VA-076	Analysis of Hippocampal Volume in Aging Combat Veterans with PTSD

VA-077	HPA Axis Reactivity in Men and Women with Chronic PTSD
VA-078	Millennium Cohort Study (See also DoD-143)
VA-080	Neurochemical and Neurobehavioral Impact of Pyridostigmine Bromide Treatment and Stress
VA-081	Stress, Pro-Inflammatory Cytokines and Coping Behavior
VA-082	Pituitary Adrenal Function in People with Fatiguing Illness
VA-083	Neuropsychological Assessment of a Population-Based Sample of Persian Gulf War Veterans and Controls
VA-084	Neurobiology of Severe Psychological Trauma in Women
VA-085	Associative Learning in Veterans with and without Combat Experience
VA-086	A Clinical Trial of Magnetic Stimulation in Depression
VA-087	Improving Outcomes of Depression in Primary Care
VA-088	Prospective Assessment of Neurocognition in Future Gulf-deployed and Gulf-nondeployed Military Personnel: A Pilot Study (See also DoD-154)
VA-089	National Registry of Veterans with Amyotrophic Lateral Sclerosis
VA-090	Differential Gene Expression in Pathologies Associated with Neuronal Hyperexcitability: Links to Gulf War Illness
VA-090A	Neuronal Hyperexcitability and Motor Neuron Regeneration
VA-090B	Gene Expression and Proteomic Strategies in Severe Psychiatric Disorders
VA-090C	Developmental Differences in Alcohol Withdrawal Sensitivity
VA-090D	Seizures and Neuroplasticity: Physiology and Biochemistry
VA-091	The Role of Dietary Choline in Neuroprotection
VA-092	Acetylcholinesterase Activity in Gulf War Veterans
VA-093	HPA Axis Alterations in PTSD: A Comparison of Gulf War and Vietnam Veterans
VA-094	The Immunology of Chronic Cutaneous Leishmaniasis
VA-095	The Role of Signal Regulatory Proteins in Astrocytomas
VA-096	Functional Imaging of Pain in Veterans with Unexplained Muscle Pain
VA-097	Improving a mM-CSF Tumor Vaccine for Established Intracranial Gliomas
VA-098	Post-Transcriptional Gene Regulation of VEGF in Malignant Gliomas
VA-099	Vaccination Against Visceral Leishmaniasis with a Multi-Epitope Vaccine
VA-100	Studies of the Blood-Brain Barrier and it's Manipulation

VA-101	Biomarkers Discovery in ALS
VA-102	Cholinergic and Monoaminergic Influences on Sleep
VA-103	Hypothalamic and Basal Forebrain Regulation of Sleep and Arousal
VA-104	Characterization of Pain Processing Mechanisms in the Irritable Bowel Syndrome
VA-105	Expression of the Major Surface Protease of Leishmania Chagasi
VA-106	Interoceptive Stressor Conditioning: A Model for Gulf War Illness
VA-107	Evaluation of Stress Response Systems in Gulf War Veterans with CMI
VA-108	Telemedicine Treatment for Veterans with Gulf War Illness
VA-109	Effects of Stress on Memory: Brain Circuits, Mechanisms and Therapeutics
VA-110	Pain Among Gulf War Veterans: Secondary Analysis of CSP#458 Data
VA-111	T-Cell Responses to Multiple Immunizations and Stress
VA-112	National VA Amyotrophic Lateral Sclerosis Research Consortium
VA-113	Novel Cause of Motor Neuron Disease
VA-114	Strategies in Therapeutic Development of Neurodegenerative Diseases
VA-115	Autonomic System Changes Cause Intestinal Symptoms in Gulf War Veterans
VA-116	Quantitative Trait Genes Controlling Circadian and Sleep Behaviors
VA-117	Estimates of Cancer Prevalence in Gulf Veterans Using State Registries
VA-118	Post War Mortality from Neurologic Diseases in Gulf Veterans, 1991-2004
VA-119	Patterns of Microarray Gene Expression in Gulf War Illness
VA-120	Arginase NO Synthase and Cell Death in Amyotrophic Lateral Sclerosis
VA-121	Genes, Environment, and Oxidative Stress in Neurodegenerative Disorders
VA-122	Role of Mitochondrial Oxidative Stress in ALS
VA-123	Interactions Between Maternal Care, Stress and Pyridostigmine Bromide
VA-124	Early Life Determinants of Vulnerability to Pyridostigmine Bromide
VA-125	Effects of Gulf War Illness on Brain Structure, Function and Metabolism: MRI/MRS at 4 Tesla
VA-126	Structural Magnetic Resonance Imaging in Gulf War-Era Veterans
VA-127	Interactions of the Leishmania sp. with Mammalian Cells
VA-128	MR Tracking of Stem Cells for Replacement Therapy in ALS

VA-129	Glucocorticoid Responsivity in Gulf War Veterans
VA-130	Tissue Factor and Gulf War-Associated Chronic Coagulopathies
VA-131	Neuroendocrine Regulators and Proteomics in GW Veterans with CMI
VA-132	Immunologic Mechanisms and Biomarkers in Gulf War Illness
VA-133	Longitudinal Study of Gene Expression and Gene Products in Veterans with Gulf War Illness
VA-134	Autonomic Functions of Gulf War Veterans with Unexplained Illnesses
VA-135	Motor Neuron Function of Gulf War Veterans with Excessive Fatigue
VA-136	Central Mechanisms Modulating Visceral Sensitivity
VA-137	Diarrhea-Predominant Irritable Bowel Syndrome in Persian Gulf Veterans
VA-138	Inspiratory Flow Dynamics During Sleep in GWS and the Effect of CPAP
VA-139	Sleep Neurobiology and Circuitry
VA-140	Integrated Neuroimaging and Neuropathological Analysis of the Effects of Physical Activity on Progression and Therapy in ALS
VA-141	Genetic Analysis of an Invertebrate Model of Amyotrophic Lateral Sclerosis
VA-142	VA Gulf War Biorepository Trust
VA-143	The Role of Protein Oxidation in the Progression of ALS
VA-144	Testing the Role of Permethrin on the Progression of ALS
VA-145	Proteomic Analysis of Cellular Response to Biological Warfare Agents
VA-146	Direct Delivery of Neurotoxins to the Brain by an Intranasal Route
VA-147	The Diagnosis and Pathogenesis of Occult Leishmaniasis
VA-148	Profile of GW Veterans Who Applied for Undiagnosed Illness Compensation
VA-149	Behavior of Neural Stem Cells in a Rat Model of GWS
VA-150	Gulf War Veterans Illnesses' Research IDIQ Contract with UTSW
VA-151	Genetic Epidemiology of ALS
VA-152	Multiple Sclerosis in Gulf War Veterans
VA-153	Bacterial Overgrowth Associated with Chronic Multi-Symptom Illness Complex
VA-154	Imaging Pain Modulation in Gulf War Veterans with Chronic Muscle Pain
VA-155	Host Defense Mechanisms in Polyaromatic Hydrocarbon Carcinogenesis

VA-156	Gulf War Era Cohort and Biorepository (CSP 585)
VA-157	A Clinical Demonstration of an EEG Brain-Computer Interface for ALS Patients (CSP 567)
VA-158	Testing the Feasibility of MC CBT for Veterans with IBS
VA-159	Somatic hypersensitivity in Veterans with IBS
VA-160	Lipoic Acid Therapy for Experimental Autoimmune Encephalomyelitis
VA-161	Multiple Antigenic Peptides to Alter the Course of Autoimmune Disease
VA-162	Transcription factors regulating sensory gene expression and pain pathways
VA-163	Immunoregulation of Myelin Specific T Lymphocytes
VA-164	Central Mechanisms Modulating Visceral Sensitivity (renewal of VA-136)
VA-165	A Pilot Study of CPAP Adherence Promotion by Peer Buddies with Sleep Apnea
VA-166	A Randomized Controlled Trial of a Mindfulness-Based Intervention for Gulf War Syndrome
VA-167	Neuroprotection and Myelin Repair Mechanisms in Multiple Sclerosis
VA-168	Sleep Neurobiology and Circuitry
VA-169	Prevention of Hippocampal Neurodegeneration Due to Age and Apnea
VA-170	Epigenetic Mechanisms Relevant to the Pathogenesis of ALS
VA-171	Nanoparticle Coupled Antioxidants for Respiratory Illness in Veterans
VA-172	Understanding Pain of Gastrointestinal Origin in Women that Serve in OEF/OIF
VA-173	Impact of Exercise Training on Pain and Brain Function in Gulf War Veterans

Appendix B

Project List by Research Focus Areas

Brain and Nervous System Function

Clinical

Research Focus	Project Focus	Project	Project Title
	Diagnosis	DoD-165	Biomarkers for Amyotrophic Lateral Sclerosis in Active Duty Military - BALSAM
	Symptoms	VA-142	VA Gulf War Biorepository Trust
	Treatment	VA-157	A Clinical Demonstration of an EEG Brain-Computer Interface for ALS Patients (CSP 567)
	Treatment; Symptoms;	DoD-166	A Placebo-Controlled Trial of Prazosin vs. Paroxetine in Combat Stress-Induced PTSD Nightmares and Sleep Disturbance
Environmental Toxicology	Symptoms; Exposure;	VA-064 A	Functional Neuroimaging in Lead Exposed Adults
Environmental Toxicology;	Symptoms Chemical Weapons	DoD-063	PGW Veterans: Epidemiological and Clinical Evidence for Residual Organophosphate Neurotoxicity
Immune Function; Symptoms and General Health	Symptoms	VA-005 B	Physiological and Psychological Assessments of Persian Gulf Veterans
Symptoms and General Health	Diagnosis	DoD-032	Neuropsychological Functioning in Persian Gulf Era Veterans
Symptoms and General Health	Symptoms	DoD-040	Psychological and Neurobiological Consequences of the Gulf War Experience
Symptoms and General Health	Prevention	DoD-083	Risk for Stress-related Substance Abuse: the Effects of Family History of Alcoholism
Symptoms and General Health	Symptoms	DoD-084	Psychobiologic Alterations in Persian Gulf War Veterans with and without PTSD
Symptoms and General Health	Symptoms	DoD-086	Effects of Combat Stress on Structure and Function of the Hippocampus
Symptoms and General Health	Symptoms	DoD-089	Limbic Blood Flow and Opiate Receptor PET in Posttraumatic Stress Disorder
Symptoms and General Health	Diagnosis	DoD-090	SPECT Benzodiazepine Receptor and MR Imaging in PTSD
Symptoms and General Health	Symptoms	DoD-132	Impaired Auditory Sensory Gating, Acoustic Startle Response: Effects of Long and Short Deployments on Army Combat Readiness
Symptoms and General Health	Diagnosis	DoD-147	Development and Validation of the Automated Neuropsychological Assessment Metric (ANAM) for Deployment Health Monitoring Applications
Symptoms and General Health	Treatment	DoD-212	Integrative Physiology of Gulf War Illness: Role of Autonomic Functi on, Central Neural Processing, and Sleep
Symptoms and General Health	Symptoms	HHS-005	Cognitive Function and Symptom Patterns in Persian Gulf Veterans
Symptoms and General Health	Symptoms	VA-004	Boston Environmental Hazards Research Center Program
Symptoms and General Health	Symptoms	VA-004 A	Evaluation of Cognitive Functioning of Persian Gulf Veterans
Symptoms and General Health	Symptoms	VA-004 B	Evaluation of Neurological Functioning in Persian Gulf Veterans

Symptoms and General Health	Diagnosis	VA-004 F	Validity of Computerized Tests

Brain and Nervous System Function

Clinical

Research Focus	Project Focus	Project	Project Title
Symptoms and General Health	Symptoms	VA-005	East Orange Environmental Hazards Research Center Program
Symptoms and General Health	Symptoms	VA-006 A	Psychosocial, Neuropsychological and Neurobehavioral Assessment (Project I)
Symptoms and General Health	Symptoms	VA-007	Desert Storm Reunion Survey
Symptoms and General Health	Symptoms	VA-009	Evaluation of Cognitive Functioning in Persian Gulf War Veterans Reporting War-related Health Problems
Symptoms and General Health	Symptoms	VA-010	Memory and Attention in PTSD
Symptoms and General Health	Symptoms	VA-011	Neuropsychological Functioning in Veterans
Symptoms and General Health	Symptoms	VA-012	Psychological Assessment of Operation Desert Storm Returnees
Symptoms and General Health	Symptoms	VA-013	Neurobehavioral Aspects of Persian Gulf Experiences: A Pilot Study
Symptoms and General Health	Symptoms	VA-020	Psychological Adjustment in Operation Desert Shield/Storm Veterans
Symptoms and General Health	Symptoms	VA-021	A Comparison of PTSD Symptomatology among Three Army Medical Units Involved in ODS
Symptoms and General Health	Symptoms	VA-050	Neuropsychological findings in a sample of Operation Desert Storm Veterans
Symptoms and General Health	Symptoms	VA-051	Psychobiological Assessment of Desert Storm Veterans
Symptoms and General Health	Symptoms	VA-054	Follow-up of Psychological and Neurocognitive Gulf War Outcome: Relation to Stress
Symptoms and General Health	Symptoms	VA-064	Boston Environmental Hazards Research Center
Symptoms and General Health	Symptoms	VA-066	Physiological Responding in Posttraumatic Stress Disorder
Symptoms and General Health	Symptoms	VA-072	Roles of Paraoxonase, Butyrylcholinesterase and Stress in Unexplained Illnesses
Symptoms and General Health	Symptoms	VA-076	Analysis of Hippocampal Volume in Aging Combat Veterans with PTSD
Symptoms and General Health	Symptoms	VA-077	HPA Axis Reactivity in Men and Women with Chronic PTSD
Symptoms and General Health	Symptoms	VA-083	Neuropsychological Assessment of a Population-Based Sample of Persian Gulf War Veterans and Controls
Symptoms and General Health	Symptoms	VA-084	Neurobiology of Severe Psychological Trauma in Women
Symptoms and General Health	Symptoms	VA-085	Associative Learning in Veterans with and without Combat Experience
Symptoms and General Health	Treatment	VA-089	National Registry of Veterans with Amyotrophic Lateral Sclerosis

Symptoms and General Health	Symptoms	VA-093	HPA Axis Alterations in PTSD: A Comparison of Gulf War and Vietnam Veterans

Brain and Nervous System Function

Clinical

Research Focus	Project Focus	Project	Project Title
Symptoms and General Health	Treatment	VA-112	National VA Amyotrophic Lateral Sclerosis Research Consortium
Symptoms and General Health	Diagnosis	VA-125	Effects of Gulf War Illness on Brain Structure, Function and Metabolism: MRI/MRS at 4 Tesla
Symptoms and General Health	Symptoms; Diagnosis;	DoD-065	Multi-disciplinary Pathophysiologic Studies of Neurotoxic Gulf War Related Syndromes Leading to Diagnosis and Treatment
Symptoms and General Health	Symptoms; Exposure;	DoD-057	Physiologic Effects of Stress in Gulf War Veterans
Symptoms and General Health	Symptoms; Exposure;	DoD-133	Odors, Deployment Stress, and Health: A Conditioning Analysis of Gulf War Syndrome
Symptoms and General Health	Diagnosis; Symptoms;	DoD-087	Measurement and Validation of Psychosocial Risk and Resilience Factors Accounting for Physical and Mental Health and Health-Related Quality of Life among PGWVs
Symptoms and General Health	Treatment; Symptoms;	DoD-125	A Randomized Clinical Trial of Cognitive-Behavioral Treatment for PTSD in Women (See VA-74)
Symptoms and General Health	Diagnosis; Symptoms;	DoD-131	Magnetic Resonance and Spectroscopy of the Human Brain in Gulf War Illnesses
Symptoms and General Health	Diagnosis; Symptoms;	DoD-144	Psychological Health Screening: Methods and Metrics for Deployed Forces
Symptoms and General Health	Diagnosis; Symptoms;	DoD-153	Gulf War Illness Research
Symptoms and General Health	Treatment; Symptoms;	DoD-164	Efficacy of Adjunct Sleep Interventions for PTSD (EASI- PTSD)
Symptoms and General Health	Treatment; Symptoms;	VA-060	Identification and Management of Sleep Disorders in Gulf War Veterans
Symptoms and General Health	Diagnosis; Symptoms;	VA-064 B	Quantification and Validation of Structure-Function relationships through visuospatial test performance
Symptoms and General Health	Diagnosis; Symptoms;	VA-067	Olfactory Functioning in Gulf War Veterans
Symptoms and General Health	Treatment; Symptoms;	VA-074	A Randomized Clinical Trial for Cognitive-Behavioral Treatment for PTSD in Women (See DoD-125)
Symptoms and General Health	Treatment; Symptoms;	VA-086	A Clinical Trial of Magnetic Stimulation in Depression
Symptoms and General Health	Treatment; Symptoms;	VA-087	Improving Outcomes of Depression in Primary Care
Symptoms and General Health	Treatment; Symptoms;	VA-138	Inspiratory Flow Dynamics During Sleep in GWS and the Effect of CPAP
Symptoms and General Health; Environmental Toxicology	Symptoms;	VA-008	Psychological Test Data of Gulf War Veterans Over Time

Symptoms and General Health;	Symptoms; Diagnosis;	DoD-197	Undiagnosed Small Fiber Polyneuropathy: Is It a Component of Gulf War Illness?

Brain and Nervous System Function

Development

Research Focus	Project Focus	Project	Project Title
	Diagnosis	HHS-013	ALS Biomarkers in the Cerebrospinal Fluid
	Treatment	DoD-189	Discovery of AMPA Receptor Potentiating Aptamers as Cognitive Enhancers
	Treatment	VA-160	Lipoic Acid Therapy for Experimental Autoimmune Encephalomyelitis
Environmental Toxicology	Treatment; Exposure; Symptoms	DoD-184	Treatment of Memory Impairment and Sensorimotor Deficits in an Animal Model for the Gulf War Veterans' Illnesses
Symptoms and General Health	Diagnosis	VA-113	Novel Cause of Motor Neuron Disease
Symptoms and General Health	Treatment; Prevention;	VA-097	Improving a mM-CSF Tumor Vaccine for Established Intracranial Gliomas
Symptoms and General Health	Diagnosis; Symptoms;	VA-101	Biomarkers Discovery in ALS
Symptoms and General Health	Treatment; Symptoms;	VA-128	MR Tracking of Stem Cells for Replacement Therapy in ALS

Epidemiology

Research Focus	Project Focus	Project	Project Title
Symptoms and General Health	Symptoms	DoD-023	Acute and Long-Term Impact of Deployment to Southwest Asia on the Physical and Mental Health of Soldiers and their Families
Symptoms and General Health	Symptoms	DoD-082	Feasibility of Developing a Registry of PTSD Affected Veteran Sib Pairs
Symptoms and General Health	Symptoms	DoD-114	A Re-examination of Neuropsychological Functioning in Persian Gulf War Veterans
Symptoms and General Health	Symptoms	DoD-118	An Epidemiological Investigation into the Occurrence of Amyotrophic Lateral Sclerosis (ALS) Among Gulf War Veterans (See also VA-61)
Symptoms and General Health	Symptoms	HHS-006	Defining Gulf War Illness
Symptoms and General Health	Diagnosis	HHS-012	Genetic Epidemiology of ALS in Veterans
Symptoms and General Health	Symptoms	VA-036	Stress Symptoms and Their Causal Attribution in Desert Storm Veterans
Symptoms and General Health	Symptoms	VA-061	An Epidemiological Investigation into the Occurrence of Amyotrophic Lateral Sclerosis (ALS) Among Gulf War Veterans (See also DoD-118)
Symptoms and General Health	Symptoms	VA-068	Family Study of Fibromyalgia
Symptoms and General Health	Symptoms	VA-075	ALS and Veterans: Are Veterans at Increased Risk?

Symptoms and General Health	Symptoms	VA-110	Pain Among Gulf War Veterans: Secondary Analysis of CSP#458 Data
Symptoms and General Health	Symptoms	VA-150	Gulf War Veterans Illnesses' Research IDIQ Contract

Brain and Nervous System Function

Epidemiology

Research Focus	Project Focus	Project	Project Title
Symptoms and General Health	Diagnosis	VA-151	Genetic Epidemiology of ALS Veterans
Symptoms and General Health	Symptoms	VA-152	Multiple Sclerosis in Gulf War Veterans
Symptoms and General Health	Symptoms; Diagnosis;	DoD-104	Clinical Evaluation of a Proposed New Gulf War Syndrome
Symptoms and General Health	Treatment; Prevention;	DoD-145	Early Intervention Research Program to Enhance Soldier Resilience
Symptoms and General Health	Diagnosis; Symptoms;	DoD-052	Female Gender and Other Potential Predictors of Functional Health Status Among Persian Gulf War Veterans
Symptoms and General Health	Diagnosis; Symptoms;	DoD-154	Prospective Assessment of Neurocognition in Future Gulf-deployed and Gulf-nondeployed Military Personnel: A Pilot Study (See also VA-088)
Symptoms and General Health	Diagnosis; Symptoms;	HHS-002	Disease Cluster in a Pennsylvania Air National Guard Unit, EPI-AID 95-18
Symptoms and General Health	Diagnosis; Symptoms;	VA-088	Prospective Assessment of Neurocognition in Future Gulf-deployed and Gulf-nondeployed Military Personnel: A Pilot Study (See also DoD-154)

Mechanistic

Research Focus	Project Focus	Project	Project Title
	Symptoms	VA-091	The Role of Dietary Choline in Neuroprotection
	Symptoms	VA-120	Arginase NO Synthase and Cell Death in Amyotrophic Lateral Sclerosis
	Symptoms	VA-139	Sleep Neurobiology and Circuitry
	Symptoms	VA-141	Genetic Analysis of an Invertebrate Model of Amyotrophic Lateral Sclerosis
	Treatment	DoD-161	Glutamate Receptor Aptamers and ALS
	Treatment	VA-140	Integrated Neuroimaging and Neuropathological Analysis of the Effects of Physical Activity on Progression and Therapy in ALS
	Treatment	VA-163	Immunoregulation of Myelin Specific T Lymphocytes
	Treatment; Symptoms;	VA-161	Multiple Antigenic Peptides to Alter the Course of Autoimmune Disease
Environmental Toxicology	Symptoms	VA-126	Structural Magnetic Resonance Imaging in Gulf War-Era Veterans
Environmental Toxicology	Symptoms;	DoD-176	Studies on Axonal Transport in an Animal Model for Gulf War

	Exposure;		Syndrome
Environmental Toxicology	Exposure; Symptoms;	DoD-190	Identification of Biological Pathways Implicated in Hippocampal Dysfunction and Cognitive Impairment in Gulf War Illness

Brain and Nervous System Function

Mechanistic

Research Focus	Project Focus	Project	Project Title
Environmental Toxicology;	Treatment; Exposure; Immune Function	DoD-185	Neuroinflammatory Pathobiology in Gulf War Illness: Characterization with an Animal Model
Environmental Toxicology; Symptoms and General Health	Symptoms; Exposure;	DoD-170	Structural MRI and Cognitive Correlates in Pest-Control Personnel from Gulf War I
Environmental Toxicology; Symptoms and General Health	Symptoms; Exposure;	DoD-198	Oxidative Stress
Symptoms and General Health	Symptoms	DoD-080	Molecular Regulation of Corticosteroid Receptor Expression in Stress-Responsive Cells
Symptoms and General Health	Symptoms	DoD-091	Neurological and Circadian Substrates of PTSD-like Behaviors
Symptoms and General Health	Symptoms	DoD-092	Traumatic Experiences Persistently Enhance Cue-dependent Learning: Toward an Animal Model of Chronic Stress and Posttraumatic Stress Disorder
Symptoms and General Health	Symptoms	DoD-105	Neuroplasticity and Calcium Signaling in Stressed Rat Amygdala
Symptoms and General Health	Treatment; Diagnosis	DoD-205	The HPA Axis and Metabolic Outcomes in Gulf War Veterans
Symptoms and General Health	Symptoms	VA-081	Stress, Pro-Inflammatory Cytokines and Coping Behavior
Symptoms and General Health	Symptoms	VA-090	Differential Gene Expression in Pathologies Associated with Neuronal Hyperexcitability: Links to Gulf War Illness
Symptoms and General Health	Symptoms	VA-090A	Neuronal Hyperexcitability and Motor Neuron Regeneration
Symptoms and General Health	Symptoms	VA-090B	Gene Expression and Proteomic Strategies in Severe Psychiatric Disorders
Symptoms and General Health	Symptoms	VA-090C	Developmental Differences in Alcohol Withdrawal Sensitivity
Symptoms and General Health	Symptoms	VA-090D	Seizures and Neuroplasticity: Physiology and Biochemistry
Symptoms and General Health	Symptoms	VA-092	Acetylcholinesterase Activity in Gulf War Veterans
Symptoms and General Health	Symptoms	VA-095	The Role of Signal Regulatory Proteins in Astrocytomas
Symptoms and General Health	Symptoms	VA-098	Post-Transcriptional Gene Regulation of VEGF in Malignant Gliomas
Symptoms and General Health	Symptoms	VA-103	Hypothalamic and Basal Forebrain Regulation of Sleep and Arousal
Symptoms and General Health	Symptoms	VA-109	Effects of Stress on Memory: Brain Circuits, Mechanisms and Therapeutics
Symptoms and General Health	Treatment	VA-114	Strategies in Therapeutic Development of Neurodegenerative Diseases
Symptoms and General Health	Symptoms	VA-116	Quantitative Trait Genes Controlling Circadian and Sleep Behaviors
Symptoms and General Health	Symptoms	VA-121	Genes, Environment, and Oxidative Stress in Neurodegenerative Disorders
Symptoms and General Health	Symptoms	VA-122	Role of Mitochondrial Oxidative Stress in ALS
Symptoms and General Health	Symptoms	VA-129	Glucocorticoid Responsivity in Gulf War Veterans

Symptoms and General Health	Treatment; Symptoms;	VA-100	Studies of the Blood-Brain Barrier and its Manipulation
Symptoms and General Health	Prevention; Symptoms;	VA-102	Cholinergic and Monoaminergic Influences on Sleep
Symptoms and General Health	Treatment	VA-167	Neuroprotection and Myelin Repair Mechanisms in Multiple Sclerosis
Symptoms and General Health	Treatment	VA-168	Sleep Neurobiology and Circuitry
Symptoms and General Health	Treatment; Prevention	VA-169	Prevention of Hippocampal Neurodegeneration Due to Age and Apnea
Symptoms and General Health	Diagnosis; Prevention	VA-170	Epigenetic Mechanisms Relevant to the Pathogenesis of ALS
Immune Function	Treatment	DoD-202	Brain-Immune Interactions as Basis of Gulf War Illness: Consortium Development

Environmental Toxicology

Clinical

Research Focus	Project Focus	Project	Project Title
Brain and Nervous System Function	Interactions; Exposure; Symptoms	VA-048	Cross-Sensitization as a CNS Model for Gulf War Chemical Intolerance
Brain and Nervous System Function; Symptoms and General Health	Exposure; Symptoms;	VA-005 C	Effects of Exertion and Chemical Stress on Persian Gulf Veterans
Chemical Weapons	Symptoms	DoD-060	Butyrylcholinesterase Genetic Variants in Persons with Gulf War Illness
Chemical Weapons	Exposure	DoD-146	Assessment of Toxicology Assay Methods and Chemical Exposures Among a Cohort of US Marines Deployed in the Gulf War
Pyridostigmine Bromide	Exposure; Prevention;	DoD-011	Male/Female Differential Tolerances to Pyridostigmine Bromide
Pyridostigmine Bromide	Exposure; Prevention;	DoD-011	Male/Female Differential Tolerances to Pyridostigmine Bromide
Pyridostigmine Bromide; Brain and Nervous System Function	Exposure; Interactions; Symptoms	DoD-124	Randomized, Controlled Trial for Combination Treatment with Pyridostigmine, DEET, and Permethrin
Pyridostigmine Bromide; Brain and Nervous System Function	Exposure; Interactions;	DoD-155	Neuropsychological Functioning in Gulf War Veterans Exposed to Pesticides and Pyridostigmine Bromide Symptoms
Pyridostigmine Bromide; Brain and Nervous System Function	Exposure; Symptoms;	DoD-064	Individual Differences in Neurobehavioral Effects of Pyridostigmine
Symptoms and General Health	Exposure; Symptoms;	VA-004 D	Evaluation of Respiratory Dysfunction Among Gulf War Veterans
Symptoms and General Health; Brain and Nervous System Function	Exposure; Symptoms;	DoD-156	The Effects of Diesel Exhaust and Stress on the Acute Phase Response and Symptoms in the Chemically Intolerant

Development

Research Focus	Project Focus	Project	Project Title
	Interactions; Exposure;	DoD-034	Characterization of Emissions from Heaters Burning Leaded Diesel Fuel in Unvented Tents

	Diagnosis; Exposure;	DoD-134	Identification and Development of Biological Markers of Human Exposure to the Insecticide Permethrin
	Exposure; Interactions;	HHS-008	Strategy to Identify Non-Additive Response to Chemical Mixtures
Brain and Nervous System Function; Symptoms and General Health	Diagnosis; Exposure; Symptoms	VA-064 C	Development of a structured neurotoxicant assessment checklist (SNAC) for clinical use in veteran populations
Chemical Weapons	Diagnosis	DoD-049	Diagnosis and Dosimetry of Exposure to Sulfur Mustard: Development of Standard Operating Procedures and Exploratory Research on Protein Adducts
Chemical Weapons	Exposure; Diagnosis;	DoD-138	Improving Blood Monitoring of Enzymes as Biomarkers of Risk from Anticholinergic Pesticides and Chemical Warfare Agents

Environmental Toxicology

Development

Research Focus	Project Focus	Project	Project Title
Chemical Weapons	Diagnosis; Exposure;	DoD-050	Toxicokinetics of 0-Ethyl S-(2-Diisopropylaminoethyl) Methylphosphonothioate [(+)-VX] in Rats, Hairless Guinea Pigs and Marmosets - Identification of Metabolic Pathways
Chemical Weapons	Diagnosis; Exposure;	DoD-137	Low Level Exposure to Sulfur Mustard: Development of an SOP for Analysis of Albumin Adducts and of a System for Non-Invasive Diagnosis on Skin
Chemical Weapons	Diagnosis; Exposure;	DoD-167	Mass Spectrometry to Identify New Biomarkers of Nerve Agent Exposure
Symptoms and General Health	Diagnosis; Exposure;	DoD-018	Kuwait Oil Fires Troop Exposure Assessment Model (TEAM)
Symptoms and General Health	Diagnosis; Exposure;	DoD-019	Persian Gulf Veterans Health Tracking System
Symptoms and General Health	Diagnosis; Exposure;	DoD-100	Antibodies to Squalene
Symptoms and General Health	Diagnosis; Exposure; Symptoms	DoD-016	Kuwait Oil Fire Health Risk Assessment

Epidemiology

Research Focus	Project Focus	Project	Project Title
Chemical Weapons	Exposure; Symptoms;	DoD-116 A	Follow-Up Investigation of Troops Exposed to Nerve Agents at Aberdeen Proving Ground (Pilot Study) (See also VA-63A; formerly VA/DoD-2DA)
Chemical Weapons	Exposure; Symptoms;	VA-063 A	Follow-Up Investigation of troops exposed to nerve agents at Aberdeen Proving Ground (Pilot Study) (See also DoD-116A; formerly VA/DoD-2VA/2DA)
Chemical Weapons; Symptoms and General Health	Exposure; Symptoms;	DoD-069	Five Year Follow-Up of Army Personnel Exposed to Chemical Warfare Agents
Chemical Weapons; Symptoms and General Health	Exposure; Symptoms;	DoD-093	Troops Exposed to Nerve Agents at Aberdeen Proving Ground: Follow-Up

Pyridostigmine Bromide	Exposure	DoD-017	Retrospective Studies Involving Military Use of Pyridostigmine as a Pretreatment for Nerve Agent
Pyridostigmine Bromide	Prevention; Exposure;	DoD-021	Study of Variability in Pyridostigmine Inhibition of Blood Cholinesterases in Healthy Adults and Individuals with Symptoms Following Participation in Operation Desert Storm
Symptoms and General Health	Symptoms	DoD-013	Effects of Persian Gulf War Service on Military Working Dogs
Symptoms and General Health	Exposure; Symptoms;	DoD-094	Combined Analysis of the VA and DoD Gulf War Clinical Registries: A Study of Clinical Findings from Systematic Medical Examinations of 100,000 U.S. Gulf War Veterans

Environmental Toxicology

Epidemiology

Research Focus	Project Focus	Project	Project Title
Symptoms and General Health	Exposure; Symptoms;	DoD-099	DoD-wide Medical Surveillance for Potential Long-Term Adverse Events associated with Anthrax Immunization in Active Duty Service Members, Proposal 1: Hospitalizations
Symptoms and General Health	Exposure; Symptoms;	VA-003	Use of Roster of Veterans Who Served in Persian Gulf Area
Symptoms and General Health	Exposure; Symptoms;	VA-006	Core Program: Portland Environmental Hazards Research Center: Environment, Veterans Health and the Gulf War Syndrome. Core Project for Clinical and Epidemiology Research

Mechanistic

Research Focus	Project Focus	Project	Project Title
	Exposure; Interactions;	DoD-103	Human Metabolism and Interactions of Deployment-related Chemicals
	Exposure; Interactions;	VA-145	Proteomic Analysis of Cellular Response to Biological Warfare Agents
	Exposure; Prevention;	HHS-003	Biomarkers of Susceptibility and Polycyclic Aromatic Hydrocarbon (PAH) Exposure in Urine and blood Cell DNA from U.S. Army Soldiers Exposed to Kuwaiti Oil Well Fires
	Exposure; Prevention;	VA-004 E	The Aromatic Hydrocarbon Receptor (AhR) as a Biomarker of Susceptibility
	Exposure; Prevention:	VA-171	Nanoparticle Coupled Antioxidants for Respiratory Illness in Veterans
Brain and Nervous System Function	Exposure	DoD-175	Novel Pharmacological Approaches for Treatment of Neurotoxicity Induced by Chronic Exposure to Depleted Uranium
Brain and Nervous System Function	Interactions; Exposure; Symptoms	DoD-178	Analysis of Paraoxonase Status among US Navy Gulf War Veterans with Increased Postwar Symptoms, Psychological Morbidity and Medical Conditions
Brain and Nervous System Function	Exposure; Interactions;	VA-146	Direct Delivery of Neurotoxins to the Brain by an Intranasal Route

Brain and Nervous System Function	Exposure; Prevention;	DoD-159	Neurotoxicity from Chronic Exposure to Depleted Uranium
Brain and Nervous System Function	Exposure; Symptoms;	VA-144	Testing the Role of Permethrin on the Progression of ALS
Brain and Nervous System Function	Exposure; Symptoms;	VA-149	Behavior of Neural Stem Cells in a Rat Model of GWS
Brain and Nervous System Function; Chemical Weapons	Exposure; Symptoms;	DoD-022	Chronic Organophosphorus Exposure and Cognition
Brain and Nervous System Function; Immune Function	Exposure; Interactions; Symptoms	DoD-037	Neurobehavioral and Immunological Toxicity of Pyridostigmine, Permethrin, and DEET in Male and Female Rats
Brain and Nervous System Function;	Exposure	DoD-126	Blood-Brain Barrier Transport of Uranium
Brain and Nervous System Function;	Exposure; Symptoms	DoD-128	Multifactorial Assessment of Depleted Uranium Neurotoxicity

Environmental Toxicology

Mechanistic

Research Focus	Project Focus	Project	Project Title
Brain and Nervous System Function;	Exposure; Symptoms	DoD-129	Inhalation of Uranium Oxide Aerosol: CNS Deposition, Neurotoxicity, and Role in Gulf War Illness
Brain and Nervous System Function; Pyridostigmine Bromide	Exposure; Interactions;	DoD-201	Synergistic Actions of Pyridostigmine Bromide and Insecticides on Muscle and Vascular Nociceptors
Brain and Nervous System Function; Pyridostigmine Bromide	Exposure; Symptoms;	VA-143	The Role of Protein Oxidation in the Progression of ALS
Brain and Nervous System Function; Symptoms and General Health	Exposure; Symptoms;	DoD-007 A	Health Risk Assessment of Embedded Depleted Uranium: Behavior, Physiology, Histology, and Biokinetic Modeling
Chemical Weapons	Exposure; Diagnosis;	DoD-136	A Mechanism-Based, Molecular Fingerprint Strategy for Detecting Biomarkers of Organophosphate Exposure
Chemical Weapons; Brain and Nervous System Function	Exposure	VA-006 D	DNA Damage from Chemical Agents and Its Repair (Project IV)
Chemical Weapons; Brain and Nervous System Function	Exposure; Diagnosis;	DoD-135	Biochemical Markers for Exposure to Low Doses of Organophosphorus Exposure
Chemical Weapons; Brain and Nervous System Function	Prevention; Exposure;	DoD-051	Transgenic Engineering of Cholinesterases: Tools for Exploring Cholinergic Responses
Chemical Weapons; Brain and Nervous System Function	Exposure; Interactions; Symptoms	DoD-054	Assessment of Subchronic Neurobehavioral and Neuropathologic Effects in Rats Following Low-Level Sarin Exposure
Chemical Weapons; Brain and Nervous System Function	Exposure; Interactions; Symptoms	DoD-055	Low-Level Exposure to GB Vapor in Air: Diagnosis/Dosimetry, Lowest Observable Effect Levels, Performance-Incapacitation, and Possible Delayed Effects
Chemical Weapons; Brain and Nervous System Function	Exposure; Interactions; Symptoms	DoD-056	Low-Level Sarin Neurotoxicity and Its Modulation by Pyridostigmine
Chemical Weapons; Brain and Nervous System Function	Exposure; Interactions; Symptoms	DoD-061	Neurophysiologic and Neuropathologic Effects in Monkeys of Low Level Exposures to Sarin, Pyridostigmine, Pesticides, and Botulinum Toxoid
Chemical Weapons; Brain and Nervous System Function	Exposure; Interactions; Symptoms	DoD-062	Sarin and Pyridostigmine Interaction under Physical Stress: Neurotoxic Effects in Mice

Chemical Weapons; Brain and Nervous System Function	Exposure; Interactions; Symptoms	DoD-072	Long-term Effects of Subchronic Exposure to Sarin, Alone and with Stress or Other Chemicals
Chemical Weapons; Brain and Nervous System Function	Exposure; Interactions; Symptoms	DoD-113	Interactions of Subsymptomatic Doses of Sarin with Pyridostigmine: Neurochemical, Behavioral, and Physiological Effects
Chemical Weapons; Brain and Nervous System Function	Exposure; Symptoms;	DoD-053	Long-Term Effects of Subclinical Exposures to Sarin
Chemical Weapons; Brain and Nervous System Function	Exposure; Symptoms;	DoD-152	Characterization of Intracellular Signaling Pathways Activated by Nerve Agents
Immune Function	Exposure; Interactions;	HHS-007	Immunotoxicity of Dermal Permethrin and Cis-Urocanic Acid
Immune Function	Exposure; Symptoms	DoD-163	Neuroimmune Effects of Inhaling Low Dose Sarin
Immune Function and Infectious Diseases	Exposure; Symptoms;	DoD-191	Neuroimmune Interactions, Low-Dose Sarin Inhalation, and Gulf War Syndrome
Immune Function	Exposure	DoD-123	Immunotoxicity of Depleted Uranium and Heavy Metal Tungsten Alloys

Environmental Toxicology

Mechanistic

Research Focus	Project Focus	Project	Project Title
Immune Function Pyridostigmine Bromide	Exposure; Interactions;	DoD-077	Percutaneous Absorption of Chemical Mixtures Relevant to the Gulf War
Immune Function Symptoms and General Health	Exposure; Symptoms;	DoD-130	Carcinogenicity and Immunotoxicity of Embedded Depleted Uranium and Heavy-Metal Tungsten Alloys in Rodents
Pyridostigmine Bromide	Prevention; Exposure;	DoD-033	Effects of Pyridostigmine in Flinders Line Rats Differing in Cholinergic Sensitivity
Pyridostigmine Bromide	Exposure; Interactions;	DoD-010	Pyridostigmine Synergistic Toxicity Study
Pyridostigmine Bromide; Brain and Nervous System Function	Exposure; Interactions;	DoD-002	Physiological and Neurobehavioral Effects in Rodents from Exposure to Pyridostigmine, Fuels, and DEET
Pyridostigmine Bromide; Brain and Nervous System Function	Exposure; Interactions;	DoD-075	Toxic Interactions of Prophylactic Drugs and Pesticides
Pyridostigmine Bromide; Brain and Nervous System Function	Exposure; Interactions;	DoD-107	Stress, Organophosphates and Blood Brain Barrier Integrity
Pyridostigmine Bromide; Brain and Nervous System Function	Exposure; Interactions; Symptoms	DoD-078	Experimental Models of Gulf War Syndrome
Pyridostigmine Bromide; Brain and Nervous System Function	Exposure; Interactions; Symptoms	DoD-079	Time Course of Stress-induced Impairment of Blood Brain Barrier
Pyridostigmine Bromide; Brain and Nervous System Function	Exposure; Interactions; Symptoms	DoD-139	Assessment of the Role of Stress-Activated Kinase in the Pathogenesis of Gulf War Illnesses
Pyridostigmine Bromide; Brain and Nervous System Function	Exposure; Interactions; Symptoms	VA-006 C	Neurotoxicity of Environmental Pollutants and Warfare Agents (Project III)
Pyridostigmine Bromide; Brain and Nervous System Function	Exposure; Interactions; Symptoms	VA-080	Neurochemical and Neurobehavioral Impact of Pyridostigmine Bromide Treatment and Stress

Pyridostigmine Bromide; Brain and Nervous System Function	Exposure; Symptoms	DoD-059	Pyridostigmine-induced Neurodegeneration: Role of Neuronal Apoptosis
Pyridostigmine Bromide; Brain and Nervous System Function	Exposure; Symptoms	VA-049	Sensitivity to Pyridostigmine Bromide: Persistent Neural Dysfunction
Pyridostigmine Bromide; Brain and Nervous System Function	Exposure; Symptoms;	VA-106	Interoceptive Stressor Conditioning: A Model for Gulf War Illness
Pyridostigmine Bromide; Brain and Nervous System Function	Exposure; Symptoms;	VA-123	Interactions Between Maternal Care, Stress and Pyridostigmine Bromide
Pyridostigmine Bromide; Brain and Nervous System Function	Exposure; Symptoms;	VA-124	Early Life Determinants of Vulnerability to Pyridostigmine Bromide
Pyridostigmine Bromide; Symptoms and General Health	Exposure; Interactions; Symptoms	VA-005 D	Effects of Genetics and Stress on Responses to Environmental Toxins
Reproductive Health;	Exposure; Symptoms;	DoD-121	Evaluation of the Health Risks of Embedded Depleted Uranium Shrapnel During Pregnancy and Offspring Development

Environmental Toxicology

Mechanistic

Research Focus	Project Focus	Project	Project Title
Symptoms and General Health	Exposure	VA-065	San Antonio Environmental Hazards Research Center
Symptoms and General Health	Exposure	VA-065 A	Does a variant of the human SOD2 gene increase sensitivity to hazards?
Symptoms and General Health	Exposure	VA-065 B	The contribution of FEN-1 to genetic integrity subsequent to oxidative stress
Symptoms and General Health	Exposure	VA-065 C	The importance of hydrogen peroxide detoxification in cellular protection
Symptoms and General Health	Exposure	VA-065 D	Do defective Gpx1 and ALDH2 genes increase sensitivity to environmental hazards?
Symptoms and General Health	Symptoms	VA-155	Host Defense Mechanisms in Polyaromatic Hydrocarbon Carcinogenesis
Symptoms and General Health	Exposure; Symptoms	DoD-160	Characterization of the Reproductive Toxicity of Depleted Uranium
Symptoms and General Health	Exposure; Symptoms	DoD-192	Exhaled Gas Frequency Comb Spectroscopy Distinguishing Biomarkers in Gulf War Illness Syndrome
Symptoms and General Health;	Exposure	DoD-007 B	Carcinogenicity of Depleted Uranium Fragments
Symptoms and General Health;	Exposure; Symptoms	DoD-122	Carcinogenic Potential of Depleted Uranium and Tungsten Alloys
Symptoms and General Health;	Exposure; Symptoms	DoD-127	Depleted Uranium Fragment Carcinogenicity: Extrapolation of Findings in Rodents to Man

Immune Function and Infectious Diseases

Clinical

Research Focus	Project Focus	Project	Project Title

	Diagnosis	DoD-047	Study of Mycoplasmal Infections in Gulf War Veterans
	Symptoms	DoD-048	Assessment of Genomic Instability via Chromosome 7 Inversion Frequency in a Gulf-War Syndrome Cohort vs. Selected Control Groups
	Diagnosis	VA-147	The Diagnosis and Pathogenesis of Occult Leishmaniasis
	Diagnosis; Treatment	VA-006 E	Clinical and Epidemiology Leishmania Research
Brain and Nervous System Function	Symptoms	DoD-088	Clinical Relevance of Novel Immunological Markers in PTSD
Brain and Nervous System Function	Symptoms	VA-017	Immunological Evaluation of Persian Gulf Veterans
Environmental Toxicology	Exposure; Interactions; Symptoms	DoD-106	The Role of Th1/Th2 cytokine balance in Gulf War-related illness
Symptoms and General Health	Treatment; Diagnosis;	DoD-067	Antibacterial Treatment Method Based Upon the Excretion of Dead and Decaying Spherical Bacteria

Immune Function and Infectious Diseases

Clinical

Research Focus	Project Focus	Project	Project Title
Symptoms and General Health	Symptoms; Exposure	VA-006 B	Clinical and Neuroendocrine Aspects of Fibromyalgia (Project II)
Symptoms and General Health	Exposure; Interactions;	DoD-162	Evaluation of the Effects of Multiple Immunizations Administered in a Stressful Environment on Immunologic Function
Symptoms and General Health	Exposure; Symptoms;	DoD-042	The Symptomatic Persian Gulf Veterans Protocol: An Analysis of Risk Factors with an Immunologic and Neuropsychiatric Assessment
Symptoms and General Health	Treatment; Symptoms;	DoD-119	Antibiotic Treatment of Gulf War Veterans' Illnesses (ABT) (See also VA-55)
Symptoms and General Health	Treatment; Symptoms;	VA-055	Antibiotic Treatment of Gulf War Veterans' Illnesses (ABT) (See also DoD-119)

Development

Research Focus	Project Focus	Project	Project Title
	Diagnosis	DoD-008 A	Serologic Diagnosis of Viscerotropic Leishmaniasis (VTL)
	Diagnosis	DoD-008 B	Development of a Leishmania Skin Test Antigen (LSTA)
	Diagnosis	DoD-038	Diagnostic Antigens of Leishmania tropica
	Diagnosis	DoD-066	Testing for mycoplasmal infection replicability of nucleoprotein gene tracking and forensic polymerase chain reaction
	Diagnosis; Treatment;	DoD-095	Development of Diagnostic tools and alternative treatment drugs for Leishmania
Symptoms and General Health	Diagnosis	DoD-097	Surveillance of B. pertussis among Military Trainees with Respiratory Disease: Development and Validation of a Highly Sensitive PCR and Beacon Probe based Method for Diagnosis of Pertussis
Symptoms and General Health	Prevention; Symptoms;	VA-099	Vaccination Against Visceral Leishmaniasis with a multi-epitope vaccine

Mechanistic

Research Focus	Project Focus	Project	Project Title
	Treatment	DoD-009	Identification of the Genetic Factors Which Control Tropism in Leishmania
	Treatment	DoD-157	Novel Leishmania and Malaria Potassium Channels: Candidate Therapeutic Targets
	Prevention	VA-015	Vaccine-Mediated Immunity Against Leishmaniasis
	Prevention	VA-016	Protective Immunity in Experimental Visceral Leishmaniasis
	Symptoms	VA-127	Interactions of the Leishmania sp. with Mammalian Cells
	Prevention; Treatment;	VA-094	The Immunology of Chronic Cutaneous Leishmaniasis
Brain and Nervous System Function	Symptoms	DoD-195	Theory-Driven Models for Correcting "Fight or Flight" Imbalance in Gulf War Illness

Immune Function and Infectious Diseases

Mechanistic

Research Focus	Project Focus	Project	Project Title
Environmental Toxicology	Exposure	DoD-151	Mechanisms and Consequences of Vaccine Effects on Th1/Th2 Balance in Gulf War Veterans
Environmental Toxicology	Exposure; Interactions;	DoD-112	Role of Respirable Saudi Arabian Sand and Pyridostigmine in the Gulf War Syndrome: An Autoimmune Adjuvant Disease?
Environmental Toxicology; Pyridostigmine Bromide	Exposure; Interactions;	DoD-076	Evaluations of Immunotoxicity due to Concurrent Exposure to DEET, Pyridostigmine, and JP-8 Jet Fuel
Environmental Toxicology; Pyridostigmine Bromide	Exposure; Interactions; Symptoms	DoD-081	Immunotoxicity due to Coexposure to DEET, Pyridostigmine, and Stress
Symptoms and General Health	Symptoms	VA-111	T Cell Responses to Multiple Immunizations and Stress
Symptoms and General Health	Treatment; Symptoms	VA-105	Expression of the Major Surface Protease of Leishmania Chagasi

Reproductive Health

Clinical

Research Focus	Project Focus	Project	Project Title
	Symptoms	VA-053	Spouses and Children Program
Environmental Toxicology; Chemical Weapons	Symptoms	VA-047	Retrospective Verification of Mustard Gas Exposure
Immune Function	Symptoms	DoD-044	Investigation of Seminal Plasma Hypersensitivity Reactions

Epidemiology

Research Focus	Project Focus	Project	Project Title
	Prevention	DoD-001 C	Epidemiologic Studies of Morbidity Among Gulf War Veterans:

			A Search for Etiologic Agents and Risk Factors; Study 3: A comparative study of pregnancy outcomes among Gulf War Veterans and other active-duty personnel
	Prevention	DoD-001 D	Epidemiologic Studies of Morbidity Among Gulf War Veterans: A Search for Etiologic Agents and Risk Factors; Study 4: Infertility and Miscarriage in Gulf War Veterans
	Symptoms	DoD-001 G	Epidemiologic Studies of Morbidity Among Gulf War Veterans: A Search for Etiologic Agents and Risk Factors; Study 7: Prevalence of Congenital Anomalies Among Children of Persian Gulf War Veterans
	Prevention; Symptoms;	DoD-035	Feasibility of Investigating Whether There is a Relationship Between Birth Defects and Service in the Gulf War.
	Prevention; Symptoms;	HHS-004	Suspected Increase of Birth Defects and Health Problems Among Children Born to Persian Gulf War Veterans in Mississippi

Reproductive Health

Mechanistic

Research Focus	Project Focus	Project	Project Title
Environmental Toxicology	Exposure; Symptoms;	DoD-158	Preconceptional Paternal Exposure to Embedded Depleted Uranium Fragments: Transmission of Genetic Damage to Offspring

Symptoms and General Health

Clinical

Research Focus	Project Focus	Project	Project Title
	Symptoms	DoD-001 A	Epidemiologic Studies of Morbidity Among Gulf War Veterans: A Search for Etiologic Agents and Risk Factors; A Study of Symptoms Among 1500 Seabees
	Diagnosis	DoD-109	Disordered Responses to Orthostatic Stress in the Pathogenesis of Gulf War Syndrome Symptoms
	Symptoms	VA-018	Chronic Gastrointestinal Illness in Persian Gulf Veterans
	Symptoms	VA-040	Musculoskeletal Symptoms in Gulf War Syndrome
	Treatment; Diagnosis; Symptoms	DoD-172	CNDP1 Polymorphisms and Carnosine Therapy in GWI
	Treatment; Symptoms	DoD-171	Q10 for Gulf War Veterans
	Treatment; Symptoms	DoD-181	Effectiveness of Acupuncture in the Treatment of Gulf War Illness
	Treatment; Symptoms	DoD-186	Small Intestinal Microbial Community in Gulf War Illness
	Treatment	DoD-204	Nasal Irrigation for Chronic Rhinosinusitis and Fatigue in Patients with Gulf War Syndrome
	Treatment; Symptoms	DoD-206	Investigating Clinical Benefits of a Novel Sleep-Focused, Mind-Body Program on Gulf War Illness Symptoms: An Exploratory Randomized Controlled Trial
	Treatment; Symptoms	VA-056	Birmingham's Gulf War Veterans' Illness Demonstration Clinic

	Treatment; Symptoms;	VA-058	Implementation and Evaluation of Gulf War Veterans' Demonstration Project
	Diagnosis; Symptoms;	VA-104	Characterization of Pain Processing Mechanisms in the Irritable Bowel Syndrome
	Treatment; Symptoms;	VA-137	Diarrhea-Predominant Irritable Bowel Syndrome in Persian Gulf Veterans
	Treatment; Symptoms;	VA-153	Bacterial Overgrowth Associated with Chronic Multi- Symptom Illness Complex
	Treatment; Symptoms;	VA-158	Testing the Feasibility of MC CBT for Veterans with IBS
	Treatment	VA-165	A Pilot Study of CPAP Adherence Promotion by Peer Buddies with Sleep Apnea
Brain and Nervous System Function	Symptoms	DoD-036	Fatigue in Persian Gulf Syndrome-Physiologic Mechanisms
Brain and Nervous System Function	Symptoms	DoD-041	Evaluation of Muscle Function in Persian Gulf Veterans
Brain and Nervous System Function	Symptoms	DoD-058	Illness Among Persian Gulf War Veterans: Case Validation Studies
Brain and Nervous System Function	Symptoms	DoD-085	CNS Cytokines and CRH in Gulf War Veterans with Multiple Unexplained Symptoms
Brain and Nervous System Function	Symptoms	DoD-101	Mechanisms in Chronic Multisymptom Illnesses
Brain and Nervous System Function	Symptoms	VA-069	Cardiovascular Hyporeactivity and Fatiguing Illness in Gulf War Veterans
Brain and Nervous System Function	Symptoms	VA-071	Central Nervous System Modulation of Visceral Pain in the Persian Gulf Syndrome

Symptoms and General Health

Clinical

Research Focus	Project Focus	Project	Project Title
Brain and Nervous System Function	Symptoms	VA-073	Pain Sensitivity in Gulf War Veterans with Medically Unexplained Musculoskeletal Pain
Brain and Nervous System Function	Symptoms	VA-082	Pituitary Adrenal Function in People with Fatiguing Illness
Brain and Nervous System Function	Symptoms	VA-096	Functional Imaging of Pain in Veterans with Unexplained Muscle Pain
Brain and Nervous System Function	Symptoms	VA-107	Evaluation of Stress Response Systems in Gulf War Veterans with CMI
Brain and Nervous System Function	Symptoms	VA-134	Autonomic Functions of Gulf War Veterans with Unexplained Illnesses
Brain and Nervous System Function	Symptoms	VA-135	Motor Neuron Function of Gulf War Veterans with Excessive Fatigue
Brain and Nervous System Function	Symptoms	VA-154	Imaging Pain Modulation in Gulf War Veterans with Chronic Muscle Pain
Brain and Nervous System Function	Symptoms; Diagnosis;	DoD-180	Exercise-Induced Cerebrospinal Fluid Proteomic Biomarkers of Fatigue
Brain and Nervous System Function	Diagnosis; Symptoms	DoD-111	Autonomic Dysfunction in Gulf War Veterans
Brain and Nervous System Function	Treatment; Symptoms;	DoD-115	A Randomized, Multi-Center, Controlled Trial of Multi- Modal Therapy in Veterans with Gulf War Illnesses (EBT) (See also VA-62; formerly VA/DoD 1D)
Brain and Nervous System Function	Treatment; Symptoms;	DoD-173	A Randomized, Double-Blind, Placebo-Controlled, Crossover Trial of Mifepristone in Gulf War Veterans with Chronic Multisymptom Illness

Brain and Nervous System Function	Treatment; Symptoms;	DoD-182	Trial of Naltrexone and Dextromethorphan for Gulf War Veterans' Illness
Brain and Nervous System Function	Treatment; Symptoms;	VA-057	Case Management and Residential Rehabilitation for Persian Gulf War Veterans
Brain and Nervous System Function	Treatment; Symptoms;	VA-059	Demonstration Treatment Program for Gulf War Veterans With Unexplained Physical Symptoms (13)
Brain and Nervous System Function	Treatment; Symptoms;	VA-062	A Randomized, Multi-Center, Controlled Trial of Multi- Modal Therapy in Veterans with Gulf War Illness (EBT) (See also DoD-115; formerly VA/DoD 1V)
Brain and Nervous System Function	Treatment; Symptoms	VA-108	Telemedicine Treatment for Veterans with Gulf War Illness
Brain and Nervous System Function	Treatment	VA-166	A Randomized Controlled Trial of a Mindfulness-Based Intervention for Gulf War Syndrome
Brain and Nervous System Function	Treatment	VA-173	Impact of Exercise Training on Pain and Brain Function in Gulf War Veterans
Brain and Nervous System Function;	Diagnosis; Symptoms	DoD-031	Dysregulation of the Stress Response in the Persian Gulf Syndrome
Brain and Nervous System Function	Treatment; Symptoms;	D0D-199	Gulf War Illness: Evaluation of an Innovative Detoxification Program
Environmental Toxicology	Treatment	DoD-177	Randomized Trial of an Environmental Medicine Approach to Gulf War Veterans' Illness
Immune Function	Symptoms	DoD-187	The Use of Comprehensive Molecular Profiling with Network and Control Theory to Better Understand GWI and Model Therapeutic Strategies
Immune Function	Symptoms	DoD-188	Epithelial Cell TRPV1-Mediated Airway Sensitivity as a Mechanism for Respiratory Symptoms Associated with Gulf War Illness
Other Topics	Treatment; Symptoms	DoD-196	Probiotic (Bifidobacterium Infantis) for Gulf War Illness

Symptoms and General Health

Development

Research Focus	Project Focus	Project	Project Title
	Treatment; Symptoms	DoD-169	Development of Novel Therapy for Chronic Neuropathic Pain
	Diagnosis	DoD-210	Assessment of Diverse Biological Indicators in Gulf War Illness: Are They Replicable? Are They Related?
Brain and Nervous System Function	Diagnosis; Symptoms	DoD-168	Developing Biomarkers for Fibromyalgia
Brain and Nervous System Function	Diagnosis; Treatment;	DoD-209	Proteomic Immune Profiling for the Therapeutic Modulation of Cognitive Impairment in a Novel GWI Mouse Model
Immune Function	Symptoms; Diagnosis;	DoD-183	Biomarkers of Gulf War Veterans' Illnesses: Tissue Factor, Chronic Coagulopathy, and Inflammation

Epidemiology

Research Focus	Project Focus	Project	Project Title
	Symptoms	DoD-001 B	Epidemiologic Studies of Morbidity Among Gulf War Veterans: A Search for Etiologic Agents and Risk Factors; Study 2: A Comparative

			Study of Hospitalizations among Active-Duty Personnel Who Participated in the Gulf War and Similar Personnel Who Did Not.
	Symptoms	DoD-001 E	Epidemiologic Studies of Morbidity Among Gulf War Veterans: A Search for Etiologic Agents and Risk Factors; Study 5: Seabee Health Study
	Symptoms	DoD-001 F	Epidemiologic Studies of Morbidity Among Gulf War Veterans: A Search for Etiologic Agents and Risk Factors; Study 6: A Comparison of Nonfederal Hospitalization Experience Among Veterans in California who have separated from active service: GWV vs. NDV
	Symptoms	DoD-004	The General Well-Being of Gulf War Era Service Personnel from the States of Pennsylvania and Hawaii: A Survey
	Symptoms	DoD-014	Risk Factors Among US Army Soldiers for Enrolling on the Department of Veterans Affairs Gulf War Registry
	Symptoms	DoD-046	Exploratory Data Analysis with the CCEP Database
	Symptoms	DoD-070	War Syndromes from 1900 to the Present: Symptom Patterns and Long-term Health Outcomes
	Symptoms	DoD-071	A Comparison of Post Deployment Hospitalization Between Vietnam and Gulf War Veterans
	Symptoms	DoD-098	Investigation of a Baseline Medical Database to Evaluate the Health of Military Forces and Veterans
	Prevention	DoD-110	Predictors of Career and Family Dysfunction in Young Adults Enlisting in the United States Navy
	Symptoms	DoD-116 B	Patterns of Pre-Persian Gulf War Illness and Health Care Seeking, Pilot Study (See also VA-63B; formerly VA/DoD-2DB)
	Symptoms	DoD-120	Assessing the Potential Health Impact of the Gulf War on Saudi Arabia National Guard Members and Their Dependents
	Diagnosis	DoD-140	US Department of Defense Surveillance for Neoplasms in Infancy
	Symptoms	DoD-148	Predicting Operational Readiness for Deployed Army National Guard and Army Reserve Soldiers and Families

Symptoms and General Health

Epidemiology

Research Focus	Project Focus	Project	Project Title
	Symptoms	DoD-150	Validation Study of Gulf War Deployment Files
	Symptoms	DoD-203	Redefining Gulf War Illness Using Longitudinal Health Data: The Devens Cohort
	Symptoms	HHS-001	Health Assessment of Persian Gulf War Veterans from Iowa
	Prevention	HHS-009	Improving Health Risk Communications to Prevent Unexplained Illnesses Related to Military Deployments
	Symptoms	HHS-011	Deployment to the Gulf War and the Subsequent Development of Cancer

	Symptoms	VA-002	National Health Survey of Persian Gulf Veterans
	Symptoms	VA-002 A	VA National Survey of Persian Gulf Veterans - Phase I
	Symptoms	VA-002 B	VA National Survey of Persian Gulf Veterans - Phase II
	Symptoms	VA-004 C	Gulf War and Vietnam Veterans Cancer Incidence Surveillance
	Symptoms	VA-046	Diarrhea in Persian Gulf Veterans: An Irritable Bowel-Like Disorder
	Symptoms	VA-063 B	Patterns of Pre-Persian Gulf War Illness and Health Care Seeking Pilot Study (See also DoD-116B; previously VA/DoD-2VB)
	Symptoms	VA-070	A Clinical Evaluation of the Health Status of Persian Gulf War Veterans in VISN 8
	Symptoms	VA-117	Estimates of Cancer Prevalence in Gulf Veterans Using State Registries
	Symptoms; Exposure;	DoD-073	Post-deployment Morbid Stress, Behavior and Health: Developing a Model for Predicting Morbidity, Mortality, and other Adverse Outcomes
	Diagnosis; Exposure;	DoD-208	Genome-Wide Association Study of a Validated Case Definition of Gulf War Illness in a Population-Representative Sample
	Prevention; Symptoms	DoD-108	Health Status of Current National Guard Members
	Prevention; Symptoms	DoD-117	Patterns of Pre-Persian Gulf War Illness and Health Care Seeking
	Prevention; Treatment;	HHS-010	Health-e Voice: Optimized Implementation of a Stepped Clinical Risk Communications Guideline
	Symptoms	DoD-015	Comparative Mortality Among US Military Personnel Worldwide During Operations Desert Shield and Desert Storm
	Prevention	DoD-102	Case-Control Study of Fatal Motor Vehicle Crashes Among Gulf War and Non-Deployed Veterans
	Symptoms	VA-001	Mortality Follow-up Study of Persian Gulf Veterans
Brain and Nervous System Function	Symptoms	DoD-039	A Controlled Epidemiological and Clinical Study into the Effect of Gulf War Service on Servicemen and Women of the United Kingdom Armed Forces
Brain and Nervous System Function	Symptoms	DoD-141	Physical, Mental, Social, and Family Health Outcomes of Gulf War Veterans
Brain and Nervous System Function	Symptoms	DoD-142	Illnesses Among Persian Gulf War Veterans: Case Validation Studies (Iowa / Great Britain)

Symptoms and General Health

Epidemiology

Research Focus	Project Focus	Project	Project Title
	Symptoms	VA-148	Profile of GW Veterans Who Applied for Undiagnosed Illness Compensation
Brain and Nervous System Function	Symptoms	DoD-143	Millennium Cohort Study
Brain and Nervous System Function	Symptoms	DoD-149	Longitudinal Health Study of Gulf War Veterans

Brain and Nervous System Function	Symptoms	VA-002 C	VA National Survey of Persian Gulf Veterans - Phase III
Brain and Nervous System Function	Symptoms	VA-005 A	Health and Exposure Survey of Persian Gulf Veterans
Brain and Nervous System Function	Symptoms	VA-078	Millenium Cohort Study
Brain and Nervous System Function	Symptoms	VA-118	Post War Mortality from Neurologic Diseases in Gulf Veterans, 1991-2004
Brain and Nervous System Function	Symptoms; Exposure	VA-156	Gulf War Era Cohort and Biorepository (CSP 585)
Brain and Nervous System Function; Reproductive Health	Symptoms	DoD-045	Air Force Women's Health Surveillance Study
Environmental Toxicology	Symptoms	VA 156	Gulf War Era Cohort and Biorepository (CSP 585)
Environmental Toxicology	Symptoms; Exposure	DoD-074	Relationship of Stress Exposures to Health in Gulf War Veterans
Environmental Toxicology; Chemical Weapons	Exposure; Symptoms;	DoD-116	VA/DoD Core Funding of the Medical Follow-Up Agency (See also VA-63; formerly VA-DoD-2D/2V)
Environmental Toxicology; Chemical Weapons	Exposure; Symptoms;	VA-063	VA/DoD Core funding of the Medical Follow-Up Agency (See also DoD-116; formerly VA/DoD-2V/2D)
Reproductive Health	Symptoms	DoD-030	Epidemiological Studies Persian Gulf War Illnesses, PG Women's Health Linkage Study
Reproductive Health	Symptoms; Diagnosis; Prevention	DoD-096	Deployment Health Center
Reproductive Health	Symptoms; Prevention	DoD-001	Naval Health Study Program

Mechanistic

Research Focus	Project Focus	Project	Project Title
	Diagnosis	DoD-193	Genome Instability: A Common Link in Gulf War Illness Patients
	Symptoms	DoD-179	Mechanisms of Mitochondrial Defects in Gulf War Syndrome
	Symptoms	VA-130	Tissue Factor and Gulf War-Associated Chronic Coagulopathies
	Symptoms	VA-131	Neuroendocrine Regulators and Proteomics in GW Veterans with CMI
	Symptoms	VA-136	Central Mechanisms Modulating Visceral Sensitivity
	Symptoms	VA-159	Somatic hypersensitivity in Veterans with IBS
	Symptoms	VA-162	Transcription factors regulating sensory gene expression and pain pathways

Symptoms and General Health

Mechanistic

Research Focus	Project Focus	Project	Project Title
	Symptoms; Treatment;	VA-164	Central Mechanisms Modulating Visceral Sensitivity (renewal of VA-136)
	Symptoms; Treatment;	VA-172	Understanding Pain of Gastrointestinal Origin in Women that Serve in OEF/OIF

Brain and Nervous System Function	Symptoms	VA-115	Autonomic System Changes Cause Intestinal Symptoms in Gulf War Veterans
Brain and Nervous System Function	Symptoms	VA-119	Patterns of Microarray Gene Expression in Gulf War Illness
Brain and Nervous System Function	Symptoms	DoD-194	Homeostatic and Circadian Abnormalities in Sleep and Arousal in Gulf War Syndrome
Brain and Nervous System Function	Treatment	DoD-207	Gulf War Illness Research Development Consortium (GWIC)
Environmental Toxicology	Exposure; Symptoms	DoD-174	Autonomic Biomarkers and Treatment for Gulf War Illness
Immune Function	Diagnosis	DoD-200	XMRV and GWI: Is There an Association?
Immune Function	Diagnosis Symptoms;	DoD-211	Detection of Xenotropic Murine Leukemia Virus-Related Virus (XMRV) in Gulf War Illness: Role in Pathogenesis or Biomarker?
Immune Function	Symptoms	VA-132	Immunologic Mechanisms and Biomarkers in Gulf War Illness
Immune Function	Symptoms	VA-133	Longitudinal Study of Gene Expression and Gene Products in Veterans with Gulf War Illness

Appendix C

Project Funding

(As of September 30, 2011)

NOTES ON REVISED TABLE OF SPENDING FOR GULF WAR VETERANS' ILLNESSES RESEARCH FROM FY 2002-2011

General Notes

1. All entries for research funding reflect money centrally obligated to researchers (both intramural and extramural) to carry out the specific projects. These funds also cover operational costs for administration, infrastructure, etc. Each department allocates these costs in slightly different ways, making it difficult to completely account for these funds. For example, in VA the research appropriation does not pay for clinician/investigator salaries. By law those funds must come from the patient care appropriation. These salary costs are not included in the obligated costs listed in the table.
2. A "blank" funding entry generally reflects years in which a project was not active (e.g., it had not started or it had come to an end).
3. Some multiyear projects receive all of their funding in the fiscal year of the authorization and appropriation. For those, the dollars authorized and obligated are shown for that fiscal year. The remaining funding entries show $0 for the years that the project is active.
4. Although all projects funded from FY 1992-2010 are listed, only the financial data for FY 2002-2011 (a 10-year window) are shown in Appendix C; Totals for FY '02-'11 do not include funds obligated in FY 1992-2000. Projects that received all of their obligated funds prior to FY 2002 will, therefore, appear in the table as having no funding.
5. Some intramural projects/programs are supported out of operational costs. For those projects, $0 is entered for the funds in the fiscal years that the project is active.
6. Programs consisting of multiple projects are represented in one of two ways depending on how funds are centrally obligated:
   a**. Funds centrally obligated to the program**: These programs are shown in the table as a main program indicated by project designation such as DoD-1, and projects within the program as DoD-1A, DoD-1B, etc. All funds are shown under the main program. Blank funding entries are shown for the individual projects.
   b. **Funds centrally obligated to projects within a program**: The funds for these programs are only indicated by their projects without a main program identifier, for example, VA-2A and VA-2B.

Specific Notes

1. DoD-4 is part of a larger US Army study conducted at Walter Reed Army Institute of Research. Funding for this project has been combined into project DoD-23. In addition, projects DoD-8A and 8B are part of a larger US Army study in which all funding has been combined and is shown under program DoD-8.
2. HHS-3 was funded from the FY'91 appropriation, which is not included in this accounting.
3. HHS-4 was funded from the FY'93 appropriation, which is not included in this accounting.
4. Funds for VA-1 for FY'94 through FY'97 represent an aggregate of funds for both the VA Mortality Study and the VA National Survey of Persian Gulf Veterans. Beginning in FY'98, VA-1 reflects continuation of the VA Mortality Study. Beginning in FY'98, VA–2A, 2B, and 2C reflect funding for separate components of the VA National Survey of Persian Gulf Veterans.
5. In nine instances (DoD-115 & VA-062, DoD-116 & VA-063, DoD-116A & VA-063A, DoD-116B & VA-063B, DoD-118 & VA-061, DoD-119 &VA-055, DoD-125 & VA-074, DoD-143 & VA-078 ,and DoD154 & VA-88), two different designations represent the same project because both DoD and VA funded them jointly. The total funding appropriated for each of these nine projects is broken down and reported separately by funding agency.

Department of Defense Gulf War Research Funding

PROJECT NO	PROJECT TITLE	STATUS	FY 2002	FY 2003	FY2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	TOTALS FY 02-11
DoD-001	Naval Health Study Program	C											$0
DoD-001 A	Epidemiologic Studies of Morbidity Among Gulf War Veterans: A Search for Etiologic Agents and Risk Factors; A Study of Symptoms Among 1500 Seabees	C											$0
DoD-001 B	Epidemiologic Studies of Morbidity Among Gulf War Veterans: A Search for Etiologic Agents and Risk Factors; Study 2: A Comparative Study of Hospitalizations among Active-Duty Personnel Who Participated in the Gulf War and Similar Personnel Who Did Not.	C											$0
DoD-001 C	Epidemiologic Studies of Morbidity Among Gulf War Veterans: A Search for Etiologic Agents and Risk Factors; Study 3: A comparative study of pregnancy outcomes among Gulf War veterans and other active-duty personnel	C											$0
DoD-001 D	Epidemiologic Studies of Morbidity Among Gulf War Veterans: A Search for Etiologic Agents and Risk Factors; Study 4: Infertility and Miscarriage in Gulf War Veterans	C											$0
DoD-001 E	Epidemiologic Studies of Morbidity Among Gulf War Veterans: A Search for Etiologic Agents and Risk Factors; Study 5: Seabee Health Study	C											$0
DoD-001 F	Epidemiologic Studies of Morbidity Among Gulf War Veterans: A Search for Etiologic Agents and Risk Factors; Study 6: A Comparison of Nonfederal Hospitalization Experience Among Veterans in California who have separated from active service: GWV vs. NDV	C											$0
DoD-001 G	Epidemiologic Studies of Morbidity Among Gulf War Veterans: A Search for Etiologic Agents and Risk Factors; Study 7: Prevalence of Congenital Anomalies Among Children of Persian Gulf War Veterans	C											$0

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Status: C=Complete; O=Ongoing

Department of Defense Gulf War Research Funding

PROJECT NO	PROJECT TITLE	STATUS	FY 2002	FY 2003	FY2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	TOTALS FY 02-11
DoD-002	Physiological and Neurobehavioral Effects in Rodents from Exposure to Pyridostigmine, Fuels, and DEET	C											$0
DoD-004	The General Well-Being of Gulf War Era Service Personnel from the States of Pennsylvania and Hawaii: A Survey	C											$0
DoD-007 A	Health Risk Assessment of Embedded Depleted Uranium: Behavior, Physiology, Histology, and Biokinetic Modeling	C											$0
DoD-007 B	Carcinogenicity of Depleted Uranium Fragments	C											$0
DoD-008	Program DoD-8.	C											$0
DoD-008 A	Serologic Diagnosis of Viscerotropic Leishmaniasis (VTL)	C											$0
DoD-008 B	Development of a Leishmania Skin Test Antigen (LSTA)	C											$0
DoD-009	Identification of the Genetic Factors Which Control Tropism in Leishmania	C											$0
DoD-010	Pyridostigmine Synergistic Toxicity Study	C											$0
DoD-011	Male/Female Differential Tolerances to Pyridostigmine Bromide	C											$0
DoD-013	Effects of Persian Gulf War Service on Military Working Dogs	C	$0	$0	$0								$0
DoD-014	Risk Factors Among US Army Soldiers for Enrolling on the Department of Veterans Affairs Gulf War Registry	C											$0
DoD-015	Comparative Mortality Among US Military Personnel Worldwide During Operations Desert Shield and Desert Storm	C											$0
DoD-016	Kuwait Oil Fire Health Risk Assessment	C											$0
DoD-017	Retrospective Studies Involving Military Use of Pyridostigmine as a Pretreatment for Nerve Agent Poisoning	C											$0
DoD-018	Kuwait Oil Fires Troop Exposure Assessment Model (TEAM)	C	$195,000	$225,000									$420,000
DoD-019	Persian Gulf Veterans Health Tracking System	C	$100,000	$50,000									$150,000

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Department of Defense Gulf War Research Funding

PROJECT NO	PROJECT TITLE	STATUS	FY 2002	FY 2003	FY2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	TOTALS FY 02-11
DoD-021	Study of Variability In Pyridostigmine Inhibition of Blood Cholinesterases in Healthy Adults and Individuals With Symptoms Following Participation in Operation Desert Storm	C											$0
DoD-022	Chronic Organophosphorus Exposure and Cognition	C											$0
DoD-023	Acute and Long-Term Impact of Deployment to Southwest Asia on the Physical and Mental Health of Soldiers and their Families	C											$0
DoD-030	Epidemiological Studies Persian Gulf War Illnesses, PG Women's Health Linkage Study	C	$0										$0
DoD-031	Dysregulation of the Stress Response in the Persian Gulf Syndrome	C											$0
DoD-032	Neuropsychological Functioning in Persian Gulf Era Veterans	C											$0
DoD-033	Effects of Pyridostigmine in Flinders Line Rats Differing in Cholinergic Sensitivity	C											$0
DoD-034	Characterization of Emissions from Heaters Burning Leaded Diesel Fuel in Unvented Tents	C											$0
DoD-035	Feasibility of Investigating Whether There is a Relationship Between Birth Defects and Service in the Gulf War.	C	$0										$0
DoD-036	Fatigue in Persian Gulf Syndrome-Physiologic Mechanisms	C											$0
DoD-037	Neurobehavioral and Immunological Toxicity of Pyridostigmine, Permethrin, and DEET in Male and Female Rats	C											$0
DoD-038	Diagnostic Antigens of Leishmania tropica	C											$0
DoD-039	A Controlled Epidemiological and Clinical Study into the Effect of Gulf War Service on Servicemen and Women of the United Kingdom Armed Forces	C	$0										$0
DoD-040	Psychological and Neurobiological Consequences of the Gulf War Experience	C	$0										$0
DoD-041	Evaluation of Muscle Function in Persian Gulf Veterans	C											$0

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Status: C=Complete; O=Ongoing

Department of Defense Gulf War Research Funding

PROJECT NO	PROJECT TITLE	STATUS	FY 2002	FY 2003	FY2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	TOTALS FY 02-11
DoD-042	The Symptomatic Persian Gulf Veterans Protocol: An Analysis of Risk Factors with an Immunologic and Neuropsychiatric Assessment	C	$0										$0
DoD-044	Investigation of Seminal Plasma Hypersensitivity Reactions	C											$0
DoD-045	Air Force Women's Health Surveillance Study	C	$0										$0
DoD-046	Exploratory Data Analysis with the CCEP Database	C											$0
DoD-047	Study of Mycoplasmal Infections in Gulf War Veterans	C											$0
DoD-048	Assessment of Genomic Instability via Chromosome 7 Inversion Frequency in a Gulf-War Syndrome Cohort vs. Selected Control Groups	C											$0
DoD-049	Diagnosis and Dosimetry of Exposure to Sulfur Mustard: Development of Standard Operating Procedures and Exploratory Research on Protein Adducts	C											$0
DoD-050	Toxicokinetics of 0-Ethyl S-(2-Diisopropylaminoethyl) Methylphosphonothioate [(+)-VX] in Rats, Hairless Guinea Pigs and Marmosets - Identification of Metabolic Pathways	C											$0
DoD-051	Transgenic Engineering of Cholinesterases: Tools for Exploring Cholinergic Responses	C											$0
DoD-052	Female Gender and Other Potential Predictors of Functional Health Status Among Persian Gulf War Veterans	C											$0
DoD-053	Long-Term Effects of Subclinical Exposures to Sarin	C	$0										$0
DoD-054	Assessment of Subchronic Neurobehavioral and Neuropathologic Effects in Rats Following Low-Level Sarin Exposure	C											$0
DoD-055	Low-Level Exposure to GB Vapor in Air: Diagnosis/Dosimetry, Lowest Observable Effect Levels, Performance-Incapacitation, and Possible Delayed Effects	C	$0										$0

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Department of Defense Gulf War Research Funding

PROJECT NO	PROJECT TITLE	STATUS	FY 2002	FY 2003	FY2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	TOTALS FY 02-11
DoD-056	Low-Level Sarin Neurotoxicity and Its Modulation by Pyridostigmine	C	$0										$0
DoD-057	Physiologic Effects of Stress in Gulf War Veterans	C	$0	$0									$0
DoD-058	Illness Among Persian Gulf War Veterans: Case Validation Studies	C	$0	$0	$0								$0
DoD-059	Pyridostigmine-induced Neurodegeneration: Role of neuronal Apoptosis	C	$0										$0
DoD-060	Butyrylcholinesterase Genetic Variants in Persons with Gulf War Illness	C											$0
DoD-061	Neurophysiologic and Neuropathologic Effects in Monkeys of Low Level Exposures to Sarin, Pyridostigmine, Pesticides, and Botulinum Toxoid	C											$0
DoD-062	Sarin and Pyridostigmine Interaction under Physical Stress: Neurotoxic Effects in Mice	C											$0
DoD-063	PGW Veterans: Epidemiological and Clinical Evidence for Residual Organophosphate Neurotoxicity	C											$0
DoD-064	Individual Differences in Neurobehavioral Effects of Pyridostigmine	C	$0										$0
DoD-065	Multi-disciplinary Pathophysiologic Studies of Neurotoxic Gulf War Related Syndromes Leading to Diagnosis and Treatment	C	$0										$0
DoD-066	Testing for mycoplasmal infection replicability of nucleoprotein gene tracking and forensic polymerase chain reaction	C	$0										$0
DoD-067	Antibacterial Treatment Method Based Upon the Excretion of Dead and Decaying Spherical Bacteria	C											$0
DoD-069	Five Year Follow-Up of Army Personnel Exposed to Chemical Warfare Agents	C	$245,910	$0	$0	$0	$0						$245,910
DoD-070	War Syndromes from 1900 to the Present: Symptom Patterns and Long-term Health Outcomes	C	$0										$0

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Department of Defense Gulf War Research Funding

PROJECT NO	PROJECT TITLE	STATUS	FY 2002	FY 2003	FY2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	TOTALS FY 02-11
DoD-071	A Comparison of Post Deployment Hospitalization Between Vietnam and Gulf War Veterans	C											$0
DoD-072	Long-term Effects of Subchronic Exposure to Sarin, Alone and with Stress or Other Chemicals	C	$0	$0									$0
DoD-073	Post-deployment Morbid Stress, Behavior and Health: Developing a Model for Predicting Morbidity, Mortality, and other Adverse Outcomes	C	$0										$0
DoD-074	Relationship of Stress Exposures to Health in Gulf War Veterans	C	$0	$0									$0
DoD-075	Toxic Interactions of Prophylactic Drugs and Pesticides	C	$0	$0	$0								$0
DoD-076	Evaluations of Immunotoxicity due to Concurrent Exposure to DEET, Pyridostigmine, and JP-8 Jet Fuel	C	$0	$0	$0								$0
DoD-077	Percutaneous Absorption of Chemical Mixtures Relevant to the Gulf War	C	$0	$0									$0
DoD-078	Experimental Models of Gulf War Syndrome	C	$0	$0									$0
DoD-079	Time Course of Stress-induced Impairment of Blood Brain Barrier	C											$0
DoD-080	Molecular Regulation of Corticosteroid Receptor Expression in Stress-Responsive Cells	C	$0	$0									$0
DoD-081	Immunotoxicity due to Coexposure to DEET, Pyridostigmine, and Stress	C	$0	$0									$0
DoD-082	Feasibility of Developing a Registry of PTSD Affected Veteran Sib Pairs	C	$0	$0									$0
DoD-083	Risk for Stress-related Substance Abuse: the Effects of Family History of Alcoholism	C	$0	$0									$0
DoD-084	Psychobiologic Alterations in Persian Gulf War Veterans with and without PTSD	C	$0	$0									$0
DoD-085	CNS Cytokines and CRH in Gulf War Veterans with Multiple Unexplained Symptoms	C	$0	$0									$0
DoD-086	Effects of Combat Stress on Structure and Function of the Hippocampus	C	$0	$0	$0								$0

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Department of Defense Gulf War Research Funding

PROJECT NO	PROJECT TITLE	STATUS	FY 2002	FY 2003	FY2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	TOTALS FY 02-11
DoD-087	Measurement and Validation of Psychosocial Risk and Resilience Factors Accounting for Physical and Mental Health and Health-Related Quality of Life among PGWVs	C	$0	$0	$0								$0
DoD-088	Clinical Relevance of Novel Immunological Markers in PTSD	C	$0	$0									$0
DoD-089	Limbic Blood Flow and Opiate Receptor PET in Posttraumatic Stress Disorder	C	$0	$0									$0
DoD-090	SPECT Benzodiazepine Receptor and MR Imaging in PTSD	C	$0										$0
DoD-091	Neurological and Circadian Substrates of PTSD-like Behaviors	C											$0
DoD-092	Traumatic Experiences Persistently Enhance Cue-dependent Learning: Toward an Animal Model of Chronic Stress and Posttraumatic Stress Disorder	C	$0										$0
DoD-093	Troops Exposed to Nerve Agents at Aberdeen Proving Ground: Follow-Up	C											$0
DoD-094	Combined Analysis of the VA and DoD Gulf War Clinical Registries: A Study of Clinical Findings from Systematic Medical Examinations of 100,000 U.S. Gulf War Veterans	C	$0										$0
DoD-095	Development of Diagnostic tools and alternative treatment drugs for Leishmania	C	$1,500,000										$1,500,000
DoD-096	Deployment Health Center	C	$1,750,000	$1,750,000	$1,750,000	$0							$5,250,000
DoD-097	Surveillance of B. pertussis among Military Trainees with Respiratory Disease: Development and Validation of a Highly Sensitive PCR and Beacon Probe based Method for Diagnosis of Pertussis	C	$151,000										$151,000
DoD-098	Investigation of a Baseline Medical Database to Evaluate the Health of Military Forces and Veterans	C	$0	$0	$0	$0	$0	$0	$0	$0			$0

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Department of Defense Gulf War Research Funding

PROJECT NO	PROJECT TITLE	STATUS	FY 2002	FY 2003	FY2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	TOTALS FY 02-11
DoD-099	DoD-wide Medical Surveillance for Potential Long-Term Adverse Events associated with Anthrax Immunization in Active Duty Service Members, Proposal 1: Hospitalizations	C	$0	$0	$0								$0
DoD-100	Antibodies to Squalene	C	$487,333	$0	$0	$0	$0	$0					$487,333
DoD-101	Mechanisms in Chronic Multisymptom Illnesses	C	$4,786,192	$644,870	$4,781,952	$2,429,999	$0	$0	$0	$0			$12,643,013
DoD-102	Case-Control Study of Fatal Motor Vehicle Crashes Among Gulf War and Non-Deployed Veterans	C	$0	$281,950									$281,950
DoD-103	Human Metabolism and Interactions of Deployment-related Chemicals	C	$0	$349,994	$242,424	$160,000	$326,570	$166,570	$0	$0			$1,245,558
DoD-104	Clinical Evaluation of a Proposed New Gulf War Syndrome	C	$0	$40,844									$40,844
DoD-105	Neuroplasticity and Calcium Signaling in Stressed Rat Amygdala	C	$0	$0	$0								$0
DoD-106	The Role of Th1/Th2 cytokine balance in Gulf War-related illness	C	$0	$0									$0
DoD-107	Stress, Organophosphates and Blood Brain Barrier Integrity	C	$0	$0	$0								$0
DoD-108	Health Status of Current National Guard Members	C	$174,651	$0	$0	$0							$174,651
DoD-109	Disordered Responses to Orthostatic Stress in the Pathogenesis of Gulf War Syndrome Symptoms	C	$0	$0									$0
DoD-110	Predictors of Career and Family Dysfunction in Young Adults Enlisting in the United States Navy	C	$0	$0									$0
DoD-111	Autonomic Dysfunction in Gulf War Veterans	C	$0	$189,609	$0	$0							$189,609
DoD-112	Role of Respirable Saudi Arabian Sand and Pyridostigmine in the Gulf War Syndrome: An Autoimmune Adjuvant Disease?	C	$0	$0									$0
DoD-113	Interactions of Subsymptomatic Doses of Sarin with Pyridostigmine: Neurochemical, Behavioral, and Physiological Effects	C	$0	$0	$0	$0							$0
DoD-114	A Re-examination of Neuropsychological Functioning in Persian Gulf War Veterans	C	$0	$0									$0

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Status: C=Complete; O=Ongoing

Department of Defense Gulf War Research Funding

PROJECT NO	PROJECT TITLE	STATUS	FY 2002	FY 2003	FY2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	TOTALS FY 02-11
DoD-115	A Randomized, Multi-Center, Controlled Trial of Multi-Model Therapy in Veterans with Gulf War Illnesses (EBT) (See also VA-62; formerly VA/DoD 1D)	C	$0	$0									$0
DoD-116	VA/DoD Core Funding of the Medical Follow-Up Agency (See also VA-63; formerly VA-DoD-2D/2V)	C	$250,000	$250,000									$500,000
DoD-116 A	Follow-Up Investigation of Troops Exposed to Nerve Agents at Aberdeen Proving Ground (Pilot Study) (See also VA-63A; formerly VA/DoD-2DA)	C											$0
DoD-116 B	Patterns of Pre-Persian Gulf War Illness and Health Care Seeking, Pilot Study (See also VA-63B; formerly VA/DoD- 2DB)	C											$0
DoD-117	Patterns of Pre-Persian Gulf War Illness and Health Care Seeking	C	$0	$0									$0
DoD-118	An Epidemiological Investigation into the Occurrence of Amyotrophic Lateral Sclerosis (ALS) Among Gulf War Veterans (See also VA-61)	C	$0	$0									$0
DoD-119	Antibiotic Treatment of Gulf War Veterans' Illnesses (ABT) (See also VA-55)	C	$0	$0									$0
DoD-120	Assessing the Potential Health Impact of the Gulf War on Saudi Arabia National Guard Members and Their Dependents	C	$0	$0									$0
DoD-121	Evaluation of the Health Risks of Embedded Depleted Uranium Shrapnel During Pregnancy and Offspring Development	C	$0										$0
DoD-122	Carcinogenic Potential of Depleted Uranium and Tungsten Alloys	C	$0										$0
DoD-123	Immunotoxicity of Depleted Uranium and Heavy Metal Tungsten Alloys	C	$0										$0
DoD-124	Randomized, Controlled Trial for Combination Treatment with Pyridostigmine, DEET, and Permethrin	C	$0	$0	$0	$0	$0						$0
DoD-125	A Randomized Clinical Trial of Cognitive-Behavioral Treatment for PTSD in Women (See VA-74)	C	$0	$0	$0	$0	$0						$0

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Department of Defense Gulf War Research Funding

PROJECT NO	PROJECT TITLE	STATUS	FY 2002	FY 2003	FY2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	TOTALS FY 02-11
DoD-126	Blood-Brain Barrier Transport of Uranium	C	$0	$0	$0	$0	$0	$0	$0	$0			$0
DoD-127	Depleted Uranium Fragment Carcinogenicity: Extrapolation of Findings in Rodents to Man	C	$0	$0	$0								$0
DoD-128	Multifactorial Assessment of Depleted Uranium Neurotoxicity	C	$0	$328,734	$0	$89,055	$0	$0	$0	$0			$417,789
DoD-129	Inhalation of Uranium Oxide Aerosol: CNS Deposition, Neurotoxicity, and Role in Gulf War Illness	C	$0	$0	$0	$0	$0	$0	$0	$0			$0
DoD-130	Carcinogenicity and Immunotoxicity of Embedded Depleted Uranium and Heavy-Metal Tungsten Alloys in Rodents	C	$0	$0	$0	$0	$0	$0	$0	$0			$0
DoD-131	Magnetic Resonance and Spectroscopy of the Human Brain in Gulf War Illnesses	C	$0	$500,000	$0	$0	$0	$0	$0	$0			$500,000
DoD-132	Impaired Auditory Sensory Gating, Acoustic Startle Response: Effects of Long and Short Deployments on Army Combat Readiness	C	v	$0	$0	$0	$0	$0					$0
DoD-133	Odors, Deployment Stress, and Health: A Conditioning Analysis of Gulf War Syndrome	C	$0	$0	$0	$0	$0	$0					$0
DoD-134	Identification and Development of Biological Markers of Human Exposure to the Insecticide Permethrin	C	$0	$0	$0	$0	$0	$0					$0
DoD-135	Biochemical Markers for Exposure to Low Doses of Organophosphorus Exposure	C	$0	$0	$0	$0							$0
DoD-136	A Mechanism-Based, Molecular Fingerprint Strategy for Detecting Biomarkers of Organophosphate Exposure	C	$0	$0	$0	$0							$0
DoD-137	Low Level Exposure to Sulfur Mustard: Development of a SOP for Analysis of Albumin Adducts and of a System for Non-Invasive Diagnosis on Skin	C	$0	$0	$0	$0	$0						$0
DoD-138	Improving Blood Monitoring of Enzymes as Biomarkers of Risk from Anticholinergic Pesticides and Chemical Warfare Agents	C	$0	$0	$0	$0	$0	$0					$0

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Department of Defense Gulf War Research Funding

PROJECT NO	PROJECT TITLE	STATUS	FY 2002	FY 2003	FY2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	TOTALS FY 02-11
DoD-139	Assessment of the Role of Stress-Activated Kinase in the Pathogenesis of Gulf War Illnesses	C	$0	$0									$0
DoD-140	US Department of Defense Surveillance for Neoplasms in Infancy	C	$0	$0	$0	$0	$0						$0
DoD-141	Physical, Mental, Social, and Family Health Outcomes of Gulf War Veterans	C	$0	$0									$0
DoD-142	Illnesses Among Persian Gulf War Veterans: Case Validation Studies (Iowa / Great Britain)	C		$168,962	$0	$0							$168,962
DoD-143	Millennium Cohort Study	O	$1,250,000	$2,000,000	$1,950,000	$2,880,000	$2,893,000	$3,251,000	$3,160,000	$3,145,000	$3,306,000	$3,347,000	$27,182,000
DoD-144	Psychological Health Screening: Methods and Metrics for Deployed Forces	C	$300,000	$0	$0	$0	$0	$0	$0	$0			$300,000
DoD-145	Early Intervention Research Program to Enhance Soldier Resilience	C	$275,000	$275,000	$0	$0	$0	$0	$0	$0	$0		$550,000
DoD-146	Assessment of Toxicology Assay Methods and Chemical Exposures Among a Cohort of US Marines Deployed in the Gulf War	C											$0
DoD-147	Development and Validation of the Automated Neuropsychological Assessment Metric (ANAM) for Deployment Health Monitoring Applications	C	$696,111	$292,530	$0	$0	$0						$988,641
DoD-148	Predicting Operational Readiness for Deployed Army National Guard and Army Reserve Soldiers and Families	C											$0
DoD-149	Longitudinal Health Study of Gulf War Veterans	C	$0	$0	$0	$0	$0						$0
DoD-150	Validation Study of Gulf War Deployment Files	C	$134,348	$0									$134,348
DoD-151	Mechanisms and Consequences of Vaccine Effects on Th1/Th2 Balance in Gulf War Veterans	C	$482,274	$0	$0	$0	$0						$482,274
DoD-152	Characterization of Intracellular Signaling Pathways Activated by Nerve Agents	C	$1,000,000	$1,019,440	$0	$0	$0	$0	$0	$0			$2,019,440
DoD-153	Gulf War Illness Research	C	$4,950,000	$920,838	$2,003,000	$928,000	$0						$8,801,838
DoD-154	Prospective Assessment of Neurocognition in Future Gulf-deployed and Gulf-nondeployed Military Personnel: A Pilot Study	C		$100,000	$566,542	$368,687	$604,372	$0	$0	$0	$0		$1,639,601

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Department of Defense Gulf War Research Funding

PROJECT NO	PROJECT TITLE	STATUS	FY 2002	FY 2003	FY2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	TOTALS FY 02-11
DoD-155	Neuropsychological Functioning in Gulf War Veterans Exposed to Pesticides and Pyridostigmine Bromide	C		$1,021,862	$0	$0	$0	$0	$0				$1,021,862
DoD-156	The Effects of Diesel Exhaust and Stress on the Acute Phase Response and Symptoms in the Chemically Intolerant	C		$1,519,951	$0	$0	$0	$0	$0				$1,519,951
DoD-157	Novel Leishmania And Malaria Potassium Channels: Candidate Therapeutic Targets	C	$0	$0	$0	$0							$0
DoD-158	Preconceptional Paternal Exposure to Embedded Depleted Uranium Fragments: Transmission Of Genetic Damage To Offspring	C	$0	$0	$0	$0							$0
DoD-159	Neurotoxicity from Chronic Exposure to Depleted Uranium	C	$0	$0	$0	$0							$0
DoD-160	Characterization of the Reproductive Toxicity of Depleted Uranium	C	$0	$0	$0	$0							$0
DoD-161	Glutamate Receptor Aptamers and ALS	C		$1,152,744		$0	$0	$0	$0	$0	$0	$0	$1,152,744
DoD-162	Evaluation of the Effects of Multiple Immunizations Administered in a Stressful Environment on Immunologic Function	C		$1,041,751	$0	$0	$0	$0	$0				$1,041,751
DoD-163	Neuroimmune Effects of Inhaling Low Dose Sarin	C		$1,828,876	$0	$0	$0	$0	$0				$1,828,876
DoD-164	Efficacy of Adjunct Sleep Interventions For PTSD (EASI-PTSD)	C				$999,623	$0	$0	$0				$999,623
DoD-165	Biomarkers for Amyotrophic Lateral Sclerosis in Active Duty Military - BALSAM	C				$1,000,799	$0	$0	$0				$1,000,799
DoD-166	A Placebo-Controlled Trial of Prazosin vs. Paroxetine in Combat Stress-Induced PTSD Nightmares and Sleep Disturbance	C				$1,000,000	$0	$0	$0				$1,000,000
DoD-167	Mass Spectrometry to Identify New Biomarkers of Nerve Agent Exposure	C					$637,848	$0	$0	$0			$637,848
DoD-168	Developing Biomarkers for Fibromyalgia	C					$936,067	$0	$0	$0			$936,067
DoD-169	Development of Novel Therapy for Chronic Neuropathic Pain	C					$840,574	$0	$0	$0			$840,574

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Department of Defense Gulf War Research Funding

PROJECT NO	PROJECT TITLE	STATUS	FY 2002	FY 2003	FY2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	TOTALS FY 02-11
DoD-170	Structural MRI and Cognitive Correlates in Pest-Control Personnel from Gulf War I	C					$208,353	$0	$0	$0			$208,353
DoD-171	Q10 for Gulf War Veterans	C					$718,261	$0	$0	$0			$718,261
DoD-172	CNDP1 Polymorphisms and Carnosine Therapy in GWI	C					$831,200	$0	$0	$0			$831,200
DoD-173	A Randomized, Double-Blind, Placebo-Controlled, Crossover Trial of Mifepristone in Gulf War Veterans with Chronic Multisymptom Illness	C					$650,279	$0	$0	$0			$650,279
DoD-174	Autonomic Biomarkers and Treatment for Gulf War Illness	C					$687,530	$0	$0	$0			$687,530
DoD-175	Novel Pharmacological Approaches for Treatment of Neurotoxicity Induced by Chronic Exposure to Depleted Uranium	C					$767,061	$0	$0	$0			$767,061
DoD-176	Studies on Axonal Transport in an Animal Model for Gulf War Syndrome	C					$112,500	$0	$0	$0			$112,500
DoD-177	Randomized Trial of an Environmental Medicine Approach to Gulf War Veterans' Illness	C					$445,865	$0	$0	$0			$445,865
DoD-178	Analysis of Paraoxonase Status among US Navy Gulf War Veterans with Increased Postwar Symptoms, Psychological Morbidity and Medical Conditions	C					$73,153	$0	$0	$0			$73,153
DoD-179	Mechanisms of Mitochondrial Defects in Gulf War Syndrome	O							$440,674	$0	$0	$0	$440,674
DoD-180	Exercise-Induced Cerebrospinal Fluid Proteomic Biomarkers of Fatigue	O							$921,000	$0	$0	$0	$921,000
DoD-181	Effectiveness of Acupuncture in the Treatment of Gulf War Illness	O							$1,015,733	$0	$0	$0	$1,015,733
DoD-182	Trial of Naltrexone and Dextromethorphan for Gulf War Veterans' Illness	O							$1,063,641	$0	$0	$0	$1,063,641
DoD-183	Biomarkers of Gulf War Veterans' Illnesses: Tissue Factor, Chronic Coagulopathy, and Inflammation	O							$653,460	$0	$0	$0	$653,460
DoD-184	Treatment of Memory Impairment and Sensorimotor Deficits in an Animal Model for the Gulf War Veterans' Illnesses	O							$311,135	$0	$0	$0	$311,135

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Department of Defense Gulf War Research Funding

PROJECT NO	PROJECT TITLE	STATUS	FY 2002	FY 2003	FY2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	TOTALS FY 02-11
DoD-185	Neuroinflammatory Pathobiology in Gulf War Illness: Characterization with an Animal Model	O							$718,326	$0	$0	$0	$718,326
DoD-186	Small Intestinal Microbial Community in Gulf War Illness	O							$634,142	$0	$0	$0	$634,142
DoD-187	The Use of Comprehensive Molecular Profiling with Network and Control Theory to Better Understand GWI and Model Therapeutic Strategies	O							$715,456	$0	$0	$0	$715,456
DoD-188	Epithelial Cell TRPV1-Mediated Airway Sensitivity as a Mechanism for Respiratory Symptoms Associated with Gulf War Illness	O							$842,400	$0	$0	$0	$842,400
DoD-189	Discovery of AMPA Receptor Potentiating Aptamers as Cognitive Enhancers	O							$303,000	$0	$0	$0	$303,000
DoD-190	Identification of Biological Pathways Implicated in Hippocampal Dysfunction and Cognitive Impairment in Gulf War Illness	O							$894,000	$0	$0	$0	$894,000
DoD-191	Neuroimmune Interactions, Low-Dose Sarin Inhalation, and Gulf War Syndrome	O								$1,247,995	$0	$0	$1,247,995
DoD-192	Exhaled Gas Frequency Comb Spectroscopy Distinguishing Biomarkers in Gulf War Illness Syndrome	O								$742,296	$0	$0	$742,296
DoD-193	Genome Instability: A Common Link in Gulf War Illness Patients	O								$904,364	$0	$0	$904,364
DoD-194	Homeostatic and Circadian Abnormalities in Sleep and Arousal in Gulf War Syndrome	O								$705,654	$0	$0	$705,654
DoD-195	Theory-Driven Models for Correcting "Fight or Flight" Imbalance in Gulf War Illness	O								$678,953	$0	$0	$678,953
DoD-196	Probiotic (Bifidobacterium Infantis) for Gulf War Illness	O								$466,260	$0	$0	$466,260
DoD-197	Undiagnosed Small Fiber Polyneuropathy: Is It a Component of Gulf War Illness?	O								$929,224	$0	$0	$929,224
DoD-198	Oxidative Stress	O								$927,000	$0	$0	$927,000
DoD-199	Gulf War Illness: Evaluation of an Innovative Detoxification Program	O								$633,677	$0	$0	$633,677
DoD-200	XMRV and GWI: Is There an	O									$565,794	$0	$565,794

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Department of Defense Gulf War Research Funding

PROJECT NO	PROJECT TITLE	STATUS	FY 2002	FY 2003	FY2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	TOTALS FY 02-11
	Association?												
DoD-201	Synergistic Actions of Pyridostigmine Bromide and Insecticides on Muscle and Vascular Nociceptors	O									$852,157	$0	$852,157
DoD-202	Brain-Immune Interactions as Basis of Gulf War Illness: Consortium Development	O									$262,052	$0	$262,052
DoD-203	Redefining Gulf War Illness Using Longitudinal Health Data: The Devens Cohort	O									$708,169	$0	$708,169
DoD-204	Nasal Irrigation for Chronic Rhinosinusitis and Fatigue in Patients with Gulf War Syndrome	O									$668,072	$0	$668,072
DoD-205	The HPA Axis and Metabolic Outcomes in Gulf War Veterans	O									$699,933	$0	$699,933
DoD-206	Investigating Clinical Benefits of a Novel Sleep-Focused, Mind-Body Program on Gulf War Illness Symptoms: An Exploratory Randomized Controlled Trial	O									$606,496	$0	$606,496
DoD-207	Gulf War Illness Research Development Consortium (GWIC)	O									$251,475	$0	$251,475
DoD-208	Genome-Wide Association Study of a Validated Case Definition of Gulf War Illness in a Population-Representative Sample	O									$140,357	$0	$140,357
DoD-209	Proteomic Immune Profiling for the Therapeutic Modulation of Cognitive Impairment in a Novel GWI Mouse Model	O									$925,368	$0	$925,368
DoD-210	Assessment of Diverse Biological Indicators in Gulf War Illness: Are They Replicable? Are They Related?	O									$741,013	$0	$741,013
DoD-211	Detection of Xenotropic Murine Leukemia Virus-Related Virus (XMRV) in Gulf War Illness: Role in Pathogenesis or Biomarker?	O									$403,050	$0	$403,050
DoD-212	Integrative Physiology of Gulf War Illness: Role of Autonomic Function, Central Neural Processing, and Sleep	O									$254,295	$0	$254,295
			$18,827,819	$16,419,497	$11,096,063	$10,091,848	$10,128,261	$3,417,570	$11,672,967	$10,380,423	$10,384,231	$3,347,000	$105,765,679

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Department of Health and Human Services Gulf War Research Funding

PROJECT NO	PROJECT TITLE	STATUS	FY 2002	FY 2003	FY2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	TOTALS FY 02-11
HHS-001	Health Assessment of Persian Gulf War Veterans from Iowa	C											$0
HHS-002	Disease Cluster in a Pennsylvania Air National Guard Unit, EPI-AID 95-18	C											$0
HHS-003	Biomarkers of Susceptibility and Polycyclic Aromatic Hydrocarbon (PAH) Exposure in Urine and blood Cell DNA from U.S. Army Soldiers Exposed to Kuwaiti Oil Well Fires	C											$0
HHS-004	Suspected Increase of Birth Defects and Health Problems Among Children Born to Persian Gulf War Veterans In Mississippi	C											$0
HHS-005	Cognitive Function and Symptom Patterns in Persian Gulf Veterans	C	$0										$0
HHS-006	Defining Gulf War Illness	C	$0										$0
HHS-007	Immunotoxicity of Dermal Permethrin and Cis-Urocanic Acid	C											$0
HHS-008	Strategy to Identify Non-Additive Response to Chemical Mixtures	C											$0
HHS-009	Improving Health Risk Communications to Prevent Unexplained Illnesses Related to Military Deployments	C	$339,814	$339,814	$0	$0	$0	$0					$679,628
HHS-010	Health-e Voice: Optimized Implementation of a Stepped Clinical Risk Communications Guideline	C	$460,000	$460,000	$0	$0	$0	$0					$920,000
HHS-011	Deployment to the Gulf War and the Subsequent Development of Cancer	C		$164,291	$0	$0	$0	$0					$164,291
HHS-012	Genetic Epidemiology of ALS in Veterans	C			$466,126	$466,481	$455,587	$441,974	$433,467	$0	$0	$0	$2,263,635
			$799,814	$964,105	$466,126	$466,481	$455,587	$441,974	$433,467	$0	$0	$0	$4,027,554

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PROJECT NO	PROJECT TITLE	STATUS	FY 2002	FY 2003	FY2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	TOTALS FY 02-11
VA-001	Mortality Follow-up Study of Persian Gulf Veterans	C	$128,496	$0									$128,496
VA-002	National Health Survey of Persian Gulf Veterans	C	$0										$0
VA-002 A	VA National Survey of Persian Gulf Veterans - Phase I	C											$0
VA-002 B	VA National Survey of Persian Gulf Veterans - Phase II	C											$0
VA-002 C	VA National Survey of Persian Gulf Veterans - Phase III	C	$30,000										$30,000
VA-003	Use of Roster of Veterans Who Served in Persian Gulf Area	C											$0
VA-004	Boston Environmental Hazards Research Center Program	C											$0
VA-004 A	Evaluation of Cognitive Functioning of Persian Gulf Veterans	C											$0
VA-004 B	Evaluation of Neurological Functioning in Persian Gulf Veterans	C											$0
VA-004 C	Gulf War And Vietnam Veterans Cancer Incidence Surveillance	C											$0
VA-004 D	Evaluation of Respiratory Dysfunction Among Gulf War Veterans	C											$0
VA-004 E	The Aromatic Hydrocarbon Receptor (AhR) as a Biomarker of Susceptibility	C											$0
VA-004 F	Validity of Computerized Tests	C											$0
VA-005	East Orange Environmental Hazards Research Center Program	C											$0
VA-005 A	Health and Exposure Survey of Persian Gulf Veterans	C											$0
VA-005 B	Physiological and Psychological Assessments of Persian Gulf Veterans	C											$0
VA-005 C	Effects of Exertion and Chemical Stress on Persian Gulf Veterans	C											$0
VA-005 D	Effects of Genetics and Stress on Responses to Environmental Toxins	C											$0
VA-006	Core Program: Portland Environmental Hazards Research Center: Environment, Veterans Health and the Gulf War Syndrome. Core Project for Clinical and Epidemiology Research	C											$0

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Department of Veterans Affairs Gulf War Research Funding

PROJECT NO	PROJECT TITLE	STATUS	FY 2002	FY 2003	FY2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	TOTALS FY 02-11
VA-006 A	Psychosocial, Neuropsychological and Neurobehavioral Assessment (Project I)	C											$0
VA-006 B	Clinical and Neuroendocrine Aspects of Fibromyalgia (Project II)	C											$0
VA-006 C	Neurotoxicity of Environmental Pollutants and Warfare Agents (Project III)	C											$0
VA-006 D	DNA Damage from Chemical Agents and Its Repair (Project IV)	C											$0
VA-006 E	Clinical and Epidemiology Leishmania Research	C											$0
VA-007	Desert Storm Reunion Survey	C											$0
VA-008	Psychological Test Data of Gulf War Veterans Over Time	C	$0	$0									$0
VA-009	Evaluation of Cognitive Functioning in Persian Gulf War Veterans Reporting War-related Health Problems	C											$0
VA-010	Memory and Attention in PTSD	C											$0
VA-011	Neuropsychological Functioning in Veterans	C											$0
VA-012	Psychological Assessment of Operation Desert Storm Returnees	C											$0
VA-013	Neurobehavioral Aspects of Persian Gulf Experiences: A Pilot Study	C											$0
VA-015	Vaccine-Mediated Immunity Against Leishmaniasis	C	$119,600	$59,800									$179,400
VA-016	Protective Immunity in Experimental Visceral Leishmaniasis	C											$0
VA-017	Immunological Evaluation of Persian Gulf Veterans	C											$0
VA-018	Chronic Gastrointestinal Illness in Persian Gulf Veterans	C											$0
VA-020	Psychological Adjustment in Operation Desert Shield/Storm Veterans	C											$0
VA-021	A Comparison of PTSD Symptomatology among Three Army Medical Units Involved in ODS	C											$0
VA-036	Stress Symptoms and Their Causal Attribution in Desert Storm Veterans	C											$0

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VA-040	Musculoskeletal Symptoms in Gulf War Syndrome	C											$0
VA-046	Diarrhea in Persian Gulf Veterans: An Irritable Bowel-Like Disorder	C											$0
VA-047	Retrospective Verification of Mustard Gas Exposure	C											$0
VA-048	Cross-Sensitization as a CNS Model for Gulf War Chemical Intolerance	C											$0
VA-049	Sensitivity to Pyridostigmine Bromide: Persistent Neural Dysfunction	C	$125,862										$125,862
VA-050	Neuropsychological findings in a sample of Operation Desert Storm veterans	C											$0
VA-051	Psychobiological Assessment of Desert Storm Veterans	C											$0
VA-053	Spouses and Children Program	C	$25,000										$25,000
VA-054	Follow-up of Psychological and Neurocognitive Gulf War Outcome: Relation to Stress	C	$86,350	$72,700	$39,375								$198,425
VA-055	Antibiotic Treatment of Gulf War Veterans' Illnesses (ABT) (See also DoD-119)	C	$254,000										$254,000
VA-056	Birmingham's Gulf War Veterans' Illness Demonstration Clinic (13)	C											$0
VA-057	Case Management and Residential Rehabilitation for Persian Gulf War Veterans (13)	C											$0
VA-058	Implementation and Evaluation of Gulf War Veterans' Demonstration Project (13)	C											$0
VA-059	Demonstration Treatment Program for Gulf War Veterans With Unexplained Physical Symptoms (13)	C											$0
VA-060	Identification and Management of Sleep Disorders in Gulf War Veterans	C											$0
VA-061	An Epidemiological Investigation into the Occurrence of Amyotrophic Lateral Sclerosis (ALS) Among Gulf War Veterans (See also DoD-118)	C	$110,600										$110,600
VA-062	A Randomized, Multi-Center, Controlled Trial of Multi-Model Therapy in Veterans with Gulf War Illness (EBT) (See also DoD-115; formerly VA/DoD 1V)	C	$44,250										$44,250

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Department of Veterans Affairs Gulf War Research Funding

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VA-063	VA/DoD Core funding of the Medical Follow-Up Agency (See also DoD-116; formerly VA/DoD-2V/2D)	C	$250,000	$250,000	$250,000	$250,000	$250,000	$250,000					$1,500,000
VA-063 A	Follow-Up Investigation of troops exposed to nerve agents at Aberdeen Proving Ground (Pilot Study) (See also DoD-116A; formerly VA/DoD-2VA/2DA)	C											$0
VA-063 B	Patterns of Pre-Persian Gulf War Illness and Health Care Seeking Pilot Study (See also DoD-116B; previously VA/DoD-2VB)	C											$0
VA-064	Boston Environmental Hazards Research Center	C	$300,000	$297,000	$337,200	$337,200	$337,200						$1,608,600
VA-064 A	Functional Neuroimaging in Lead Exposed Adults	C											$0
VA-064 B	Quantification and Validation of Structure-Function relationships through visuospatial test performance	C											$0
VA-064 C	Development of a structured neurotoxicant assessment checklist (SNAC) for clinical use in veteran populations	C											$0
VA-065	San Antonio Environmental Hazards Research Center	C	$300,000	$300,000	$337,200								$937,200
VA-065 A	Does a variant of the human SOD2 gene increase sensitivity to hazards?	C											$0
VA-065 B	The contribution of FEN-1 to genetic integrity subsequent to oxidative stress	C											$0
VA-065 C	The importance of hydrogen peroxide detoxification in cellular protection	C											$0
VA-065 D	Do defective Gpx1 and ALDH2 genes increase sensitivity to environmental hazards?	C											$0
VA-066	Physiological Responding in Posttraumatic Stress Disorder	C											$0
VA-067	Olfactory Functioning in Gulf War Veterans	C											$0
VA-068	Family Study of Fibromyalgia	C	$50,000										$50,000
VA-069	Cardiovascular Hyporeactivity and Fatiguing Illness in Gulf War Veterans	C	$141,815	$48,947									$190,762

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Department of Veterans Affairs Gulf War Research Funding

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VA-070	A Clinical Evaluation of the Health Status of Persian Gulf War Veterans in VISN 8	C	$4,900										$4,900
VA-071	Central Nervous System Modulation of Visceral Pain in the Persian Gulf Syndrome	C	$186,524	$47,975									$234,499
VA-072	Roles of Paraoxonase, Butyrylcholinesterase and Stress in Unexplained Illnesses	C	$50,000	$50,000									$100,000
VA-073	Pain Sensitivity in Gulf War Veterans with Medically Unexplained Musculoskeletal Pain	C	$50,000	$50,000									$100,000
VA-074	A Randomized Clinical Trial for Cognitive-Behavioral Treatment for PTSD in Women (See DoD-125)	C	$896,550	$1,346,863	$1,912,448								$4,155,861
VA-075	ALS and Veterans: Are Veterans at Increased Risk?	C	$139,600	$139,600	$78,455								$357,655
VA-076	Analysis of Hippocampal Volume in Aging Combat Veterans with PTSD	C	$145,100	$135,000	$151,740								$431,840
VA-077	HPA Axis Reactivity in Men and Women with Chronic PTSD	C	$101,400	$101,300	$113,861								$316,561
VA-078	Millenium Cohort Study	C											$0
VA-080	Neurochemical and Neurobehavioral Impact of Pyridostigmine Bromide Treatment and Stress	C		$203,400	$119,818	$248,458	$253,277	$252,602					$1,077,555
VA-081	Stress, Pro-Inflammatory Cytokines and Coping Behavior	C		$193,800	$186,035								$379,835
VA-082	Pituitary Adrenal Function in People with Fatiguing Illness	C	$88,000	$135,000	$151,740	$276,112	$121,842						$772,694
VA-083	Neuropsychological Assessment of a Population-Based Sample of Persian Gulf War Veterans and Controls	C	$18,988	$50,000	$31,012								$100,000
VA-084	Neurobiology of Severe Psychological Trauma in Women	C	$135,000	$135,000	$151,740								$421,740
VA-085	Associative Learning in Veterans with and without Combat Experience	C	$60,400	$74,000	$232,458								$366,858
VA-086	A Clinical Trial of Magnetic Stimulation in Depression	C	$131,400	$131,400	$147,694								$410,494
VA-087	Improving Outcomes of Depression in Primary Care	C	$152,065	$201,926	$218,280								$572,271
VA-088	Prospective Assessment of Neurocognition in Future Gulf-deployed and Gulf-nondeployed Military Personnel: A Pilot Study	C		$24,057	$47,011								$71,068

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Department of Veterans Affairs Gulf War Research Funding

PROJECT NO	PROJECT TITLE	STATUS	FY 2002	FY 2003	FY2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	TOTALS FY 02-11
VA-089	National Registry of Veterans with Amyotrophic Lateral Sclerosis	C		$319,229	$625,564	$799,104	$863,951						$2,607,848
VA-090	Differential Gene Expression in Pathologies Associated with Neuronal Hyperexcitability: Links to Gulf War Illness	O		$250,000	$281,000	$281,000	$449,990	$449,990	$0	$0	$0	$281,000	$1,992,980
VA-090A	Neuronal Hyperexcitability and Motor Neuron Regeneration	C											$0
VA-090B	Gene Expression and Proteomic Strategies in Severe Psychiatric Disorders	C											$0
VA-090C	Developmental Differences in Alcohol Withdrawal Sensitivity	C											$0
VA-090D	Seizures and Neuroplasticity: Physiology and Biochemistry	C											$0
VA-091	The Role of Dietary Choline in Neuroprotection	C			$196,951								$196,951
VA-092	Acetylcholinesterase Activity In Gulf War Veterans	C		$89,920	$49,833								$139,753
VA-093	HPA Axis Alterations in PTSD: A Comparison of Gulf War and Vietnam Veterans	C		$56,750	$36,080	$163,205	$127,405						$383,440
VA-094	The Immunology of Chronic Cutaneous Leishmaniasis	C			$192,204	$157,360	$202,320						$551,884
VA-095	The Role of Signal Regulatory Proteins in Astrocytomas	C		$54,158	$231,566	$238,239	$178,679						$702,642
VA-096	Functional Imaging of Pain in Veterans with Unexplained Muscle Pain	C			$49,035	$128,698	$70,302	$135,127	$95,382				$478,544
VA-097	Improving a mM-CSF Tumor Vaccine for Established Intracranial Gliomas	C		$99,563	$215,093	$241,957	$246,355	$134,628					$937,596
VA-098	Post-Transcriptional Gene Regulation of VEGF in Malignant Gliomas	C			$44,420	$168,600	$168,600						$381,620
VA-099	Vaccination Against Visceral Leishmaniasis with a multi-epitope vaccine	C	$65,700	$123,413	$116,896	$118,863	$117,908						$542,780
VA-100	Studies of the Blood-Brain Barrier and its Manipulation	C	$151,875	$151,875	$151,740	$151,740	$151,740						$758,970
VA-101	Biomarkers Discovery in ALS	C			$50,518	$227,130	$151,555	$112,009	$299,165	$274,432			$1,114,809
VA-102	Cholinergic and Monoaminergic Influences on Sleep	C	$92,588	$92,588	$134,160	$175,814	$134,328						$629,478
VA-103	Hypothalamic and Basal Forebrain Regulation of Sleep and Arousal	C		$210,600	$296,657	$307,253	$317,845						$1,132,355

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Department of Veterans Affairs Gulf War Research Funding

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VA-104	Characterization of Pain Processing Mechanisms in the Irritable Bowel Syndrome	C		$114,975	$168,600	$168,600	$84,300						$536,475
VA-105	Expression of the Major Surface Protease of Leishmania Chagasi	C	$76,613	$135,628	$298,175	$119,535	$92,817						$722,768
VA-106	Interoceptive Stressor Conditioning: A Model for Gulf War Illness	C				$193,440	$198,161						$391,601
VA-107	Evaluation of Stress Response Systems in Gulf War Veterans with CMI	C				$192,766	$117,412	$210,637	$173,321	$93,226	$0		$787,362
VA-108	Telemedicine Treatment for Veterans with Gulf War Illness	C				$185,714	$238,616	$224,916	$11,100				$660,346
VA-109	Effects of Stress on Memory: Brain Circuits, Mechanisms and Therapeutics	C				$158,372	$306,912	$317,503	$321,148	$241,520			$1,345,455
VA-110	Pain Among Gulf War Veterans: Secondary Analysis of CSP#458 Data	C				$96,439	$48,557						$144,996
VA-111	T Cell Responses to Multiple Immunizations and Stress	C				$112,399	$112,399						$224,798
VA-112	National VA Amyotrophic Lateral Sclerosis Research Consortium	C				$1,171,208	$734,590						$1,905,798
VA-113	Novel Cause of Motor Neuron Disease	C				$166,352	$110,152	$110,152	$110,152	$0			$496,808
VA-114	Strategies in Therapeutic Development of Neurodegenerative Diseases	C				$266,950	$370,920						$637,870
VA-115	Autonomic System Changes Cause Intestinal Symptoms in Gulf War Veterans	C				$275,623	$275,623						$551,246
VA-116	Quantitative Trait Genes Controlling Circadian and Sleep Behaviors	C				$125,888	$228,734						$354,622
VA-117	Estimates of Cancer Prevalence in Gulf Veterans Using State Registries	C				$42,206	$151,740	$115,772	$66,597	$0			$376,315
VA-118	Post War Mortality from Neurologic Diseases in Gulf Veterans, 1991-2004	C				$42,262	$160,535	$119,453					$322,250
VA-119	Patterns of Microarray Gene Expression in Gulf War Illness	C				$192,204	$168,600	$168,600					$529,404
VA-120	Arginase NO Synthase and Cell Death in Amyotrophic Lateral Sclerosis	C				$90,988	$165,116						$256,104
VA-121	Genes, Environment, and Oxidative Stress in Neurodegenerative Disorders	C				$295,938	$441,612						$737,550
VA-122	Role of Mitochondrial Oxidative Stress in ALS	C				$55,188	$271,896						$327,084

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Department of Veterans Affairs Gulf War Research Funding

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VA-123	Interactions Between Maternal Care, Stress and Pyridostigmine Bromide	C				$60,134	$48,332	$178,447					$286,913
VA-124	Early Life Determinants of Vulnerability to Pyridostigmine Bromide	C				$213,110	$195,688						$408,798
VA-125	Effects of Gulf War Illness on Brain Structure, Function and Metabolism: MRI/MRS at 4 Tesla	C				$322,532	$479,892	$743,778	$653,747	$560,455	$5,135,117		$7,895,521
VA-126	Structural Magnetic Resonance Imaging in Gulf War-Era Veterans	C				$159,552	$165,565	$165,565					$490,682
VA-127	Interactions of the Leishmania sp. with Mammalian Cells	C				$101,216	$166,464						$267,680
VA-128	MR Tracking of Stem Cells for Replacement Therapy in ALS	C				$236,730	$236,730						$473,460
VA-129	Glucocorticoid Responsivity in Gulf War Veterans	C				$168,600	$167,164	$168,600					$504,364
VA-130	Tissue Factor and Gulf War-Associated Chronic Coagulopathies	O					$194,826	$217,055	$248,741	$273,861	$158,089	$161,644	$1,254,216
VA-131	Neuroendocrine Regulators and Proteomics in GW Veterans with CMI	C					$60,767	$163,579					$224,346
VA-132	Immunologic Mechanisms and Biomarkers in Gulf War Illness	C					$64,630	$112,400	$112,400	$56,200	$56,200		$401,830
VA-133	Longitudinal Study of Gene Expression and Gene Products in Veterans with Gulf War Illness	C					$112,400	$112,400					$224,800
VA-134	Autonomic Functions of Gulf War Veterans with Unexplained Illnesses	O					$8,880	$0	$0	$25,880	$101,863	$72,667	$209,290
VA-135	Motor Neuron Function of Gulf War Veterans with Excessive Fatigue	O					$6,744	$0	$0	$79,242	$103,549	$25,712	$215,247
VA-136	Central Mechanisms Modulating Visceral Sensitivity	C					$83,288	$81,715	$121,055				$286,058
VA-137	Diarrhea-Predominant Irritable Bowel Syndrome in Persian Gulf Veterans	C					$161,968	$224,294	$217,325	$0	$104,982		$708,569
VA-138	Inspiratory Flow Dynamics During Sleep in GWS and the Effect of CPAP	C					$226,773	$235,240	$258,136	$9,819			$729,968
VA-139	Sleep Neurobiology and Circuitry	C					$33,720						$33,720
VA-140	Integrated Neuroimaging and Neuropathological Analysis of the Effects of Physical Activity on Progression and Therapy in ALS	C					$232,553						$232,553

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Department of Veterans Affairs Gulf War Research Funding

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VA-141	Genetic Analysis of an Invertebrate Model of Amyotrophic Lateral Sclerosis	C					$243,779						$243,779
VA-142	VA Gulf War Biorepository Trust	O					$991,510	$991,510	$1,091,547	$5,664,976	$754,942	$948,168	$10,442,653
VA-143	The Role of Protein Oxidation in the Progression of ALS	C					$112,400	$112,400					$224,800
VA-144	Testing the Role of Permethrin on the Progression of ALS	C					$112,400	$112,400					$224,800
VA-145	Proteomic Analysis of Cellular Response to Biological Warfare Agents	C					$129,260	$224,800	$224,800	$112,400	$67,752		$759,012
VA-146	Direct Delivery of Neurotoxins to the Brain by an Intranasal Route	C					$161,687	$256,159	$245,295	$195,214			$858,355
VA-147	The Diagnosis and Pathogenesis of Occult Leishmaniasis	C					$98,350						$98,350
VA-148	Profile of GW Veterans Who Applied for Undiagnosed Illness Compensation	C					$24,307	$71,008					$95,315
VA-149	Behavior of Neural Stem Cells in a Rat Model of GWS	C						$129,861	$268,901	$273,801	$136,900		$809,463
VA-150	Gulf War Veterans Illnesses' Research IDIQ Contract with UTSW	O						$15,000,000	$15,000,000	$6,972,481	$2,288,755	$31,472	$39,292,708
VA-151	Genetic Epidemiology of ALS Veterans	O							$2,116,602	$377,557	$353,309	$242,775	$3,090,243
VA-152	Multiple Sclerosis in Gulf War Veterans	C							$122,010	$137,791	$120,866		$380,687
VA-153	Bacterial Overgrowth Associated with Chronic Multi-Symptom Illness Complex	O								$8,377	$168,600	$94,681	$271,658
VA-154	Imaging Pain Modulation in Gulf War Veterans with Chronic Muscle Pain (renewal of VA-096)	O								$300,782	$258,076	$259,657	$818,515
VA-155	Bacterial Host Defense Mechanisms in Polyaromatic Hydrocarbon Carcinogenesis	O					$71,486	$156,461	$176,790	$165,790	$165,790	$222,552	$958,869
VA-156	Gulf War Era Cohort and Biorepository (CSP 585)	O									$28,361	$5,110	$33,471
VA-157	A Clinical Demonstration of an EEG Brain-Computer Interface for ALS Patients (CSP #567)	O									$2,368,460	$965,519	$3,333,979
VA-158	Testing the Feasibility of MC CBT for Veterans with IBS	O									$17,953	$93,153	$110,746
VA-159	Somatic hypersensitivity in Veterans with IBS	O								$56,200	$112,400	$112,400	$281,000

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Department of Veterans Affairs Gulf War Research Funding

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VA-160	Lipoic Acid Therapy for Experimental Autoimmune Encephalomyelitis	O									$224,126	$168,600	$392,726
VA-161	Multiple Antigenic Peptides to Alter the Course of Autoimmune Disease	O									$332,743	$168,600	$501,343
VA-162	Transcription factors regulating sensory gene expression and pain pathways	C								$94,416	$168,600		$263,016
VA-163	Immunoregulation of Myelin Specific T Lymphocytes	O								$371,209	$361,972	$168,600	$901,781
VA-164	Central Mechanisms Modulating Visceral Sensitivity (renewal of VA-136)	O								$255,170	$267,687	$119,256	$642,113
VA-165	A Pilot Study of CPAP Adherence Promotion by Peer Buddies with Sleep Apnea	O										$94,838	$94,838
VA-166	A Randomized Controlled Trial of a Mindfulness-Based Intervention for Gulf War Syndrome	O										$106,898	$106,898
VA-167	Neuroprotection anf Myelin Repair Mechanisms in Multiple Sclerosis	O										$267,287	$267,287
VA-168	Sleep Neurobiology and Circuitry	O										$244,063	$244,063
VA-169	Prevention of Hippocampal Neurodegeneration Due to Age and Apnea	O										$202,742	$202,742
VA-170	Epigenetic Mechanisms Relevant to the Pathogenesis of ALS	O										$182,650	$182,650
VA-171	Nanoparticle Coupled Antioxidants for Respiratory Illness in Veterans	O										$140,500	$140,500
VA-172	Understanding Pain of Gastrointestinal Origin in Women that Serve in OEF/OIF	O										$84,300	$84,300
VA-173	Impact of Exercise Training on Pain and Brain Function in Gulf War Veterans	O										$104,167	$104,167
			$4,512,676	$5,746,467	$7,644,559	$9,484,679	$13,013,552	$22,059,061	$21,934,214	$16,600,799	$13,856,752	$5,569,011	$120,421,770

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