Welcome & Introductory Comments

Anthony Hardie
National Chair & Director
Veterans for Common Sense
Co-Hosted by:
Welcome & Introductory Comments

Anthony Hardie
National Chair & Director
Veterans for Common Sense
Lea Steele, PhD

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Baylor College of Medicine

Former Scientific Director
Research Advisory Committee on Gulf War Veterans’ Illnesses (RAC-GWVI)
U.S. Department of Veterans Affairs

Author of the Kansas Case Definition of Gulf War Illness
Long-term Effects of Military Service in the 1990-1991 Gulf War

Gulf War illness: Overview and Research Update

Lea Steele, PhD
Baylor College of Medicine
Gulf War Illness

Overview

- Background: the 1990-1991 Gulf War

- Big Picture Questions: Gulf War Illness
  - What is it?
  - What caused it?
  - Who is affected?

- Scientific advances in GWI research
1990-1991 Gulf War:
Operations Desert Shield/Desert Storm

Aug 2, 1990 - Iraq invaded Kuwait
Jan 16, 1991 - Air strikes began
Feb 24, 1991 - Ground combat began
Feb 28, 1991 - Cease fire declared

- 697,000 U.S. troops
- 37 countries in Allied Coalition
- Brief combat period; decisive victory
- 6 weeks air strikes, 4 day ground war
1991: Returning Veterans Report a Range of Difficult Symptoms, Not Explained by Any Known Diagnoses

“Gulf War Syndrome”: Widespread reports of unexplained, persistent health problems

- Chronic headaches
- Widespread pain
- Memory and concentration problems
- Persistent, unexplained fatigue
- Chronic diarrhea
- Difficulty breathing, respiratory problems
- Unusual skin rashes
- Other unexplained problems

Now referred to as Gulf War Illness; consistent complex of chronic symptoms that still affect Gulf War veterans, 30 years after the war.
How is Gulf War illness Defined?

2 Case Definitions Recommended by National Academy of Sciences (IOM, 2014)

- CDC-defined Chronic Multisymptom Illness (Fukuda et al, 1998)
- Kansas Study-defined Gulf War illness (Steele, 2000)
30 Years After Desert Storm:
What Have We Learned About Gulf War Illness?

- GWI affects about one third of 697,000 U.S. veterans who served in the 1991 Gulf War
- Highest rates in enlisted personnel (vs. officers), ground troops (Army, Marines)
- Few veterans with GWI have recovered over time
- Studies have identified multiple brain, immune, and other biological differences in veterans with GWI; detailed insights from animal studies
- Studies consistently show that GWI is not due to combat stress or any psych disorder
- Cause of GWI: Consistent findings from multiple large veteran studies, animal studies point to a group of neurotoxicant exposures during Gulf War deployment
- Most consistently identified: high levels of pesticide use, anti-nerve gas pills (PB), low-level chemical weapons not ruled out
Chemical Weapons
- Multiple chemical alarms, reported incidents during the 1990-1991 Gulf War.
- Best documented: Demolition of large Iraqi weapons depot near Khamisiyah Iraq; DOD models indicate > 100,000 U.S. troops potentially exposed to sarin, cyclosarin
**PB:** Pyridostigmine Bromide or NAPP pills (anti-nerve gas pills)
Required use directed by unit command (3x/day) as protective measure against effects of nerve agents. Widely used (~50% of troops) only in the 1990-91 Gulf War.
Heavy, extended use of multiple pesticides, insect repellants

Table 2. Pesticides and Insect Repellants Identified as Pesticides of Potential Concern by the Deployment Health Support Directorate

<table>
<thead>
<tr>
<th>Compound</th>
<th>Use</th>
<th>Chemical Class</th>
<th>Purpose</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>DEET, 33% cream, stick</td>
<td>Personal use repellent</td>
<td>Diethylamide</td>
<td>Repel flies and mosquitoes</td>
<td>By hand to skin</td>
</tr>
<tr>
<td>DEET, 75% liquid</td>
<td>Personal use repellent</td>
<td>Diethylamide</td>
<td>Repel flies and mosquitoes</td>
<td>By hand to skin, uniform, netting</td>
</tr>
<tr>
<td>Permethrin, 0.5% spray</td>
<td>Personal use repellent</td>
<td>Pyrethroid</td>
<td>Repel flies and mosquitoes</td>
<td>Sprayed on uniforms</td>
</tr>
<tr>
<td>d-Phenomenon, 0.2% aerosol</td>
<td>Area use repellent</td>
<td>Pyrethroid</td>
<td>Knock down, kill flies and mosquitoes</td>
<td>Sprayed in tents, other enclosed areas</td>
</tr>
<tr>
<td>Methomyl 1% crystals</td>
<td>Fly bait</td>
<td>Carbamate</td>
<td>Attract and kill flies</td>
<td>Plac lathni</td>
</tr>
<tr>
<td>Azamethiphos, 1% crystals</td>
<td>Fly bait</td>
<td>Organophosphate</td>
<td>Attract and kill flies</td>
<td>Plac lathni</td>
</tr>
<tr>
<td>Dichlorvos, 20% pest strip</td>
<td>Pest strip</td>
<td>Organophosphate</td>
<td>Attract and kill mosquitoes</td>
<td>Hun area</td>
</tr>
</tbody>
</table>

Pesticides Used by Pesticide Applicators:

- Chlorpyrifos, 45% liquid
  - Sprayed liquid
  - Organophosphate
    - Kill flies, mosquitoes, flying insects
    - Sprayed crate
  - Organophosphate
    - Kill flies, mosquitoes, flying insects
    - Sprayed crate
  - Carbamate
    - Kill flies, mosquitoes, flying insects
    - Sprayed crate
  - Carbamate
    - Kill flies, mosquitoes, flying insects
    - Sprayed crate
  - Organophosphate
    - Kill flies, mosquitoes, flying insects
    - Sprayed crate
  - Organophosphate
    - Kill flies, mosquitoes, flying insects
    - Sprayed crate
  - Organophosphate
    - Kill flies, mosquitoes, flying insects
    - Sprayed crate
  - Organophosphate
    - Kill flies, mosquitoes, flying insects
    - Sprayed crate
  - Organophosphate
    - Kill flies, mosquitoes, flying insects
    - Sprayed crate
  - Organophosphate
    - Kill flies, mosquitoes, flying insects
    - Sprayed crate

A Survey of Gulf War Veterans

Pesticide Use During the Gulf War

An analysis of data from the 1990-1991 Gulf War health study, a study of veterans who served in the Gulf War, found that veterans who reported using pesticides were more likely to have a variety of physical and mental health problems than veterans who did not use pesticides. The study was conducted by the Department of Veterans Affairs and the Centers for Disease Control and Prevention.

1-800-222-4357

Dana A. Vose
Assistant Director for Gulf War Illnesses, Medical Readiness, and Military Health
Department of Defense

3101032.00001
Advances in Gulf War Illness Research: Bottom Line

- **Gulf War Illness is a serious, debilitating medical condition. Most prominent risk factors are neurotoxicant exposures during 1991 Gulf War deployment**

- **Hundreds of thousands of Gulf War veterans affected; few have recovered**

- **Significant advances have improved understanding of the causes and biological processes that underlie the symptoms of GWI**

- **Urgent need remains for effective treatments; many veterans ill for 30 years!**

- **Focus on treatment research has yielded a rapid growth in new studies; results beginning to emerge**
Thank you

Lea.Steele@bcm.edu
James O’Callaghan, PhD

Lab Chief, Molecular Neurotoxicology Laboratory
Health Effects Laboratory Division
U.S. Centers for Disease Control and Prevention–NIOSH
WHY ANIMAL MODELS OF GWI?

1. Direct examination of the brain tissue is a key advantage

2. Persistent molecular (molecules), cellular (specific brain cell types) and functional effects (e.g. behavior) associated with individual and combined exposures/conditions encountered in the Gulf War can be evaluated

3. Specific hypotheses can be tested

4. Therapeutic interventions can be evaluated
STUDYING GWI: HUMAN TO ANIMAL TO HUMAN

1990-1991:
- Model wartime exposures in animals
  - Nerve agent
  - Pesticides
  - Stress
  - Vaccines and preventative meds
  - Others

Present Day:
- Infer treatments
- Identify underlying cause of illness

Validate:
- Animal model
- Biomarkers of illness

Images from Military.com and Boston University School of Public Health
Kimberly Sullivan, PhD

Research Associate Professor, Department of Environmental Health
Boston University School of Public Health

Director, Boston Biorepository, Recruitment, and Integrative Network (BBRAIN) for GWI

Former Associate Scientific Director, Research Advisory Committee on Gulf War Veterans’ Illnesses (RAC-GWVI), U.S. Department of Veterans Affairs
• 16 collaborators from 9 study sites including US and Australia

• Designed to bring preclinical (cell and animal) and clinical (human) researchers together to speed development of understanding pathobiology of Gulf War Illness (GWI), identify diagnostic markers of GWI and to develop treatments.

• Our focus - study brain-immune pathways and chronic release of chemical messengers and excitatory neurotransmitters from immune cells of the brain that lead to chronic inflammation. These messengers include cytokines and glutamate.

https://sites.bu.edu/gwic
Boston GWI Consortium affiliated studies

2013
CDMRP # GW120037
GWI Consortium

2014
CDMRP # GW130100
PET imaging of neuroinflammation in GWI

CDMRP # GW130045
Lipid markers of neuroinflammation

2015
CDMRP # GW140140
CNS autoantibody in GWI

CDMRP # GW140086
GW hiPSC Stem cell study

2016
CDMRP # GW150116
GW women’s health study

CDMRP # GW150037
biomarker study

2017
CDMRP # GW160053
BChE biomarkers of GWI

CDMRP # GW160096
Epigenetic studies Of GWI

CDMRP # GW160151
Tau markers in GWI

CDMRP # GW160032
Machine learning in GWI

2018
CDMRP # GW170068
Gut microbiome study

CDMRP # GW170055
BBRAIN

CDMRP # GW170044
GWICTIC

CDMRP # GW170103
PET imaging of microglia and astrocytes

2019
CDMRP # GW180150
Mitochondrial Functioning in GWI

CDMRP # GW180099
GW White matter brain imaging study

CDMRP # GW180103
PET imaging of microglia and astrocytes

CDMRP # GW180121
CNS autoantibodies and brain imaging outcomes

https://sites.bu.edu/gwic
https://sites.bu.edu/bbrain
Key Biomarker Research Accomplishments

- PET imaging of chronic inflammation in GWI
- Blood markers of chronic inflammation, excitatory neurotransmitter glutamate and CNS autoantibodies
- Machine learning brain imaging studies
- Human induced pluripotent Stem Cells for studying brain cell changes

Alshelh et al., *Brain, Behavior and Immunity* 2020

Abou-Donia et al., *Brain Sciences* 2020
A diagnostic test for GWI?

"Can MRI markers from GWIC predict Kansas criteria?"

Guan et al., *Brain Sciences* 2020
Abou-Donia et al., *Brain Sciences* 2020; 2021

90% GWI cases score above 30 on AA Index Score

CDMRP# GW160032

CDMRP# GW140140
Boston Biorepository, Recruitment and Integrative Network (BBRAIN) for GWI

- Building Scientific Collaborations in GWI Research Community
- Due to the highly successful GWIC research collaborations, the next step was to increase this highly valuable resource by replenishing GWIC samples and by increasing the diagnostic and treatment capability by including investigators from 8 additional study sites in addition to the current GWIC sites
- BBRAIN includes investigators from 10 study sites around the country so far.
- Additional researchers are applying for funds to share more samples with BBRAIN in the coming years
BBRAIN: a repository for GWI investigators

Veterans of the 1991 Gulf War continue to experience chronic symptoms including fatigue, memory and concentration problems, muscle and joint pain, headaches and gastrointestinal problems known as Gulf War Illness (GWI). Preliminary evidence shows that GWI is related to immune dysfunction, neuroinflammation, cognitive decrements, CNS autoantibodies, lipidomics/proteomics, axonal transport/microtubule stability, mitochondrial function and oxidative stress, gut microbiome and genetic/genomic/epigenetic susceptibility.

BBRAIN is designed to act as a retrospective and prospective biorepository for GWI through a collaboration of investigators at our resource sites (Boston University School of Public Health, the Bronx VA, the San Francisco VA, and the Miami VA). We are collecting blood, plasma, serum, saliva, stool, and urine samples from 500 Gulf War veterans as well as demographic surveys and cognitive test data. We will combine demographic, health, and exposure data with cognitive test outcomes and brain imaging data (MRI, DTI, fMRI, PET imaging) from 10 collaborating institutions into a centralized catalog available for data mining and sharing. We will also be including de-identified previously collected survey, clinical, and preclinical data compiled from the 10 participating GWI investigators to be made available to the BBRAIN repository.

BBRAIN Inventory

**Biological Samples**
- Whole blood
- Stem cells
- CSF
- Saliva
- DNA
- Plasma

**Clinical Data**
- Fitbit measures (heart rate, sleep, exercise)
- Cognitive tests (executive functioning, attention, vigilance, and tracking, motor function, visuospatial function; memory; motivation; mood; general intellectual abilities)
- Brain imaging (PET, MRI, DTI, fMRI)

Data Sharing
Requests to access data in our repository can be made through our website: sites.bu.edu/bbrain

Contact Us

Principal Investigator:
Kimberly Sullivan, PhD
kty@bu.edu
617-358-2588

https://wwwapp.bumc.bu.edu/BEDAC_BBrainRetro
Future Directions

• Validate blood and brain imaging diagnostic Biomarkers of GWI

• Identify objective biomarkers of GWI with tau proteins, glutamate and cytokine markers

• Focus on these markers for current and planned targeted treatment trials including:
  • HDAC6 inhibitors, tubacin, Phosphatidylserine
  • Low glutamate diet
  • Metformin
  • Bacopa
  • N-acetyl cysteine (NAC)
Peter W. Baas, PhD

*Professor*, Department of Neurobiology and Anatomy & *Director*, Graduate Program in Neuroscience
Drexel University College of Medicine

*Senior Editor, Cytoskeleton*
A Cellular Approach to Understanding and Treating Gulf War Illness

Peter W. Baas
Drexel University
(with many collaborations, including Liang Qiang and Kim Sullivan)

Central Nervous System symptoms
• Headaches
• Memory problems
• Fatigue
• Sleep problems

Early work
• Veteran questionnaires
• Rodent models

Our approach
• Underlying cellular mechanisms
Many cell types make up the brain. How do we study them?

- Neurons transmit and receive information
- Immune Cells
- Other glial support cells, such as myelin-making cells
- Any of these or all of these could contribute to GWI

Human Induced Pluripotent Stem Cell Technology

- From skin or blood of adult, stem cells are made in the lab. **We made them from blood cells of GWI veterans.**
- They can be differentiated in virtually any cell type of the body.
- They can be used to learn general principles but also “personalized” information from the individual donor.
My approach: To treat GWI, we need to understand what’s going wrong inside the cells.

I mainly study **microtubules**, which are the principal structural elements and highways in all of the cell types of the brain but especially important for the long projections that connect neurons into network.

Many proteins associate with microtubules that could go awry in diseases but chief among them is **tau**, which goes awry in Alzheimer’s disease and many neurodegenerative diseases.

**Might microtubule defects and especially tau defects be at the heart of the central nervous system symptoms of GWI?**

If so, can we fix the detects with available knowledge, tools, medicines and FDA-approved compounds?
What did we find?

• Microtubules are less acetylated
• Tau levels are higher
• Phosphorylation of tau is higher
• Greater indications of neuroinflammation
• Many other aspects of the neurons such as changes in their signal transduction rates and dopamine release that might explain the GWI symptoms
• Most of what we saw is worse in cells coming from Veterans with GWI compared to Veterans without GWI, suggesting potential predisposition of some soldiers for the disease.
Newest Development - Now, we can make human “mini-brain organoids” from these cells.
Treatments for GWI are imminent

- Tubacin/Tubastatin
- Phosphatidylserine

Blood levels are a biomarker for GWI

Treatments may involve antisense oligonucleotides to bring down excess tau levels

Focus on FDA-approved drugs and food additives that can be rushed to the veterans, such as blending phosphatylserine or tau antisense with:
- CoQ10
- Curcumin
- Resveratrol

Studies and treatments all based on cellular mechanisms

Tau
- Blood levels are a biomarker for GWI
- Treatments may involve antisense oligonucleotides to bring down excess tau levels
Nancy Klimas, MD

Director, Institute for Neuro-Immune Medicine (INIM), Dr. Kiran C. Patel College of Osteopathic Medicine;
Professor and Chair, Department of Clinical Immunology; &
Assistant Dean for Research
Nova Southeastern University

Professor Emeritus, University of Miami School of Medicine

Director, Environmental Medicine Research & Clinical Program, Miami VA Medical Center

Director, Gulf War Illness Clinical Trials & Interventions Consortium (GWICTIC)
Nancy Klimas, MD
Director, Institute for Neuro Immune Medicine
Nova Southeastern University
and the Miami VAMC
CDMRP Program getting results – a strategy to move basic science through to effective treatment
Gulf War Illness Consortia (GWICs)
Gulf War Illness Clinical Trials and Interventions Consortium (GWICTIC)
Key Findings: GWICS

- Neuro-inflammation
- Mitochondrial dysfunction
- Immune dysfunction
- Autonomic dysfunction
- Metabolic dysfunction
- Homeostatic regulatory imbalance
Phase 1 and 2 studies of the “reboot” strategy

In order to reduce the administrative time anticipated in a Phase 1 to Phase 2 design, we compressed the two protocols, and submitted them to the internal review panel, the IRB and to HRPO (initially for prereview, then for final review).

The design requires a Phase 1 Phase of etanercept/mifepristone that will be compared to a shorter duration of treatment Phase 1 study currently underway. The results are analyzed and the more effective strategy moves forward to the Phase 2 placebo controls study. This final design will be re-reviewed by the external review panel, IRB, and HRPO, but we anticipate a quick process, as a simple amendment.
Integrating basic science with clinical data... *one-two endocrine-immune punch*
GWICTIC Anticipated Outcomes

- Based on our proposed studies with combinations of synergistic approaches such as etanercept/mifepristone and antioxidants/intranasal insulin in GWI as well as single agents with multiple mechanisms of action such as bacopa.

- This consortium sets to provide the infrastructure needed to backbone additional studies in collaboration with the GWICTIC investigators and other clinical investigators.

- The phase 1 bridge from preclinical to translational human studies as well as an efficient multicenter program that can move promising studies on from phase 1 to phase 2 and 3 trials will be provided to the broader research community.

- Currently support 7 clinical trials, with 13 additional studies submitted last Thursday for review.
Beatrice Golomb, MD, PhD

Professor of Medicine, University of California, San Diego School of Medicine

Director, Golomb Research Group

Former Scientific Director and Chief Scientist, Research Advisory Committee on Gulf War Veterans’ Illnesses (RAC-GWVI), U.S. Department of Veterans Affairs

GWI-Specific Research Leads to Breakthroughs and Treatments.

Beatrice Alexandra Golomb, MD, PhD
UC San Diego School of Medicine

August 23, 2021
First evidence of mitochondrial impairment in GWI\textsuperscript{1-2}

Phosphocreatine recovery time (n=30)

<table>
<thead>
<tr>
<th>Control</th>
<th>GWI</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean (SD)</td>
<td>Mean (SD)</td>
<td></td>
</tr>
<tr>
<td>30 (8.7)</td>
<td>47 (17)</td>
<td>0.001</td>
</tr>
</tbody>
</table>

Phosphocreatine (PCr) = backup energy source for muscle. Levels fall with exercise. Slowed recovery = index of slowed ATP production (mito impairment). PCr-R = recovery time constant. Longer = worse.

Muscle biopsy: Mito impairment. Basis for symptoms in GWI\(^1\).

20/20 in predicted direction: \(p<0.0001\)  17/20 “borderline” significant: \(p<0.0001\)  11/20 frankly significant: \(p<0.0001\)

Ciciiox: Relation to GWI symptoms (UCSD GWI symptom survey). \(N=32\)

<table>
<thead>
<tr>
<th>Symptom</th>
<th>Ciciiox</th>
<th>P</th>
<th>Symptom</th>
<th>Ciciiox</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Difficulty Remembering</td>
<td>-0.45</td>
<td>0.010</td>
<td>Irritability</td>
<td>-0.36</td>
<td>0.044</td>
</tr>
<tr>
<td>Dry Skin</td>
<td>-0.44</td>
<td>0.011</td>
<td>Muscle Pain</td>
<td>-0.35</td>
<td>0.052</td>
</tr>
<tr>
<td>Post-Exertion Fatigue</td>
<td>-0.43</td>
<td>0.014</td>
<td>Joint Pain</td>
<td>-0.34</td>
<td>0.059</td>
</tr>
<tr>
<td>Anxiety</td>
<td>-0.43</td>
<td>0.015</td>
<td>Aches/Pains</td>
<td>-0.33</td>
<td>0.069</td>
</tr>
<tr>
<td>Concentration Problems</td>
<td>-0.41</td>
<td>0.019</td>
<td>Impatience</td>
<td>-0.33</td>
<td>0.069</td>
</tr>
<tr>
<td>Headache</td>
<td>-0.40</td>
<td>0.024</td>
<td>Need to Recheck</td>
<td>-0.33</td>
<td>0.063</td>
</tr>
<tr>
<td>Reading difficulty</td>
<td>-0.39</td>
<td>0.029</td>
<td>Ringing in Ears</td>
<td>-0.31</td>
<td>0.079</td>
</tr>
<tr>
<td>Low Energy</td>
<td>-0.37</td>
<td>0.036</td>
<td>Tiredness</td>
<td>-0.26</td>
<td>0.16</td>
</tr>
<tr>
<td>Muscle Weakness</td>
<td>-0.37</td>
<td>0.038</td>
<td>Sleep Problems</td>
<td>-0.13</td>
<td>0.48</td>
</tr>
<tr>
<td>x Word/Name Recall</td>
<td>-0.37</td>
<td>0.038</td>
<td>Cold Limbs</td>
<td>-0.03</td>
<td>0.86</td>
</tr>
</tbody>
</table>

**Bolded** correlation coefficients reflect a \(p\)-value of <0.1

---

Mitochondrial genetics predict GWI severity\(^1\).

Mitochondria have separate DNA inherited only from the mother.

<table>
<thead>
<tr>
<th>Mito genetic feature</th>
<th>(\beta^*) (SE)</th>
<th>(P)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mito haplogroup U</td>
<td>45.4 (13.0)</td>
<td>0.001</td>
</tr>
<tr>
<td>Mito DNA mutations</td>
<td>49.5 (12.6)</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

Adjusted for NAT2 g2863

*# points added if feature is present (200 point severity scale)

CoQ10 treatment targets mito function – improves GWI\textsuperscript{1}.

Participants: 46 with GWI.

Intervention: CoQ10 100 mg per day x 3.5 mos (vs placebo).

Led to:
- Improved general health (men): \( p=0.04 \).
- Improved symptoms: 19/20 direction favors CoQ10 \( (p<0.0001) \).
  - Many individual symptoms significantly better.
- Improved function: >80% improved on CoQ10 (vs 40% on placebo): \( p=0.025 \).

Change in CoQ10 blood levels significantly predicted improvement.

Mitochondrial cocktail trial now underway!

\textsuperscript{1} Golomb BA. Coenzyme Q10 benefits symptoms in Gulf War veterans: results of a randomized double-blind study. \textit{Neural Comput} 26:2594-651
Harvest treatment experience of GWV to identify best treatments to test.

Number who cited treatment as the best of all treatments tried, divided by number who cited it as the worst.
Discounts benefits based on harms (n≈400).

Identifies promising new treatment for testing, that addresses multiple mechanisms relevant to GWI.

None of this is possible without GWIRP!

CDMRP GW110065
To Recap:

GWI-specific research leads to breakthroughs and treatments.
Fiona Crawford, PhD

President & Chief Executive Officer, The Roskamp Institute

Research Career Scientist, James A. Haley Veterans’ Hospital,
U.S. Department of Veterans Affairs

Chief Operating Officer, Archer Pharmaceuticals
Roskamp Institute
Gulf War Illness Research Program

Fiona Crawford, Ph.D.
President and CEO, Roskamp Institute
Sarasota, Florida
Institute Research

- Focus on neurological and neuropsychiatric disorders
  - Alzheimer’s Disease - our AD research has provided us with a Roadmap for Clinical Translation
  - Gulf War Illness
  - Traumatic Brain Injury
  - Post-traumatic Stress Disorder
  - Red Tide Exposure (Harmful Algal Bloom)

- Identification of novel treatments and diagnostics
Approach

Patient population

Development and characterization of in vitro and in vivo models

Identification of pathogenic mechanisms and molecular targets for drug development

Clinical trials of new, effective therapeutics
Pathology
Genome/Microbiome
Mass Spectrometry – lipidomics, proteomics, metabolomics
Drug Discovery
Chemistry
Key Cellular Mechanisms in the Pathobiology of GWI

♦ Mechanisms
  ❖ Lipid dysregulation
  ❖ Mitochondrial dysfunction
  ❖ Immune/inflammatory disturbances

♦ Biomarkers
  ❖ Lipid profiles
New Treatments being tested in our Clinic

**OEA** (oleoylethanolamide)  
- targeting lipid dysregulation  
- Clinical Trial in GWI patients underway

**NR** (nicotinamide riboside)  
- targeting mitochondrial dysfunction  
- Clinical Trial starting later this year  
- collaboration between the Roskamp Clinic and Dr. Klimas
Closing Comments

Anthony Hardie
National Chair & Director
Veterans for Common Sense
GWIRP-Funded Gulf War Illness Clinical Trial & Research Study Opportunities from our Presenters:

Gulf War Illness Clinical Trials & Interventions Consortium (GWICTIC) (Multiple U.S. sites):  www.nova.edu/nim/GWICTIC


Golomb Research Group (San Diego & Nationwide):  www.golombresearchgroup.org/ParticipateInOurResearch

The Roskamp Institute (Sarasota, FL):  www.RoskampInstitute.org

NSU Florida, Institute for Neuro-Immune Medicine (INIM) (South Florida):  nova.edu/nim/research-studies/research-studies.html
Q&A Opportunity

with the

Presenters

You may email additional questions for the presenters to: info@VeteransForCommonSense.org
Thank you to our distinguished speakers and co-hosts!

Today’s recording will be available at:

• Veterans for Common Sense webpage &
• Institute for Neuro-Immune Medicine
CAPITOL HILL FORUM ON
GULF WAR ILLNESS