Presentation 10 – Lea Steele

Additional Exposures of Possible Concern in Relation to the Health of Gulf War Veterans

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Additional Exposures Potentially Associated with Adverse Health Effects

- Microwaves/electromagnetic radiation
- Contaminated food and water
- Decontaminating agents
- CARC Paint

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Additional Exposures

- *Most affect smaller subset of veterans*
- *Not clear what chronic health effects might be*
- *Tend to not have little data or specific information on either exposures or health effects*

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Microwaves/ Electromagnetic Radiation

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Electromagnetic Radiation

Sources:

- Communications Equipment
  - Microwave towers
  - Radios
- Energy beam weapons being developed/tested in 1990-1991 Gulf War

Self-Reported Exposures to Electromagnetic and Microwave Radiation

Study	Population	Exposure		
Kang, 2000	11,441 GW vets	microwaves	All veterans	23.7%
Kroenke, 1998	18,495 CCEP registrants	microwaves		33.0%
Pierce, 2005	495 female GW vets	Electromagnetic radiation	Avg. # days exposed =	43.61
Stuart, 2002	54,244 GW Vets, CCEP partic.	microwaves	Male Female	18.3% 23.5%
Combined Analysis	21,306 VA registrants	microwaves		33%

Electromagnetic Radiation

Summary:

- Exposure reported by 20-30% of surveyed veterans
- No data on health effects
- Potential association with Gulf War illnesses?

Contaminated Food and Water

Contaminated Food and Water

- Government reports suggest nearly all food and water was supplied by the military
- Food poisoning events in camps commonly reported by veterans

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Government Reports Suggest Nearly All Food Was Supplied by the Military

- " All food DOD military and civilian personnel consumed was provided by the military in the form of meals ready to eat (MREs) or provided in mess halls. Large numbers of meals were not eaten on the local economy and there was no reason to believe that the local food was contaminated with oil fire residue."

--- Environmental Surveillance Health Risk Assessment, Kuwait Oil Fires, CHPPM, 1998

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Contaminated Food and Water: Government Reports Suggest Water Was all Bottled or From Clean Military Tankers

- "DOD military and civilian personnel were provided with sealed containers of bottled water for their consumption. Local drinking water supplies were not utilized. Drinking water was therefore considered a safe, uncontaminated media..."

---- Environmental Surveillance Health Risk Assessment, Kuwait Oil Fires, CHPPM, 1998

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Exposures to Contaminated Water OSAGWI 2000 Report

- While the overall result of water operations during ODS/S was a reliable supply of water fit for consumption, there were exceptions:
  - U.S. supplies of non-potable water were occasionally used for food preparation and drinking
  - A number of units were forced to rely on host nation water delivered by tankers
  - Field Manual 10-280, in effect during ODS allowed use of petroleum transport tankers to carry water, once tanks super-chlorinated and flushed thoroughly

--- DOD, Close-out Report: Water Use, 2000

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Epidemiologic Studies: Local or Contaminated Food How Many Were Exposed?

Study	Population	Exposure		
Kang, 2002	11,441 GW vets	Ate local non-military food	All vets	74.9%
		Ate food contam w/ smoke, oil, chem	All vets	30.2%
Kroenke, 1998	18,495 CCEP registrants	Non-US foods Contaminated foods		66.0% 21.0%
McCauley, 1999	305 GW vets	Ate local foods		74.0%

Epidemiologic Studies: Local or Contaminated Food How Many Were Exposed?

Study	Population	Exposure	Avg. # days exposed
Pierce, 2005	495 AF female GW vets	Contaminated food or water Local, non-AF food	24.75 days 57.09 days
Reid, 2001	3,531 UK GW vets	Local food	20.6%
Unwin, 1999	2,735 UK GW vets	Local food	69.1%
VA Registry		Ate non-US food Ate contaminated food	71.3% 33.2%

Epidemiologic Studies: Contaminated Food Associations with Health Outcomes

Study	Outcome	Exposure	Findings
Boyd, 2003 (978 GW registry vets w/GWI)	Mean factor scale score	Food, infection, equipment factor – incl. contaminates, unsafe food or water	High symptom 3.30 Low symptom 2.87 Effect size 0.16, p=0.01
		Ate local food or drank local water, non-mil supplied	High symptom 2.43 Low symptom 2.26 Effect size 0.06, p = 0.06
Gray, 2002 (3,831 Seabees)	GWI	Food poisoning in unit	OR = 2.14 (1.77-2.58)unadj OR = 1.44(1.13-1.82) sat.
		Got food poisoning	OR = 2.53 (1.92-3.34)unadj
		Ate local food	OR = 1.32(1.13-1.55)unadj.
Reid, 2001 (3,531 UK GW vets)	CFS	Local food	OR = 0.8 (0.5-1.4) unadj OR = 0.9 (0.5-1.6) adj.
	MCS	Local food	OR = 0.8 (0.4-1.6) unadj OR = 0.9 (0.5-1.7) adj

Epidemiologic Studies: Contaminated Food Associations with Health Outcomes

Study	Outcome	Exposure	Findings
Kang, 2002	11,441 GW vets	Ate food contaminated w/smoke, oil, chem	GWI 'cases' 73.4% Non-cases 20.6%
Snadicani, 1999 (667 Danish GW vets)	Neuropsych symptoms: memory, headache, dizziness, fatigue, sleep problems	Ingestion of contaminated food (fumes, oil, chemicals)	Bivariate assoc. w/ # symptoms p <= 0.001, n.s. in multivariate model
		Ingestion of local food	P <= 0.001, n.s. in multivariate model
Unwin, 1999 (2,735 UK GW vets)	CMI	Local food	OR = 1.1 (0.9-1.3)

Epidemiologic Studies: Contaminated Water
How Many Were Exposed?

Study	Population	Exposure		
Kang, 2002	11,441 GW vets	Bathed in or drank water contam. w/ smoke, oil, other chemicals	All vets	28.1%
		Bathed/swam in local pond, river, Gulf	All vets	23.3%
Kroenke, 1998	18,495 CCEP registrants	Non-US water		31.0%
McCauley, 1999	305 GW vets	Water from local taps Water from local wells		34.0% 6.0%

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Epidemiologic Studies: Contaminated Water
How Many Were Exposed?

Study	Population	Exposure		
Pierce, 2005	495 female GW vets (AF)	Contaminated food or water Bathed/swam in local pond, river, Gulf	Avg. # days exposed	24.75 days 6.23 days
Stuart, 2002	54,244 GW vets, CCEP partic.	Contaminated water	Male Female	11.2% 11.7%
Vasterling, 2003	72 GW vets, LA NGreserve	Contaminated shower water		25%
CCEP Report, 1996		Bathed in contaminated water Bathed in non-US water		20% 32%
SIU Report		Bathed in contaminated water Bathed in non-military water		28.6% 30.5%

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Epidemiologic Studies: Contaminated Water
Associations with Health Outcomes

Study	Outcome	Exposure	Findings	
Kang, 2002	11,441 GW vets	Bathed in or drank contaminated water	GWI 'cases' Non-cases	59.8% 19.1%
Gray, 2002 (3,831 Seabees)	CHI	Drank contam. water	OR = 3.79 (3.09-4.67)unadj OR = 1.71(1.32-2.23) sat.	
		Drank water from desert bag	OR = 1.98 (1.66-2.36)unadj OR = 1.36 (1.10-1.72) sat.	
		Bathe in local pond/river/Gulf	OR = 1.76(1.48-2.09)unadj.	

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Epidemiologic Studies: Contaminated Water
Associations with Health Outcomes

Study	Outcome	Exposure	Findings
Haley, 1997 (249 GW vets)	3 syndromes, derived by factor analysis	Drinking water w/ petroleum taste	Impaired Cognition RR = 2.6 (0.9-7.7) Confusion/ataxia OR = 2.8 (1.3-6.3) Arthro-myo-neuropathy OR = 2.6 (1.2 -5.6) (All n.s. in multivariate)
Snodicanin, 1999 (667 Danish GW vets)	Neuropsych symptoms: memory, headache, dizziness, fatigue, sleep problems	Bathed in/drank water contam w/ fumes, oil, chemicals Tooth brushing using wather contam w/ chem or pesticides	Bivariate assoc. w/ # symptoms p <= 0.001, OR = 2.9 (1.8-4.6) multivariate model P <= 0.001, n.s. in multivariate model

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Summary:
Local/Contaminated Food and Water

Summary: Self/Reported Exposures:

- Use of local food reported by: ~ 75%
  Use of local water reported by: ~ 30%
- Exposure to contaminated food reported by: ~ 20-30%
  Exposure to contaminated water reported by: ~ 20-30%

Summary:
Local/Contaminated Food and Water

Summary: Health Effects

- Local food: little association with health outcomes
  Local water: *no information*
- Contaminated food: OR~1.5 – 2.5
  Contaminated water: OR ~ 1.8 - 3.8

  Consumption of both contaminated food and water highly associated with GW-factor case status in large VA study

Summary:
Contaminated Food and Water

- Widespread exposure to locally-supplied food and water, but little indication of link to poor health
- Epi studies suggest possible associations between chronic symptoms and contaminated food/water
- No data to suggest possible mechanism for such a link; speculative possibilities might include:
  - *Food or waterborn pathogen associated with chronic "subclinical" infection?*
  - *Acute debilitation caused by food poisoning alters effects of other exposures?*
  - *Toxic effects of ingested oily substances?*
  - *Spurious findings?*

Decontaminating Agents

Decontaminating Agents: DS2

Decontaminating Solution 2

- Used in the Gulf War to decontaminate equipment exposed to chemical warfare agents
- Principal constituent is 2ME (ethylene glycomonomethyl ether)
  - *Widely used in paints, varnishes, industrial solvents*
- Animal studies indicate hematological, reproductive effects *(testicular damage, diminished fertility)*
- Chronic effects after limited exposures? unknown
- One report of soldiers with dermal exposures developed rashes

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CARC Paint

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Chemical Agent Resistant Coating (CARC) Paint

- Thousands of military vehicles and other equipment shipped into theater in association with the Gulf War
- Most of the equipment was still painted green "woodland camouflage" when it arrived
- Urgent need to repaint vehicles to desert camouflage colors
- Painting operations set up to paint large number of incoming vehicles in theater prior to Desert Storm
- After the war, similar operations repainted many vehicles back to woodland camouflage

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Chemical Agent Resistant Coating (CARC) Paint

- A polyurethane paint applied to military equipment
  - Improve protection from chemical warfare agents
  - Facilitate decontamination
  - Extends service life of vehicles and equipment
- CARC contains multiple hazardous compounds (toluene, benzene, crystalline silica, ketone)
- Most concern focused on HDI (hexamethylene diisocyanate) which hardens the paint
- Additional hazardous solvents (paint thinners, cleaners, etc) used in painting operations

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Chemical Agent Resistant Coating (CARC) Painting Operations

- First painting operations set up by experienced civilian painting contractors in Sep, 1990 at port of Ad Dammam, SA
  - This group had protective equipment
- Two additional major CARC spray painting operations established by the Army
  - Ad Dammam
  - Al Jubayl
- These sites operated by a Florida Army National Guard Unit, the 325th Maintenance Company
  - This unit not trained in painting operations, did not have proper protective equipment
- Other, smaller operations also established for shorter periods

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Health effects of CARC exposure

- Aerosolized, freshly applied paint:
  - Respiratory problems, asthma
  - Dizziness
  - Fatigue
  - Nausea
  - Headache
  - Skin rashes
  - Nausea, vomiting, diarrhea
  - Sensitization
- After it hardens, CARC (HDI) thought to present a problem only if heated to high temperatures (also if sanded/chipped?)

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325th Maintenance Company

- Started painting in Nov 1990; operations lacked proper personal protective equipment, air circulation equipment
- Began reporting health problems during operations (Dec 90 report): dizziness, rashes, vomiting, nausea
- Local command concerned; ANG alerted ARCENT; family members contacted Adj General, Congress
- Onsite investigation of operations at Ad Dammam and Al Jubayl December-June; operations shut down temporarily
- Protective equipment eventually provided

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325th Maintenance Company: the Story

- Health, respiratory evaluations provided to all members by Army physician in 1992 during 2-week training period at Ft. Stewart, GA
- Met with representatives of South Florida VBA Regional Office to assist with filing claims
- Regional office handled the issue locally
- What happened?
  - How many became ill?
  - What were there symptoms, diagnosed conditions?
  - Benefits provided?
  - Effort to assist other units involved in CARC painting operations?

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325th Maintenance Company

- No study or data available; no comprehensive report summarizing how many affected and how
- Sources of information
  - OSAGWI Environmental Exposure Report
  - 1993 Report to Congress
  - Information from Florida RO
  - Information from Congressman Putnam's office
  - Information from ANG rep, company commander, physician who assisted ill veterans, affected veterans, OSAGWI lead sheets

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325th Maintenance Company

- Physician who examined 20-30 veterans in 1992:
  - Reported paint fumes permeated entire camp:--administrative, eating, sleeping area—at Al Jubayl operations
  - So much solvent vapor in the air, lights had to be replaced with type that resist explosions
  - Veterans he examined showed multiple nonspecific symptoms:
    - *Headache*
    - *Fatigue*
    - *Sleep disturbances*
    - *Asthma-like symptoms*
    - *Some became highly sensitized*

325th Maintenance Company

- Representative of Florida Army National Guard
  - Problems had been severe in theater: coughed up paint, joint swelling, rashes, respiratory problems, nerve problems
  - Afterwards, the unit had a lot of problems, not sure if it was Gulf War syndrome or effects of CARC paint
  - Guard never received funding to do medical evaluations of the whole unit; urged them to go to VA
  - Many of those in the unit were poor, couldn't get to Tampa VA for evaluation

325th Maintenance Company

- Severely ill veteran
  - Veteran had been a runner, black belt karate instructor
  - Says lungs are badly damaged from chemicals: wheelchair bound, requires oxygen, "it ate half a lung"
  - Has lupus, "esophagus closed", allergic to chemicals and perfumes, skin lesions, rash since the war
  - Described others in unit who had brain and/or lung cancer, says about 8 had died so far
  - He is 100% service connected; took 5 years

325th Maintenance Company

- VA Regional Office in St. Petersburg, FL
  - Handled the issue locally, established guidelines for service connection
  - All members of the unit presumed exposed to CARC; veterans filed claims, required opinion of doc performing C&P exam
  - CARC-specific service connection allowed only for respiratory and skin problems; other symptoms/undiagnosed conditions not S-C
  - Tried very hard to service-connect "applied any and all laws"
  - Some claims still pending: Recalled about 200 cases processed, but CARC cases not specifically collated. +As of June, 1993:
    - *70 individuals from 325th listed in VA files*
    - *20 had filed claims: 6 pending, 8 denied, 6 service connected*
    - *Claims involving resp/env hazard: 2 s/c, 4 denied*

325th Maintenance Company

- Dr. Bruce Pettyjohn
  - Was medical officer for the 325th; did exams predeployment and postdeployment
  - Most patients had memory problems, skin rashes, muscle pain, GI problems; not sure how much was due to CARC, other exposures
  - Wrote ~ 50 page report for about 200 veterans to assist with benefits applications
  - VA "poo-pooed" the problem
  - Some have died from various causes; he thinks they deserve purple hearts

Epidemiologic Studies: CARC Paint How Many Were Exposed?

Study	Population	Exposure		
Kang, 2000	11,441 GW vets	CARC paint	All veterans VA registry vets	21.7% 35.0%
Kroenke, 1998	18,495 CCEP registrants	CARC paint		48.0%
Stuart, 2002	54,284 GW Vets, CCEP partic.	CARC paint	Male Female	31.1% 20.3%
Australian GW Study	1,456 Austr. GW vets	contact with wet CARC paint		1.3%

Epidemiologic Studies: CARC Paint Association with Health Outcomes

Study	Outcome	Exposure	Findings
Haley, 1997 (249 GW vets)	3 syndromes, derived by factor analysis	Near enough to smell CARC paint sprayed	Impaired Cognition RR = 0.9 (0.1-6.9) Confusion/ataxia RR = 3.2 (1.3-8.0) Arthro-myo-neuropathy RR = 1.6 (0.5-5.1)
Spencer, 2001 (1,119 GW vets)	CMI	Painted with CARC	OR = 3.29 (1.88-5.76)
Kang, 2002	11,441 GW vets	CARC paint	GWI 'cases' 51.2% Non-cases 16.3%

CARC Paint: Epidemiologic Findings

- ~20 % Gulf veterans report exposure to CARC paint; higher among Registry participants
- Association of s/r CARC paint exposure to multisymptom complexes: OR ~ 3.0

CARC Paint: Summary

- Appears that excess exposure to CARC paint did occur in some individuals, likely resulted in serious health problems
- Epi studies suggest possible association with multisymptom illness
- Most information available on the 325th Maintenance Co.
- No reports identified that summarized clinical findings in this group, or other CARC-exposed groups
- Unclear whether symptoms of these veterans all due to CARC, or potentially related to other causes
- Little info re: effects of CARC exposures with other painting operations

Misc exposures

Additional Exposures Potentially Associated with Adverse Health Effects

Misc

- Hydraulic fluid
- Purple T shirt incident
- Other industrial exposures?

Exposure to Hydraulic Fluid

Study	Outcome	Exposure	Findings
Spencer, 2001 (1,119 OR/WA GW vets)	CMI	Cleaned hydraulic leaks	OR = 2.45 (1.31-4.58) unadjusted