

**Appendix A**

**Presentation 1 – Barbara LaClair**

**Overview of Exposures and Health Conditions  
Reported by Countries who Served in the  
1990-1991 Gulf War Allied Coalition**

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**Meeting of the Research Advisory Committee  
on Gulf War Veterans' Illnesses  
December 12, 2005**

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**Gulf War-related Exposures and Health  
Outcomes Reported by Coalition Countries**

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- Preliminary ecological "Big Picture" assessment
- "Work in progress" based on published government reports and journal articles; additional information needed to complete analyses
- Generalized comparisons only: types of questions, strength of information varies widely by country

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## The Allied Forces Coalition

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- 38 countries in addition to U.S.
- Slightly more than 200,000 troops
- Members of the Coalition included Argentina, Australia, Bahrain, Bangladesh, Belgium, Canada, Czechoslovakia, Denmark, Egypt, France, Germany, Greece, Italy, Japan, Kuwait, Morocco, Netherlands, New Zealand, Niger, Norway, Oman, Pakistan, Poland, Portugal, Qatar, Saudi Arabia, Senegal, South Korea, Spain, Syria, Turkey, United Arab Emirates, United Kingdom and the United States.
- Germany and Japan provided financial assistance instead of military aid.
- Israel remained officially neutral.



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## United Kingdom

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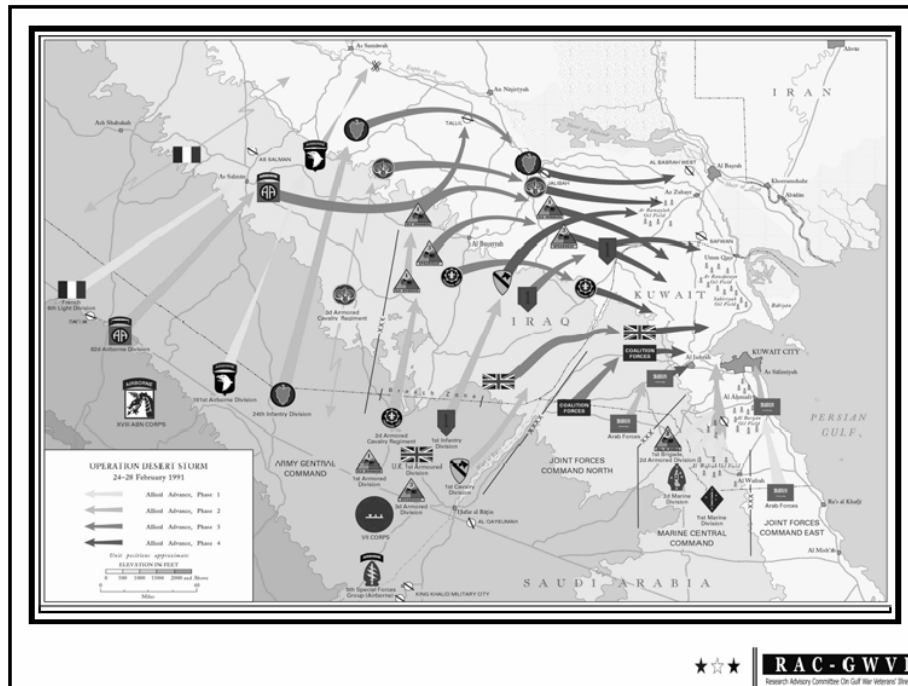


- Approximately 53,000 deployed
  - > 70% Army
  - > 11% Navy
  - > 19% Air Force
- Forces concentrated closer to Saudi / Kuwait border



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## United Kingdom: Health Studies



- **Unwin et al, 1999**
  - Cross-sectional postal survey
  - 4,248 GWV; 4,250 Bosnia vets; 4,246 NGW era vets
  - Aug 1997-Nov 1998
- **Cherry et al, 2001**
  - Cross-sectional questionnaire
  - 9,585 GWV; 4,787 NGW era vets
  - Dec 1997-Sept 1999

## United Kingdom: Exposures

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<b>Pesticides</b>	<p>69.2 % used personal insecticides            34.4% used &gt; 14 days            20.1% in sprayed quarters            38.4% on clothing, bedding  <b>DEET</b> for skin application  <b>Permethrin</b> for clothing, mosquito netting, area spray            Locally purchased azamethipos pesticides for flies            Malathion for de-lousing</p>
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## United Kingdom: Exposures

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<b>Nerve Agents</b>	70-82% wore protective gear/ heard alarms								
<b>PB/NAPs</b>	<p>81.6% reported use            65.1% &gt; 14 days</p>								
<b>Vaccines</b>	<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="padding: 2px 5px;">Anthrax</td> <td style="padding: 2px 5px;">57-75% (pertussis adjuvant)</td> </tr> <tr> <td style="padding: 2px 5px;">Plague</td> <td style="padding: 2px 5px;">25.7%</td> </tr> <tr> <td style="padding: 2px 5px;">Typhoid</td> <td style="padding: 2px 5px;">12.5%</td> </tr> <tr> <td style="padding: 2px 5px;">Cholera</td> <td style="padding: 2px 5px;">13.7%</td> </tr> </table>	Anthrax	57-75% (pertussis adjuvant)	Plague	25.7%	Typhoid	12.5%	Cholera	13.7%
Anthrax	57-75% (pertussis adjuvant)								
Plague	25.7%								
Typhoid	12.5%								
Cholera	13.7%								

## United Kingdom: Exposures




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Oil Fires	61-72% reported smoke exposure
Depleted Uranium	No data
CARC paint	No data

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## United Kingdom: Health Symptoms




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- Current symptoms (past month):

Symptom	% in GWV	Excess Prev	Adj. OR
Fatigue	50.7%	23.0%	2.7*
Headache	53.5%	17.9%	2.1*
Memory problems	44.9%	27.8%	4.2*
Muscle/joint/musculosk. pain	40.0%	16.5%	2.8*
Diarrhea	NR		
Dyspepsia/indigestion	NR		
Skin problems	NR		
Shortness of breath	NR		

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## United Kingdom: Health Conditions




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- Conditions seen, diagnosed or treated by physician (s/r):

Complaint/ Condition	% in GWV	Excess Prev	Adj. OR
Skin condition (dermatitis)	21.3%	9.0%	1.5*
Arthritis/ joint problem	9.7%	1.8%	1.4*
GI problems	NR		
Respiratory problem (asthma)	6.5%	1.8%	1.8*
CFS	3.3%	3.0%	4.2*
PTSD	13.2%	9.1%	3.8*
CMI	61.9%	25.5%	2.9*


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## United Kingdom: Summary




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- GW cohort reported symptoms & disorders more frequently than Bosnia and Era cohorts
- Majority of exposures associated with all outcomes
- Vaccination against biological warfare & multiple routine vaccination associated with CMI


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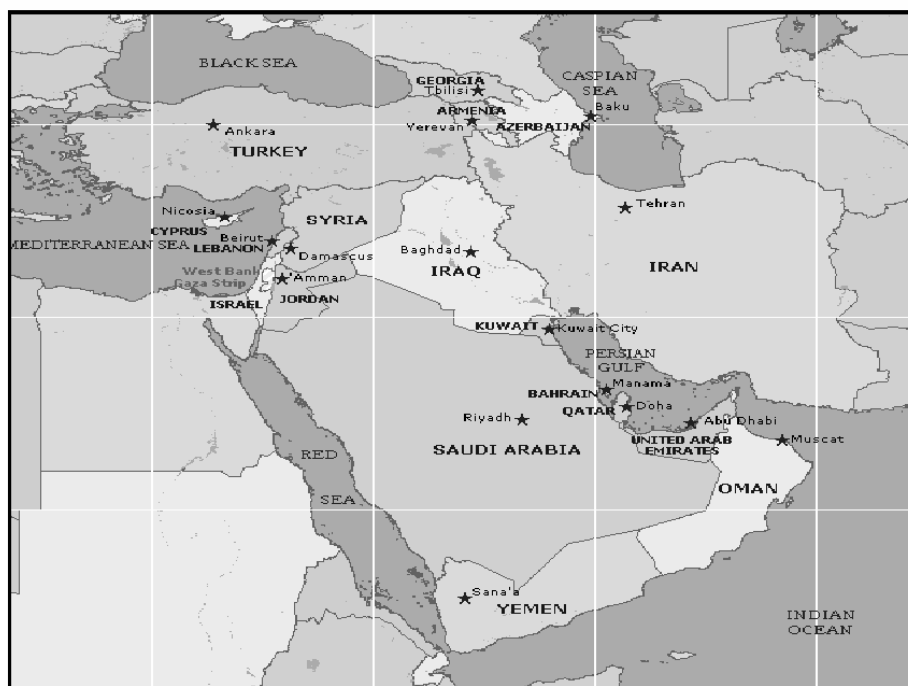
## Canada




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- Approximately 4,447 troops deployed
  - > 27% Army
  - > 33% Navy
  - > 40% Air Force
- August 1990 to July 1991
- Diverse locations, including Cyprus, Iraq, Kuwait, Saudi Arabia
- 2 largest contingents in naval blockade and air war
- Operated 1 field hospital
- Minimal involvement in ground conflict

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## Canada: Health Studies




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- *Health Study of Canadian Forces Personnel Involved in the 1991 Conflict in the Persian Gulf*, Goss Gilroy, Inc., April 1998
- Cross-sectional survey, all Canadian GWVs
- Conducted in 1997
- Postal questionnaire
- Comparison group of Canadian Forces members serving in other locations at time of Gulf War
- Results also compared to OHS study of population health

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## Canada: Exposures




<b>Pesticides</b>	Minimal exposure. Approximately 20% ever used DEET Permethrin use rare
<b>Nerve Agents</b>	Not reported.
<b>PB/ NAPs</b>	85% reported use. Duration varied from 3 days to 4 weeks.
<b>Vaccines</b>	Few received anthrax. Indiv. serving with 1st Canadian Field Hospital received plague and anthrax vaccine with pertussis adjuvant.

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## Canada: Exposures




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Oil Fires	Minimal exposure
Depleted Uranium	Troops rarely inside destroyed Iraqi vehicles, and then usually weeks after destruction.
CARC paint	Few individuals involved with painting vehicles.


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## Canada : Health Symptoms



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- Symptom checklist of 37 symptoms, matching list used by U.S. CCEP program
- Symptom report data aggregated to “combined symptom clusters”, similar to those in Iowa Persian Gulf Study
- Findings generally comparable to those of Iowa study, except for higher rates of cognitive dysfunction, CFS, and depression among Can. GW vets

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## Canada: Summary



- Prevalence of chronic health problems among NGW control group similar to that of general population
- GWs had higher prevalence of most conditions, esp. diseases of bone & joints, allergies, stomach problems
- Symptoms of cognitive dysfunction, CFS, MCS showed largest differences from controls (adj. PORs = 4 - 5)
- Cognitive dysfunction most strongly associated with psych stressors (POR 2.1), physical trauma (POR 1.5) and CNS exposure factors (POR 1.5)
- Provider-diagnosed PTSD associated with psych stressors (POR 5.8), chemical warfare agents (POR 5.3), CNS factors (POR 3.0)



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## Australia

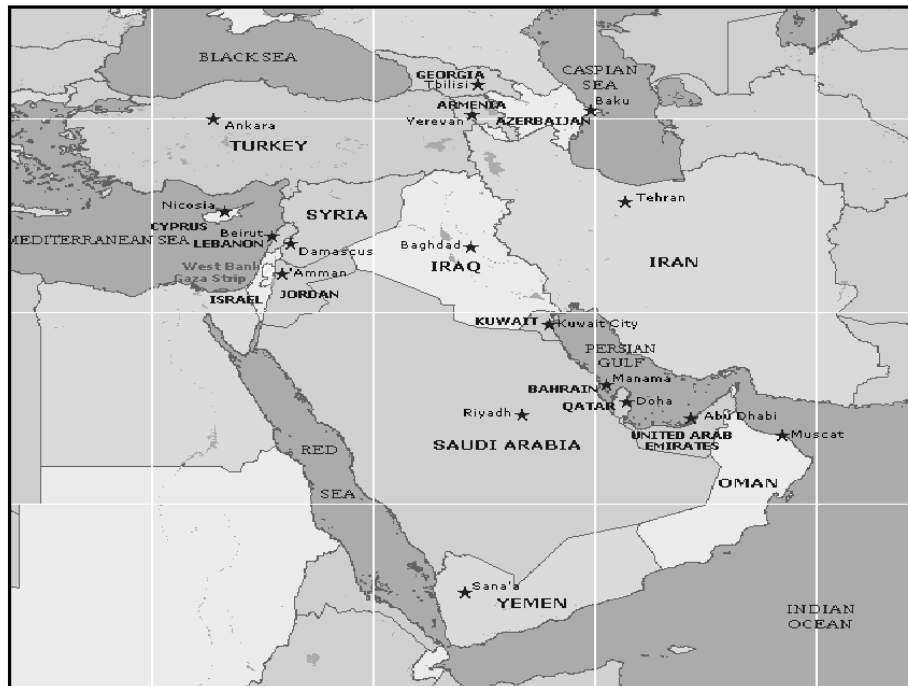


- Approximately 1,900 deployed
  - > 6% Army
  - > 87% Navy
  - > 7% Air Force (transport & logistic support only)
- Majority of troops located on-ship in Gulf of Oman



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## Australia: Health Studies



- ***Australian Gulf War Veterans' Health Study, Prof. Malcolm Sim, 2003***
  - Cross-sectional survey of all 1,873 GW veterans
  - Postal questionnaire and medical evaluation
  - Recruitment ended April 2002
  - Comparison group of era ADF personnel, eligible for deployment but non-deployed
- ***Kelsall HL et al, 2004***


## Australia: Exposures



<b>Pesticides</b>	<p>26% used personal pesticides                  20% lived where pesticide sprayed/ fogged                  11% applied pesticides                  5% clothing/ uniforms treated with pesticides                  3% tent treated with pesticides (permethrin)                  0.4% wore flea collar</p> <p style="font-size: small;">Army used Dieldrin (OCI); Malathion, Diazanon, Temephos (OP); Baygon, Bendiocarb (Carbamates).                  Clothing &amp; tents dipped in permethrin &amp; dried.                  DEET-based insect repellants issued.</p>
<b>Nerve Agents</b>	<p>46% used NBC suits                  11% in area where chemical warfare used</p>


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## Australia: Exposures



<b>PB/ NAPs</b>	51.4% reported use; 17% took >180 pills
<b>Vaccines</b>	<p>15.3% reported anthrax vaccine (not on official schedule)                  48.1% reported plague vaccine                  14% reported &gt;5 immunizations w/in 1 week                  Routine vaccines included typhoid, cholera</p>
<b>Oil Fires</b>	54% SMOIL exposure
<b>DU</b>	19.3% handled DU shell casings


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## Australia: Exposures

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<b>CARC paint</b>	<b>Exposure unlikely</b> 1.3% self-reported exposure
<b>Sand</b>	48% exposed to dust storms
<b>Fuels</b>	79% solvents, oils, diesel, fuels on skin 78% refueling
<b>Food/Water</b>	57% ate locally sourced military food 41% drank water from local taps/ wells 15% showered with water with fuel in it 12% drank water with oil in it






## Australia: Health Symptoms


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- Current symptoms (past month):

Symptom	% in GWV	Excess Prev	Adj. OR
<b>Fatigue</b>	<b>66%</b>	<b>10%</b>	<b>1.6*</b>
<b>Headache</b>	<b>61%</b>	<b>7%</b>	<b>1.3*</b>
<b>Memory problems</b>	<b>46%</b>	<b>12%</b>	<b>1.7*</b>
<b>Muscle/joint/musculosk. pain</b>	<b>39%</b>	<b>5%</b>	<b>1.3*</b>
<b>Diarrhea</b>	<b>26%</b>	<b>9%</b>	<b>1.7*</b>
<b>Dyspepsia/indigestion</b>	<b>28%</b>	<b>5%</b>	<b>1.4*</b>
<b>Skin problems (rash, irritation)</b>	<b>36%</b>	<b>8%</b>	<b>1.5*</b>
<b>Shortness of breath</b>	<b>31%</b>	<b>9%</b>	<b>1.6*</b>



## Australia: Health Conditions




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- Conditions seen, diagnosed or treated by physician (s/r):

Complaint/ Condition	% in GWV	Excess Prev	Adj. OR
Skin condition (any other)	16%	4%	1.4*
Arthritis/ joint problem	22%	2%	1.2
GI problems	11%	1%	1.1
Respiratory problem (asthma)	4%	1%	1.2
CFS	1%	0%	0.8
PTSD	5%	3%	3.1*
CMI	NR		

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## Australia: Summary



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- GWVs reported all general health symptoms more frequently than NGVs, more likely to report higher number of symptoms, greater symptom severity
- Rates of psychological disorders (PTSD, anxiety, depression, substance abuse) higher among GWV than comparison group
- Weak associations between neurological symptoms and # of immunizations, exposures to PB, anti-malarials, anti-biologicals, solvents, pesticides, repellants (Adj. ORs 1.1-1.9)

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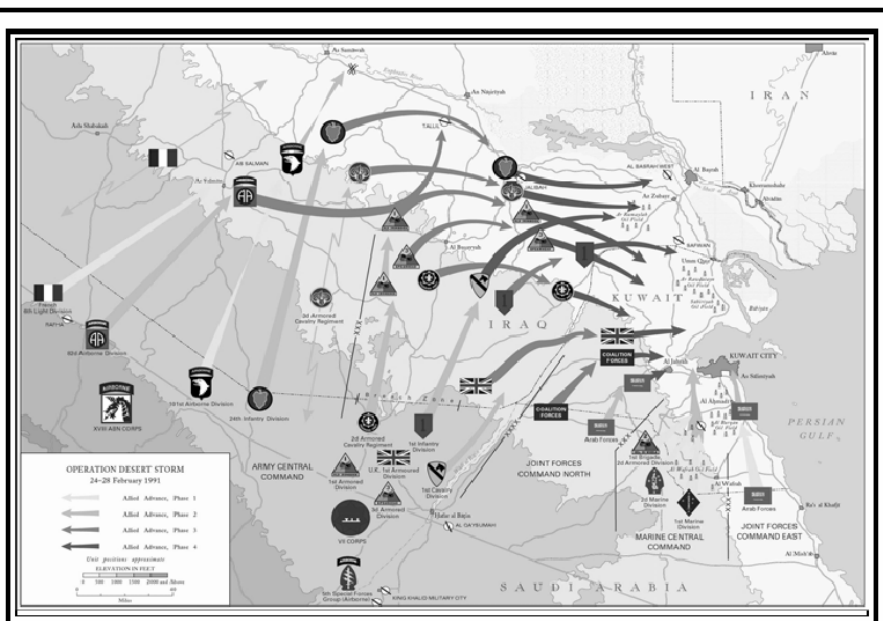
## France



- **Approximately 21,000 deployed**
  - 62% Army
  - 23% Air Force
  - Other – Navy, Medical Services, Fuel Services
- **Troops located primarily on western flank**




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## France: Health Studies




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- *The French study on the Gulf War and its impact on health*, Prof. R. Salamon, July 2004
- Cross-sectional study of all French military and civilian personnel who served in Gulf War
- Conducted from October 2001 to June 2004
- Postal questionnaire; free medical exams offered
- 5,666 questionnaires; 1008 medical exams
- No comparison group

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## France: Exposures



<b>Pesticides</b>	25% reported contact 14% used personal insecticides No Organophosphates DEET for personal repellent K-orthrin on mosquito netting Lindane on ground, sprayed tents & buildings Pyrethrins for pest control on aircraft No systematic spraying of aerosols
<b>Nerve Agents</b>	63% experienced at least 1 alert


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**France: Exposures** 

<b>PB/NAPs</b>	31% reported use Relied more on protective gear – tropical suits & ventilated shelters
<b>Vaccines</b>	No anthrax, botulinum Did receive plague, typhoid


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**France: Exposures** 

<b>Oil Fires</b>	28% reported smoke exposure
<b>Depleted Uranium</b>	No data
<b>Petrochemicals</b>	No data
<b>Food/water</b>	Relied on bottled water. Some reports of drinking bottled water from Iraqi stock, water transported in fuel tanker trucks

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## France: Health Symptoms




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- Checklist of 49 symptoms, experienced at any time since return from Gulf War
- No estimates of current symptom prevalence
- Reported symptom rates not comparable to other countries

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## France: Health Conditions



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- Conditions seen, diagnosed or treated by physician, since return from Gulf (s/r):

Complaint/ Condition	% in GWV	Excess Prev	Adj. OR
Skin condition	8%		
Arthritis/ joint problem	NR		
GI problems	11%		
Respiratory problem	14%		
CFS	NR		
PTSD	0.2%		
CMI	NR		

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## France: Summary



- **Lack of current prevalence and comparison groups limit interpretation of symptom and condition reports**
- **No evaluation of associations between exposures & health outcomes**
- **89% of study participants reported current health status as very good or good**
- **150 GW veterans have applied for pensions:**
  - 61 denied
  - 38 pending
  - 51 approved
    - 24 GW service connected



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## Denmark



- **Total of 821 served between August 1990- December 1997**
  - **About 60% deployed from 1992-1994**
  - **Troops successively replaced every 6 months**
- **Deployed primarily in peace-keeping and humanitarian operations after war**
- **29-member surgical team deployed with British hospital in Al Jubayl**



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## Denmark: Health Studies

- Danish Gulf War Study, Ishoy, Suadicani *et. al*, 1999
- Cross-sectional study, Jan 1997- Jan 1998
- 686 GW veterans, 400 non-deployed controls matched on age, sex, profession
- Symptom & exposure questionnaires, health examinations

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## Denmark: Exposures

Pesticides	26.9% lotions/sprays for fleas 19.5% insecticides for cockroaches
Nerve Agents	0.4% nerve gas 0.3% mustard gas or similar 4.0% SCUD explosions w/in 2 km
PB/NAPs	Unknown
Vaccines	Unknown

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## Denmark: Exposures

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<b>Oil Fires</b>	45% fumes from burning wells
<b>Depleted Uranium</b>	3% reported DU exposure 54% inside destroyed Iraqi tanks
<b>Petrochemicals</b>	64% diesel, kerosene other fuels 57% skin contact 34% evaporated diesel on ground
<b>Food/water</b>	77% ate local foods 16% bathed/drank contaminated water (chemical, pesticides)

## Denmark: Health Symptoms

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• **Current symptoms (past 12 months, onset during/after GW):**

Symptom	% in GWV	Excess Prev	Adj. OR
Fatigue	26.4%	15.6%	3.0*
Headache	19.2%	12.7%	3.4*
Memory problems	31.2%	23.0%	5.1*
Muscle/joint/musculosk. pain	9.2%	(-1.6%)	0.8
Diarrhea	17.2%	13.3%	5.1*
Dyspepsia/indigestion	16.9%	9.1%	2.4*
Skin problems <sup>¶</sup>	17.1%	11.9%	3.8*
Shortness of breath	14%	10.5%	4.5*

¶ lifetime prevalence

## Denmark: Health Conditions



- At clinical examination, significantly larger proportion of GW veterans had one or more ICD-10 diagnoses (80.8% vs. 71%,  $p=0.002$ )
- 38% of GW veterans had one or more diagnoses that could be related to service in Gulf



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## Denmark: Summary



- Except for muscle/joint symptoms, symptom patterns similar to U.S., U.K veterans
- Higher symptom prevalence among GWV was seen for symptoms with onset since GW; prevalence prior to August 1990 was similar to NGV group
- Neuropsych symptoms associated with:
  - > Bathe in /drink contaminated water OR=5.0 (2.9-8.9)
  - > Exposure to DU OR=4.2 (1.4-13.0)
  - > Contact with dead animals OR=1.4 (1.1-1.8)
  - > Burning waste/ manure OR=1.8 (1.1-2.9)
- GI symptoms associated with:
  - > Burning waste/ manure OR=2.5 (1.3-5.0)
  - > Insecticide against cockroaches OR=2.3 (1.2-4.4)



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## Czechoslovakia



- 367 troops deployed (169 in Phase I, 198 in Phase II)
- Primarily conducted CW agent detection
- Located in Kuwait & Saudi Arabia



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## Czechoslovakia: Studies




- Czech government conducted 2 studies of health of Gulf War veterans
- 198 veterans ordered to undergo yearly health exams



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## Czechoslovakia: Exposures



Pesticides	Unknown
Nerve Agents	Czech detection teams reported chemical alerts Jan 19, 1991 and Jan 24, 1991
PB/NAPs	Not used
Vaccines	Broad array of vaccinations No inoculations for Anthrax
Oil Fires	No data
Depleted Uranium	No data

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## Czechoslovakia: Health Outcomes



- “Studies found no similarity between symptoms reported by Czech veterans and U.S. veterans” (GulfNEWS, January 26, 1998)
- SIU Report (1998) – Czechs examined 86% of GW veterans residing in Czech Republic:
  - > 40% in good health
  - > Most frequent complaints fatigue, headaches, joint pain
  - > No objective explanation of illness in 6 veterans (4.5%), but not attributed to Gulf War service

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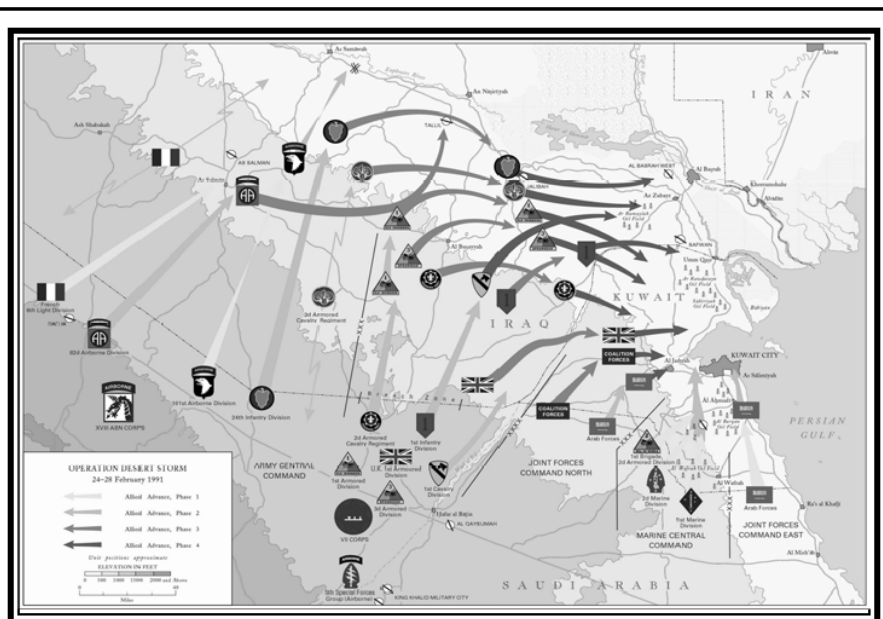
## Arab Coalition

- Saudi Arabia ~ 45,000
- Egypt ~ 35,000
- Syria ~ 20,000
- Kuwait, Bahrain, UAE, Oman, Qatar ~ 17,000
- Pakistan ~ 5,000
- Morocco ~ 1,500
- Also Hungary and Slovakia



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## Arab Coalition: Studies

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- Gackstetter et al, 2005
  - Hospitalizations of Saudi Arabian National Guard veterans, 1991-1999
  - 8,342 soldiers exposed to combat at Al Khafji, compared to 7,270 soldiers in Riyadh area



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## Arab Coalition: Exposures

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- No Data



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## Arab Coalition: Health Outcomes

- Gackstetter study:
  - > Slight increase in hospitalizations among combat group  
 RR=1.80, (95% CI 1.25-2.59)
  - > No unusual patterns of diagnosis found
- “Middle Eastern countries have not reported unusual health problems in their military populations. Early concerns about respiratory disorders that might be related to oil well fires had not been substantiated.” [Gulf War Review](#), May 2001



## Summary: Excess prevalence of symptoms

Symptom	U.S.	U.K.	Can	Austr	Den
Fatigue	23%	23%		10%	16%
Headache	17%	18%		7%	13%
Memory problems	32%	28%		12%	23%
Muscle/joint pain	18%	17%		5%	(-2%)
Diarrhea	16%			9%	13%
Dyspepsia/indigestion	12%			5%	9%
Skin problems	16%			8%	12%
Shortness of breath	13%			9%	11%



### Summary: Excess prevalence of conditions

Condition	U.S.	U.K.	Can	Austr	Den
Skin condition	20-21%	21%	4- 7%	4%	
Arthritis/ joint problem	6-11%	10%	-1 – 3%	2%	
GI problems	15%		5- 7%	1%	
Respiratory problem	4-7%	2%	2- 5%	1%	
CFS	1-4%	3%		0%	
PTSD	3-6%	9%	6%	3%	
CM	13-25%	26%			



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### Summary: Allied Coalition Exposures

Pesticides	U.S.	U.K.	Can	Aust	Fr	Den
Any Contact	44-63%		Minimal		25%	
Personal pesticide	48%	69%	20%	26%-37%	14%	27%
On clothes, bedding		38%		5%		



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### Summary: Allied Coalition Exposures Types of pesticides & repellants used

Category	U.S.	U.K.	Can	Aust	Fr	Den
OP	Azimuthipos Chlorpyrifos Diazanon Dichlorovos Malathion	Azimuthipos Malathion	?	Malathion Diazanon Temephos	None	?
OCI	Lindane	?	?	Dieldrin	Lindane	?
Carbamate	Bendiocarb Methomyl Propoxur	?	?	Baygon Bendiocarb	?	?
Pyrethroids	Permethrin d-phenothrin	Permethrin	Permethrin	Perigan	Pyrethrins K-orthrin	?
Repellants	DEET	DEET	DEET	DEET	DEET	?



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### Summary: Allied Coalition Exposures

Nerve Agents	U.S.	U.K.	Can	Austr	Fr	Den
Heard alarms/ wore gear	56-72%	70-82%	?	46%	63%	
Nerve gas	5-12%					0.4%
Near SCUD explosion	43%					4%
<b>PB/NAPs</b>						
Used PB	42-49%	82%	85%	51%	31%	?
Duration/freq		65% >14d	3d-4wk	17% > 180 pills		



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### Summary: Allied Coalition Exposures

Vaccines	U.S.	U.K.	Can	Austr	Fr	Den
Anthrax	41%	57-75%	Few	15%	0%	?
Plague	22%	26%	Some	48%	Routine	?
Typhoid	59%	13%	Routine	Routine	Routine	?
Cholera	0%	14%	0%	Routine	?	?
Botulinum	12.5%	0%	0%	0%	0%	?



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### Summary: Allied Coalition Exposures

	U.S.	U.K.	Can	Austr	Fr	Den
Oil Fire Smoke	65%	61-72%	Minimal	54%	28%	45%
DU	2-10% ?	8-10%	Minimal	19% handled DU shell casings	?	54% inside destroyed Iraqi vehicles
CARC paint	21%	18-46%	Minimal	1.3%	?	?



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## Summary: Health Outcomes

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- When compared to non-deployed controls, GWV consistently report higher rates of symptoms and health conditions
- US & UK- GW vets have similar patterns of health symptoms and conditions
- Denmark - similar for GI, respiratory, skin. Somewhat lower in neuro symptoms, lower in musculoskeletal
- Australia – lower overall
- Canada – may be similar to US & UK, but not clear
- France - may be less ill, but not clear



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## How do illness patterns relate to exposures?

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What exposures do the US & UK have in common, for which Denmark may be different, and Australia is different and France is different?



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### Summary: Allied Coalition Exposures

Pesticides	U.S.	U.K.	Den	Austr	Fr
Use	≈	≈	↓	↓	↓↓
<b>Types used</b>					
OPs	YES	YES	?	YES	NO
OCI	YES	?	?	YES	YES
Carbamate	YES	?	?	YES	?
Pyrethrins	YES	YES	?	YES	YES
DEET	YES	YES	?	YES	YES



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### Summary: Allied Coalition Exposures

Exposure	U.S.	U.K.	Den	Austr	Fr
Chemical weapon alerts/exposures	≈	≈	↓↓	↓	≈
PB	≈	↑	? ↓	≈	↓
<b>Vaccines</b>					
Anthrax	≈	↑	?	↓↓	No
Plague	≈	≈	?	↑	Routine
Botulinum	Yes	No	No	No	No
Oil Fires	≈	≈	↓	↓	↓↓
DU	Poor Data				
CARC	≈	≈	?	↓↓	?



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## Summary Overview

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- **US & UK**
  - Similar in all symptoms, conditions
  - Similar in rate of pesticide use, types of pesticides
  - Similar reported s/r exposures to nerve agents, oil fires, plague vaccine
  - UK > US on PB use, anthrax rate (pertussis adjuvant)



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## Summary Overview

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- **Denmark**
  - Similar to US and UK in GI, respiratory, skin; somewhat less in neuro; much less in musculoskeletal symptoms
  - Primarily peace-keeping role after cease-fire
  - Lower rates of pesticide use, types unknown
  - Much lower rates of s/r exposure to nerve agents
  - Somewhat less exposure to oil fires
  - PB use unlikely (but unknown)
  - Vaccines unknown



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## Summary Overview

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- **Australia**
  - Lower rates of excess health problems overall
  - Lower rates of pesticide use, but similar types
  - Lower rates of exposure to nerve agents
  - Lower rates of anthrax vaccination
  - Less exposure to oil fires
  - Frequency of PB use similar to U.S.



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## Summary Overview

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- **France**
  - Possibly fewer health problems
  - Lower rates of pesticide use, no OPs , ? carbamates, others similar types
  - Similar rates of s/r chemical alerts
  - Less use of PB
  - No anthrax vaccination
  - Less exposure to oil fires



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## **Preliminary Conclusions**

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- **US and UK, with highest rates of excess illness, are distinguished from other nations by higher rates of pesticide use, use of anthrax vaccine, and somewhat higher rates of exposures to oil fire smoke and reported chemical alerts**
- **France, with possibly the lowest illness rates, had lower rates of pesticide use, no use of organophosphate pesticides, no use of anthrax vaccine**
- **Relationships between PB use and illness rates are unclear**



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