

**Presentation 14 – Clare Mahan**

**ANTHRAX VACCINATION AND SELF-REPORTED SYMPTOMS,  
FUNCTIONAL STATUS AND MEDICAL CONDITIONS IN THE  
NATIONAL HEALTH SURVEY OF GULF WAR-ERA VETERANS AND  
THEIR FAMILIES**

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**NATIONAL HEALTH SURVEY POPULATION**

- Phase I – questionnaire mailed to 30,000 veterans
  - 15,000 Gulf
  - 15,000 Non-Gulf
- 15,817 respondents from Phase I
- Phase II – telephone interviews of non-respondents
- 5,100 respondents from Phase II
- 70% over all response rate (N=20,917)
  - 11,441 Gulf
  - 9,476 Non-Gulf

**QUESTIONNAIRE FOR NATIONAL HEALTH SURVEY  
OF GULF WAR-ERA VETERANS AND THEIR FAMILIES**

- Functional impairment
- Limitation of employment
- Clinic visit during past year
- Hospitalization during past year
- Self-report symptoms inventory of 48 items
- Symptoms coded as none, mild, or severe
- Self-report of 31 medical conditions present during past 12 months

**COMPARISON GROUPS**

- N= 4601 self-report, received anthrax vaccination (40.2%)
- N= 3961 self-report, unknown if received anthrax vaccination (33.7%)
- N= 2979 self-report, did not receive anthrax vaccination (26.0%)
- N= 352 anthrax vaccination record on file with DoD
- N= 11,441 all Gulf veterans

**OBJECTIVE**

**COMPARE:**

- Functional status
- Medical care utilization
- Symptoms
- Chronic disease status

of Gulf War veterans for whom anthrax vaccination records exist to Gulf veterans who self-reported "no" s/he had not received anthrax vaccination.

**TABLE 1. Percent distribution of selected characteristics for 11441 Gulf War veterans according to self-report of anthrax vaccination and for exposed group documented to have received anthrax vaccination**

Characteristic	Anthrax		Vaccination	
	S-R Yes (N=4601)	S-R Unknown (N=3861)	S-R No (N=2979)	Documented DoD (N=352)
<b>Gender</b>				
Male	78.6	83.6	82.8	71.6
Female	21.4	16.4	17.2	28.4
<b>Age (mean age in yrs in 1997) (interquartile range)</b>	30.8 23-37	29.8 23-35	30.7 24-36	31.5 23-39
<b>Race</b>				
White	74.9	71.5	74.7	77.0
Black	18.2	20.3	18.6	15.3
Other	6.8	8.2	6.7	7.7
<b>Marital status</b>				
Single	41.5	44.3	40.5	49.7
Married	52.4	50.8	54.9	44.3
Other	6.1	4.9	4.5	6.0
<b>Rank</b>				
Other	13.2	8.3	16.4	13.6
Warrant	1.6	1.3	0.8	2.0
Enlisted	85.2	90.4	82.8	84.4

**TABLE 1. Percent distribution of selected characteristics for 11441 Gulf War veterans according to self-report of anthrax vaccination and for exposed group documented to have received anthrax vaccination (cont.)**

Characteristic	Anthrax		Vaccination	
	S-R Yes (N=4601)	S-R Unknown (N=3861)	S-R No (N=2979)	Documented DoD (N=352)
<b>Branch of Service</b>				
Air Force	8.6	9.4	22.4	3.4
Air Force	74.4	64.6	44.3	96.6
Marine	11.3	12.5	9.1	0.0
Navy	5.7	13.4	24.2	0.0
<b>Unit Type</b>				
Active Duty	28.6	38.5	49.1	4.8
National Guard	31.2	28.8	23.3	22.4
Reserve	40.2	32.7	27.6	72.7
<b>Alcohol use (past 12 months)</b>	76.1	75.6	76.6	75.6
Cigarette (past 12 months)	34.9	35.7	32.3	31.2
<b>Number of Vaccines (other than anthrax)</b>				
0	10.5	37.1	29.3	19.6
1	20.8	27.4	27.3	22.4
2	28.8	20.6	25.8	23.0
3	21.5	11.0	13.3	20.7
4	10.5	3.4	3.6	11.1
5	7.9	0.4	0.7	3.1

**TABLE 2. Prevalence and adjusted odds ratios of functional impairment, limitation of employment, and medical consultation due to illness among 11441 Gulf War veterans according to self-report of anthrax vaccination and for Gulf War veterans for whom anthrax vaccination is documented to be 0**

Outcome	Self-Reported Anthrax Vaccination		Documented		Adjusted Odds Ratio (95% CI)	
	Yes (N=4601)	Unknown (N=3861)	Yes (N=2979)	DoD (N=352)	Unadjusted	DoD <sup>a</sup>
<b>Functional Impairment<sup>b</sup></b>	327	28.6	9.1	26.0	1.73 (1.54-1.96)	1.68 (1.41-1.79)
<b>Limitation of Employment<sup>c</sup></b>	213	17.9	10.2	17.3	2.13 (1.83-2.48)	1.86 (1.62-2.14)
<b>Clinic Visit<sup>d</sup></b>	567	48.4	45.6	54.3	1.36 (1.22-1.50)	1.14 (1.01-1.29)
<b>Hospitalization<sup>e</sup></b>	22	7.6	6.3	9.4	1.22 (0.64-4.8)	1.21 (0.94-1.47)

<sup>b</sup> Postulate response to the question, "Thinking back over the past 2 weeks, did you stay in bed or at home all or part of any day because you did not feel well or as a result of illness or injury?"

<sup>c</sup> Postulate response to the question, "Are you limited in your employment or the kind of work you can do around the house because of any limitation or health problems?"

<sup>d</sup> Clinic visit because of illness during past 12 months.

<sup>e</sup> Hospitalization because of illness during past 12 months.

<sup>f</sup> CI = Confidence Interval

<sup>a</sup> Adjusted odds ratios (ORs) were derived from logistic models. Reference category was self-report "No." Adjusted ORs were made for number of vaccines received other than anthrax (0, 1, 2, 3, 4, 5); gender (male vs. female); age in 1997 (0-20 vs. 21-30 vs. 31-40 vs. 41 or other); marital status (single vs. other married); race (white vs. other); branch of service (Army vs. other); type of service (ground troops) and component (active duty vs. National Guard or Reserve); current alcohol use (within past 12 months); and current cigarette use (within past 12 months).

<sup>b</sup> Adjusted odds ratios (ORs) for documented vaccination by both records relative to self-report "No." were derived through stratified Cochran-Mantel-Haenszel (15) analysis. Adjusted ORs were made for variables that were correlated with both exposure (anthrax vaccination) and outcome (condition). These confounding factors included number of vaccines received other than anthrax, (0, 1, 2, 3, 4, 5); gender (male vs. female); branch of service (ground troops vs. ground troops) and component (active duty vs. National Guard or Reserve).

TABLE 3. Prevalence and adjusted odds ratios of selected self-reported medical conditions among 11,441 Gulf War veterans according to self-report of anthrax vaccination, also to 352 Gulf War veterans for whom anthrax vaccination is documented in DoD records.

Conditions	Self-Reported Anthrax Vaccination			DoD (N=352)	Adjusted Odds Ratio (95% CI)		
	Yes (N=4601)	Unknown (N=2951)	No (N=2979)		Anthrax Vaccination		
					Yes†	Unknown†	No†
Dermatitis	24.9	23.4	18.7	29.7	1.26 (1.04-2.08)	1.62 (1.44-1.83)	1.26 (1.05-1.52)
Osteitis	33.8	27.4	18.1	28.9	1.35 (1.04-2.09)	1.55 (1.38-1.74)	1.48 (1.11-1.92)
Arthritis	29.9	24.2	18.6	26.4	1.51 (1.28-1.77)	1.33 (1.14-1.47)	1.22 (1.03-1.42)
Frequent diarrhea	29.6	23.6	13.8	23.8	1.53 (1.08-2.20)	1.69 (1.48-1.93)	1.26 (1.03-1.59)
Hair loss	22.0	19.8	11.8	16.3	1.27 (1.02-2.16)	1.73 (1.50-1.99)	1.26 (1.03-1.73)
Migraines	21.2	19.1	13.6	16.9	1.42 (1.23-1.63)	1.31 (1.19-1.47)	0.96 (0.89-1.24)
Lumbago	18.6	16.3	9.4	14.4	1.23 (1.09-2.14)	1.22 (1.09-2.13)	1.00 (0.92-1.09)
Bronchitis	16.4	12.4	10.2	13.0	1.33 (1.14-1.56)	1.22 (1.10-1.42)	1.14 (0.79-1.69)

†95% Confidence Interval

†Adjusted odds ratios (95% CI) were derived from logistic models. Reference category was self-report "No." Adjustments were made for number of vaccines received other than anthrax (0, 1, ..., 5); gender (male vs. female); age in 1991 (<30 vs. ≥30 yrs.); race (white vs. other); marital status (single vs. non-married); rank (enlisted or warrant officer vs. officer); branch of service (non-ground troops vs. ground troops); unit component (active duty vs. National Guard or Reserve); current alcohol use (within past 12 months); and current cigarette use (within past 12 months).

†Adjusted odds ratios (95% CI) for documented vaccination by DoD records relative to self-report "No." were derived through limited Cochran-Mantel-Haenszel (16) analysis. Adjustments were made for variables that were correlated with both exposure (anthrax vaccine) and outcome (medical condition). These confounding factors included number of vaccines received other than anthrax (0, 2 vs. ≥3); gender (male vs. female); branch of service (non-ground troops vs. ground troops); unit component (active duty vs. National Guard or Reserve).

TABLE 4. Prevalence and adjusted odds ratios of selected self-reported severe symptoms among 11,441 Gulf War veterans according to self-report of anthrax vaccination, also to 352 Gulf War veterans for whom anthrax vaccination is documented in DoD records.

Symptoms	Self-Reported Anthrax Vaccination			DoD (N=352)	Adjusted Odds Ratio (95% CI)		
	Yes (N=4601)	Unknown (N=2951)	No (N=2979)		Anthrax Vaccination		
					Yes†	Unknown†	No†
Joint aches or pain	21.8	16.8	9.7	16.6	2.05 (1.76-2.39)	1.76 (1.61-2.00)	1.50 (1.09-2.10)
Runny nose	21.7	17.8	12.9	20.6	1.53 (1.39-1.70)	1.43 (1.24-1.64)	1.30 (0.96-1.80)
Headaches	21.4	17.7	11.3	16.8	1.69 (1.46-1.95)	1.53 (1.32-1.77)	1.19 (0.98-1.64)
Back pain/spasms	20.4	18.6	12.4	13.1	1.64 (1.34-1.92)	1.61 (1.31-1.74)	0.96 (0.69-1.40)
Anxious, irritable or upset	19.2	16.1	8.2	16.0	2.02 (1.72-2.35)	1.75 (1.49-2.06)	1.49 (1.03-2.07)
Excessive fatigue	18.8	13.4	7.1	14.3	2.19 (1.85-2.60)	1.89 (1.64-2.16)	1.62 (1.14-2.31)
Sleep difficulty	18.3	13.8	7.6	16.1	2.04 (1.72-2.40)	1.71 (1.44-2.02)	1.57 (1.11-2.21)
Awaken tired or worn out	17.8	13.8	7.8	14.0	1.95 (1.67-2.19)	1.62 (1.38-1.92)	1.30 (0.95-1.80)
Been depressed or blue	15.4	11.8	6.7	12.1	1.94 (1.62-2.31)	1.65 (1.38-1.97)	1.40 (0.99-2.09)
Reflex, heartburn, indigestion	14.8	11.9	6.7	12.0	1.93 (1.62-2.31)	1.72 (1.44-2.06)	1.68 (1.13-2.43)

†95% Confidence Interval

†Adjusted odds ratios (95% CI) were derived from logistic models. Reference category was self-report "No." Adjustments were made for number of vaccines received other than anthrax (0, 1, ..., 5); gender (male vs. female); age in 1991 (<30 vs. ≥30 yrs.); race (white vs. other); marital status (single vs. non-married); rank (enlisted or warrant officer vs. officer); branch of service (non-ground troops vs. ground troops); unit component (active duty vs. National Guard or Reserve); current alcohol use (within past 12 months); and current cigarette use (within past 12 months).

†Adjusted odds ratios (95% CI) for documented vaccination by DoD records relative to self-report "No." were derived through limited Cochran-Mantel-Haenszel (16) analysis. Adjustments were made for variables that were correlated with both exposure (anthrax vaccine) and outcome (severe symptom). These confounding factors included number of vaccines received other than anthrax (0, 2 vs. ≥3); gender (male vs. female); branch of service (non-ground troops vs. ground troops); unit component (active duty vs. National Guard or Reserve).

TABLE 5. Prevalence of disability, health care utilization, and selected medical conditions among 352 Gulf War veterans for whom anthrax vaccination records exist in DoD stratified by self-reported response to question on anthrax vaccination.

Indices/Conditions	Documented DoD N=352		
	Yes N=260	Unknown N=58	No N=34
Functional Impairment	30.3	13.8	14.7
Limitation of Employment	19.9	12.3	5.9
Chronic Illness	58.1	41.4	47.1
Hospitalization	10.0	8.6	5.9
Dermatitis	31.2	28.1	20.6
Gastritis	32.6	20.7	14.7
Arthritis	29.3	19.0	17.6
Frequent diarrhea	28.8	12.1	5.9
Hair Loss	17.1	17.2	8.8
Migraines	17.6	12.3	8.8
Lumbago	14.5	17.2	8.8
Bronchitis	14.6	6.9	11.8

Significance probability for Wilcoxon signed ranks test, p < .01 (2-tailed). (17)

TABLE 6. Prevalence of severe symptoms among 352 Gulf War veterans for whom anthrax vaccination records exist in DoD stratified by self-reported response to question on anthrax vaccination.

Symptoms	Documented DoD N=352		
	Yes N=260	Unknown N=58	No N=34
Joint aches or pain	17.7	12.1	15.2
Runny nose	22.8	10.3	20.6
Headaches	18.1	17.5	5.9
Back pain/spasms	14.2	12.1	5.9
Anxious, irritable or upset	18.0	8.6	2.9
Excessive fatigue	17.4	6.9	2.9
Sleep difficulty	17.8	8.6	5.9
Awaken tired or worn out	17.1	6.9	2.9
Been depressed or blue	14.2	6.9	5.9
Reflex, heartburn, indigestion	12.0	10.5	14.7

Significance probability for Wilcoxon signed ranks test, p < .01 (2-tailed). (17)

#### CONCLUSIONS

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- This survey data along with the DoD list of GulfWar veterans who received anthrax vaccine provide an opportunity to evaluate the long-term health consequences of anthrax vaccination.
- Those who reported exposure to anthrax vaccination do express more adverse health outcomes than those who reported no anthrax vaccination.
- The possibility of a reporting bias in exposure history should be carefully considered when one evaluates the health consequences of anthrax vaccination based on self-reported vaccination data.