17 OCT 1996

Ref: 96-F-1923

Ms. Randall Forsberg
Institute for Defense and Disarmament Studies
675 Massachusetts Avenue
Cambridge, MA 02139

Dear Ms. Forsberg:

This letter responds to your October 1, 1996, Freedom of Information Act (FOIA) request.

The enclosed document is provided as responsive to your request. There are no chargeable costs for processing your FOIA request in this instance.

Sincerely,

Signed

A. H. Passarella
Director
Freedom of Information
and Security Review

Enclosures:
As stated

Prepared by VOORHIES:gjv:10/17/96:DFOI:gr__pk__yl__wh__

R/R Pls

#832

Institute for Defense & Disarmament Studies

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96-F-1923

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Randall Forsberg

UN NGO Representative
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1 October 1996

Mr C. Y. Talbott
FOI Office
Directorate for Defense Information
Fax No: 703/693-7341 (Tel: 703/697-1180)

Dear Mr. Talbott:

I would like to make a Freedom of Information request for a copy of the U.S. submission to the GEMI, Global Exchange of Military Information, made in Vienna, Austria, on or around 30 April 1996, as a confidence-building measure associated with the Treaty on Conventional Armed Forces in Europe.

The agency in the Department of Defense responsible for the release of the document is the Office of Arms Control Implementation and Compliance. Lt Col Michael McNiff (OUSD(A&T), 3E129 PNT, 7-8158), in that office, suggested that I route the request through the FOI process.

The document, which is distributed to other governments and updated annually, is not classified. We plan to use it in a nonprofit research and public education project, in which this Institute will publish a survey of post-Cold War trends in armed forces.

The document is readily available and is less than 50 pages long. We would be glad to pay any costs, such as copying, associated with this request.

Since our deadline for using this material is 30 November 1996, we would be very grateful for your help in expediting the request.

Yours sincerely,

Randall Forsberg

(Ms.) Randall Forsberg, Executive Director

ORGANIZATION FOR SECURITY AND COOPERATION IN EUROPE

GLOBAL EXCHANGE OF MILITARY INFORMATION

UNITED STATES OF AMERICA

#832

VALID AS OF
1 JANUARY 1996

STATE: UNITED STATES OF AMERICA

VALID AS OF: 1 January 1996

CHART 1: INFORMATION ON GENERAL OR EQUIVALENT STAFF, PROVIDED IN ACCORDANCE WITH PARAGRAPH 2.1 OF THE DOCUMENT ON GLOBAL EXCHANGE OF MILITARY INFORMATION*

Location 2.1.1	Peacetime authorized personnel strength 2.1.2
(a)	(b)
WASHINGTON, DC US 38°52'00"N 077°03'00"W	1287

* Filled in with due account to national practice

STATE: UNITED STATES OF AMERICA

VALID AS OF: 1 January 1996

CHART 1: INFORMATION ON GENERAL OR EQUIVALENT STAFF, PROVIDED IN ACCORDANCE WITH PARAGRAPH 2.1 OF THE DOCUMENT ON GLOBAL EXCHANGE OF MILITARY INFORMATION

Note: Column (b) includes military and staff augmentation positions of the Joint Staff.

STATE: UNITED STATES OF AMERICA

VALID AS OF: 1 January 1996

CHART 2: INFORMATION ON THE COMMAND ORGANIZATION OF THE CONVENTIONAL ARMED FORCES, PROVIDED IN ACCORDANCE WITH PARAGRAPH 2.2 AND 4.1 OF THE DOCUMENT ON GLOBAL EXCHANGE OF MILITARY INFORMATION

Line No.	Designation of formation 2.2.1	First level of Subordination* 2.2.2	Normal peacetime location of headquarters specifying the exact geographic terms and/or co-ordinates 2.2.3
(a)	(b)	(c)	(d)
1	US ATLANTIC COMMAND (USACOM)	SECDEF	NORFOLK, VA US 36°56'14"N 076°17'26"W
2	US CENTRAL COMMAND (USCENTCOM)	SECDEF	MCDILL AFB, FL US 27°51'00"N 082°31'18"W
3	US EUROPEAN COMMAND (USEUCOM)	SECDEF	PATCH BARRACKS STUTTGART DE 48°44'09"N 009°04'54"E
4	US PACIFIC COMMAND (USPACOM)	SECDEF	CAMP H.M. SMITH, HI US 21°22'00"N 157°55'00"W
5	US SOUTHERN COMMAND (USSOUTHCOM)	SECDEF	QUARRY HEIGHTS PA 08°57'00"N 079°33'00"W
6	US SPECIAL OPERATIONS COMMAND (USSOCOM)	SECDEF	MCDILL AFB, FL US 27°51'00"N 082°31'18"W

* First higher echelon

STATE: UNITED STATES OF AMERICA

VALID AS OF: 1 January 1996

CHART 2: INFORMATION ON THE COMMAND ORGANIZATION OF THE CONVENTIONAL ARMED FORCES, PROVIDED IN ACCORDANCE WITH PARAGRAPH 2.2 AND 4.1 OF THE DOCUMENT ON GLOBAL EXCHANGE OF MILITARY INFORMATION

Line No.	Designation of formation 2.2.1	First level of Subordination* 2.2.2	Normal peacetime location of headquarters specifying the exact geographic terms and/or co-ordinates 2.2.3
(a)	(b)	(c)	(d)
7	US TRANSPORTATION COMMAND (USTRANSCOM)	SECDEF	SCOTT AFB, IL US 38°32'36"N 089°51'06"W
8	HQ, DEPARTMENT OF THE ARMY (HQDA)	SECDEF	WASHINGTON, DC US 38°52'00"N 077°03'00"W
9	US ARMY EUROPE (7TH ARMY) (USAREUR (7 ARMY))	USEUCOM	CAMPBELL BARRACKS HEIDELBERG DE 49°23'15"N 008°41'21"E
10	V CORPS (V CORPS)	USAREUR (7 ARMY)	CAMPBELL BARRACKS HEIDELBERG DE 49°23'15"N 008°41'21"E
11	3RD INFANTRY DIVISION (3 ID)	V CORPS	LEIGHTON BARRACKS WUERZBURG DE 49°47'32"N 009°58'16"E
12	1ST ARMORED DIVISION (1 AD)	V CORPS	ROSE BARRACKS BAD KREUZNACH DE 49°50'35"N 007°52'45"E

* First higher echelon

STATE: UNITED STATES OF AMERICA

VALID AS OF: 1 January 1996

CHART 2: INFORMATION ON THE COMMAND ORGANIZATION OF THE CONVENTIONAL ARMED FORCES, PROVIDED IN ACCORDANCE WITH PARAGRAPH 2.2 AND 4.1 OF THE DOCUMENT ON GLOBAL EXCHANGE OF MILITARY INFORMATION

Line No.	Designation of formation 2.2.1	First level of Subordination* 2.2.2	Normal peacetime location of headquarters specifying the exact geographic terms and/or co-ordinates 2.2.3
(a)	(b)	(c)	(d)
13	8TH ARMY (8 ARMY)	USPACOM	YONGSAN KR 37°32'00"N 126°59'00"E
14	2ND INFANTRY DIVISION (2 ID)	8 ARMY	CAMP RED CLOUD KR 37°44'00"N 127°03'00"E
15	FORCES COMMAND (FORSCOM)	USACOM	FORT MCPHERSON, GA US 33°42'00"N 084°25'00"W
16	1ST ARMY (1 ARMY)	FORSCOM	FORT GILLEM, GA US 33°35'00"N 084°21'00"W
17	5TH ARMY (5 ARMY)	FORSCOM	FORT SAM HOUSTON, TX US 29°27'00"N 098°27'00"W
18	III CORPS (III CORPS)	FORSCOM	FORT HOOD, TX US 31°08'00"N 097°46'00"W

* First higher echelon

STATE: UNITED STATES OF AMERICA

VALID AS OF: 1 January 1996

CHART 2: INFORMATION ON THE COMMAND ORGANIZATION OF THE CONVENTIONAL ARMED FORCES, PROVIDED IN ACCORDANCE WITH PARAGRAPH 2.2 AND 4.1 OF THE DOCUMENT ON GLOBAL EXCHANGE OF MILITARY INFORMATION

Line No.	Designation of formation 2.2.1	First level of Subordination* 2.2.2	Normal peacetime location of headquarters specifying the exact geographic terms and/or co-ordinates 2.2.3
(a)	(b)	(c)	(d)
19	1ST INFANTRY DIVISION (1 ID)	III CORPS	FORT RILEY, KS US 39°10'00"N 096°49'00"W
20	4TH INFANTRY DIVISION (4 ID)	III CORPS	FORT HOOD, TX US 31°08'00"N 097°46'00"W
21	1ST CAVALRY DIVISION (1 CD)	III CORPS	FORT HOOD, TX US 31°08'00"N 097°46'00"W
22	XVIII AIRBORNE CORPS (XVIII AIRBORNE CORPS)	FORSCOM	FORT BRAGG, NC US 35°08'00"N 078°59'00"W
23	10TH MOUNTAIN DIVISION (10 MD)	XVIII AIRBORNE CORPS	FORT DRUM, NY US 44°03'00"N 075°44'00"W
24	24TH INFANTRY DIVISION (24 ID)	XVIII AIRBORNE CORPS	FORT STEWART, GA US 31°51'00"N 081°36'00"W

* First higher echelon

STATE: UNITED STATES OF AMERICA

VALID AS OF: 1 January 1996

CHART 2: INFORMATION ON THE COMMAND ORGANIZATION OF THE CONVENTIONAL ARMED FORCES, PROVIDED IN ACCORDANCE WITH PARAGRAPH 2.2 AND 4.1 OF THE DOCUMENT ON GLOBAL EXCHANGE OF MILITARY INFORMATION

Line No.	Designation of formation 2.2.1	First level of Subordination* 2.2.2	Normal peacetime location of headquarters specifying the exact geographic terms and/or co-ordinates 2.2.3
(a)	(b)	(c)	(d)
25	82ND AIRBORNE DIVISION (82 ABN DIV)	XVIII AIRBORNE CORPS	FORT BRAGG, NC US 35°08'00"N 078°59'00"W
26	101ST AIRBORNE DIVISION (AIR ASSLT) (101 ABN DIV (AA))	XVIII AIRBORNE CORPS	FORT CAMPBELL, KY US 36°40'00"N 087°29'00"W
27	US ARMY PACIFIC (USARPAC)	USPACOM	FORT SHAFTER, HI US 21°18'00"N 157°53'00"W
28	I CORPS (I CORPS)	USARPAC	FORT LEWIS, WA US 47°05'00"N 122°36'00"W
29	25TH INFANTRY DIVISION (25 ID)	USARPAC	SCHOFIELD BARRACKS, HI US 21°29'00"N 158°05'00"W
30	US ARMY SPECIAL OPERATIONS COMMAND (USASOC)	USSOCOM	FORT BRAGG, NC US 35°08'00"N 078°59'00"W

* First higher echelon

STATE: UNITED STATES OF AMERICA

VALID AS OF: 1 January 1996

CHART 2: INFORMATION ON THE COMMAND ORGANIZATION OF THE CONVENTIONAL ARMED FORCES, PROVIDED IN ACCORDANCE WITH PARAGRAPH 2.2 AND 4.1 OF THE DOCUMENT ON GLOBAL EXCHANGE OF MILITARY INFORMATION

Line No.	Designation of formation 2.2.1	First level of Subordination* 2.2.2	Normal peacetime location of headquarters specifying the exact geographic terms and/or co-ordinates 2.2.3
(a)	(b)	(c)	(d)
31	U.S. ARMY SOUTH (USARSO)	USSOUTHCOM	FORT CLAYTON PA 09°00'00"N 079°35'00"W
32	3RD ARMY (3 ARMY)	USCENTCOM	FORT MCPHERSON, GA US 33°42'00"N 084°25'00"W
33	HQ, DEPARTMENT OF AIR FORCE (HQAF)	SECDEF	WASHINGTON, DC US 38°52'00"N 077°03'00"W
34	AIR COMBAT COMMAND (ACC)	USACOM	LANGLEY AFB, VA US 37°05'00"N 076°21'42"W
35	1ST AIR FORCE (1 AF)	ACC	TYNDALL AFB, FL US 30°04'12"N 085°34'36"W
36	8TH AIR FORCE (8 AF)	ACC	BARKSDALE AFB, LA US 32°30'06"N 093°39'48"W

* First higher echelon

STATE: UNITED STATES OF AMERICA

VALID AS OF: 1 January 1996

CHART 2: INFORMATION ON THE COMMAND ORGANIZATION OF THE CONVENTIONAL ARMED FORCES, PROVIDED IN ACCORDANCE WITH PARAGRAPH 2.2 AND 4.1 OF THE DOCUMENT ON GLOBAL EXCHANGE OF MILITARY INFORMATION

Line No.	Designation of formation 2.2.1	First level of Subordination* 2.2.2	Normal peacetime location of headquarters specifying the exact geographic terms and/or co-ordinates 2.2.3
(a)	(b)	(c)	(d)
37	9TH AIR FORCE (9 AF)	ACC	SHAW AFB, SC US 33°58'24"N 080°28'24"W
38	12TH AIR FORCE (12 AF)	ACC	DAVIS MONTHAN AFB, AZ US 32°10'00"N 110°53'00"W
39	AIR FORCE SPECIAL OPERATIONS CMD (AFSOC)	USSOCOM	HURLBURT FIELD, FL US 30°25'42"N 086°41'18"W
40	AIR MOBILITY COMMAND (AMC)	USTRANSCOM	SCOTT AFB, IL US 38°32'36"N 089°51'06"W
41	15TH AIR FORCE (15 AF)	AMC	TRAVIS AFB, CA US 38°15'48"N 121°55'36"W
42	21ST AIR FORCE (21 AF)	AMC	MCGUIRE AFB, NJ US 40°00'54"N 074°35'36"W

* First higher echelon

STATE: UNITED STATES OF AMERICA

VALID AS OF: 1 January 1996

CHART 2: INFORMATION ON THE COMMAND ORGANIZATION OF THE CONVENTIONAL ARMED FORCES, PROVIDED IN ACCORDANCE WITH PARAGRAPH 2.2 AND 4.1 OF THE DOCUMENT ON GLOBAL EXCHANGE OF MILITARY INFORMATION

Line No.	Designation of formation 2.2.1	First level of Subordination* 2.2.2	Normal peacetime location of headquarters specifying the exact geographic terms and/or co-ordinates 2.2.3
(a)	(b)	(c)	(d)
43	US CENTRAL AIR FORCES (CENTAF)	USCENTCOM	SHAW AFB, SC US 33°58'24"N 080°28'24"W
44	US PACIFIC AIR FORCE (PACAF)	USPACOM	HICKAM AFB, HI US 21°19'06"N 157°55'18"W
45	5TH AIR FORCE (5 AF)	PACAF	YOKOTA AB JP 35°45'00"N 139°20'54"E
46	7TH AIR FORCE (7 AF)	PACAF	OSAN AB KR 37°05'24"N 127°01'48"E
47	11TH AIR FORCE (11 AF)	PACAF	ELMENDORF AFB, AK US 61°15'12"N 149°47'36"W
48	13TH AIR FORCE (13 AF)	PACAF	ANDERSON AFB, GU US 13°34'54"N 144°55'30"E

* First higher echelon

STATE: UNITED STATES OF AMERICA

VALID AS OF: 1 January 1996

CHART 2: INFORMATION ON THE COMMAND ORGANIZATION OF THE CONVENTIONAL ARMED FORCES, PROVIDED IN ACCORDANCE WITH PARAGRAPH 2.2 AND 4.1 OF THE DOCUMENT ON GLOBAL EXCHANGE OF MILITARY INFORMATION

Line No.	Designation of formation 2.2.1	First level of Subordination* 2.2.2	Normal peacetime location of headquarters specifying the exact geographic terms and/or co-ordinates 2.2.3
(a)	(b)	(c)	(d)
49	US AIR FORCES EUROPE (USAFE)	USEUCOM	RAMSTEIN AB DE 49°26'30"N 007°35'00"E
50	3RD AIR FORCE (3 AF)	USAFE	RAF MILDENHALL AB GB 52°21'38"N 000°29'19"E
51	16TH AIR FORCE (16 AF)	USAFE	AVIANO AB IT 46°01'54"N 012°35'53"E
52	17TH AIR FORCE (17 AF)	USAFE	SEMBACH AB DE 49°30'12"N 007°51'00"E
53	DEPARTMENT OF THE NAVY (DON)	SECDEF	WASHINGTON, DC US 38°52'00"N 077°03'00"W
54	COMMANDER IN CHIEF ATLANTIC FLEET (CINCLANTFLT)	USACOM	NORFOLK, VA US 36°56'30"N 076°17'30"W

* First higher echelon

STATE: UNITED STATES OF AMERICA

VALID AS OF: 1 January 1996

CHART 2: INFORMATION ON THE COMMAND ORGANIZATION OF THE CONVENTIONAL ARMED FORCES, PROVIDED IN ACCORDANCE WITH PARAGRAPH 2.2 AND 4.1 OF THE DOCUMENT ON GLOBAL EXCHANGE OF MILITARY INFORMATION

Line No.	Designation of formation 2.2.1	First level of Subordination* 2.2.2	Normal peacetime location of headquarters specifying the exact geographic terms and/or co-ordinates 2.2.3
(a)	(b)	(c)	(d)
55	COMMANDER SECOND FLEET (COMSECONDFLT)	CINCLANTFLT	NORFOLK, VA US 36°56'30"N 076°17'30"W
56	COMMANDER IN CHIEF PACIFIC FLEET (CINCPACFLT)	USPACOM	PEARL HARBOR, HI US 21°22'00"N 157°58'00"W
57	COMMANDER THIRD FLEET (COMTHIRDFLT)	CINCPACFLT	SAN DIEGO, CA US 32°41'57"N 117°12'52"W
58	COMMANDER SEVENTH FLEET (COMSEVENTHFLT)	CINCPACFLT	YOKOSUKA JP 36°17'17"N 139°40'21"E
59	CINC US NAVAL FORCES EUROPE (CINCUSNAVEUR)	USEUCOM	LONDON GB 51°31'00"N 000°06'00"W
60	COMMANDER SIXTH FLEET (COMSIXTHFLT)	CINCUSNAVEUR	GAETE IT 41°13'00"N 013°10'00"E

* First higher echelon

STATE: UNITED STATES OF AMERICA

VALID AS OF: 1 January 1996

CHART 2: INFORMATION ON THE COMMAND ORGANIZATION OF THE CONVENTIONAL ARMED FORCES, PROVIDED IN ACCORDANCE WITH PARAGRAPH 2.2 AND 4.1 OF THE DOCUMENT ON GLOBAL EXCHANGE OF MILITARY INFORMATION

Line No.	Designation of formation 2.2.1	First level of Subordination* 2.2.2	Normal peacetime location of headquarters specifying the exact geographic terms and/or co-ordinates 2.2.3
(a)	(b)	(c)	(d)
61	CINC US NAVAL FORCES CENTRAL (CINCUSNAVCENT)	USCENTCOM	MANAMA BH 26°16'00"N 050°38'00"E
62	COMMANDER FIFTH FLEET (COMFIFTHFLT)	CINCUSNAVCENT	MANAMA BH 26°16'00"N 050°38'00"E
63	CINC US NAVAL FORCES SOUTH (CINCUSNAVSOU)	USSOUTHCOM	RODMAN NAVAL BASE PA 08°33'00"N 079°22'00"W
64	COMMANDER MARINE FORCES ATLANTIC (COMMARFORLANT)	USACOM	CAMP LEJEUNE, NC US 34°40'30"N 077°22'18"W
65	SECOND MARINE EXPEDITIONARY FORCE (II MEF)	COMMARFORLANT	CAMP LEJEUNE, NC US 34°40'30"N 077°22'18"W
66	SECOND MARINE DIVISION (SECOND MARDIV)	II MEF	CAMP LEJEUNE, NC US 34°40'30"N 077°22'18"W

* First higher echelon

STATE: UNITED STATES OF AMERICA

VALID AS OF: 1 January 1996

CHART 2: INFORMATION ON THE COMMAND ORGANIZATION OF THE CONVENTIONAL ARMED FORCES, PROVIDED IN ACCORDANCE WITH PARAGRAPH 2.2 AND 4.1 OF THE DOCUMENT ON GLOBAL EXCHANGE OF MILITARY INFORMATION

Line No.	Designation of formation 2.2.1	First level of Subordination* 2.2.2	Normal peacetime location of headquarters specifying the exact geographic terms and/or co-ordinates 2.2.3
(a)	(b)	(c)	(d)
67	SECOND MARINE AIR WING (SECOND MAW)	II MEF	CHERRY POINT, NC US 34°54'00"N 076°53'00"W
68	SECOND SURV, RECON, AND INTEL GROUP (SECOND SRIG)	II MEF	CAMP LEJEUNE, NC US 34°40'30"N 077°22'18"W
69	SECOND FORCE SERVICE SUPPORT GROUP (SECOND FSSG)	II MEF	CAMP LEJEUNE, NC US 34°40'30"N 077°22'18"W
70	COMMANDER MARINE FORCES PACIFIC (COMMARFORPAC)	USPACOM	CAMP H.M. SMITH, HI US 21°22'00"N 157°55'00"W
71	FIRST MARINE EXPEDITIONARY FORCE (I MEF)	COMMARFORPAC	CAMP PENDLETON, CA US 33°21'30"N 117°26'20"W
72	FIRST MARINE DIVISION (FIRST MARDIV)	I MEF	CAMP PENDLETON, CA US 33°21'30"N 117°26'20"W

* First higher echelon

STATE: UNITED STATES OF AMERICA

VALID AS OF: 1 January 1996

CHART 2: INFORMATION ON THE COMMAND ORGANIZATION OF THE CONVENTIONAL ARMED FORCES, PROVIDED IN ACCORDANCE WITH PARAGRAPH 2.2 AND 4.1 OF THE DOCUMENT ON GLOBAL EXCHANGE OF MILITARY INFORMATION

Line No.	Designation of formation 2.2.1	First level of Subordination* 2.2.2	Normal peacetime location of headquarters specifying the exact geographic terms and/or co-ordinates 2.2.3
(a)	(b)	(c)	(d)
73	THIRD MARINE AIR WING (THIRD MAW)	I MEF	EL TORO, CA US 33°40'20"N 117°43'36"W
74	FIRST SURV, RECON, AND INTEL GROUP (FIRST SRIG)	I MEF	CAMP PENDLETON, CA US 33°21'30"N 117°26'20"W
75	FIRST FORCE SERVICE SUPPORT GROUP (FIRST FSSG)	I MEF	CAMP PENDLETON, CA US 33°21'30"N 117°26'20"W
76	THIRD MARINE EXPEDITIONARY FORCE (III MEF)	COMMARFORPAC	CAMP COURTNEY OKINAWA JP 26°21'00"N 127°46'00"E
77	THIRD MARINE DIVISION (THIRD MARDIV)	III MEF	CAMP COURTNEY OKINAWA JP 26°21'00"N 127°46'00"E
78	FIRST MARINE AIR WING (FIRST MAW)	III MEF	CAMP BUTLER OKINAWA JP 26°21'20"N 127°46'21"E

* First higher echelon

STATE: UNITED STATES OF AMERICA

VALID AS OF: 1 January 1996

CHART 2: INFORMATION ON THE COMMAND ORGANIZATION OF THE CONVENTIONAL ARMED FORCES, PROVIDED IN ACCORDANCE WITH PARAGRAPH 2.2 AND 4.1 OF THE DOCUMENT ON GLOBAL EXCHANGE OF MILITARY INFORMATION

Line No.	Designation of formation 2.2.1	First level of Subordination* 2.2.2	Normal peacetime location of headquarters specifying the exact geographic terms and/or co-ordinates 2.2.3
(a)	(b)	(c)	(d)
79	THIRD SURV, RECON, AND INTEL GROUP (THIRD SRIG)	III MEF	CAMP HANSEN OKINAWA JP 26°29'00"N 127°53'00"E
80	THIRD FORCE SERVICE SUPPORT GROUP (THIRD FSSG)	III MEF	CAMP KINSER OKINAWA JP 26°30'00"N 128°00'00"E

* First higher echelon

STATE: UNITED STATES OF AMERICA

VALID AS OF: 1 January 1996

CHART 2: INFORMATION ON THE COMMAND ORGANIZATION OF THE CONVENTIONAL ARMED FORCES, PROVIDED IN ACCORDANCE WITH PARAGRAPH 2.2 AND 4.1 OF THE DOCUMENT ON GLOBAL EXCHANGE OF MILITARY INFORMATION

Note: US Fifth Fleet and US Central Air Forces established this reporting year. 2nd Army, 6th Army, and 2nd Armored Division inactivated this reporting year.

STATE: UNITED STATES OF AMERICA

VALID AS OF: 1 January 1996

CHART 3: INFORMATION ON TOTAL PERSONNEL OF CONVENTIONAL ARMED FORCES, PROVIDED IN ACCORDANCE WITH PARAGRAPH 2.3 OF THE DOCUMENT ON GLOBAL EXCHANGE OF MILITARY INFORMATION

Total authorized conscripts	Total authorized professional officers/enlisted	Total officers/enlisted on active duty by rank*			Total personnel in reserve status who have completed their initial military service or training and who have been called up or have reported voluntarily for military service or training since the last exchange of information	Total military personnel serving under the command of the United Nations or under a mandate of the OSCE
2.3.2	2.3.2	2.3.3			2.3.4	2.3.5
(a)	(b)	(c)			(d)	(e)
0	205678	1	Generals and equivalents	854	883950	494
	1178720	2	Colonels and equivalents	11621		
		3	Lieutenant Colonels and equivalents	28503		
		4	Majors and equivalents	42120		
		5	Captains and equivalents	80460		
		6	First Lieutenants and equivalents	25115		
		7	Lieutenants and equivalents	21325		
		8	Sub-Lieutenants and equivalents	0		
		9	Warrant Officers and equivalents	14967		
		10	Master Sergeants and equivalents	68147		
		11	Sergeants and equivalents	601719		
		12	Corporals and equivalents	568296		

*Filled in with due account to national practice

STATE: UNITED STATES OF AMERICA

VALID AS OF: 1 January 1996

CHART 4: INFORMATION ON TOTAL HOLDINGS OF WEAPON AND EQUIPMENT SYSTEMS IN CONVENTIONAL ARMED FORCES, PROVIDED IN ACCORDANCE WITH PARAGRAPH 3 OF THE DOCUMENT ON GLOBAL EXCHANGE OF MILITARY INFORMATION

BT	ACV 3.2			AVLB	ATGM	Self propelled and towed artillery (100 mm calibre or larger) 3.5			Aircraft 3.6				Helicopters 3.7			Surface Warships greater than 400 tons fully loaded displacement	Submarines greater than 50 tons submerged
	APC	AIFV	HACV			GUN/HOW	MORTAR	MLRS	Total CA	CA, capable of operating from aircraft carriers	MTA	PTA	AH	CSH	MTH		
3.1	3.2.1	3.2.2	3.2.3	3.3	3.4	3.5.1	3.5.2	3.5.3	3.6.1	3.6.1	3.6.2	3.6.3	3.7.1	3.7.2	3.7.3	3.8	3.9
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
6917	4685	6565	917	508	708	4236	1876	671	3185	1461	1005	1768	1759	2003	888	235	96

STATE: UNITED STATES OF AMERICA

VALID AS OF: 1 January 1996

CHART 4: INFORMATION ON TOTAL HOLDINGS OF WEAPON AND EQUIPMENT SYSTEMS IN CONVENTIONAL ARMED FORCES, PROVIDED IN ACCORDANCE WITH PARAGRAPH 3 OF THE DOCUMENT ON GLOBAL EXCHANGE OF MILITARY INFORMATION

Note: Information on Total Holdings includes holdings of Joint Activities and US Element NATO. These numbers are not included in Table 5, 6, or 7.

STATE: UNITED STATES OF AMERICA

VALID AS OF: 1 January 1996

CHART 5: INFORMATION ON PERSONNEL, WEAPON AND EQUIPMENT SYSTEMS OF ALL LAND FORCES STATIONED WITHIN THE TERRITORY OF THE REPORTING STATE, PROVIDED IN ACCORDANCE WITH PARAGRAPH 4.2 OF THE DOCUMENT ON GLOBAL EXCHANGE OF MILITARY INFORMATION*

Line No.	Designation of formation	Peacetime authorized personnel strength	BT	ACV 3.2			AVLB	ATGM	Self propelled and towed artillery (100mm calibre or larger) 3.5			Aircraft 3.6			Helicopters 3.7		
				APC	AIFV	HACV			GUN/ HOW	MOR-TAR	MLRS	CA	MTA	PTA	AH	CSH	MTH
	4.2	2.3.1	3.1	3.2.1	3.2.2	3.2.3	3.3	3.4	3.5.1	3.5.2	3.5.3	3.6.1	3.6.2	3.6.3	3.7.1	3.7.2	3.7.3
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
1	FORSCOM	326	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	1 ARMY	150698	3501	1378	2425	646	166	285	1815	1306	237	0	82	0	679	790	161
3	5 ARMY	143592	1398	1706	1262	271	143	11	868	272	307	0	6	0	348	556	61
4	3 ARMY	292	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	MARINE CORPS	144413	215	73	1093	0	31	67	770	0	0	459	83	16	149	77	392

*Filled in with due account to national practice

STATE: UNITED STATES OF AMERICA

VALID AS OF: 1 January 1996

CHART 5: INFORMATION ON PERSONNEL, WEAPON AND EQUIPMENT SYSTEMS OF ALL LAND FORCES STATIONED WITHIN THE TERRITORY OF THE REPORTING STATE, PROVIDED IN ACCORDANCE WITH PARAGRAPH 4.2 OF THE DOCUMENT ON GLOBAL EXCHANGE OF MILITARY INFORMATION*

Note: Formation designations FORSCOM and 3 ARMY are Headquarters Elements.

Note: Of 459 Marine Corps CA (CAIR), 447 are aircraft carrier capable (ACCAIR).

STATE: UNITED STATES OF AMERICA

VALID AS OF: 1 January 1996

CHART 6: INFORMATION ON PERSONNEL, WEAPON AND EQUIPMENT SYSTEMS OF ALL OTHER FORCES STATIONED WITHIN THE TERRITORY OF THE REPORTING STATE, PROVIDED IN ACCORDANCE WITH PARAGRAPH 4.3 OF THE DOCUMENT ON GLOBAL EXCHANGE OF MILITARY INFORMATION

Line No.	Designation of service*	Peacetime authorized personnel strength	BT	ACV 3.2			AVLB	ATGM	Self propelled and towed artillery (100 mm calibre or larger) 3.5			Aircraft 3.6				Helicopters 3.7			Surface Warships greater than 400 tons fully loaded displacement	Submarines greater than 50 tons submerged
				APC	AIFV	HACV			GUN/ HOW	MOR-TAR	MLRS	Total CA	CA, capable of operating from aircraft carriers	MTA	PTA	AH	CSH	MTH		
	4.3	2.3.1	3.1	3.2.1	3.2.2	3.2.3	3.3	3.4	3.5.1	3.5.2	3.5.3	3.6.1	3.6.1	3.6.2	3.6.3	3.7.1	3.7.2	3.73	3.8	3.9
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(l)	(k)	(m)	(n)	(o)	(p)	(q)	(r)	(s)	(t)	(u)
1	AIR FORCE	305575	3	16	0	0	0	0	0	0	0	1030	0	496	1151	0	55	21	0	0
2	NAVY	420538	0	0	0	0	0	0	0	0	0	1190	949	161	601	278	89	149	217	96

*Filled in with due account to national practice

STATE: UNITED STATES OF AMERICA

VALID AS OF: 1 January 1996

CHART 7: INFORMATION ON PERSONNEL, WEAPON AND EQUIPMENT SYSTEMS OF CONVENTIONAL ARMED FORCES STATIONED BEYOND THE TERRITORY OF THE REPORTING STATE, PROVIDED IN ACCORDANCE WITH PARAGRAPH 4.4 OF THE DOCUMENT ON GLOBAL EXCHANGE OF MILITARY INFORMATION

Line No.	Each respective region in which such forces are stationed*	Peacetime authorized personnel strength	BT	ACV 3.2			AVLB	ATGM	Self propelled and towed artillery (100 mm calibre or larger) 3.5			Aircraft 3.6				Helicopters 3.7			Surface Warships greater than 400 tons fully loaded displacement	Sub-marines greater than 50 tons sub-merged
				APC	AIFV	HACV			GUN/ HOW	MOR-TAR	MLRS	Total CA	CA, capable of operat-ing from aircraft carriers	MTA	PTA	AH	CSH	MTH		
	4.4	2.3.1	3.1	3.2.1	3.2.2	3.2.3	3.3	3.4	3.5.1	3.5.2	3.5.3	3.6.1	3.6.1	3.6.2	3.6.3	3.7.1	3.7.2	3.7.3	3.8	3.9
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)	(s)	(t)	(u)
1	REGION 1	110990	1270	1030	1049	0	121	246	547	203	87	218	3	75	0	154	245	36	1	0
	ARMY	65008	1200	984	925	0	119	238	517	203	87	0	0	20	0	154	228	32	0	0
	AIR FORCE	35291	12	37	0	0	0	0	0	0	0	200	0	46	0	0	10	0	0	0
	NAVY	9078	0	0	0	0	0	0	0	0	0	15	0	9	0	0	7	4	1	0
	MARINES	1613	58	9	124	0	2	8	30	0	0	3	3	0	0	0	0	0	0	0
2	REGION 2	91924	355	362	488	0	31	91	182	59	40	281	62	69	0	151	153	65	17	0
	ARMY	24328	284	287	275	0	29	79	77	59	40	0	0	8	0	131	134	32	0	0
	AIR FORCE	24546	13	60	0	0	0	0	0	0	0	209	0	34	0	0	14	0	0	0
	NAVY	19888	0	0	0	0	0	0	0	0	0	15	5	9	0	12	0	3	17	0
	MARINES	23162	58	15	213	0	2	12	105	0	0	57	57	18	0	8	5	30	0	0
3	REGION 3	2389	174	120	248	0	16	8	54	36	0	7	0	12	0	0	0	3	0	0
	ARMY	900	116	110	124	0	14	0	24	36	0	0	0	0	0	0	0	0	0	0
	AIR FORCE	413	0	1	0	0	0	0	0	0	0	0	0	9	0	0	0	0	0	0
	NAVY	758	0	0	0	0	0	0	0	0	0	7	0	3	0	0	0	3	0	0
	MARINES	318	58	9	124	0	2	8	30	0	0	0	0	0	0	0	0	0	0	0
4	REGION 4	772	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
	ARMY	17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	AIR FORCE	20	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
	NAVY	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	MARINES	731	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

*Filled in with due account to national practice, specifying the numbers for each service separately

STATE: UNITED STATES OF AMERICA

VALID AS OF: 1 January 1996

CHART 7: INFORMATION ON PERSONNEL, WEAPON AND EQUIPMENT SYSTEMS OF CONVENTIONAL ARMED FORCES STATIONED BEYOND THE TERRITORY OF THE REPORTING STATE, PROVIDED IN ACCORDANCE WITH PARAGRAPH 4.4 OF THE DOCUMENT ON GLOBAL EXCHANGE OF MILITARY INFORMATION

Line No.	Each respective region in which such forces are stationed*	Peacetime authorized personnel strength	BT	ACV 3.2			AVLB	ATGM	Self propelled and towed artillery (100 mm calibre or larger) 3.5			Aircraft 3.6				Helicopters 3.7			Surface Warships greater than 400 tons fully loaded displacement	Submarines greater than 50 tons submerged
				APC	AIFV	HACV			GUN/ HOW	MOR-TAR	MLRS	Total CA	CA, capable of operating from aircraft carriers	MTA	PTA	AH	CSH	MTH		
	4.4	2.3.1	3.1	3.2.1	3.2.2	3.2.3	3.3	3.4	3.5.1	3.5.2	3.5.3	3.6.1	3.6.1	3.6.2	3.6.3	3.7.1	3.7.2	3.7.3	3.8	3.9
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)	(s)	(t)	(u)
5	REGION 5	12889	0	0	0	0	0	0	0	0	0	0	0	20	0	0	31	0	0	0
	ARMY	4865	0	0	0	0	0	0	0	0	0	0	0	0	0	0	31	0	0	0
	AIR FORCE	2367	0	0	0	0	0	0	0	0	0	0	0	20	0	0	0	0	0	0
	NAVY	1861	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	MARINES	3796	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

*Filled in with due account to national practice, specifying the numbers for each service separately

STATE: UNITED STATES OF AMERICA

VALID AS OF: 1 January 1996

CHART 7: INFORMATION ON PERSONNEL, WEAPON AND EQUIPMENT SYSTEMS OF CONVENTIONAL ARMED FORCES STATIONED BEYOND THE TERRITORY OF THE REPORTING STATE, PROVIDED IN ACCORDANCE WITH PARAGRAPH 4.4 OF THE DOCUMENT ON GLOBAL EXCHANGE OF MILITARY INFORMATION

Note: The following list defines Regions utilized in the compilation of holdings and personnel but is not totally inclusive of all countries.

REGION 1 -- EUROPE

Includes among others the following: Belgium, Germany, Greece, Greenland, Iceland, Italy, Netherlands, Norway, Portugal, Spain, Turkey, and the United Kingdom as well as forces afloat.

REGION 2 -- EAST ASIA and PACIFIC

Includes among others the following: Australia, Japan, Republic of Korea, Singapore and Thailand as well as forces afloat.

REGION 3 -- NORTH AFRICA, NEAR EAST, and SOUTH ASIA

Includes among others the following: Bahrain, Diego Garcia, Egypt, Kuwait, and Saudi Arabia as well as forces afloat.

REGION 4 -- SUB-SAHARAN AFRICA

Key States: The remainder of Africa less those identified in Region 3 as well as forces afloat.

REGION 5 -- WESTERN HEMISPHERE

Includes among others the following: Bermuda, Canada, Cuba (Guantanamo), Honduras, and Panama as well as forces afloat.

Note: Holding totals in Region 1 include 5 Battle Tanks, 5 Armored Combat Vehicles, and 22 Artillery pieces of display equipment.

Note: Peacetime authorized personnel strength (c) represents personnel strength permanently in the region. Personnel for forces afloat are reflected in tables 5 and 6 based on homeport/permanent unit location.

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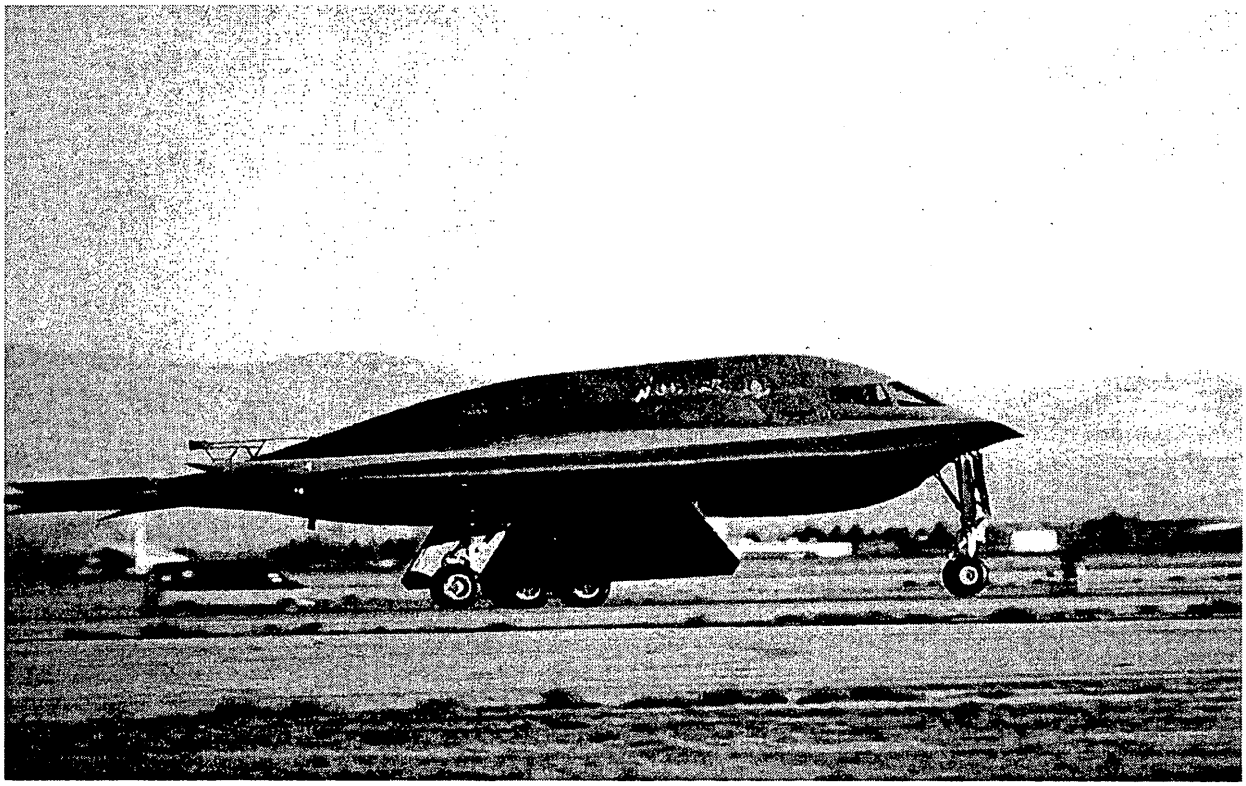
VALID AS OF: 1 January 1996

CHART 8: INFORMATION ON WEAPON AND EQUIPMENT SYSTEMS NEWLY ENTERED INTO SERVICE, PROVIDED IN ACCORDANCE WITH PARAGRAPH 6 OF THE DOCUMENT ON GLOBAL EXCHANGE OF MILITARY INFORMATION

Entered into service through	BT	ACV 3.2			AVLB	ATGM	Self propelled and towed artillery (100 mm calibre or larger) 3.5			Aircraft 3.6				Helicopters 3.7			Surface Warships greater than 400 tons fully loaded displacement	Sub-marines greater than 50 tons submerged
		APC	AIFV	HACV			GUN/ HOW	MOR-TAR	MLRS	Total CA	CA, capable of operating from aircraft carriers	MTA	PTA	AH	CSH	MTH		
	3.1	3.2.1	3.2.2	3.2.3	3.3	3.4	3.5.1	3.5.2	3.5.3	3.6.1	3.6.1	3.6.2	3.6.3	3.7.1	3.7.2	3.7.3	3.8	3.9
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)	(s)
National production 6.1	0	0	0	0	0	0	0	120	34	70	45	18	122	37	63	14	13	4
Imports 6.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

COMBAT AIRCRAFT: B2A

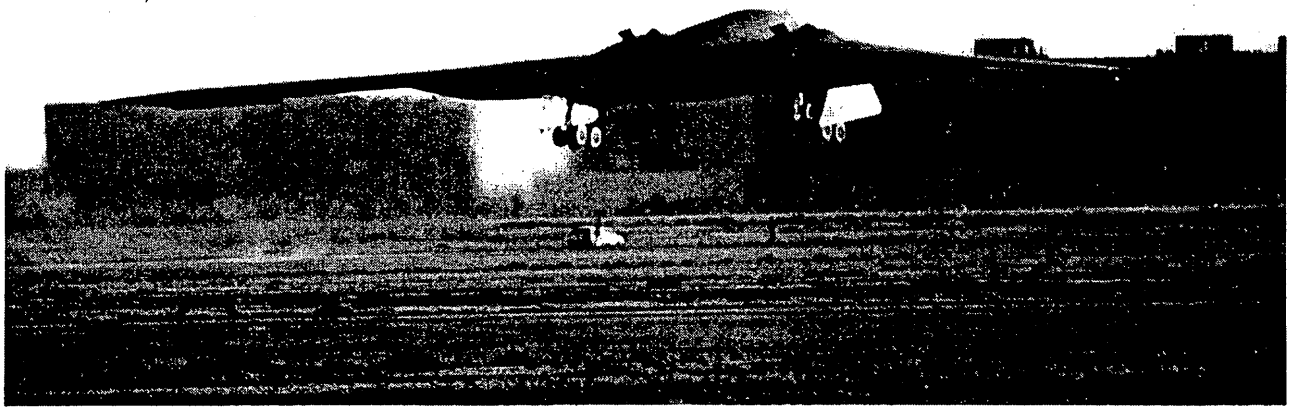


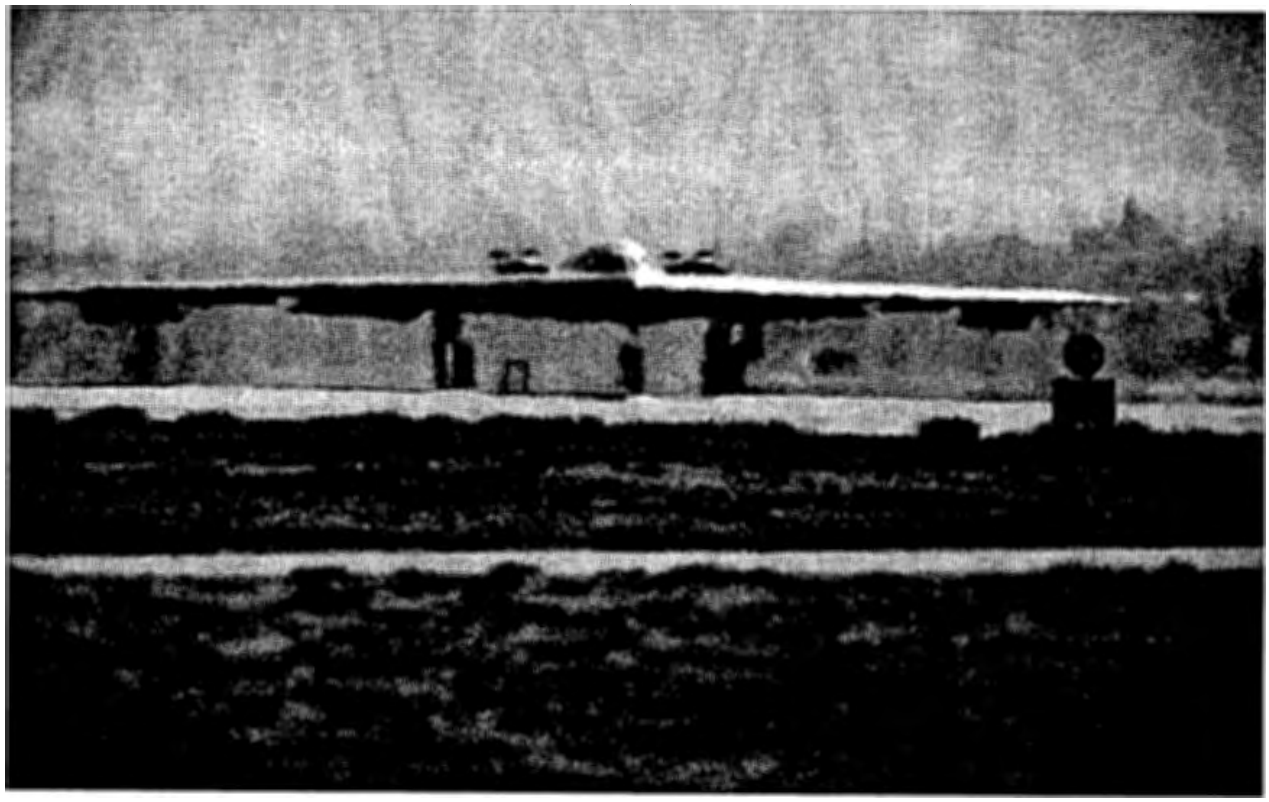
NATIONAL NOMENCLATURE: B2A SPIRIT

DESCRIPTION: LONG RANGE STRATEGIC BOMBER

TECHNICAL DATA:

- ARMAMMENTS BOMBS





REPORT

OF THE

DEFENSE SCIENCE BOARD

TASK FORCE

ON

PERSIAN GULF WAR HEALTH EFFECTS

JUNE 1994

Office of the Under Secretary of Defense for Acquisition and Technology

Washington, D.C. 20301-3140

OFFICE OF THE SECRETARY OF DEFENSE
WASHINGTON, D.C. 20301-3140

EFENSE SCIENCE
BOARD

MEMORANDUM FOR UNDER SECRETARY OF DEFENSE (ACQUISITION & TECHNOLOGY)

SUBJECT: Report of the Defense Science Board (DSB) Task Force on Persian Gulf War Health Effects

I am pleased to forward the final report of the DSB Task Force on Persian Gulf War Health Effects. In the Terms of Reference, Dr. Deutch directed the Task Force to review information regarding the possible exposure of personnel to chemical and biological weapons agents and other hazardous material during the Gulf War and its aftermath. The entire matter of unexplained illnesses reported by some Gulf War participants has become one of intense political and emotional interest, and the work of this Task Force contributes materially to the debate.

In the course of their work, the Task Force heard presentations from a wide range of scientific and medical experts from within and outside of the Department of Defense. The members reached consensus on a number of key points, the most viable one of which they found no evidence that either chemical or biological weapons were used against US service members. The report also concludes that none of the proposed etiologies have caused chronic illness on a significant scale in the absence of acute injury at initial exposure.

Another significant finding was that there is insufficient epidemiological evidence at this time to support the concept of any coherent "syndrome". Because many veterans report symptoms similar to "Chronic Fatigue Syndrome: (CFS); the Task Force feels that it would be advantageous to coordinate further research on veterans' illness in this category with ongoing studies of CFS in the civilian population. While much remains unknown about the organic origin of CFS, severe stress, infection and trauma experienced during Desert Storm may well be precipitating causes. Much further work is needed to verify whether the incidence of symptoms can be associated with any specific aspects of ODS experience, or indeed is provably different among ODS veterans compared to other armed forces or the civilian population.

Despite the intense external interest in the results of the report, the Task Force confined their recommendations to actions within the purview of the Secretary of Defense. Specifically,

the Task Force noted that substantial improvements are needed in pre- and post-deployment medical assessments and data handling. The report advises that while carefully controlled treatment protocols may assist in carving out specific syndromes from the broad range of symptoms noted, treatment would be managed on a case-by-case basis directed at the symptoms presented. Finally, high-tech, low-casualty campaigns in exotic places will probably continue to engender a preoccupation with residual health effects as a fact of life for the foreseeable future.

I would like to echo the Task Force's feeling that the Department must clearly enunciate its commitment to care for those that fight their country's wars. The controversy surrounding this issue will likely continue, but implementation of recommendations in this report should move the medical and scientific communities toward a more complete understanding of the problem of Gulf War veterans who are ill. I endorse the report and recommend that you forward it to the Secretary of Defense.

Paul G. Kaminski

Paul G. Kaminski
Chairman

OFFICE OF THE SECRETARY OF DEFENSE
WASHINGTON, D.C. 20301-3140

DEFENSE SCIENCE
BOARD

MEMORANDUM FOR CHAIRMAN, DEFENSE SCIENCE BOARD

SUBJECT: Report of the Defense Science Board (DSB) Task Force on Persian Gulf War Health Effects

Attached is the final report of the DSB Task Force on Persian Gulf War Health Effects. The Task Force was established by the Under Secretary of Defense (Acquisition & Technology) to review information regarding the possible exposure of personnel to chemical and biological weapons agents and other hazardous material during the Gulf War and its aftermath. Specifically, the terms of Reference requested that the Task Force review:

- all available intelligence and reports of chemical or biological agent detection or exposure during the Persian Gulf War
- scientific and medical evidence relating to exposure to nerve agents at low levels and possible long term effects
- other potential health consequences resulting from low level chemical exposure, environmental pollutants, Kuwaiti oil fires, endemic biologics or other health hazards attributed to Persian Gulf service

The Task Force heard presentations from a wide range of scientific and medical experts from within and outside the Department of Defense. We also reviewed written information from published and unpublished sources that was pertinent to our terms of reference.

In this report, we confine ourselves to conclusions for which there is substantial supporting evidence. There is a substantial hiatus between the imaginable and the plausible and the proven.

On the order of 1 per thousand or less of the troops deployed in Operation Desert Shield/Storm (ODS) have reported symptoms and complaints for which there is not a conventional medical diagnosis and explanation. Many conjectures could be entertained, and would be hard to prove or disprove, about exposures and consequences at this level of outcome; ODS was not conducted as a controlled clinical experiment for our analytical convenience. It might take many years of further investigation to run every conjecture to ground beyond any remote possibility of doubt. In our proceedings, we relied on the veracity of reports briefed to us by the analysts from the Department of Defense, the intelligence community, and other government agencies. In our view, we had unstinting cooperation from all of these; but beyond our examination for face consistency, and an effort to get corroboration from

primary records, e.g. log books, we had no resources or procedure to challenge that veracity.

Accordingly, our conclusions are as follows:

- There is no persuasive evidence that any of the proposed etiologies caused chronic illness on a significant scale in the absence of acute injury at initial exposure. In fact, the overall health experience of US troops in ODS was favorable beyond previous military precedent, with regard to non-combat as well as combat-related disease. This remarkably low background has probably put into relief the residual health problems that have instigated this inquiry.

- The Task Force found no evidence that either chemical or biological warfare was deployed at any level against us, or that there were any exposures of US service members to chemical or biological warfare agents in Kuwait or Saudi Arabia. We are aware of one soldier who was blistered, plausibly from mustard gas, after entering a bunker in Iraq during the post-war period.

- The Task Force felt that there is insufficient epidemiological evidence at this time to support the concept of any coherent "syndrome". We do recognize that veterans numbering in the hundreds have complained of a range of symptoms not yet explained by any clear-cut diagnosis -- a number of cases in many respects resemble the "Chronic Fatigue Syndrome"; it would be advantageous to coordinate further research on veterans' illness in this category with ongoing studies of "CFS" in the civilian population. This is not to deny the possibility of service-connectedness, as severe stress, infection and trauma may well be precipitating causes of "CFS".

- Much further work is needed, even to verify whether the incidence of symptomatic events, beyond the reports of complaints that can be elicited by wide publicity, is associated with any specific aspects of ODS experience, or indeed is provably different among ODS veterans compared to other armed forces or the civilian population. This remark is not to be read as denying service-connectedness, but simply a reflection of the tenuous state of the available epidemiological data in the absence of controlled surveys and studies.

Despite the intense external interest in the results of this report, as our report is to the Secretary of Defense, we confine our recommendations to actions within his purview:

- The Department of Defense needs substantial improvements in pre- and post-deployment medical assessments and data handling. These must obviously be coordinated between DoD and DoVA.

- The appropriate Service medical facilities should ensure that clinical treatment, absent a proven etiology, is managed on a case-by-case basis, directed at the symptoms presented. Carefully controlled treatment protocols might assist in carving out specific syndromes from the broad range of symptoms noted.

- The Task Force advises that high-tech, low-casualty campaigns in exotic places will engender a preoccupation with residual health effects as a fact of life for the foreseeable future. If chemical or biological weapons are ever actually employed, there will be a gross multiplication of those residuals (on top of obvious acute physical and psychological casualties), and further research is needed on long-term consequences of exposure.

In light of the consequences of a perception to the contrary, the Task Force believes that DoD must clearly sustain its historic commitment to providing the highest quality health care to those who serve the nation in their military missions.

Joshua Lederberg
Chairman

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I. OVERVIEW

The Undersecretary of Defense (Acquisition & Technology) established the Defense Science Board (DSB) Task Force on Persian Gulf War Health Effects to review:

-all available intelligence and reports of chemical or biological agent detection or exposure during the Persian Gulf War
-scientific and medical evidence relating to exposure to nerve agents at low levels and possible long term effects
-other potential health consequences resulting from low level chemical exposure, environmental pollutants, Kuwaiti oil fires, endemic biologics or other health hazards attributed to Persian Gulf service

Members of the Persian Gulf War Health Effects Task Force are:

Dr. Joshua Lederberg	The Rockefeller University
Dr. George M. Whitesides	Harvard University
Dr. Paul Doty	Professor Emeritus, Harvard University
Dr. Abba I. Terr	Stanford University Medical Center
Dr. Joseph Bunnett	University of California, Santa Cruz
Dr. John D. Baldeschweiler	California Institute of Technology
Dr. Margaret Hamburg	NYC Commissioner of Public Health
Major General Phil Russell, US Army (retired)	Johns Hopkins University School of Medicine

The following Government and special advisors assisted the Task Force:

Government Advisors	Agency
Dr. Ruth Etzel	Centers for Disease Control, Department of Health & Human Services
Dr. Susan Mather	Department of Veterans Affairs
Dr. Ann Norwood	Uniformed Services University of the Health Services, Department of Defense

Special Advisors	Agency

Dr. Richard Miller	Institute of Medicine, National Academy of Sciences
Dr. Graham Pearson	Director General, Chemical & Biological Defense Establishment, United Kingdom

Administrative and research support was provided by Colonel Frank Cox and Major Ben Hagar, Office of the Assistant to the Secretary of Defense (Atomic Energy).

Following a series of fact-finding meetings (Appendix A) the Task Force developed the following principal conclusions and recommendations:

A. Conclusions

- There is no persuasive evidence that any of the proposed etiologies caused chronic illness on a significant scale in the absence of acute injury at initial exposure. In fact, the overall health experience of US troops in Operation Desert Storm (ODS) was favorable beyond previous military precedent, with regard to non-combat as well as combat-related disease. This remarkably low background has probably put into relief the residual health problems that have instigated this inquiry.

- There is no scientific or medical evidence that either chemical or biological warfare was deployed at any level against us, nor that there were any exposures of US service members to chemical or biological warfare agents in Kuwait or Saudi Arabia. We are aware of one soldier who was blistered, plausibly from mustard gas, after entering a bunker in Iraq during the post-war period.

- The epidemiological evidence is insufficient at this time to support the concept of any coherent "syndrome." We do recognize that veterans numbering in the hundreds have complained of a range of symptoms not yet explained by any clear-cut diagnosis -- a number of cases in many respects resemble the "Chronic Fatigue Syndrome"; it would be advantageous to coordinate further research on veterans' illness in this category with ongoing studies of "CFS" in the civilian population. This is not to deny the possibility of service-connectedness, as severe stress, infection and trauma may well be precipitating causes of "CFS."

- Much further work is needed, even to verify whether the incidence of symptomatic events, beyond the reports of complaints that can be elicited by

wide publicity, is associated with any specific aspects of ODS experience, or indeed is provably different among ODS veterans compared to other armed forces or the civilian population. This remark is not to be read as denying service-connectedness, but simply a reflection of the tenuous state of the available epidemiological data and the absence of controlled surveys and studies.

B. Recommendations

- The Department of Defense needs substantial improvements in pre- and post-deployment medical assessments and data handling. These must obviously be coordinated with the Department of Veterans Affairs.

- Clinical treatment, absent a proven etiology, must be managed on a case-by-case basis, directed at the symptoms presented. Carefully controlled treatment protocols might assist in carving out specific syndromes from the broad range of symptoms noted.

- We advise that high-tech, low-casualty military campaigns in exotic places will engender a preoccupation with residual health effects as a fact of life for the foreseeable future. If chemical or biological weapons are ever actually employed, there will be a gross multiplication of those residuals (on top of obvious acute physical and psychological casualties), and further research is needed on long-term consequences of exposure. The Department of Defense must plainly sustain its historic commitment to providing the highest quality of health care to those who serve the nation in their military missions.

II. TERMS OF REFERENCE

The full text of the revised Terms of Reference, signed on February 1, 1994, by John Deutch, is as follows:

> You are requested to establish a Defense Science Board Task Force regarding the possible exposure of personnel to chemical and biological weapons agents and other hazardous material during the Gulf War and its aftermath. The purpose of this Task Force is to review all available intelligence and reports of detection of the post war period. The Task Force should also review scientific and medical evidence relating to exposure to nerve agents at low levels and long term health effects. A similar review should be conducted for other potential health consequences resulting from low level chemical exposure, environmental pollutants, Kuwait oil fires, endemic biologics or other health hazards. The Task Force may call upon all sources in making its appraisal and should be briefed on background

evidence concerning the possession of CW agents and their use in other settings; however, judgments should be focused on Desert Storm as described above. All DoD-related elements who have technical capabilities that can be brought to bear on this analysis should provide support to this effort. In addition, the Task Force should look at the health-related studies on-going in other governmental agencies.

The Under Secretary of Defense (Acquisition & Technology) will sponsor this Task Force. Dr. Joshua Lederberg will serve as Chairman of the Task Force. Colonel Frank Cox, USA, of the Office of the Assistant to the Secretary of Defense (Atomic Energy) will serve as Executive Secretary. LTC John Dertzbaugh, USA, will be the Defense Science Board Secretariat representative. The Office of the USD(A&T) will provide funding and other support as may be necessary. It is not anticipated that this Task Force will need to go into any "particular matters" within the meaning of Section 208 of Title 18, U.S. Code, nor will it cause any member to be placed in the position of acting as a procurement official. An interim report should be provided by March 31, 1994, and a final report completed by June 15, 1994.

III. BACKGROUND

A. Deployment of troops - Operation Desert Shield

From August 1990, continuing into 1991, the United States conducted a large-scale military deployment, following the decision to confront Iraq after its invasion of Kuwait. This massive operation involved nearly 700,000 service men and women deployed into the actual theater of operation, with many thousands more assisting the effort from the US and other foreign bases.

As US and other forces began to arrive in the theater of operations, planners were concerned that the large, well-equipped Iraqi Army posed an immediate threat to the coalition force.

Analysts were concerned with the potential for massive combat casualties, predicting as many as 40,000 killed or wounded. There were also early concerns involved with endemic infectious diseases, not unusual for any deployment of US troops to non-developed areas, particularly the array of gastrointestinal pathogens causing vomiting and diarrhea.

B. Stressors of deployment

The Gulf War brought both old and new threats to American and Coalition forces. There were a number of stressors unique to living in the desert. Familiar and well-publicized threats included venomous snakes and scorpions indigenous to

Southwest Asia. From a medical perspective, however, the largest predictable threat initially was heat injury. Air temperature in the summer can exceed 115 degrees Fahrenheit. Sand receiving full sun is usually 30-45 degrees hotter than the air and can reach temperatures of 150 degrees Fahrenheit. For soldiers wearing chemical protective gear, these temperatures presented a serious risk of overheating and maintaining adequate hydration became a significant challenge.

The desert can also become very cold in the winter with wind-chills at night dropping well below freezing. The sand in the Gulf region was often extremely fine, covering everything with layers of fine dust. After the Iraqis set fire to the oil wells, some troops reported breathing in oily residue and finding a layer of soot coating the environs. Protection of skin and eyes from sand and dust was imperative. The wearing of contact lenses was prohibited except in areas that were air-conditioned and protected from sand. Sunglasses and goggles were distributed for eye protection. Soldiers were also urged to use extra caution in securing tent pegs and other objects that could be turned into missiles by high winds.

Service members in Saudi Arabia had very limited social outlets available to them during infrequent time off. They were culturally isolated, instructed not to fraternize with local people. Also, in accord with the religious dictates of the host country, alcohol was prohibited. Living conditions were harsh: hot showers were an infrequent luxury. Cots were usually lined up side-by-side in buildings, affording virtually no privacy or quiet. The unremitting pace of both the build-up and the war created physically demanding working environments. Support personnel routinely worked 16-18 hour days without respite in order to ensure that logistical goals were met. The use of night vision equipment meant that soldiers could fight effectively around the clock, also contributing to physical strain.

Combat-related stressors included "friendly fire" incidents, tank battles, air-strikes, and other potentially lethal events. The anxiety and apprehension about the use of chemical or biological weapons were omnipresent, with the need for sustained vigilance for incoming conventional or chemical or biological SCUD missiles, and terrorist attacks added to this apprehension. Fears of capture, injury, and death were common concerns of those sent to the combat theater. In the course of the war and its aftermath, many personnel saw the bodies of dead Iraqis and Kuwaitis. The debilitated condition of the Iraqi Enemy Prisoners of War (EPW's) and ethnic minorities such as the Kurds was also distressing to many.

Often, actual combat-related stressors are focused on too narrowly, overlooking the fact that exposures to death, injury and the grotesque are not the only stressors that cause pain and suffering. Other stressors associated with war include the important sequelae of separation from family members and friends. In the case of Reserve and Guard personnel, this also entailed leaving their full-time civilian careers. Many reservists and guardsmen reported feelings of shock and surprise, not anticipating that they would ever have to go to war. Some personnel reported financial problems secondary to deployment. For all service members, normal routines were disrupted and the usual comforts of home became luxuries.

Deployment and reunion also entailed the shifting of normal family roles and their resumption, a challenging process for both service personnel and their families.

C. Medical Problems

Following the triumphant return of the troops from the desert, not unexpectedly, some began to experience health problems. Many of the veterans seen in Veterans Affairs (VA) hospitals following the war were for a normal range of injuries and illnesses, which conformed to established diagnoses.

Initially, only those veterans who could show a service connection for their ailments were able to seek treatment in the VA system. As time went on however, some veterans began to show up at VA centers with unexplained symptoms for which the service-connection could not be determined within established diagnoses and etiologies.

D. Registry Efforts

1. Characteristics of Deployed Troops

One of the first efforts undertaken by the Department of Defense (DoD) and VA at the conclusion of the war was to construct a roster of all men and women assigned to military units that served in the Persian Gulf area. Both departments agreed that in order to address anticipated concerns of veterans over exposures to smoke from oil well fires as well as exposures to other environmental hazards, all individuals who served in the area needed to be identified along with appropriate demographic and military information. The Defense Manpower Data Center (DMDC) prepared a computer file of the 696,562 individuals deployed to the Persian Gulf area during the war and provided the file to VA. Table 1 describes the demographic and military characteristics of military personnel deployed to the Persian Gulf area during the Persian Gulf War.

Table 1
Demographic and Military Characteristics of Participants in Persian Gulf War

Characteristics	Active Units (n=580,433) %	Reserve Units (n=72,348) %	National Gd (n-43,781) %	Total (n=696,5 %
Sex				
Male	93.7	84.9	89.1	92.
Female	6.1	14.7	9.6	7.
Unknown	0.2	0.4	1.3	0.
Race				
White	69.6	73.4	77.7	70.
Black	23.3	21.0	18.3	22.
Other	7.0	5.7	3.9	6.
Marital Status				
Single	42.8	49.9	34.7	43.
Married	54.3	44.8	57.8	53.
Formerly Married	2.7	4.9	6.2	3.
Unknown	0.2	0.4	1.4	0.
Rank				
Enlisted	89.3	86.4	90.4	89.
Officer	9.3	12.6	8.5	9.
Warrant	1.4	1.0	1.0	1.
Branch				
Air Force	12.2	7.6	14.7	11.
Army	46.0	64.6	85.3	50.
Marine	15.7	17.8		14.
Navy	26.0	10.0		22.
Coast Guard	0.1			0.
Mean Age (1991)	27.4	30.4	32.6	2

Source: Defense Manpower Data Center

Certain demographic characteristics are substantially different for those who served in active units and those who served in activated reserve or national guard units. Individuals who served in active units were younger (mean age 27.4), and included a relatively smaller proportion of women (6.1%) than those who served in activated reserve or national guard units. Unlike the Vietnam War, a larger portion of deployed troops (17%) originated from activated Reserve and National Guard units.

The majority of troops were deployed in the theater before the air war began on January 16, 1991, and over 50% of the deployed troops were withdrawn from the area by the first week of May 1991. The median length of service in the area was five months. Varying times of entry to and departure from the theater resulted in

some veterans being subject to different natural and man-made environmental exposures. Those who left the theater before the commencement of the air war would not have been exposed to smoke from the oil well fires. Similarly, those who arrived during the period following the conclusion of the ground war would not have been concerned with the threat of biological and chemical warfare, and did not receive prophylactic treatment of pyridostigmine bromide, anthrax vaccine, and botulinum toxoid vaccine. Additionally, the climate and living conditions were substantially different at the beginning of deployment in August 1990 compared to the end of ground war in February 1991.

2. Veterans Affairs

Public Law 102-585, the "Persian Gulf War Veterans' Health Status Act" of 1992, mandated that the Department of Veterans Affairs (VA) create a registry of the health examinations that may be requested by veterans of the Persian Gulf War. This program allows veterans with health concerns to obtain a comprehensive physical examination with appropriate baseline laboratory tests. Additional diagnostic tests and referrals to specialists are made where indicated. Certain information from these examinations is recorded on a two-page registry code sheet at the local VA hospitals for forwarding to a central location. The code sheet data then is keyed in, and a computerized database is created and updated periodically. VA provides a registry examination to veterans who served on active military duty in Southwest Asia during the Persian Gulf War between August 2, 1990, and the official termination date (which is yet to be established). In addition to providing medical examinations to concerned Persian Gulf War veterans, the registry is being used to assist VA in identifying unusual clusters of illnesses among the veterans and to conduct outreach activities to inform Persian Gulf War veterans of VA programs and policies. As of February 1994, some 16,000 Persian Gulf War veterans have completed the registry examination.[1]

3. Department of Defense

The DoD Registry program consists of a two year effort to build a computerized system to identify and track the location of veterans, by unit, for each day of the war, to aid in later identification of those units who may have been in close proximity to potential hazards. The program was initiated to identify those units who may have been exposed to the oil fire plumes from burning oil wells in Kuwait during and following the war, but can be adapted to portray other hazards as required. It is expected to be completed by mid-summer 1995.[2]

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[1]Kang, Briefing to DSB Task Force,

[2]US Army and Joint Service Environmental Support Group

E. Czech Announcements

In the summer of 1993, the Czech government officially announced that Czechoslovakian chemical detachments had reported that their detectors for nerve and mustard agents had responded on a few occasions during the war. They stressed that their personnel had suffered no medical effects, and that it was certain that the chemical agent had not been as a result of Iraqi offensive action. A team of DoD analysts traveled to Prague in September 1993, and concluded on the basis of the Czechs' training, equipment and procedures that their account of the detections was credible. There had been no other objective verification of the detections during the war, however, and no samples were taken that could have confirmed the actual presence of chemical agent. At a press conference on November 10, 1993, Secretary Aspin and Under Secretary Deutch discussed the DoD assessment of the Czech detections and the possible medical consequences of those events, had they occurred. It was at this time that the formation of this Defense Science Board Task Force was announced.

IV. MEDICAL OBSERVATIONS

A. General

In previous wars, the expected hazards of war were directly responsible for the overwhelming majority of casualties. The attention of military leaders, their medical forces, and the nation as a whole was focused on the expected and known hazards of war. In WW II, Korea and Vietnam, US forces sustained large numbers of killed, wounded, combat stress casualties and high DNBI (disease/non-battle injuries) rates, especially due to infectious diseases. Post-war military and VA medical care was also focused on veterans who had been victims of the known hazards of war, some of which may have provided convenient explanations for undiagnosable complaints.

The very fact that combat casualties in Desert Shield/Storm period were lower by far than any previous large engagement (See Table 2) has allowed attention to be focused on other aspects of military health.

Table 2
Historical Casualty Data

	Total Deaths #		Admissions per 1,000/day	Admissions per 1,000 per year	Admissions per 1,000/day
War	**Battle**	**Other**	**Wounded**	**Combat Stress**	**Disease, Non-Battle Injuries**
WW II	292,131	115,185	(Mideast theater) .40-2.30	25.6	(Mideast theater) 1.60-1.96
Korea	33,629	20,617	.54-.82	unk	.96-2.14
Vietnam	47,244	10,446	.14-.42	1.6-2.3	.89-.92
Persian Gulf	96	133	354 (total #)	unk	.34-.40

US Army OTSG

B. Unexplained Medical Complaints in Gulf War Participants

What is the Problem

A certain number of Gulf War participants have come forward with symptomatic complaints, usually of a multi-system nature, and/or non-specific, which they attribute to their experience in the Gulf. Generally, their physical examinations and laboratory results are negative or non-diagnostic. The exact number of such veterans is currently unknown. This group has attracted the attention of the media and some members of Congress.

A variety of studies have attempted to shed light on specific aspects of the problem. These include epidemiological studies by the Army and Navy (123d ARCOM, Seabees), clinical studies (leishmaniasis, depleted uranium), environmental studies (9th ACR) and pathological studies (AFIP). The VA has responded to the diagnostic, clinical and political challenges with a registry of personnel and medical data and tertiary care referral program. Efforts are being made to determine the extent of and consequences of environmental exposure to oil fire products. Lacking however, are a thorough and comprehensive, epidemiologic study and analysis of the entire illness phenomenon.

Although the cases of unexplained medical complaints in Gulf War participants seem to be concentrated in reserve units and seem to affect older individuals, such "risk factors" have not been systematically examined by appropriate epidemiologic methods. The Army and the Navy medical departments have strong preventive medicine assets linked to capable biomedical research organizations. These assets have not been effectively utilized to address the entirety of the problem. Constraints such as the vagueness of the clinical syndrome, lack of a case definition, absence of a biological marker for the disease, and the differences between the medical and patient care systems of the reserves, the VA, and the active forces have been some of the barriers to a comprehensive epidemiological study. These obstacles must be overcome to gain a complete picture of the problem and develop a deeper understanding of the nature of the total health consequences of Persian Gulf War service.

V. EPIDEMIOLOGICAL CORRELATIONS

Review of the VA Persian Gulf Registry Data

Of the veterans entered on the VA Persian Gulf Registry, Table 3 describes the distribution of demographic characteristics for 7,427 whose data was available for analysis. Although the number of veterans actually registered continues to increase, the task force was provided data from VA based on analysis of the first 7,247 records to be compiled. Demographic characteristics of those who came to VA for an examination do not appear substantially different from those troops deployed in the Gulf area. However, the military characteristics of the registry participants are significantly different when compared to the characteristics of the entire cohort of deployed troops (Table 4). Even after considering eligibility status for the registry examination, those who served in national guard and reserve units are more likely to have participated in the registry examination than those who served in their counterpart active units. Their rate of registry participation was several-fold greater than their counterparts (see Figure 1, Appendix D). Distribution of time of arrival, departure from and length of stay in the theater for the veterans on the VA registry is not significantly different from those of the overall Persian Gulf War participants (Figures 2-4, Appendix D).

Table 3

Distribution of Demographic Characteristics of 7,427 Veterans on the Persian Gulf Registry and of 696,562 participants in the Persian Gulf War

Characteristics	PG Registry Number	PG Registry Percent
Sex		
Male	6600	88.9
Female	827	11.1
Unknown	-	-
Race		
White	5171	69.6
Black	1686	22.7
Other/Unknown	570	7.7
Marital Status		
Single	2194	29.5
Married	4062	54.7
Formerly Married	1171	15.8
Unknown	-	-
Age in 1991		
< 24	2245	30.3
25-29	1441	19.4
30-34	1097	14.8
35-39	944	12.7
40-44	931	12.5
45+	769	10.4
Mean Age (1991)	31.6	

Source: Defense Manpower Data Center

Table 4

Distribution of Military Characteristics of 7,427 Veterans on the Persian Gulf Registry and of 696,562 participants in the Persian Gulf War

Characteristics	PG Registry Number	PG Registry Percent	
Rank			
Enlisted	6589		87.6
Officer	391		5.3
Warrant	97		1.3
Unknown	430		5.8
Branch			
Air Force	416	(100)	5.6
Active	187	(45)	
Reserve	79	(19)	
Guard	69	(17)	
Unknown	81	(19)	
Army	5549	(100)	74.7
Active	2095	(38)	
Reserve	1398	(25)	
Guard	1812	(33)	
Unknown	244	(4)	
Marine Corps	838	(100)	11.3
Active	645	(77)	
Reserve	167	(20)	
Unknown	26	(3)	
Navy	590	(100)	7.9
Active	245	(42)	
Reserve	274	(46)	
Unknown	71	(12)	
Coast Guard	28		<1
Unknown	6		<1

Source: Defense Manpower Data Center

A wide variety of complaints were made by the registry participants, although only 3 could be entered in each veteran's computer file for centralized analysis. Table 5 lists the ten most frequent complaints among the 7,427 veterans. Skin rash, fatigue, muscle and joint pain, headache and loss of memory are most frequently mentioned; complaints listed are subjective symptoms reported by the registry participants, and may or may not have been objectively verified by physical examination. It is important to note that information from all veterans on the Persian Gulf Registry has been included. Many of these veterans have received appropriate medical diagnoses for their complaints, so this table does not accurately represent the most frequent complaints for those veterans with unexplained illness. It can also be noted that 1,294 veterans (17.4%) expressed no specific complaints at all.

Table 5
Ten Most Frequent Complaints Among 7,427 Veterans on the Persian Gulf Registry

Complaints	Total # of Complaints	Percent of 7,247 veterans with this complaint
Skin Rash	1124	15.1
Fatigue	1044	14.1
Muscle, Joint Pain	981	13.2
Headache	847	11.4
Loss of Memory	823	11.1
Shortness of Breath	521	7.0
Diarrhea	346	4.7
Cough	295	4.0
Choking Sensation, Sneezing, Halitosis, Mouth Breathing	274	3.7
Chest Pain	195	2.6
No complaint	1294	17.4

Table 6 lists the distribution of major categories of diagnosis as reported by VA environmental physicians, by military unit status. There seems to be no significant variation in occurrence of major categories of medical problems, or any specific medical conditions (Table 7) by unit status despite much higher rates of participation and a significantly greater proportion of individuals with complaints among veterans who served in the reserve or guard units. Similarly, distribution of the same categories of medical conditions by branch of service does not vary substantially (Table 8). It was originally assumed that troops who served in one branch of service (e.g., Army) might have different environmental exposures in the Gulf area than troops in another branch of service (e.g., Navy) leading to different patterns of complaints and medical conditions.

Table 6

Percentage Distribution of Diagnosis for 7,427 Veterans on the Persian Gulf Registry by Military Unit Status

Diagnosis (ICD9)	Active (%) (N=3,172)	Reserve (%) (N=1,918)	Guard (%) (N=1,881)
Infectious Diseases (001-139)	233 (7)	136 (7)	117 (6)
Neoplasms (140-239)	46 (1)	28 (1)	26 (1)
Mental Disorders (290-319)	346 (11)	268 (14)	240 (13)
Nervous System (320-389)	225 (7)	141 (7)	148 (8)
Circulatory System (390-459)	177 (6)	135 (7)	130 (7)
Respiratory system (460-519)	506 (16)	288 (15)	318 (17)
Digestive system (520-579)	325 (10)	224 (12)	212 (11)
Genitourinary system (580-629)	90 (3)	63 (3)	63 (3)
Skin & Sub cutaneous tissue (680-709)	393 (12)	249 (13)	248 (13)
Musculoskeletal/connective tissue (710-739)	708 (22)	477 (25)	468 (25)
Injury & Poisoning (800-999)	197 (6)	76 (4)	98 (5)
No medical Diagnosis	760 (24)	399 (21)	487 (26)

Table 7

Percentage Distribution of Selected Diagnoses for 7,427 Veterans on the Persian Gulf Registry by Military Unit Status

Diagnosis (ICD9)	Active (%) (N=3,172)	Reserve (%) (N=1,918)	Guard (%) (N=1,881)
Leishmaniasis (085)	3	4	1
Athlete's foot (110.4)	44 (1.4)	40 (2.1)	24 (1.3)
Anxiety states (300.0)	51 (1.6)	48 (2.5)	30 (1.6)
Neurasthenia (300.5)	138 (4.4)	157 (8.2)	112 (6.0)
Tension headache (307.81)	49 (1.5)	36 (1.9)	35 (1.9)
Chronic PTSD (309.8)	73 (2.3)	51 (2.7)	45 (2.4)
Depressive Disorder (311)	47 (1.5)	39 (2.0)	34 (1.8)
Chronic bronchitis (491)	21 (0.7)	17 (0.9)	20 (1.1)
Asthma, unspecified (493.9)	101 (3.2)	35 (1.8)	41 (2.2)
Chronic airway obstruction (496)	33 (1.1)	30 (1.6)	35 (1.9)
Gingival & periodontal disease (523)	22 (0.7)	16 (0.8)	15 (0.8)
Non-infectious gastroenteritis & colitis (558.9)	110 (3.5)	75 (3.9)	66 (3.5)
Dermatitis, unspecified cause (692.9)	84 (2.6)	65 (3.3)	75 (4.0)
Baldness, alopecia (704.0)	65 (2.0)	33 (1.9)	24 (1.3)
Pain in joint (719.4)	179 (5.6)	134 (7.0)	135 (7.2)
Low back pain (724.2)	105 (3.3)	62 (3.2)	65 (3.5)
Total	3,172 (100)	1,918 (100)	1,881 (100)

Table 8

Percentage Distribution of Diagnoses for 7,427 Veterans on the Persian Gulf Registry by Branch

Diagnosis (ICD9)	Army (N=5549) %	Marine (N=838) %	Navy (N=590) %	Air Force (N=416) %	Total (7427) %
Infectious Diseases (001-139)	7	8	7	6	7
Neoplasms (140-239)	1	1	2	2	1
Mental Disorders (290-319)	13	12	13	11	13
Nervous System (320-389)	8	6	8	7	8
Circulatory System (390-459)	7	3	6	6	6
Respiratory system (460-519)	16	17	14	16	16
Digestive system (520-579)	11	8	10	11	11
Genitourinary system (580-629)	3	3	3	2	3
Skin & Sub cutaneous tissue (680-709)	13	13	11	13	13
Musculoskeletal/connective tissue (710-739)	25	20	23	20	24
Injury & Poisoning (800-999)	6	5	5	14	5
No medical Diagnosis	23	26	23	24	24

Table 9 describes 19 cases of cancer reported in the registry (18 males and 1 female). There is no discernible demographic, military or pathological pattern to the distribution of cancer cases. Because it is a self-selected group of individuals, it would be difficult to make a meaningful comparison with a general population. Whether the observation of 19 cancer cases out of 7,427 examinations reflects an abnormal rate of occurrence is unknown. Furthermore, because of the long latency period associated with cancer originating from environmental exposures, it is too early to evaluate the cancer risk related to Persian Gulf service. Likewise, it is unknown whether some or all of the cancers were present prior to Persian Gulf deployment.

Table 9
Distribution of Cancer Cases by Site Among 7,427 Veterans on the Persian Gulf Registry

Type	Male No.	Female No.
Tongue	1	
Lung	2	
Pleura	1	
Soft Tissue	2	
Melanoma	1	
Other Skin	3	
Prostrate	1	
Testis	2	
Adrenal Gland	1	
Hodgkin's Disease	1	1
Other Lymphoma	1	
Others	2	
Total	18	1

Table 10 summarizes veterans' responses to a question about birth defects in children conceived before service in the Persian Gulf War and in children conceived after veterans returned from the war. According to the registry of 7,427 veterans, 209 veterans reported having children with birth defects: 115 as having been conceived before Persian Gulf war service and 94 after the war. The nature of the birth defects, however, is not defined or verified and the occurrences of birth outcomes are based on self-reports.

Table 10
Self-Reported Incidence of Birth Defects Among Veteran's Children

Events	Number	Percent
No children born	1565	21.1
No birth defects	5653	76.1
Yes birth defects	209	2.8
Conceived before Persian Gulf Service	115	1.5
Conceived after Persian Gulf Service	94	1.3
Total	7427	100

In analyzing and describing the registry data, it is necessary to recognize many limitations related to the source of the data and therefore to exercise great caution in its use. The veterans in the registry are a self-selected group of veterans who are concerned about the possible adverse health effects of service in the Gulf area and who were willing to come to VA hospitals for physical examinations. Many veterans who are covered by civilian health insurance may be seeking their health care through a civilian health care provider. In addition, a majority of troops who served in the war are still in service with active units, and they would not yet seek medical care from a VA hospital. Therefore, the registry participants may not be representative of either the troops deployed in the Gulf area overall or of those who are eligible for medical care from VA. One cannot be sure whether certain symptoms and diseases in the registry participant population are under-represented or over-represented. A valid external comparison of health outcomes from this group to another population is difficult to make for this reason.

In spite of the several limitations to the VA registry, it serves as a useful tool in suggesting areas for further in-depth reviews and study. The registry can provide an opportunity to identify possible adverse health trends on which to base the design and conduct of appropriate epidemiologic studies.

1. VA Hospital Discharge Data for Persian Gulf War Veterans

The Patient Treatment File (PTF) is a computerized hospital discharge abstract system of inpatient records, including patients' demographic data, surgical and procedural transactions, and patient movement and diagnosis. One PTF

record is prepared for each discharged VA inpatient by the discharging station. Over one million veterans are treated as inpatients in VA hospitals each year. The PTF record contains information on such variables as name, Social Security number, date of birth, sex, marital status, period of military service and discharge diagnosis. Military service during the Persian Gulf era is noted on the record but actual service in the Persian Gulf area is not documented. The PTF was matched with the Persian Gulf War roster of veterans prepared by the DMDC, and VA inpatients who served in the Persian Gulf area were identified. The Task Force was presented data, as of September 30, 1993, that compared the data from 6092 ***Persian Gulf veterans*** and 6265 ***era veterans*** (those in service during the same period but not actually deployed to the Gulf) treated in VA hospitals on an inpatient basis.

Table 11 describes the demographic characteristics of 6092 Persian Gulf veterans and 6265 era veterans who were treated in VA hospitals. Women veterans constituted 7.6% of the Persian Gulf veteran patients, whereas 14% of era veteran patients were women. The 7.6% figure may be a simple reflection of the gender distribution of the troops deployed in the Persian Gulf area: 7.2% of the deployed troops were women and 8.8% of the troops excluding those who were still on active duty as of September 30, 1993, were women. Otherwise, the racial distribution, marital status and age distribution of the two groups were similar.

Table 11

Demographic Characteristics of 6,092 Persian Gulf Veterans and 6,265 Era Veterans Treated in VA Hospitals on an Inpatient Basis

	Persian Gulf Vets		Era Vets	
Characteristics	Number	Percent	Number	Percent
Sex				
Male	5629	92.4	5363	85.6
Female	463	7.6	902	14.4
Race				
White	3863	64.4	4168	66.5
Black	1520	24.9	1442	23.0
Other	709	11.7	655	10.5
Marital Status				
Never Married	2230	36.6	2010	32.1
Married	2400	39.4	2528	40.4
Divorced/Separated	1405	23.1	1633	26.1
Other	57	0.9	94	1.5
Mean Age (years)	29 years		31 years	

Table 12 describes the distribution of military characteristics of these patients. This distribution is also a reflection of the characteristics of the troops deployed in the Persian Gulf area. For example, the distribution of Army troops deployed in the area by unit status is 76% in active units, 13% in reserve units and 11% in national guard units. Excluding those who were still on active duty, the distribution is 60% in active units, 22% in reserve units and 18% in national guard units. In the PTF, the distribution of Army Persian Gulf veteran patients by unit status is 58% in active units, 23% in reserve units and 19% in national guard units. Unlike the Persian Gulf Registry, veterans who served in the reserve or guard units are not over-represented in the VA inpatient population. It could not be determined whether Persian Gulf War veterans were over-represented in the VA inpatient population because different eligibility rules covered hospital admission for different service era veterans.

Table 12

Distribution of Military Characteristics of 6,092 Persian Gulf Veterans Treated in VA Hospitals on an Inpatient Basis, 696,562 Participants in the Persian Gulf War, and 371,197 Potentially Eligible for VA Medical Care

Characteristics	VA Inpatients Percent	Gulf War Participants (Percent)
Rank		
Enlisted	96.8	89.1
Officer	2.7	9.6
Warrant	0.5	1.3
Unknown	1.7	-
Branch		
Air Force	(100) 5.5	(100) 11.9
Active	(80)	(85)
Reserve	(8)	(7)
Guard	(12)	(8)
Army	(100) 59.6	(100) 50.4
Active	(58)	(76)
Reserve	(23)	(13)
Guard	(19)	(11)
Marine Corps	(100) 15.3	(100) 14.9
Active	(88)	(88)
Reserve	(12)	(12)
Navy	(100) 19.7	(100) 22.7
Active	(88)	(95)
Reserve	(11)	(5)
Coast Guard	6	<0.1

*As of September 30, 1993

Table 13 lists the distribution of major categories of discharge diagnosis. There appears to be no significant variation between the type of medical conditions for which the two groups of patients were treated. One possible exception is that relatively more Persian Gulf veterans were treated for adjustment disorders including PTSD than the era veteran patients. A separate review of the discharge diagnoses for women veteran patients also showed similar results (Table 14).

Table 13

Distribution of 6,092 Persian Gulf Veterans and 6,265 Era Veterans Treated on an Inpatient Basis By Selected Diagnostic Group

Discharge Diagnoses (ICD 9)	Persian Gulf Veterans		Era Veterans	
	Number	Percent	Number	Percent
Infectious and parasitic diseases (001-139)	183	2.5	222	2.9
Malignant Neoplasms (140-208)	127	1.7	187	2.4
Other Tumors (210-239)	74	1.0	104	1.4
Mental Disorders (290-319)	2556	34.7	2356	30.6
Alcohol dependence (303)	856	11.6	759	9.9
Drug dependence (304)	373	5.1	316	4.1
Adjustment disorders including PTSD (309)	446	6.1	268	3.5
Diseases of nervous system and sense organs (320-289)	259	3.5	368	4.8
Diseases of circulatory system (390-459)	258	3.5	375	4.9
Diseases of respiratory system (460-519)	389	5.3	375	4.9
Diseases of the digestive system (520-579)	812	11.0	767	10.0
Diseases of the genitourinary system (580-679)	292	4.0	360	4.7
Skin and subcutaneous tissue (680-709)	172	2.3	147	1.9
Diseases of the Musculoskeletal and connective tissue (710-739)	669	9.1	828	10.8
Injury and poisoning (800-999)	671	9.1	625	8.1
Others	903	12.3	974	12.7

Note: These tabulations represent primary diagnosis from all inpatient visits, with some veterans having more than one inpatient stay. Percentages are of either the total number of diagnoses for Persian Gulf Veterans (7365) or the total number of diagnoses for the Era Veterans (7688).

Table 14

Distribution of 463 Women Persian Gulf Veterans and 902 Women Era Veterans Treated on an Inpatient Basis By Selected Diagnostic Group

Discharge Diagnoses (ICD 9)	Persian Gulf Veterans		Era Veterans	
	Number	Percent	Number	Percent
Infectious and parasitic diseases (001-139)	12	2.1	26	2.3
Neoplasms (140-239)	18	3.1	75	6.6
Mental Disorders (290-319)	188	32.1	282	24.9
Alcohol dependence (303)	18	3.1	45	4.0
Drug dependence (304)	21	3.6	22	1.9
Adjustment disorders including PTSD (309)	38	6.5	47	4.1
Diseases of nervous system and sense organs (320-289)	27	4.6	77	6.8
Diseases of circulatory system (390-459)	12	2.1	36	3.2
Diseases of respiratory system (460-519)	28	4.8	53	4.7
Diseases of the digestive system (520-579)	50	8.6	89	7.9
Diseases of the genitourinary system (580-679)	78	13.3	150	13.2
Skin and subcutaneous tissue (680-709)	10	1.7	14	1.2
Diseases of the Musculoskeletal and connective tissue (710-739)	60	10.3	117	10.3
Injury and poisoning (800-999)	24	4.1	69	6.1
Others	78	13.3	146	12.9

Note: These tabulations represent primary diagnosis from all inpatient visits, with some veterans having more than one inpatient stay. Percentages are of either the total number of diagnoses for Persian Gulf Veterans (585) or the total number of diagnoses for the Era Veterans (1134).

Persian Gulf veterans who received inpatient medical care at VA hospitals are similar to overall troops deployed in the Persian Gulf area with respect to their demographic and military characteristics. The types of medical conditions for which they were treated were also similar to other veteran patients who were in the military during the same period. No one category of medical condition is either over-represented or under-represented among the Persian Gulf veteran patients in comparison to the era veterans, with the possible exception of mental disorders. The reason for the apparent variation needs to be evaluated further.

Because the rules and regulations governing the eligibility of VA hospital admission may affect the Persian Gulf veterans and the era veterans differently, one needs to be cautious of a simple comparison of these two groups of veterans. On December 20, 1993, legislation was enacted into law which authorized priority health care for Persian Gulf veterans for both outpatient and inpatient treatment (Public Law 103-210). The same priority consideration is not authorized for the era veterans.

2. VA Referral Centers

In August 1992, the Department of Veterans Affairs established three referral centers at its medical centers in Houston, Texas, West Los Angeles, California and Washington, DC to evaluate cases of undiagnosed illnesses being reported by veterans of the Persian Gulf conflict. These centers were selected for three major reasons: because of their geographic location (East Coast, Middle U.S., and West Coast), because of their own special clinical expertise, and finally because of their geographic proximity to other centers for military medicine, occupational health and toxicology.

A Persian Gulf veteran, whose condition has evaded diagnosis at the local VA facility, can be transferred to one of the designated centers for tertiary consultation, diagnosis, and management. The transfer of a Gulf War veteran is a mutual decision made by the physicians at the originating medical center and the referral center of jurisdiction. Because of the multisystem nature of many of the veterans health complaints, these evaluations are often quite extensive, involving consultations by multiple subspecialty services and entire array of diagnostic tests.

As of February 1994, the Centers have admitted 84 Persian Gulf veterans under the Referral Center Program. The predominant complaints include skin rash, chronic fatigue, muscle aches and spasms, joint pain, diarrhea, abdominal pain, shortness of breath, chronic cough, weakness, dizziness, headache, and memory loss. These symptoms occur singly or, more often, in combination. VA investigations of the health problems of these individuals have resulted in the diagnosis of a diverse group of disease entities including: asthma, inflammatory bowel diseases, irritable bowel syndrome, gastrointestinal parasitic infection with giardia, gastritis, abnormal liver function tests, rheumatologic conditions including Reiter's Syndrome, Sjogren's syndrome and fibromyalgia, idiopathic thrombocytopenic purpura (ITP), a pituitary tumor with neuroendocrine dysfunction, cases of dizziness due to vestibulitis or vestibular dysfunction, CNS vasculitis, sleep disorders, compression neuropathies and various common skin conditions including nevi, warts and fungal infections. Psychiatric diagnoses included major depression, post-traumatic stress disorder (PTSD), somatization disorder and panic disorder. Psychiatric conditions were listed as one of the discharge diagnoses in 20 of the 84 patients admitted to the referral center programs. It is the VA's best medical judgment that these diagnoses do not point to a single inciting cause or agent. Some of these cases still remain undiagnosed at present.

3. Depleted Uranium (DU) Surveillance Program

During the Persian Gulf War, 15 Bradley Fighting Vehicles and 9 Abrams tanks were mistakenly attacked and struck by DU munitions. Some crew members who survived sustained wounds and have retained fragments of presumed DU shrapnel. An initial check by the Army Office of The Surgeon General has revealed that there were 22 soldiers clearly identified whose records indicate that they have

imbedded fragments that might contain DU. There are additionally 13 soldiers who were wounded and hospitalized but were not specifically identified as having shrapnel. Other crew members (in addition to the 35 already discussed) were either not wounded during the incident or received first aid for minor wounds in the battlefield. The latter two groups of soldiers might have inhaled DU or experienced DU contamination of wounds.

The concern for these soldiers centers principally on the possibility that fragments could serve as a reservoir for absorbable uranium. Animal and human studies have shown uranium to be nephrotoxic.

The Department of Veterans Affairs has recently established a clinical surveillance program at the Baltimore VAMC (Veterans Affairs Medical Center) to identify individuals with retained depleted uranium (DU) fragments, DU contaminated wounds or significant amounts of inhaled DU. This clinical surveillance will provide early detection of untoward health effects related to the presence of DU, an epidemiologic follow-up program and provide recommendations for treatment to participating veterans and the physicians caring for them.

Patients will undergo a thorough clinical evaluation including exposure history and review of systems, administration of health status questionnaire, neuropsychiatric test battery and laboratory testing. Lab tests obtained will include CBC, platelet count, free erythrocyte protoporphyrin to assess bone marrow effects. Bilirubin, transaminases and alkaline phosphatase will assess liver injury. CPK and aldolase will be measured to assess muscle injury. Particular focus will be placed on measures of renal injury. Serum will be analyzed for creatinine, BUN, electrolytes, glucose, calcium and phosphorus. A 24-hour urine will be collected for measurements of creatinine, glucose, beta-2-microglobulinuria, and urine protein. Fragment size will be estimated using plain x-rays and MRI. Blood and urine uranium levels will also be measured. Finally, individuals will undergo whole body counting at the Environmental Protection Agency (EPA) laboratory at Las Vegas, Nevada.

In addition, 27 other veterans from the 144th Supply and Service Company (Army National Guard) performed clean-up of contaminated vehicles. As they entered and re-entered vehicles over a three-week period, it is believed that they had the potential to inhale or ingest depleted uranium residues. Because of this potential risk, a screening program was instituted for this Company. Twelve of the twenty-seven individuals have undergone whole-body counting at the Boston VA Medical Center, all with negative results. Urine samples were also analyzed for depleted uranium; all had negative results. The remaining fifteen individuals have been contacted and have chosen not to be tested.

4. Birmingham Pilot Program

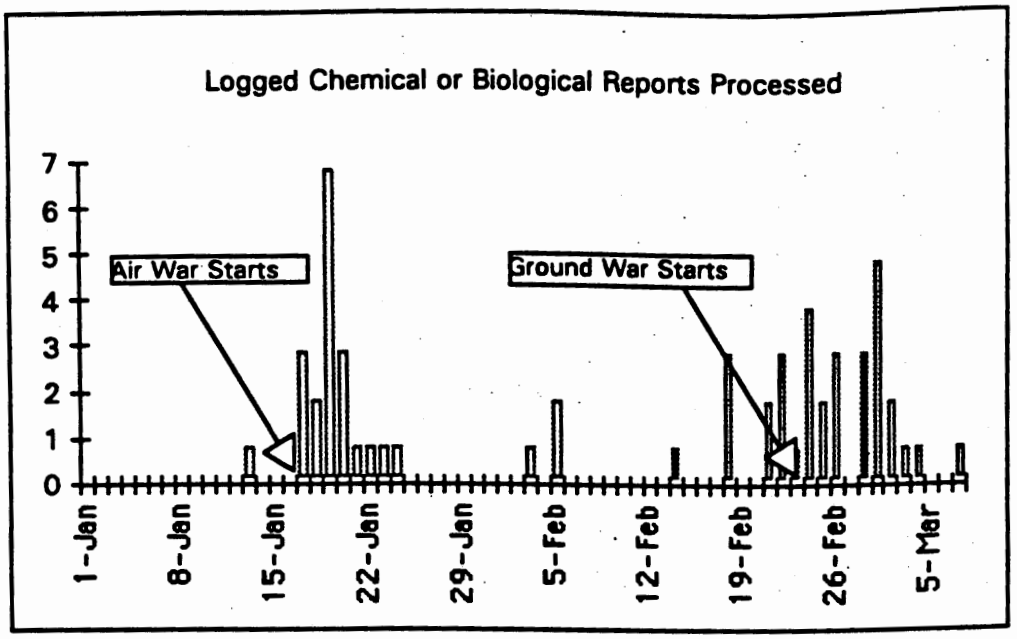
The Birmingham VA Medical Center has been designated by the Secretary of the Department of Veterans Affairs as a Center for Persian Gulf Veterans Chemical Agent Pilot Site. The Birmingham VAMC will begin testing Persian Gulf veterans

from Alabama and Georgia who believe that they may have been exposed to chemical-biological warfare agents. The Birmingham VAMC program will administer a clinical symptom screening survey, perform detailed occupational health exams for veterans with positive symptom survey and administer a neuropsychological testing battery in order to assess potential health effects of CBW exposure.

VI. CHEMICAL/BIOLOGICAL WARFARE

Overview

One focus of concern about the exposures that might have led to adverse health effects has been the possibility of their exposure to chemical and/or biological weapons. Saudi Arabia during both Desert Shield and Desert Storm was an environment in which there was a significant threat that this unfamiliar class of weapons might be used. The troops were very aware of the chemical and biological threat, and were nervous about it. Iraq had developed several types of chemical weapons, and had previously used sulfur mustard (HD, a blister agent) and nerve agent in the war with Iran. It had publicly threatened the use of chemical weapons in the Gulf War. It was also believed to have an active program developing biological weapons (in particular, anthrax and botulinum toxin). Many of the coalition forces *expected* to encounter chemical and/or biological weapons, and had trained extensively for this encounter. This tension and anticipation resulted in clusters of alarms and warnings, anecdotal stories and rumors concentrated in the periods in which the tempo of the war increased (the start of the air war, and again starting just before the ground war.) The figure below illustrates the increase in the number of reports logged within the NBC (Nuclear, Biological and Chemical) cells of the Central Command, Army Central Command and VII Army Corps.



Careful analysis by the Coalition forces following Desert Storm led to the conclusion that there was no intentional, tactical use of either biological or chemical weapons by Iraq during the war. More recently, however, the possibility has been recognized that there might have been other types of releases of chemical or biological agents, most plausibly during bombing of Iraqi munitions bunkers or production facilities. This section summarizes an analysis, drawn from information collected predominantly from U.S. sources, but with corroboration from British sources, of evidence relevant to possible exposures of U.S. forces to biological and chemical agents.

1. Biological Agents.

Biological agents are easily recognized through their effects on a target population. The effects of the two most likely Iraqi agents--botulinum toxin and anthrax--are very well understood and easily recognized.

Table 15
Biological Agent Symptoms/Effects

BW Agent	Likely Dissemination	Symptoms/Effects	On-Set
Anthrax	1. Aerosol	Initial symptoms mild and non-specific. Followed by abrupt onset of difficult or labored breathing, fast or irregular heartbeat, with rapid progression to blueness of skin, shock and death.	1-6 Days
Botulinum Toxin	1. Food & Water Supply 2. Aerosol	Flaccid paralysis of arms and legs, difficulty swallowing, double vision, paralysis and drooping of the eyelid, generalized slight or incomplete paralysis, respiratory arrest, death.	Hours-days

Anthrax, in particular, can be immediately identified in an afflicted individual, both by symptoms and by direct detection of the organism. There were no reported cases of botulinum toxicity or of infection by anthrax (although anthrax is enzootic in that region of the Gulf, and is the occasional cause of death in animals). Examination of bunkers in the southern and eastern parts of Iraq (that is, the part closest to the U.S. forces) after the war revealed no biological weapons, and no evidence that they had been deployed and then retrograded. Inspections in the post-war period by UN biological weapons teams found no weaponized stores of toxins, spores or organisms (although this finding does not answer the question of the size and scope of the Iraqi program in biological weapons, since the evidence has almost certainly been hidden or may have been destroyed in the period immediately after the ground war). Interviews with senior Iraqi officers after the war confirmed that neither chemical nor biological weapons were used, or deployed in anticipation of use. It thus appears that Iraqi forces made the strategic decision not to deploy or use biological weapons in the Gulf war.

2. Chemical Agents.

Attention has also focused on chemical weapons, and the possibility that troops were targeted by these weapons, or were exposed to low levels of chemical warfare agents. It is important to recognize that the nature of an attack with chemical weapons is to produce a localized concentration of chemical warfare agent that is sufficient to kill or incapacitate unprotected personnel in the immediate area of attack. The cloud of chemical warfare agent vapor resulting from an attack is dispersed through diffusion into the atmosphere both horizontally and vertically. The rate of this process of dispersion is determined by the nature of the local meteorological conditions. During conditions of atmospheric stability, the cloud can present a hazard for a kilometer or so downwind of the point of attack but this distance is significantly reduced under unstable atmospheric conditions that prevail for most daytime hours in the Gulf. As a result, the concentration of chemical warfare agents in the air is reduced to an insignificant level very rapidly as a

function of distance and time. So far as has been currently determined, there was no use of chemical weapons during the war. Any exposure would have had to resulted from accidental release following bombing of storage bunkers or deployment sites.

Table 16

Chemical Agent Effects

Agents	Toxicity	Signs and Symptoms	Antidotes	Care
Nerve Agents GA (Tabun) GB (Sarin) GD (Soman) GF VX	-Immediately life-threatening -Causes paralysis by interfering with transmission of nerve impulses	Eye, nose, lung, and gastro-intestinal effects. Large dose: almost immediate loss of consciousness, convulsions, cessation of respiration, flaccid paralysis, copious nasal and oral secretions, intense bronchoconstriction.	-Pyridostigmine bromide pre-treatment -Atropine sulfate, pralidoxime chloride after exposure	Administration of antidotes, ventilation, administration of diazepam (Valium)
Blister Agents Sulfur mustard Lewisite	-Delayed effects; large dose life-threatening if untreated -Injures eyes and lungs and burns/blisters the skin -Lewisite causes immediate pain	Erythema; vesication; burns; eye, lung, and skin damage; respiratory effects; leukopenia; thrombocytopenia;decrease in red blood cells; sepsis	None; decontamination within 2 minutes to prevent tissue damage	Burn care, eye therapy, pulmonary support

3. *Evidence for the Presence of Chemical Agents in the Gulf Theater.*

Iraq possessed large stores of chemical weapons, and deployed them to rear storage areas, with the closest of those to U.S. forces located northeast of Kuwait, about 150 km from the Saudi border. Information on the location and conformation of these storage areas was derived from analysis of intelligence information before and during the war, and from on-site examination of them after the war. Iraq is believed to be the only nation that had chemical weapons in the Gulf theater.

During and immediately after cessation of the active campaign, coalition forces examined all the forward bunkers within the occupied portion of Iraq, essentially south from the Euphrates River. These were the bunkers that housed Iraqi troops, conventional munitions, and other stores of supplies; if chemical munitions had been deployed forward, it is likely they would have been present when the ground war occurred, and overrun by coalition forces. No quantities of

chemical munitions of any type were found. There were also no Iraqi chemical mines encountered, either during the hostilities or during the extensive postwar cleanup. The fact that no chemical munitions have been discovered is the most compelling evidence that, for whatever reason, Iraq did not have chemical weapons deployed to forward positions in preparation for use at the time of the land war. Chemical weapons were present in rear storage areas nearer the production facilities.

The conclusion that there were not chemical weapons directly in the war zone is compatible with other, more indirect, evidence from interviews of Iraqi troops although this source must, for obvious reasons, be considered uncertain in their reliability and their relevance to the entire period of U.S. presence in northern Saudi Arabia preceding the land war. The subsequent Iraqi declarations to the UN inspection teams after the land war had ended also did not indicate that there were chemical weapons directly in the war zone.

A number of pieces of information--satellite photographs, other intelligence information, on-site ground assessment by U.S. forces during and at the conclusion of the land war, and inspection by UN teams that included US personnel--located the area in which chemical weapons may have been stored closest to coalition forces as being in the general vicinity of An Nasiriyah. (3058N:04611E) Some of the bunkers in this general area were identified as possibly containing chemical or biological munitions, primarily on the basis of their characteristic structure. Bunkers in a storage area at An Nasiriyah were first targeted on January 17, the first day of the air war (and later, on January 30 and February 1); those at Talil airbase on February 19. These bunkers suffered varying degrees of damage, confirmed by aerial imagery. There were also reports of damage by the United Nations Special Commission inspection team that visited a different location in the general vicinity of An Nasiriyah several months after the cessation of hostilities. There are indications that the site visited by the UNSCOM team was not a site targeted during the air war but may have been specially constructed for the UN inspectors.

It is unclear what quantities, if any, and types of chemical warfare agent may have been released during these attacks. Detailed assessment of damage was difficult. It is, however, relevant that when the bombs penetrated the bunkers and exploded, they often did not produce massive explosions that could have scattered and disrupted the contents of the bunker. Rather, photo reconnaissance indicated that damage ranged from a single hole in the bunker (from bomb entry) with no other apparent damage, to major structural damage with the roof slab broken in several places and collapsed.

Release of chemical agents from these damaged bunkers would have resulted from damage to the munitions in the bunkers and then escape of the chemical agents as vapors. It is difficult to model the disruption of munitions in bunkers, but given the relatively low vapor pressures of the agents, the uncertainties in the extent of damage inside the bunkers, and the apparent absence

of factors that might have accelerated the escape of the chemicals (such as large secondary explosions or fires that would have destroyed the chemical agents which are organic compounds), escape of agents would have occurred slowly (if at all) over an interval of time (probably days to weeks) rather than as a point event.

There are three sites that may have stored chemical munitions in the vicinity of An Nasiriyah. The indication is that UN inspectors were taken to a separate site that was not bombed.

An Nasiriyah. The extent of damage to An Nasiriyah, and when it actually occurred, due to the bombing is not completely clear: imagery shows only one of the possible CBW bunkers was hit on the January 17, with minor damage. Eventually all the bunkers were destroyed, but it is unclear whether any contained chemical munitions.

The storage facility near the airbase at Talil. Talil was a major airbase, and associated with it was an extensive complex of bunkers for the storage of supplies and munitions. Reconnaissance identified several bunkers as possible sites for storage of chemical and biological weapons, based on observations of the use of bunkers with similar characteristics during the war with Iran. At least some of these bunkers were hit during the air bombardment. If any chemical munitions were stored in these bunkers, any release of chemical agents was not relevant to the reported responses of the Czech detectors, as the bombing of the Talil bunkers occurred much later in the war.

The site visited by the UN inspection team. Several months after the end of the war, a UN inspection team visited a site in the general area of An Nasiriyah. It appeared this was a separate site constructed by Iraq after the war to show to the UN inspectors. The Iraqis claimed that munitions containing 16 tons of Sarin were destroyed in the bombing (a number in agreement with the complete destruction of the rockets in the bunker). There was also some indication that the munitions were only destroyed subsequent to the ground war by the Iraqis. The uncertainty stems from the fact that it is not clear whether the site the UN inspection team was shown was in fact this subject of bomb damage.

Probably the most compelling evidence against a large release of chemical agents from these sites is the absence of any reports of casualties among Iraqi personnel, or at other Iraqi chemical weapons sites that were attacked during the air war. Neither reconnaissance evidence nor interviews with Iraqis after the war indicated that there had been casualties from escape of chemical agents from bunkers damaged at these sites. Examination of the damage around Muthanna (the central Iraqi chemical weapons production facility) after the war, and interviews with local personnel, also indicated that there were not extensive local casualties following damage to this site. This evidence that venting of chemical

agents from damaged bunkers was at a low level, even locally, is important. For there to have been significant exposure to U.S. forces located approximately 200 km from An Nasiriyah, there would have been a very large release at the source. There is no evidence that such a point release occurred.

What level of exposure would have been detected locally? Sensitivities and Detector Networks.

During the period from the beginning of the air war to the end of the ground war, there were a number of alarms from U.S. chemical agent detectors. (Appendix B contains a timeline that highlights some of these) None of these alarms were confirmed as valid: all were concluded to be false alarms. This conclusion was also reached by other nations in the coalition forces.

There were, however, a small number of events that might, somewhat ambiguously, have resulted from the presence of chemical agents--

-several claims of detections of chemical agents by Czech detection units. The equipment and mobile laboratory are now being evaluated at Edgewood Arsenal.

-a description by a French officer to Senator Shelby of a possible detection event. Information from the French has been sparse, and it has been difficult to learn what they actually detected or how reliable their information is.

-In addition, there was almost certainly an exposure of a U.S. soldier to mustard during inspection of empty bunkers after the end of the war.

None of these claims of detection have been confirmed. These events are described below in greater detail. The absence of confirmed detections of chemical agents by U.S. forces lead to the conclusion no exposure to chemical agents by US forces occurred, as any hypothesis that some troops were exposed to levels less than those detectable by US detectors and such that casualties would have been suffered from chemical agents.

Interpreting the conclusion that there was no *detectable* exposure to chemical agents requires both understanding the structure of the U.S. system for detection of chemical agents, the distribution, reliability and sensitivity of the detectors that form this system, and the protocols followed in the use of the system. U.S. forces are equipped at various levels with detectors that serve different purposes, and have inherent sensitivities and specificities.

4. Liquid Chemical Agent Detectors

The most widely available detectors are treated papers (M8 and M9) that are sensitive to droplets of liquid chemical agents. These papers were distributed to individual level, and are worn attached to clothing or equipment (M9), or are used to investigate surfaces suspected of being contaminated (M8). These papers are

Table 17
Liquid Chemical Agent Detector Characteristics

Item	Agents	Sensitivity *	Response Time	Basis of Issue (Army)
M8 Paper	V,G,L,HD, HN,CX	0.02 ml drops	<=30 sec	1/soldier
M9 Paper	All liquid agents	100 micron droplet	<=20 sec	1/soldier
MM-1 (in FOX NBC Reconnaissance System)	Multiple	0.1-100 ug	<=45 sec	6/Army division (10 w/USMC)
M272 Kit	AC HD,L G,V	20 mg/l 2.0 mg/l 0.02 mg/l	6 min 7 min 7 min	Specialized teams in Medical, Engineer, Quartermaster and Chemical units

** The quantitative units used for each device vary due to method of use and design specification.*

intended only to provide indication of the presence of a liquid chemical agent hazard, either after receiving a suspected chemical attack, or when entering an area of suspected contamination. They are inexpensive and effective for an individual to determine if there is a liquid chemical agent hazard present, but they are not highly specific for chemical agents. They can respond to other organic substances, such as brake fluid. Users are trained to avoid placing the paper in contact with other substances known to cause false readings, and to consider other possible indicators of chemical agent presence when assessing a positive reaction of the paper.

A specialized kit that was fielded to units responsible for fresh-water handling, the M272 kit can detect the presence of chemical agents in water. If a supply of water is suspected of being contaminated, because the water source has been in the area of a chemical attack or if it has flowed through an area of contamination, this device would be used to ensure the safety of the drinking water.

The FOX NBC (Nuclear, Biological and Chemical) Reconnaissance System is a wheeled, armored vehicle equipped with an on board mass spectrometer for the identification of chemical contamination. Sixty FOX systems were given to the US by Germany during Desert Shield; 50 went to Army units, and 10 to US Marine Corps forces. The FOX was designed to locate and mark the presence and extent of liquid chemical agent contamination. Two sampling wheels mounted on the rear of the vehicle roll on the ground, and are lifted up and "sniffed" by the sampling probe at intervals. The FOXs, operated by specially trained chemical specialists, were called on, if located nearby, to confirm possible or suspected chemical agent detections.

5. Vapor Chemical Agent Detectors

Table 18
Vapor Chemical Agent Detector Characteristics

Item	Agents	Sensitivity	Response Time	Basis of Issue (Army)
M8A1 Alarm	G, V nerve	0.1-0.2 mg/m3	<=2 min	5/ company
M256A1 Kit	G V H L CX CK AC	0.005 mg/m3 0.02 mg/m3 2 mg/m3 9 mg/m3 3 mg/m3 8 mg/m3 9 mg/m3	15 min 15 min 15 min 15 min 15 min 15 min 25 min	1/squad
CAM	GA, GB, VX, HD, HN	<=0.1 mg/m3	<= 1 min	2/company
M18A2 Kit	GB CG HD L AC	0.1 & 1.0 mg/m3 12.0 mg/m3 0.5 mg/m3 10 mg/m3 8 mg/m3	NA	1/Explosive Ordnance Disposal team
MM-1 (in FOX NBC Recon System)	CG CK GB	115 mg/m3 46 mg/m3 62 mg/m3	<=45 sec	6/Army Division (10 w/USMC)

The most widely available detector for determining the presence of chemical agent vapors is the M256A1 Chemical Agent Detector Kit. These kits contain vials of liquid chemical reagents that are combined and exposed to the air in a specific sequence to indicate the presence of hazardous levels of chemical agent vapors. The kits must be manually manipulated, and the full sequence of tests takes 20-25 minutes; consequently, these are not used for monitoring or warning of personnel. Rather, these devices are used by trained personnel after a unit has entered full protective posture, to determine if a hazard actually exists in the immediate area, and to assist the local commander in initiating un-masking procedures if there is no indication of hazard. These kits are more sensitive for nerve agent than the automatic alarm, and are not sensitive to the same type of interferents that can cause false alarms. Approximately 45,000 of these detector kits (each of which contains 12 actual detector packets) were deployed in the Gulf.

The M8A1 Automatic Chemical Agent Alarm electronically monitors for hazardous levels of nerve agent vapor. Once placed into operation, it will run for up to 24 hours before needing servicing. The detector component of this system can be displaced upwind from the unit's position and connected by wire to an audible and visible alarm module. Units use this device when in stationary positions; it cannot generally be operated while on the move. While sensitive, this device is also prone to false positive responses under some conditions due to high concentrations of certain organic compounds (some pesticides, vehicle exhausts, rocket smoke) and troops are trained to use care in emplacing the device to minimize the chance of false alarms.

Although it detects vapors, in actual practice the Chemical Agent Monitor (CAM) serves as a post-attack device for determining the presence of vapors emanating from localized liquid contamination. This hand-held air sampler detects and identifies nerve and blister agent vapors, and depicts in a rough quantitative form on a bar-graph display, the degree of contamination.

Although sensitive and specific for identification of ground contamination, the mass spectrometer system on board the FOX is not optimized for sampling and alerting to generalized airborne vapors of chemical materials. When operating in the air sampling mode, the FOX is not a suitable warning device; very high concentrations of chemical agents would have to be present, such that unprotected troops in the vicinity would be adversely and acutely affected.

The confirmation of the presence of a chemical agent requires examination by a second detector, one using a different principle of operation. For final field verification of the presence of chemical agent, the FOX was the item of choice. In practice, none of the preliminary alerts for possible presence of chemical agents reported or investigated by U.S. forces were confirmed as valid. Consistent with the experience of other coalition partners, this conclusion confirms that there were no exposures at levels high enough to trigger U.S. alarms. It does not, by itself, rule out the possibility of exposures below the threshold of U.S. detectors, although such exposure could not occur without detectors located upwind having positive and confirmed responses and possible physiological signs from chemical agent exposure at these higher levels.

The highest level of chemical agent to which U. S. personnel could have been exposed without triggering an alarm is determined by the threshold sensitivity of the detectors. On the basis of detector specifications, the highest concentration to which U.S. personnel could have been exposed was 0.2 mg/m^3 of nerve agent, and 2 mg/m^3 of mustard.

Possible Detection Incidents: A Mustard-contaminated Bunker near Basra.

The incident that provides the most probable case of exposure of an American soldier to a chemical agent was an accidental exposure that occurred while inspecting bunkers in southern Iraq after the conclusion of the ground war. The solder entered a number of bunkers while performing his mission to locate enemy equipment, personnel or intelligence material. Approximately 8 hours later, he experienced skin irritation and reddening. After 8 more hours, he presented to unit medical personnel with erythema and two small (1-2 cm) blisters on one arm consistent with a mustard exposure. A FOX vehicle was called to determine if the soldier's clothing was contaminated; it initially identified HQ mustard. The following day, two FOXs were called in to confirm the reading; of the two FOXs present on this occasion, only one could get a reading, but this time of HD mustard. The FOX teams were not able to find contamination in any of the bunkers entered by the soldier.

Several other scientific findings confound this story, however. When the soldier's clothing was shipped back to the US for subsequent examination under laboratory conditions, no traces of mustard or its highly stable degradation products were found. Additionally, urine samples taken from the soldier were negative for the presence of thiodiglycol, a metabolite typically observed from exposure victims. Nevertheless, based on the symptoms shown by the soldier, and on the positive identification by one FOX, it seems plausible that this soldier was, in fact, exposed to mustard. As an apparently singular event, however, it carries no implication of a mechanism for exposure of a significant number of other U.S. personnel.

Possible Detection Incidents: Czech Announcements of Detection.

The announcement in the summer of 1993, following US media and Congressional interest in whether there were unexplained health effects in Gulf War participants, that Czech chemical detection units had reported that their detectors had responded in three separate incidents during the beginning of the air war, attracted substantial attention. These reports were the only ones that seemed to provide any support to the idea that there might have been any chemical agents in the regions occupied by U.S. forces, and that these agents might have originated in bunkers damaged during the bombings.

Examination of the Czech reports indicates that the accuracy of their detection is still uncertain and that there are a number of internal inconsistencies in the available information. It is not clear that any of the incidents described by the Czechs unambiguously identified chemical agents, and the origin of the materials sampled is even more uncertain.

The important incidents surrounding the Czech detections are listed below in boldface; associated, relevant events are also included in this list. A map of Saudi Arabia at Appendix E.

- **Jan. 17: Bombing of An Nasiriyah**
- Jan. 18: Hussein announced on CNN that he had chemical weapons; tension increased on the subject of chemical weapons.
- Jan. 19: A Czech unit reported nerve agent at the Engineering School at KKMC. An attempt at confirmation by U.S. personnel failed. (CENTCOM log)
- **Jan. 19: French and Czech units report nerve agent 30 km from KKMC in two separate incidents.**
- Jan. 20: Czechs detect low levels of mustard vapor near the Engineering School in KKMC for 2 hr.
- Jan. 20: Czechs report a small patch of nerve agent: U.S. examination does not confirm.
- **Jan. 24: Czechs are directed to a puddle of mustard by Saudis.** Not in any available log.
- **Feb. 9: Bombing of storage bunkers at Talil airfield.**

These incidents can be broken into two sets: the cluster of reports of nerve agents by Czech units in the three days (Jan 18 - Jan 20) following the bombing of An Nasiriyah on Jan 17, and the examination of the puddle of mustard on the 24th. The date of another possible release--the bombing of a bunker at Talil--is also included for comparison, although there were no alarms following this event and it occurred much later in the air war.

Czech and French reports in the Interval January 17 - 20. These events were in a time period when it might, in principle, have been possible for them to reflect venting from a bunker or bunkers at An Nasiriyah. Because of the uncertainties in the estimates of damage at An Nasiriyah, it is only possible to provide an upper limit to the possible release of nerve agents. If it is assumed that one bunker was destroyed, that the bunker had contained chemical agents and that an estimate of 16 tons of sarin being contained in a single bunker is correct, then the maximum release of nerve agent that could have occurred on the 17th was 16 tons. In fact, the total amount would have been less, since the venting would occur slowly, and all the chemical agent in the chemical rounds in the bunker would not actually be released.

On January 17 and 18--the days immediately following the bombing of An Nasiriyah--the weather conditions were unfavorable for movement of vented material toward the coalition forces: On the 18th it rained all day, and the wind was from the Southeast (that is, from Saudi Arabia into Iraq). Due to the high solubility of Sarin in water (21 g/L) rain would have significantly reduced the concentration of Sarin vapor. On the 19 th the wind began to shift to the northwest, but there was an occluded front over the region in question. The microclimate was variable, and the Czech report of local winds from the northwest in the wadi in which they were traveling is believable, but probably not relevant to movement of a plume from An Nasiriyah toward U.S. forces.

The mustard puddle on January 24. This event occurred too late to be associated with the bombing on the 17th. Saudi personnel *directed* the Czech unit to a puddle of damp ground in a remote area, and asked them to investigate. The Czechs detected mustard. No effort was made to confirm the identity of the material, nor were soil samples taken for laboratory confirmation. This peculiar event may have been some type of test or training exercise by the Saudis, although no confirmation of this hypothesis has been received from them.

Other Incidents.

There were a number of other observations and events reported as evidence of use of chemical weapons. Appendix B lists a number of these. Here we describe four, with the purpose of showing how combinations of anxiety, inexperience with equipment or unfamiliarity with the local environment generated confusion about the presence of chemical weapons.

Event near Al Jubayl. On January 20, members of 24th Naval Reserve Construction Battalion (Seabees) were awakened from sleep by a loud noise. They moved to bunkers and donned protective masks. Tests for chemical agents were negative. Recent reports by members of this group, describing a strong ammonia smell and burning skin was not corroborated by log entries. An adjacent unit described a sonic boom at roughly the same time, but no other unusual events.

"Purple Tee-Shirts". Members of the same Seabee unit reported an event in which a distant noise, a "mist" and a smell of ammonia were accompanied, subsequently, by sections (especially in the area of the armpits) of the brown tee-shirts worn by some personnel turning purple. There were no symptoms of chemical toxicity. This configuration of events was interpreted by some of those involved as evidence of attack by a rocket with a chemical warhead. There was no evidence to support this interpretation.

An analysis of dye chemistry, and of several tee-shirt samples obtained from the unit, conducted by the Natick Research, Development and Engineering Center concluded that the probable cause of the color change was exposure to nitric or nitrous oxide fumes.[3] These materials may have been present in the industrial area in which the Navy unit was billeted. Tests using a wide range of industrial acids, bases and oxidizers were used to determine dye reaction; it is interesting to note that exposure to ammonia did not elicit a color change. Past records from agent challenge tests to clothing materials, conducted at Dugway Proving Ground, indicate no color change associated with any chemical agent test.

Although the details of the events contributing to the incident are still not clear, it is probable that exposure to a release of some industrial chemical or to perspiration (or some combination of these factors) was the factor underlying the color changes.

"Lewisite Detection". On February 26, during the ground war, a FOX operated by Marines operating along the Saudi Arabia/Kuwait border alerted to Lewisite; reexamination with the M256A1 kit failed to confirm this detection. Lewisite was not in the Iraqi inventory. The mass spectrometer on the FOX operates by drawing a sample from the exterior through a silicone membrane into the inlet of the mass spectrometer. The FOX involved in this incident was operating with a new membrane, and with a crew that had only recently completed training. The mass spectrometric signature of Lewisite is similar to that of silicone plasticizers used in the membrane. This incident thus probably reflects a

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[3]Color Changes of T-Shirts Worn During Operation Desert Shield/Storm, Letter Report, Natick Research, Development and Engineering Center, 17 May 1994.

misinterpretation of a confusing signal, resulting from the leakage of silicone plasticizer from the new membrane.

"Dead Animals along the Road." U.S. forces noted the presence of numbers of dead animals along the sides of the roads in certain areas, and were concerned that these animals had died by exposure to chemical or biological agents. The animals were certainly present, but the interpretation of their presence requires an understanding of the Saudi Arabian agricultural system. When valuable domesticated animals--sheep, goats, camels--die in Saudi Arabia, the carcass is moved to a nearby road. Collecting the remains along the roads has two purposes: to allow the local administrators to verify the deaths (in order to compensate the owner for the losses), and, in some cases, to help the local agricultural officers or veterinary personnel to inspect or sample the carcasses to help establish the cause of death. No information was presented that would indicate that the circumstances surrounding the dead animals were related to chemical or biological agents.

Could Chemical Agents Released on Bombing the Storage Sites in the Vicinity of An Nasiriyah Have Exposed U.S. Forces?

Since these sites were suspected at the time to have chemical weapons, and since they were the closest such sites to U.S. and coalition forces, the circumstances surrounding their bombing has been examined to detail to see if they could be the source of the chemical agents detected by the Czech units, or if there might otherwise plausibly be a source of low-level exposure of U.S. personnel.

Modeling performed by the Defense Nuclear Agency using the ANBACIS (Automated Nuclear, Biological and Chemical Information System) II computer program demonstrates that the maximum extent to which a lethal concentration (LCt 50: lethal to 50% of exposed personnel) would travel would be 8.7 km. Incapacitating effects would be expected out to 9.3 km. Similar examinations of the other southernmost suspected chemical storage bunkers resulted in similar hazard distances. No cases resulted in any hazard areas coming within 150 km of any US or other coalition forces. These estimates are very similar to the results of an unpublished CBDE Porton Down Report dated September 1992, which detailed UK studies on the potential effects of bombing Iraqi CBW production and storage sites.

Several lines of evidence indicate that it is improbable that any release of chemical warfare agents at An Nasiriyah is connected to Czech detections (with the obvious further caution that the Czech detections themselves remain suspect, pending checks on the performance of their equipment and resolution of inconsistencies in accounts by Czech personal of equipment and procedures).

- *Extent of Damage at An Nasiriyah*. If chemical munitions were stored at An Nasiriyah and if a bunker containing chemical munitions was hit, then a

plausible upper limit to the amount of nerve agent in such a bunker would be 16 tons; in practice, the amount released would be much less. Plausible amounts of vented material are too low to have traveled the 150 - 200 km to the Czech units in detectable concentrations.

• *Apparent Absence of Other Casualties in the Vicinity of An Nasiriyah.* To have a detectable amount of nerve agent in Saudi Arabia, there would have had to have been a large release in An Nasiriyah. A large release should have produced local casualties. None apparently occurred. The inference that any release was small, even at the source, is confirmed by observations after a later bombing at Talil, and by bombings at Muthanna.

• *Weather.* The weather was unfavorable for movement of nerve agent toward coalition forces: the wind measured at Hafir al Batin between the 17th and the 19th was from the south-southwest, then southeast on the 17th; from the ease-southeast on the 18th with rain; from the east-southeast in the morning of the 19th, changing to from the north-northeast with the passage of a weather front.

• *Plume Analysis.* Mathematical modeling of the plume from a release suggests that a larger quantity than could have plausibly been released would have been required to reach the Czech forces in detectable amounts. The task force was briefed that under best case weather conditions, 80-100 tons of agent instantaneously released could have resulted in the concentrations described by the Czechs.[4]

The conclusion from these considerations is that it is very unlikely that the Czech units detected nerve agent released on bombing An Nasiriyah.

This same analysis shows that, regardless of the truth of the Czech reports, bombing the sites around An Nasiriyah was not likely to be a more general source of significant exposure of U.S. forces. If the Czech detections were correct, and if they were detecting chemicals vented from An Nasiriyah (both substantial "ifs"), the plume would have had to be relatively sharply defined (another conclusion that is difficult to believe, given the variability of the wind direction and the weather in this period). A sharply defined plume that coincidentally reached the Czech units would not have covered a significant area of the front, and would not have exposed many U.S. personnel.

More Distant Storage Sites.

Chemical weapons were also present at several sites in central Iraq (Al Habbaniyah, Karbala, Samarra). In the period leading up to Desert Storm, some

[4]Plume Modeling briefing to DSB Task Force, McNalley R.

chemical munitions were dispersed from the manufacturing and filling site at Muthanna to these storage sites . The distances of these other sites from the area of operations in the theater precludes them as a source of chemical exposure to U.S. forces. Dilution in the air of agents released in bombing the sites, and the effects of atmospheric turbulence and rain make it impossible for these more distant sites to have acted as significant sources of exposure.

Conclusions. The conclusion from this analysis is that U.S. personnel were not exposed to any significant levels of chemical or biological agents during the Gulf war. A summary of the evidence and inferences follow:

- There was no evidence of the deployment or use of biological weapons in the Gulf theater. Recognition of an infectious agent such as anthrax is straightforward, and no cases of anthrax were detected in U.S. forces. The symptoms of exposure to botulinum toxin, and of other biological warfare agents, are also well understood, and were not detected.

- There were no overt, intentional uses of chemical weapons by Iraq. This conclusion is confirmed by other members of the coalition, and by senior Iraqi officers.

- There were either no, or essentially no, chemical munitions deployed forward by Iraq. The absence of chemical weapons makes it impossible that there could have been unauthorized or accidental use by local commanders, and also indicates that release from forward bunkers during bombardment is not a credible source of chemical exposure to U.S. forces.

- The most plausible potential source of chemical exposure was damage to bunkers at An Nasiriyah if these bunkers contained chemical weapons. An Nasiriyah was separated from the nearest U.S. forces (with the possible exception of special operations forces) by a minimum of approximately 150 km. When An Nasiriyah was bombed, the plausible quantities of nerve agent released and the weather combine to make it very unlikely that it could have been the source of the Czech detections, or of more general exposure of U.S. personnel. Other possible sources of chemical agents released on bombardment (such as Muthanna) were too far away to provide significant exposure.

- The absence of local casualties at An Nasiriyah, Muthanna and Talil suggest that even when bunkers which might have contained chemical weapons were bombed, the rate and extent of release did not pose a great risk even to those in the immediate vicinity.

• The Czech claims of detection--the only reports that seemed to lend some credibility to the idea of exposure of some type--are themselves clouded by a number of peculiarities and internal inconsistencies. These reports cannot be confirmed or dismissed until the evaluation of the Czech detection system now in progress at Edgewood is complete.

• The one plausible injury of a U.S. soldier by a chemical agent occurred after the end of the ground war, and originated during inspection and demolition of Iraqi bunkers. It seemed to be the result of accidental contact of the soldier with contaminated soil in a bunker that may have been used previously (probably during the Iran/Iraq war) for storing mustard.

• In the absence of confirmation of the Czech reports, there are no data suggesting exposure of U.S. personnel to chemical weapons. The threshold sensitivity of U.S. detectors was approximately 0.05 mg m^3 and while levels lower than this cannot be excluded on the basis of physical measurement, the absence of any credible source of exposure makes it unlikely that there was any level of exposure.

VII. LONG TERM EFFECTS OF LOW-LEVEL EXPOSURE TO CHEMICAL AGENTS

This section discusses what is known about the long-term effects of exposure to low-levels of chemical warfare agents.

During the period from 1958-1975 some 6720 soldiers took part in a voluntary test program of 24 chemical agents conducted by the US Army at the Army Chemical Test Center at Edgewood, Maryland. In 1980, the Department of the Army asked the Committee on Toxicology of the National Research Council's Board on Toxicology and Environmental Health Hazards to study possible chronic or delayed adverse long-term health effects incurred by servicemen who took part in these tests. The terms of reference to the panel were:

1. determine whether the data available were sufficient to estimate the likelihood that the test chemicals have long-term health effects or delayed sequelae
2. determine whether the involved chemicals, as tested, are likely to produce long-term adverse health effects or delayed sequelae in the test subjects.

Their findings were presented in three volumes: Volume I covered anticholinesterase and anticholinergic chemicals; Volume II covered cholinesterase reactivators, psychochemicals, mustard gas and several irritating substances;

Volume III was a follow-up report on the current (as of 1985) health of the test subjects.[5]

The panel concluded that although no evidence had been developed that any of the anticholinesterase (anti-ChE) test compounds surveyed carries long-range adverse health effects in the doses used, they were unable to unequivocally rule out the possibility that some anti-ChE agents produced long-term adverse health effects in some individuals. While exposures to low doses of organophosphate compounds had been reported in the research literature (but not confirmed) to produce subtle changes in EEGs, sleep patterns, and behavior that persisted for up to a year, such effects were not known or reported for the Edgewood cohorts.

There was no firm evidence that any of the anticholinergic test compounds tested produced long-range adverse human health effects in the doses used in the Edgewood tests. However, the high frequency of uncontrolled test variables made evaluation of behavioral effects difficult. The panel concluded that given the available data, it was unlikely that administration of these anticholinergic compounds will have long-term toxicity effects or delayed sequelae. For both the anti-ChE and anticholinergic test subjects, mortality rates were not significantly higher than those for the US population, categorized by age and calendar year.

There was no evidence of chronic disease associated with single or repeated doses of the cholinesterase reactivators; however, lack of follow-up data on the volunteers and the absence of conclusive studies precluded any conclusions regarding the carcinogenicity, mutagenicity or reproductive anomalies that might be associated with these agents.

Mustard gas has known carcinogenicity and mutagenicity at high, long term dosages, but the effects are unknown for low dose exposures.

A follow-up study in 1985 based on a mailed questionnaire concluded that there were no significant long-term effects of any kind or occurrence of clustering of physiological problems that could distinguish the test group exposed to agents from those not exposed, or from the general population. The conclusions were based on responses by 4085 of the 6720 persons tested. The questionnaire was supplemented by a review of VA hospital admissions records of the test subjects, specifically for malignant neoplasms, for mental disorders, and for diseases of the nervous system and sense organs. Study of admission statistics showed no significant admission for these categories than the unexposed baseline test population.

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[5] Possible Long Term Health Effects of Short Term Exposure to Chemical Agents, Vols. I, II, and III, Committee on Toxicology, Board on Toxicology and Environmental Health Hazards, Commission on Life Sciences, National Research Council, National Academy Press, Washington DC, Vol I-1982, Vol II-1984, and Vol III-1985

A more recent study by Sidell and Hurst[6] updates the NRC study and is supported by 124 references. The report summarizes historical data on single or repeated acute doses of nerve agents or mustard. The report implicates nerve agents and mustard as the cause or probable cause of several long-term health effects. Repeated symptomatic exposures to mustard seem well established as a causal factor in airway cancer. Delayed keratitis has appeared more than 25 years after acute severe lesion due to mustard; pigment changes and skin cancer also have been observed as delayed sequelae at the site of mustard-induced lesions. While the production of non-airway cancer by mustard has been observed in animals, there is little evidence to implicate mustard as the causal agent for non-airway cancer in humans. Despite unequivocal laboratory evidence of, and its classification as a mutagen, there seem to be no definitive data to implicate mustard as a reproductive toxicant in man.

Regarding nerve agents, Sidell and Hurst make the point that while nerve agents and insecticides are both organophosphates, their effects are distinct and differ in their duration. Cholinergic intoxication due to nerve agents lasts for hours, while that from insecticides may persist for weeks. Some pesticides do not cause polyneuropathy, though others have been shown to do so in animals at sub-lethal doses; nerve agents cause polyneuropathy only at doses many times the LD_{50}, requiring extreme intervention to keep the animal alive to observe the effect. Exposure to insecticides has also been shown to express as an "intermediate syndrome" -- that is, intermediate between acute cholinergic effects and delayed neuropathy. Intermediate syndrome has not been described after exposure to nerve agents. Psychological problems, sleep disturbance, and psychomotor difficulties appear with varying degrees of persistence after insecticide exposure.

In its 1993 report[7], the Institute of Medicine found a causal relationship between substantial exposure to Mustard or Lewisite and a number of conditions including respiratory and skin cancers, skin pigmentation abnormalities, chronic skin ulceration, chronic respiratory diseases, chronic conjunctivitis, delayed recurrent keratitis of the eye, bone marrow and immunosuppression, psychological disorders, and sexual dysfunction. It reported insufficient information to demonstrate causal relationship between exposure and gastrointestinal, hematological, neurological and cardiovascular diseases.

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[6] The Long-Term Health Effects of Nerve Agents and Mustard, F.R. Sidell and C.G. Hurst, US Army Medical Research Institute of Chemical Defense, APG, MD, 1993.

[7] Veterans at Risk, CM. Pechura and D.B. Rall, editors, National Academy Press, Washington, DC, 1993.

VIII. PROPOSED EXPOSURE ETIOLOGIES

A. Chemical Warfare Agents

As discussed in sections VI and VII above, there is no evidence that either high or low levels of exposure of US troops to chemical agents occurred, and there is no indication from research that there would be chronic sequelae from low level exposure even if it had occurred.

B. Biological Agents

While Iraq has been assessed as having had an active offensive BW program, there is no evidence for the deployment of BW during ODS. The diseases associated with BW agents, e.g., anthrax, botulinum, etc., are notable for acute effects and would have been rapidly evident and readily diagnosed had they occurred among US or coalition troops during the war.

C. Infectious Disease

By any previous standards, casualties from infectious diseases were extremely low during Desert Shield/Desert Storm, reflecting effective application of preventive medicine doctrine and good discipline. Food and water-borne diseases and vector borne diseases have, in the past, caused very high casualties to armies in that region. The major causes of morbidity from infectious diseases were self-limiting diarrhea and respiratory illnesses. Low overall enteric disease rates testify to safe food supplies and food preparation and effective water purification methods. The virtual absence of vector-borne viral diseases such as sandfly fever and only 7 cases of malaria appear to be the result of a combination of vector control, personal protection, and climatic factors.[8,9]

1. Insect-borne

One vector-borne parasitic disease, leishmaniasis, has been suggested as a potential cause in later development of chronic unexplained illness.[10] The leishmania species present in the theater can cause self limiting skin infections (cutaneous leishmaniasis), severe visceral disease (kala azar) and, a chronic disseminated infection without obvious skin lesions or major organ involvement.

Thirty-one cases of leishmaniasis contracted in the theater have been diagnosed in military personnel. Nineteen cases were cutaneous disease and 12 were disseminated disease. Clinical and parasitologic studies by Army investigators have defined the spectrum of illnesses caused by *Leishmania tropica*, the predominate Leishmania species in the region. The cases of disseminated viscerotropic illnesses caused by this species was a surprising new observation leading to the hypothesis that there may be additional cases of cryptic infections causing chronic illness that cannot be diagnosed by current parasite isolation or serologic methods.

There was some evidence for clustering of leishmaniasis cases in units -- not unexpected since transmission is by sandfly vectors. The reported studies are clinical, parasitologic and immunologic studies and do not address the epidemiology of the disease in DS/DS. Also lacking are data on the distribution of sandfly vectors in the theater, although information presented by a Navy entomologist with the

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[8]Richards AL, Malone JD, Sheris S, et al. Arbovirus and rickettsial infections among combat troops during Operation Desert Shield/Desert Storm. J Infect Dis 1993;168:1080-1081.

[9]Richards AL, Hyams KC, Merrell BR, et al. Medical aspects of Operation Desert Storm. N Engl J Med 1991; 325:970.

[10]Macgill AJ, Grogl M, Gasser RA, Sun W, Oster CN. Visceral infection caused by Leishmania Tropica in veterans of Operation Desert Storm, N Engl J Med 1993; 328:1383-1387.

DoD Pest Control Board indicated that some surveys had found very little evidence for large numbers of the sandfly in areas of high troop concentrations.[11]

A possible role for leishmaniasis in later unexplained illness has been suggested, but additional studies are warranted to rule out such chronic infections which result in very little antibody and are difficult to diagnose. Development of more sensitive and less invasive diagnostic methods is an important research effort that will help to define the full extent of disease due to leishmania parasites and determine whether Leishmaniasis is a significant contributor to the chronic unexplained illness. The lack of outbreaks of sandfly fever probably indicates a low overall exposure to sandfly bites. A comprehensive epidemiologic study, however, should include a study of the distribution of leishmaniasis cases.

2. Food Borne

Contaminated lettuce from local vendors was described as having led to outbreaks of diarrhea.[12] Additionally, although standard sanitary practices were in place, it is probable that some of the incidence of diarrheal disease was related to contaminated water, foods or utensils. Giardia lamblia can be a cause of prolonged, watery diarrhea in veterans returning from areas where the water supply has been contaminated, although the task force did not receive information that this had been noted through surveillance of Gulf War veterans.

3. Respiratory

There were many instances of respiratory ailments beginning, or being aggravated by the living and working conditions for troops in Saudi Arabia. In one instance, troops occupying a long-vacant Saudi housing area in Al Eskan experienced significant rates of respiratory disease due to the fine sand and dust from accumulated pigeon droppings.[13] The disease was described as self-limiting, and while it is possible that some individuals who experienced this condition may have developed chronic sequelae, the extent of the conditions precipitating these cases does not provide an explanation for most of the veterans with undiagnosed medical complaints.

D. Environmental/Occupational Pollutants

The very nature of warfare exposes combatants to a variety of hazardous substances, not the least of which is flying steel, shrapnel and blast overpressures

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[11]DoD Pest Management Board, briefing to DSB Task Force, February 8, 1994.

[12]Korenyi-Both AL, Molnar AC. Al Eskan Disease: Desert Storm Pneumonitis. Mil Med 1992; 157: 455.

[13]Korenyi-Both AL, Molnar AC. Al Eskan Disease: Desert Storm Pneumonitis. Mil Med 1992; 157: 452-461.

from conventional warfare munitions. Most exposures during the Desert Shield/Storm time frame involved materials of lesser toxicity. Several situations of note included exposures to petroleum products, pesticides and CARC (Chemical Agent Resistant Coating) paint.

1. Petroleum Products

While a wide variety of fuels, lubricants and solvents were present routinely in many situations during the operation, it is not clear that exposures were different than soldiers encounter during peacetime military operations and training.

2. Alcohol Substitutes

No inquiry has been made on the extent of substance abuse (e.g., solvent sniffing, etc.) in a population that was abruptly deprived of alcohol. Some troops in the Vietnam war are known to have injured themselves by ingesting RDX, a plastic explosive, and a small number of individuals are bound to have experimented with these and other substances.

3. Insecticides

The Task Force received information[14] regarding the use of pesticides used for vector-borne or rodent disease prevention and control. All such materials used by military are EPA approved, and applied by trained technicians. Relative quantities of pesticides available to deployed units can be deduced from supply records, but application records do not exist.

Common pesticides used included *d*-phenothrin, chlorpyrifos, resmethrin, malathion, methomyl, lindane, pyrethroids and DEET.

There are potential acute adverse effects from pesticide poisoning; organophosphates can cause headache, diarrhea, dizziness, blurred vision, weakness, nausea, cramps, discomfort in the chest, nervousness, sweating, miosis (pinpoint pupils), tearing, salivation, pulmonary edema, uncontrollable muscle twitches, convulsions, coma, and loss of reflexes and sphincter control. Nausea, incoordination, and eye and skin irritation can occur following acute pyrethroid exposure. Polyneuropathy can occur 2-3 weeks following high-level exposure to some organophosphates (malathion, chlorpyrifos).[15]

While some individuals may have experienced some effects from local pesticide use, there were no reports of acute pesticide poisoning during the war. If continued analysis of the VA registry indicates a higher incidence of neurophysical disorders in those veterans whose duties included routine application

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[14]DoD Pest Management Board, briefing to DSB Task Force, February 8, 1994.

[15]Ecobichon DJ ,Davies JE ,Doull J , et al. Neurotoxic Effects of Pesticides. Advances in Modern Environmental Toxicology, Volume XVIII, Princeton Scientific Publishing Co., Inc, NJ. 131-199.

of pesticides, pesticide exposure may come under closer scrutiny as an etiological factor for other participants.

4. Oil Well Fires

On February 23, 1991, Iraqi forces began to destroy and set on fire more than 700 oil wells throughout Kuwait. All the fires were extinguished and the wells were capped by early November, 1991, but there was great concern regarding the potential health risk to personnel in the region as a result of their exposure. [16,17,18,19]

During the 8 month period in which the oil wells were burning, numerous efforts were undertaken to assess the air quality over Kuwait and to determine the health risks posed to the populations living, working, and serving in the military in the region. The U.S. Interagency Air Quality Assessment team arrived in Kuwait in March 1991 to begin to assess the possible health effects of the smoke from the oil fires. This team was composed of scientists from the U.S. Environmental Protection Agency, the National Oceanographic and Atmospheric Administration, and the Department of Health and Human Services.

During the period of the fires, the measured levels of two major air pollutants (sulfur dioxide, nitrogen dioxide) did not reach harmful levels. The level of particulate matter measuring less than 10 microns (PM_{10}), that portion of airborne particulate with the greatest impact on the respiratory system, did exceed the U.S. "alert level" on several occasions. However, Kuwait has frequent sand and dust storms, and the average level of PM_{10} in Kuwait is nearly 600 ug/m^3, the highest in the world.

The hazards to the soldiers posed by the smoke were largely dependent on the concentration of the pollutants in the air near the camps. Fortunately, the plumes resulting from the fires rose up to 10,000 to 12,000 feet, mixing with the air and then being dispersed for several thousand miles downwind over a period of several weeks. As the plume traveled, the particles and gases contained within it became more widely dispersed and also more diluted. The highest concentrations were in the areas nearest the affected oil fields and the areas immediately downwind. Few soldiers were in those areas for long periods of time. Considerable

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[16]Riley JJ, Hicks NG, Thompson TL. Effect of Kuwait oil field fires on human comfort and environment in Jubail, Saudi Arabia. Internat J Biometeorology 1992: 36-38.

[17]Ferek RJ, Hobbs PV, Herring JA, Laursen KK, Weiss RA, Rasmussen RA. Chemical composition of emissions from the Kuwait oil fires. Geophysical Research 1992; 97: 14483-14489.

[18]Hobbs PV, Radke LF. Airborne studies of the smoke from the Kuwait oil fires. Science 1992; 256:987-991.

[19]Laursen KK, Ferek RJ, Hobbs PV, Rasmussen RA. Emission factors for particulates, elemental carbon, and trace gases from the Kuwait oil fires. Geophys Res 1992; 97:14491-14497.

dilution took place over space, such that by the time the plume reached areas of troops in Saudi Arabia, it was far less visible and less concentrated than in Kuwait.

Potential effects on the respiratory system, such as a small loss in lung function or the development of chronic bronchitis, would be of particular concern to those who were exposed for many months to severe particulate pollution. These effects might be more likely to occur in cigarette smokers.

The US Army Environmental Hygiene Agency report of its participation in ODS provides some useful insights regarding industrial hygiene, preventive medicine and the impact of oil fires on health issues. The report cites no incidents regarding exposure to chemical weapons agents. Principal USAEHA efforts were to evaluate the health effects risks due to oil fires. On the basis of air and soil pathway analysis, excess cancer risk resulting from exposure to the Persian Gulf environment ranged from 2 to 5 per 10,000,000 well below the EPA range of concern of 1 per 10,000 through 1 per 1,000,000. The cancer risk assessment was based primarily on the risk from chromium. There was little difference in risk levels found between Saudi permanent monitoring sites and those in Kuwait near the oil fires. These results were based on collection of over 4,000 samples at 10 fixed ground sites over a period of seven months beginning in May 1991.[20]

Additionally, the National Center for Environmental Health, Centers for Disease Control and Prevention, performed surveys of VOC (volatile organic compounds) in the whole blood of two groups; American personnel employed in Kuwait City, about 20 km from the burning wells, and firefighters and medical personnel working at the burning oil wells.[21] Concentrations were compared to those of a random sample of persons in the United States. Median concentrations of the first group were equal or lower than those of the reference group; the firefighters did have elevated levels of some VOCs over those of the reference group. Since US military personnel were not involved directly in the fire fighting operations, their exposures would have been more comparable to those study personnel in Kuwait City, who showed no elevation in VOC level.

5. Sand

Because many US troops trained, executed maneuvers and actually lived out in the desert, there was initial concern for the possible adverse effects of being exposed to high levels of blowing and suspended sand. The sand was often powdery in consistency, and some personnel with respiratory problems did experience aggravated symptoms. An epidemiologic survey conducted among 2598 men stationed in northern Saudi Arabia, however, found that the type of structure in

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[20]Operation Desert Shield/Desert Storm: History of Participation by the US Army Environmental Hygiene Agency , Aberdeen Proving Ground, MD 7 August 1990 - 31 December 1991.

[21]Etzel RA, Ashley DL; Volatile organic compounds in the blood of persons in Kuwait during the oil fires, Int Arch Occup Environ Health, Spring 1994.

which a person slept may have been as important a risk factor for developing respiratory complaints as exposure to outdoor air pollutants.[22] The personnel who slept in air-conditioned buildings, for example, were much more likely to develop a cough and sore throat than those who lived in tents and warehouses.

It is reasonable to expect that inhalation of particulate matter could have resulted in some short-term airway irritation, and could have aggravated personnel with asthmatic conditions that were previously minor or asymptomatic. While little is known specifically regarding the long-term effects of inhaling fine sand, it does not seem likely to be a major contributing factor to the complex of symptoms being reported by veterans.

6. *CARC (Chemical Agent Resistant Coating) Paint*

Chemical agent resistant coating (CARC) used to paint combat vehicles and equipment, releases toluene diisocyanate during the curing process. Some civilian workers and several support units may have conducted painting without required respiratory protection. The extent of such exposures are unlikely to be a factor for the majority of personnel suffering from unexplained symptoms.

E. Medical Prophylaxis

Protective measures taken to prevent chemical or biological warfare casualties included vaccination against anthrax and botulinum toxin and prophylactic use of pyridostigmine as a nerve agent pretreatment. No evidence has been found to implicate any of these measures in the unexplained medical complaints in Gulf War participants.

1. *Pyridostogmine Bromide*

Pyridostigmine Bromide (PB) was issued as a nerve agent pretreatment to nearly all US troops, as well as 45,000 participants from the United Kingdom. Use of low doses (30mg 3x daily) of PB, taken orally upon direction of unit commanders, confers significant protection to troops when used with the other post-attack treatment measures (atropine and 2-Pam chloride). Although all units were given PB, the Department of Defense does not have records of which military personnel actually ingested PB, nor of how many tablets may have been ingested.

Most of the extensive clinical experience with the drug in civilian medicine has been with patients suffering from myasthenia gravis, a neuromuscular disorder. These patients are given doses as high as ten times those taken by troops. Metabolic and toxicologic studies and the relatively small amount of drug actually taken by military personnel make pyridostigmine an extremely unlikely contributing factor in the unexplained medical complaints in Gulf War participants.

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[22]Richards AL, Hyams KC, Watts DM et al. Respiratory disease among military personnel in Saudi Arabia during Operation Desert Shield. Am J Public Health 1993; 83:1326-1329.

The Army is preparing a formal NDA (new drug application) submission specifically for the indicated application of CW prophylaxis. The FDA procedures will entail a thorough and formal reexamination of the toxicological, metabolic and epidemiological data. While it is extremely difficult to rule out idiosyncratic side-effects at the level of 1 per thousand or fewer of those exposed, this hypothetical concern should be weighed against the hazards of unprotected exposure to chemical attack.

2. Anthrax Vaccine

Anthrax vaccine was administered to about 150,000 troops in the theater, about 1/5 of those deployed. The licensed anthrax vaccine, produced by the Michigan State Department of Public Health, has been extensively used for years in civilian wool factory workers and laboratory workers, and its safety is well documented.

3. Botulinus Toxoid Vaccines

Botulinus toxoid administration was restricted to relatively few units that were thought to be at highest risk. Only about 8000 doses were administered, but hardly any to reservists, which group is prominent among those reporting symptoms. This vaccine is made by the same process as tetanus toxoid that is used in infants worldwide, and is also produced by the Michigan State Department of Public Health.

F. Depleted Uranium

Operation Desert Storm was the first conflict that involved the use of depleted uranium (DU) munitions. Armor piercing projectiles fired from tanks and A-10 aircraft consisted of DU kinetic energy penetrators, enabling U.S. forces to engage and kill enemy vehicles at standoff ranges that enhanced their own safety.

Concern has developed around the possibility that expended DU projectiles, or the dust and fragments from them, posed a residual hazard to troops on the battlefield. Additionally there are a limited number of US soldiers whose vehicle was struck by friendly fire, resulting in DU shrapnel wounds. These soldiers are being followed up by a long-term study that will examine possible chronic effects from embedded DU fragments.

The other highest probability exposures from DU are among a group of maintenance workers who cleaned out a US tank that had been struck by enemy fire and burned while carrying DU ammunition. Careful radiological monitoring of these individuals during and after exposure led to the conclusion that the residual DU particles posed a minimal hazard to personnel working around contaminated vehicles with appropriate protection.

IX. POST TRAUMATIC STRESS AND SOMATOFORM DISORDERS

A. Psychiatric Morbidity

Psychiatric morbidity due to service during the Gulf War was predicted to be low for several reasons: the short duration of the conflict, the relatively low casualties sustained by American forces, and the positive support for the war at home. Examination of records of evacuation during the conflict is one approach to examining the extent of psychiatric morbidity: the Army rate of evacuation for psychiatric reasons translated to only 2.7 per 1,000 evacuations per year.[23] This very low rate of psychiatric evacuations is in contrast to prior wars in which evacuations for psychiatric disorders in comparison to total evacuations were: 23% in World War II, 10% for Korea, and 7% from Vietnam[24]. Of the roughly 250 Army personnel evacuated from the Gulf for psychiatric reasons, approximately fifty (20%) were later determined to be disabled for further military service; levels of Post Traumatic Stress Disorder (PTSD) were found to be very low, with only four of these 50 carrying a diagnosis of PTSD[25]. Another approach to assessing psychiatric morbidity possibly relating to service in the Gulf is to examine the numbers of service members referred for disability determination due to psychiatric disorders. As of March 1994, approximately 294 soldiers with psychiatric-related diagnoses were referred for disability determinations. Of these, 112 carried the diagnosis of PTSD.[26] There are several studies in the literature which report on the prevalence of psychiatric disorders and stress symptoms during and following the Gulf

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[23]Hales RE: Psychiatric lessons from the Persian Gulf War. Hosp Community Psychiatry 43:769, 1992

[24]Ursano RJ, Holloway HC: Military Psychiatry, in Comprehensive Textbook of Psychiatry/I V. Edited by Kaplan HI, Sadock BJ. Baltimore, MD, Williams & Wilkins, 1900-1909, 1985

[25]Fagan J., personal communication, 1994

[26]Fagan J., personal communication, 1994

War[27,28,29,30,31,32,33,34]. However, it is difficult to generalize from these papers because of the unique characteristics of the populations studied.

Studies from the Veterans Administration have shown somewhat higher levels of PTSD. A preliminary report estimated a prevalence of PTSD at roughly 9%[35]. Of note is that 34% appeared to have experienced other forms of significant psychological distress upon return[36].

In the initial phase of the ODS Veterans Survey spanning from October 15, 1991, to April 15, 1992, 1006 surveys were completed; roughly one-half at VA centers, and one-half at outreach locations. A composite PTSD measure was created on the basis of random structured psychiatric telephone interviews and their relation to the completed survey. At the initial survey, PTSD levels were

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[27]Perconte ST, Dietrick AL, Wilson AT, Spiro KJ, Pontius EB: Psychological and war stress symptoms among deployed and non-deployed reservists following the Persian Gulf War. Milit Med 158:516-521, 1993

[28]Southwick SM, Morgan A, Nagy LM, Bremner D, Nicolaou AL, Johnson DR, Rosenheck R, Charney DS, et al: Trauma-related symptoms in veterans of Operation Desert Storm: a preliminary report. Am J Psychiatry 150:1524-1528, 1993

[29]Labbate LA, Snow MP: Posttraumatic Stress symptoms among soldiers exposed to combat in the Persian Gulf. Hosp Community Psychiatry 43(8):831-832, 1992

[30]Perconte S, Wilson A, Pontius E, Dietrick AL, Kirsch C, Sparacino C: Unit-based intervention for Gulf War soldiers surviving a SCUD missile attack: program description and preliminary findings. Journal of Traumatic Stress 6(2):225-238, 1993

[31]Johnson LB, Cline DW, Marcum JM, Intress JL: Effectiveness of a stress recovery unit during the Persian Gulf War. Hosp Community Psychiatry 43:829-831, 1992

[32]McDuff DR, Johnson JL. Classification and characteristics of Army stress casualties during Operation Desert Storm. Hosp Community Psychiatry 43:812-815.

[33]McCarroll JE, Ursano RJ, Fullerton CS: Symptoms of Posttraumatic Stress Disorder following recovery of war dead. Am J Psychiatry 150(12):1875-1877, 1993

[34]Garland FN: Combat stress control in the Post-War Theater: mental health consultation during the redeployment phase of Operation Desert Storm. Milit Med 158(5):334-338, 1993

[35]Rosenheck R, Becnel H, Blank AS, Farley F, Fontana A, Friedman MJ, Fulton J, Gelsomino J, Grishman M, Gusman F, Keane T, Lehmann L, Podkul TB, Ursano RJ, Wolfe J: Returning Persian Gulf troops: First year findings, VA Northeast Program Evaluation Center (NEPEC), The Evaluation Division of the National Center for PTSD. West Haven, CT, VA Medical Center, 1992

[36]Rosenheck R, Becnel H, Blank AS, Farley F, Fontana A, Friedman MJ, Fulton J, Gelsomino J, Grishman M, Gusman F, Keane T, Lehmann L, Podkul TB, Ursano RJ, Wolfe J: Returning Persian Gulf troops: First year findings, VA Northeast Program Evaluation Center (NEPEC), The Evaluation Division of the National Center for PTSD. West Haven, CT, VA Medical Center, 1992

found to be 36.5% for veterans seeking psychological treatment at Vet Centers ("treatment-seeking"), 4.9% for those veterans seeking other services at Vet center ("service-seeking"), and 5.3% for veterans who completed the survey at an outreac location ("non-service-seeking")[37]. At the six month follow-up (April 15 -- October 15, 1992), treatment-seeking veterans exhibited less PTSD at follow-up (19.4% compared to 37.1%)[38]. The non-service-seeking veterans exhibited more PTSD (7.6% versus 5.4% at Time 1) and the service-seeking veterans exhibited twice the level of PTSD (9.8% versus 4.9%.)[39]

The prevalence of psychiatric conditions in veterans enrolled in the active duty and VA registries for Desert Storm-related conditions appears to be modest. Inpatient primary psychiatric diagnoses in Persian Gulf veterans showed 34.7% suffering from mental disorders; 11.6% from alcohol dependence; 5.1% from drug dependence and 6.1 % from adjustment disorders (including PTSD)[40]. Of the 67 individuals enrolled in the Navy Gulf War registry in February 1994, 6 were listed as having a psychiatric condition as their major complaint (1 adjustment disorder with depressed features; 1 major depression; 4 PTSD)[41]. Approximately 7 other individuals carried associated or incident psychiatric diagnoses (3 depressive disorders, 2 PTSD, 1 adjustment disorder and 2 personality disorders)[42]. Of the 149 individuals enrolled in the Army's Gulf Syndrome Registry as of February 1994, 12 were listed as having presumed or confirmed PTSD; 4 suffered depressive disorders; 2 panic disorders; 1 bipolar disorder.[43] Similarly, a group of 78 veterans complaining of symptoms of fatigue was found to have a low prevalence of psychiatric disorders (@12%).[44]

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[37]DoVA Readjustment Counsel Svc(115) Washington DC, 1994, unpublished data

[38]DoVA Readjustment Counsel Svc(115) Washington DC, 1994, unpublished data

[39]National Center for PTSD, preliminary report, 1994

[40]Kang HK, Dalager NA: Health surveillance of Persian Gulf War veterans: a review of the Department of Veterans Affairs Persian Gulf Registry and the Patient Treatment File, 1993

[41]Naval Environmental Health Center, 1994

[42]Naval Environmental Health Center, 1994

[43]Department of the Army, Preventive Medicine Consultants Division, 1994

[44]Defraites RF, Wanat ER, Norwood AE, Williams S, Cowan D, Callahan T: Investigation of a Suspected Outbreak of an Unknown Disease Among Veterans of Operation Desert Shield/Storm. Washington, DC, Walter Reed Army Institute of Research, 1992

B. Historical Background

Appreciation for the role of situational stress as a major military medical problem began in the latter half of the 19th century and paralleled the development of psychiatry as a medical specialty. During the Civil War, DaCosta attributed a syndrome consisting of generalized weakness to an irritable and exhausted heart. A similar constellation of symptoms was described as neurocirculatory asthaenia during World War I.[45] Physicians in the past have attempted to understand the etiology of these syndromes. As in today's discussion of complex illnesses, there was much controversy surrounding the relative contribution of "organic" (medical) versus "functional" (psychological) factors.

In current military psychiatry the term *acute stress reaction* or *battle fatigue* is applied to a wide range of somatic (physical) and psychological responses in the combat theater. When military psychiatric principles of proximity, immediacy and expectancy are employed, the vast majority of these casualties can be returned to duty.

Numerous studies have demonstrated that participating in combat is related to an increase in nonsurgical illness .[46] Much less is known about the longer term medical and psychological consequences of going to war (See Rundell and Ursano[47] for review). Vietnam veterans reported many more physical symptoms and illnesses than did military contemporaries not serving in combat; 25% more Vietnam veterans sought medical care for health problems than did non-combat veterans.[48] Vietnam veterans were almost twice as likely to describe their health as "fair" or "poor" in comparison with veterans during that time period who did not serve in Vietnam (19.6% versus 11.1%).[49] It is of note that physical examinations and laboratory studies found few differences between these two groups.

In looking at the general literature on the relationship of exposure to trauma and subsequent health, numerous investigators have noted a relationship between

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[45]Glass AJ: Army psychiatry before World War II, in Neuropsychiatry in World War II; Volume I: Zone of Interior. Edited by Anderson RS, Glass AJ, Bernucci RJ. Office of the Surgeon General, Department of the Army, 1966

[46]Solomon Z: Body and Soul, in Combat Stress Reaction: The Enduring Toll of War. Edited by Solomon Z. New York, NY, Plenum Press, 1993, pp 147-162

[47]Rundell J, Ursano RJ: Psychiatric responses to trauma, in The Persian Gulf War: Soldiers and Families, Communities and Nations. Edited by Ursano RJ, Norwood AE, in preparation

[48]Kulka RA, Schlenger WE, Fairbank JA, Hough RL, et al: National Vietnam veterans readjustment study (NVVRS): Description, current status, and initial PTSD prevalence estimates. Veterans Administration, Washington, DC, 1988

[49]The Centers for Disease Control Vietnam Experience Study: Health Status of Vietnam Veterans II. Physical Health. JAMA 259:2708-2714, 1988

Post-Traumatic Stress Disorder (PTSD) and somatic complaints. For example, 5 out of 9 firefighters with chronic PTSD presented to their physicians with somatic complaints that distracted attention from the underlying PTSD.[50] High amounts of PTSD symptomatology were found to correlate with reports of high amounts of physical health problems in veterans.[51] Similar relationships between PTSD in Vietnam combat-veterans and increased reporting of health complaints were also found by Litz et al[52]. These investigators noted those health complaints in the veterans with PTSD clustered around symptoms suggestive of sympathetic hyperactivity, especially gastrointestinal and cardiopulmonary complaints. Health complaints were found to correlate positively to severity of PTSD. The presence of physician-diagnosed medical conditions did not differentiate between combat veterans with and without PTSD. In a study of Israeli combat veterans[53], the 50 veterans with PTSD reported significantly more symptoms than did age-matched combat veterans without PTSD. However, the veterans with PTSD did not differ from the controls in findings on physical examination or laboratory evaluation. Solomon and colleagues[54] found that one, two, and three years after their participation in the Lebanon war, Israeli combat veterans who had experienced combat stress reactions during the war reported significantly more health problems.

C. Relationship Between War-Related Stress and Health

The relationship between exposure to war-related stress and long-term effects on health is not well understood. Various hypotheses have been advanced to explain the ways in which stress can affect health (see Litz et al[55] for a review of

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[50]McFarlane AC: The phenomenology of post-traumatic stress disorder following a natural disaster. J Nerv Ment Dis 176:22-29, 1988

[51]Stretch RH: Posttraumatic stress disorder among Vietnam and Vietnam era veterans, in Trauma and Its Wake, Vol 2: Traumatic Stress Theory, Research and Intervention. Edited by Figley C. New York, NY, Brunner/Mazel, 1986, pp 156-192

[52]Litz BT, Keane TM, Fisher L, Marx B, Monaco V: Physical health complaints in combat-related Post-Traumatic Stress Disorder: a preliminary report. Journal of Traumatic Stress, 5:131-141, 1992

[53]Shalev A, Bleich A, Ursano RJ: Posttraumatic Stress Disorder: somatic comorbidity and effort tolerance. Psychosomatics, 31:197-202, 1990

[54]Solomon Z: Somatic complaints, stress reaction, and Posttraumatic Stress Disorder: a three-year follow-up study. Behavioral Medicine, 14:179-185, 1988

[55]Litz BT, Keane TM, Fisher L, Marx B, Monaco V: Physical health complaints in combat-related Post-Traumatic Stress Disorder: a preliminary report. Journal of Traumatic Stress, 5:131-141, 1992

proposed mechanisms). Recent attention has turned to the effects of stress on the endocrine and immune systems[56,57,58].

In terms of the Persian Gulf War, several studies have found that deployed veterans reported more somatic complaints than did non-deployers. In a study of Desert Storm veterans from New England[59], in a survey taken 18 months after their return from the Gulf, 32.4% of all respondents reported that their health had changed for the worse since their homecoming. Higher endorsement of symptoms was found in subjects who exceeded clinical cutoffs for PTSD: mean numbers of health problems in this group were nearly triple those of the other soldiers. The 3 most commonly endorsed health problems were general aches and pains, headaches, and a lack of energy.

In a sample of 4334 veterans from Hawaii and Pennsylvania, of whom 1739 deployed to the Persian gulf, both the active duty and reserve sample of deployers were significantly more likely to report higher levels of almost all symptoms, often at rates of two-to-one.[60]

The relationship between self-report of symptoms and diagnoses of PTSD based on questionnaire cut-off scores must be interpreted cautiously, however. In a multiphase study on the physical and psychosocial impact of activation and deactivation on Army Reserve nurses who did not deploy to the Gulf, over half endorsed PTSD symptoms of intrusion in the high range and about two-third endorsed high avoidance symptoms[61]. Given the low casualties sustained during the war and the fact that these nurses were not in the combat theater, it is unlikely that these scores reflect traditional war-related stressors per se. Somatic complaints were endorsed at a high rate by this group with over half complaining of headaches. Sleep disturbance, sore muscles, nausea, and lower back pains were also reported to be common.

The positive correlation between PTSD and health complaints suggests that Desert Storm veterans with PTSD are at higher risk for complaints of health

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[56]Chrousos GP, Gold PW: The concepts of stress and stress system disorders: overview of physical and behavioral homeostasis. JAMA 267:1244-1252, 1992

[57]Cohen S, Williamson GM: Stress and infectious disease in humans. Psychol Bull 109:5-24, 1991

[58]Malarkey WB, Kiecolt-Glaser JK, Pearl D, Glaser R: Hostile behavior during marital conflict alters pituitary and adrenal hormones. Psychosom Med 56:41-51, 1994

[59]Wolfe J, Keane TM, Young BL: From soldier to civilian: acute adjustment patterns of returned Persian Gulf veterans, in The Persian Gulf War: Soldiers and Families, Communities and Nations. Edited by Ursano RJ, Norwood AE, in preparation

[60]Marlowe, et al WRAIR, preliminary report on Persian Gulf, 1994

[61]Ryan-Wenger NM: Physical and psychosocial impact of activation and deactivation on Army Reserve nurses. Milit Med 157:447-452, 1992

problems. In Vietnam veterans, the National Vietnam Veterans Readjustment Study (NVVRS) found that 15.2% of the male and 8.5% of the female Vietnam theater veterans suffered from PTSD at the time of the survey.[62] In terms of forecasting rates of PTSD from the Gulf War, it may be more instructive to examine the Israeli experience following the 1982 Lebanon War, a war lasting a matter of weeks rather than years. It is important to note that 14% of combat veterans who had not displayed acute stress reactions during combat met diagnostic criteria for PTSD one year after the war.

X. OTHER SYNDROMES

The medically unexplained illnesses in Gulf War participants have been called a "Mystery Illness," and as such it is instructive to compare and contrast it with other puzzling and controversial illnesses that have been and currently are reported. A unique feature of the Gulf War cases is the relatively short time period and restricted geographic localization of potential causative exposures. This feature of the condition raises suspicion that there was a single (or limited number of) environmental agents responsible for causing the illness.

A. Multiple Chemical Sensitivities (MCS)

The term "multiple chemical sensitivities" was first used by Cullen in 1987. He defined it as:

> "an acquired disorder characterized by recurrent symptoms, referable to multiple organ systems, occurring in response to demonstrable exposure to many chemically unrelated compounds at doses far below those established in the general population to cause harmful effects. No single widely accepted test of physiologic function can be shown to correlate with symptoms."

MCS is the new name given to a condition previously called Environmental Illness (EI), originally proposed by Randolph in the 1950s. Patients with a variety of symptoms but without physiological abnormalities were considered to suffer from a previously undescribed form of sensitivity or allergy to environmental chemicals, foods, and/or drugs, for which restrictive diets and environmental avoidance measures are prescribed.

The list of environmental chemicals purported to cause the condition and trigger symptoms is large and heterogeneous, but items most frequently mentioned by these patients are pesticides, perfumes, organic solvents, vehicle exhaust fumes, fuels, glues, and carpeting.

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[62] Kulka RA, Schlenger WE, Fairbank JA, Hough RL, et al: National Vietnam veterans readjustment study (NVVRS): Description, current status, and initial PTSD prevalence estimates. Veterans Administration, Washington, DC, 1988

Theories of pathogenesis have included immunotoxic, neurotoxic, and psychosomatic mechanisms, but clinical or experimental evidence conclusively validating these theories has yet to appear. A number of independent studies now establish that many patients with the diagnosis of MCS or EI are immunologically normal by objective laboratory test.

Based on a number of published studies of persons diagnosed as MCS, the most frequently reported symptoms, in descending order of frequency, are as follows:

Fatigue
Headache
Nausea
Confusion
Memory loss
Dizziness
Difficulty concentrating
Ocular and respiratory irritation
Musculoskeletal pain
Visceral pain
Dyspnea

The concept of MCS and the theories and diagnostic methods of its proponents have continued to be highly controversial for the past 40 years.

Relation to Gulf War Participants with Unexplained Illness

Discussions of the unexplained medical complaints in Gulf War participants occasionally include reference to MCS. In some cases veterans carry both diagnoses concurrently. In other cases, these complaints are viewed as identical with or as a subset of MCS. The summaries of illness reported among Gulf War participants with unexplained medical complaints examined by the VA show similarities and differences with those reported in MCS. However, the absence of substantial abnormalities on physical examination and laboratory testing is a striking feature of both conditions.

B. Chronic Fatigue Syndrome (CFS)

A committee of the Centers for Disease Control's Division of Viral Diseases in 1988 proposed the name "Chronic Fatigue Syndrome" and established a working case definition[63] to "improve the comparability and reproducibility of clinical research and epidemiological studies, and to provide a rational basis for evaluating

[63]Holmes G, Kaplan J, Gantz N, et al. Chronic Fatigue Syndrome: A Working Case Definition. Annals of Internal Medicine. 1988;108:387-389.

patients who have chronic fatigue of unknown cause." In brief, the diagnosis must fulfill the following 2 major criteria:

1. New onset of debilitating fatigue that does not resolve on bedrest, severe enough to reduce daily activity > 50% for more than 6 months.
2. Other clinical conditions are excluded by appropriate evaluation.

and 6 or more of the following 11 symptom criteria:

1. Mild fever.
2. Sore throat.
3. Painful cervical or axillary lymph nodes.
4. Unexplained generalized muscle weakness.
5. Muscles discomfort or myalgia.
6. Fatigue for 24 hrs after exercise that would have previously been tolerated.
7. Generalized headache of a type not previously experienced.
8. Migratory non-inflammatory arthralgia.
9. Neuropsychologic complaints.
10. Sleep disturbance.
11. Description of the main symptom complex as initially developing over a few hours to a few days.

and 2 or more of the following 3 physical criteria documented by a physician on two or more occasions at least 1 month apart:

1. Temperature 37.6-38.6C (oral) or 37.8-38.3C (rectal)
2. Nonexudative pharyungitis.
3. Palpable or tender cervical or axillary lymph nodes or Eight or more of the symptom criteria.

The name and working case definition of CFS arose from reports beginning in 1985 of clusters and individual case reports of a possible new disease with numerous general and specific symptoms without physical or laboratory abnormalities. The illness was first believed to be a chronic Epstein-Barr virus (EBV) infection because of the presence of EBV antibodies, but further epidemiological investigations revealed that the types and titers of the antibodies in these patients were not clearly distinguishable from those in age-matched healthy controls.

The case definition of CFS was intended as an operational concept designed for research purposes, and the criteria reflect the original concept of the disease as an infectious process. Subsequently, investigators have searched for evidence of infection by other viruses, notably HHV-6 and HTLV-1, to explain the etiology of CFS, but to date a specific causative virus (or group of viruses) has not yet been identified. One theory postulates that CFS can be explained as a chronically "activated" immune system, possibly initiated by a viral infection.

In the past a number of illness "epidemics" have been reported with similar features of subjective symptoms without significant physical abnormalities or identifying diagnostic laboratory tests. Some of these events are:

Los Angeles Co. Hospital Illness (1934)
Iceland disease (1948)
London Middlesex Hospital disease (1952)
Royal Free Hospital Disease (1955)
Incline Village (NV) outbreak (1984)

Relation to Gulf War Participants with Unexplained Illness

As with MCS, there are similarities and differences between CFS and the unexplained medical complaints in Gulf War participants, but all 3 illnesses are subjective without diagnostic objective criteria by physical examination or laboratory testing.

C. Symptoms in the General Population

When considering the rate of occurrence of the reported symptoms in Gulf War veterans, it is instructive to examine what is known about the general occurrence of medical complaints in the population. A number of studies have looked at the prevalence of common symptoms in various outpatient populations. The incidence for some of the symptoms associated with Gulf War veterans is very similar, or even higher, in various groups of subjects studied. For instance, fatigue was reported by between 22 and 51 percent, and headache by 14 to 49 percent.[64]

Additionally of interest, a high percentage of these common complaints cannot be diagnosed with a clear organic etiology, and many of the symptoms do not improve through specific treatment.[65]

One of the clear but challenging goals of researchers in the Gulf War health phenomenon will be to determine what differences exist between the veterans conditions and those that exist at some background in the general population.

D. Other Coalition Forces

One striking feature of the post-war health phenomenon is the fact that it has been reported only in US personnel. The Saudi Arabian Ministry of Health, in meetings both with Senator Shelby and with Under Secretary of Defense Dorn, has stated that they have not observed any reports of the typical mix of symptoms being reported by some veterans, nor have they observed in their public health

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[64]Kroenke K et al. Symptoms and Therapy in Medical Outpatients. Arch Intern Med; 150:1688.

65Kroenke K, Mangelsdorf AD. Common symptoms in ambulatory care: incidence, evaluation, therapy and outcome. Am J Med 86:262-266, 1989.

surveillance program any unexpected increase in unusual health problems of any sort. They also have specifically stated that there were no reports during the war of any civilians being treated for any injury typical of exposure to chemical warfare agent.

Other European and Middle East region governments who supplied forces to the coalition, during meetings with Senator Shelby, have stated that they have not observed unexplained incidence of disease in their troop populations who served during the war.

The Task Force received presentations by, and enjoyed the participation of, the Director General of the United Kingdom's Chemical & Biological Defense Establishment, Dr. Graham Pearson.

The United Kingdom deployed approximately 45,000 troops to the Persian Gulf War, referred to in their military parlance as Operation Granby. These troops comprised 31,000 ground troops, 5 destroyer/frigates, 5 mine sweepers, 10 support ships, and 75 combat aircraft. The British ground contingent consisted of their 1st Armoured Division, with the 7th and 4th Armoured Brigades, division troops, and several infantry battalions tasked with enemy prisoner of war (EPW) handling. These units were almost exclusively made up of active duty military personnel; only 3.6% were reservists.

For the conduct of the ground war, the British division fell under the operational control of the US VII Corps, and was placed on the inner hinge of the wide sweeping attack around Iraq's western flank.

Although no pattern of illness has been apparent in either the British military medical channels, or in the state-sponsored medical system, with regard to those military veterans who had been deployed into the theater of war, the public there followed with interest the increasingly frequent accounts in the American media regarding the so-called "Gulf War Illness". This interest was heightened following a feature on US reports of a Gulf related illness broadcast during a BBC current affairs program on 7 June 1993. Subsequently, the Minister for the Armed Forces appeared on a later edition of this program, dated 7 July 1993, to urge any Gulf War veterans who were experiencing health problems that they believed may be connected with their Gulf service to contact the Ministry of Defense. As of 17 March 1994, 28 veterans had contacted the Ministry, 14 of who took up the offer of medical assessment by a military consultant. By 17 March 1994, 11 of these had been examined and all have been diagnosed as having standard ailments. Thus, we are not aware of any British soldiers who have undiagnosed medical problems that are similar to those being described for US veterans.

Several similarities exist in potential exposures to the British contingent and the US forces that may ultimately be of use to researchers; in addition to being in the same environmental conditions, the widespread administration of anti-biological warfare vaccines and pyridostigmine bromide (nerve agent pretreatment) within both forces are two of interest.

The British report no incidents of detecting chemical or biological warfare agents, and concur in the assessment that chemical or biological agents were not used during the conflict.

GLOSSARY

AC - Hydrogen Cyanide
AFIP - Armed Forces Institute of Pathology
ANBACIS - Automated Nuclear Biological and Chemical Information System
ARCOM - Army Reserve Command
BUN - Blood Urea Nitrogen
BW - Biological Warfare
CAM - Chemical Agent Monitor
CARC - Chemical Agent Resistant Coating
CBC - Complete Blood Count
CBDE - Chemical & Biological Defense Establishment (UK)
CPK - Creatinine Phospho Kinase
CBW - Chemical/Biological Warfare
CENTCOM - (US) Central Command
CFS - Chronic Fatigue Syndrome
ChE - Cholinesterase
CNS - Central Nervous System
CW - Chemical Warfare
CX - choking agent (phosgene oxime)
DEET - diethyl toluamide, insect repellant
DMDC - Defense Manpower Data Center
DNBI - Disease/Non-Battle Injuries
DoD - Department of Defense
DoVA - Department of Veterans Affairs
DS/DS - Desert Shield/Desert Storm
DSB - Defense Science Board
DU - Depleted Uranium
EBV - Epstein Barr Virus
EEG - Electroencephalogram
EI - Environmental Illness
EPA - Environmental Protection Agency
EPW - Enemy Prisoner of War
Era Veterans - those veterans in service during the same period (as Gulf War veterans) but not actually deployed to the Gulf
FDA -Food & Drug Administration
GA - nerve agent (Tabun)
GB - nerve agent (Sarin)
GD - nerve agent (Soman)
GF - flouride-containing organophosphate nerve agent
HD - blister agent (distilled mustard)

ICD9 - International Classification of Diseases
ITP - idiopathic thrombocytopenic purpura
L - blister agent (lewisite)
LD_{50} - lethal dose to 50% of exposed population
MCS - Multiple Chemical Sensitivity
MRI - Magnetic Resonance Imaging
NBC - Nuclear, Biological and Chemical
NDA - New Drug Application
NRC - National Research Council
NVVRS -National Vietnam Veterans Readjustment Study
NYC - New York City
ODS - Operation Desert Storm (can include Desert Shield)
PB - Pyridostigmine Bromide
PTF - Patient Treatment File
PTSD - Post Traumatic Stress Disorder
RCP - Referral Center Program
RDX - Royal Demolition Explosive, an explosive ingredient
SCUD - Soviet-designed surface-to-surface missile
UN - United Nations
UNSCOM - United Nations Special Commission
US - United States
USAEHA - US Army Environmental Hygiene Agency
VAMC - Veterans Affairs Medical Center
VOC - Volatile Organic Hydrocarbons
VX - nerve agent
WW II - World War II

APPENDIX A

Appendix A

Summary of Task Force Fact Finding Meetings

December 21-22, 1993
-Interagency Efforts
-Current Congressional Concerns
-DoVA Perspective, Clinical Background Information
-Intelligence Assessment of Chemical/Biological Warfare in Gulf War
-Reported Incidents of Chemical Agent Detection or Exposure
-US/Coalition Force Chem/Bio Detection Equipment Capabilities, Limitations & Operational Employment
-Health Effects Overview
-Health Effects of Chemical/Biological Agents
-Iatrogenic Effects (Pyridostigmine Bromide, vaccines)
-123d ARCOM EPICON Investigation
-Psychosocial Stressors
-24th Naval Reserve Construction Battalion EPICON Investigation
-Leishmaniasis
-Depleted Uranium
-Kuwaiti Oil Well Fires Studies
-Institute of Medicine's Effort (Charter & law)

January 10-11, 1994 (CW/BW Panel)
-Chemical Agent Detection Technology
-Biodetection Program
-Natick Lab Evaluation of T-shirt Color Change
-UK Perspective on Persian Gulf Chemical Incidents
-Low-level Exposure Effects
-Other Detection Programs
-Update on Chemical Incident Review
-Meteorological Assessment of Persian Gulf Region (1/17/91 - 3/2/91)
-Modeling of Czech Incident; Other Hypothetical Scenarios; Cloud Travel; Diffusion Modeling
-OSHA: Effects of Chronic Pesticide Exposure
-EPA: Pesticide Hazards (Low-level Effects)
-VA: Registry Summary
-Joint Service Environmental Support Group

January 27-28, 1993 (Medical Panel)
-DoVA Update (Registry, Clinical, Research)
-MG Blanck Update on Middle East Trip
-Medical R&D Presentations
-Multiple Chemical Sensitivities
-Toxicology Forum
  – Organophosphates

- Mustard Agents
- Pyridostogmine Bromide
- Gulf War Tissue Study
- Inhaled Particulates
- Other Health Hazards

-Update on Chemical Incident Review
-Other Gulf War Committees Activities
-Joint Service Environmental Support Group Registry
-Epidemiological Efforts and Plans
-CW/BW Panel Update

February 7-8, 1994 (CW/BW Panel)
-Active Duty Registry Profile
-Chemical Officer Forum
- UNSCOM Team
- Central Command
- Army Central Command
- Army VII Corps
- Army 82 Airborne Division
- Army 2d Chemical Battalion

-Health Panel Update
-UK Presentation
-Modeling Update
- overhead imagery
- micrometeorological data

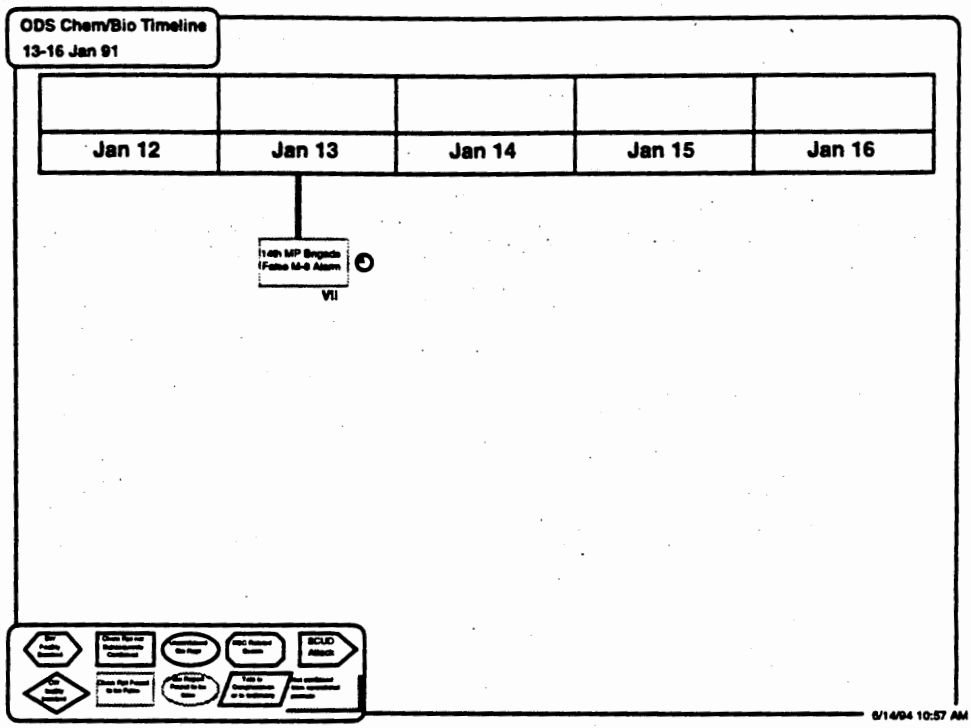
-C/B Detection Program
- Requirements Development
- R&D
- Tech Base

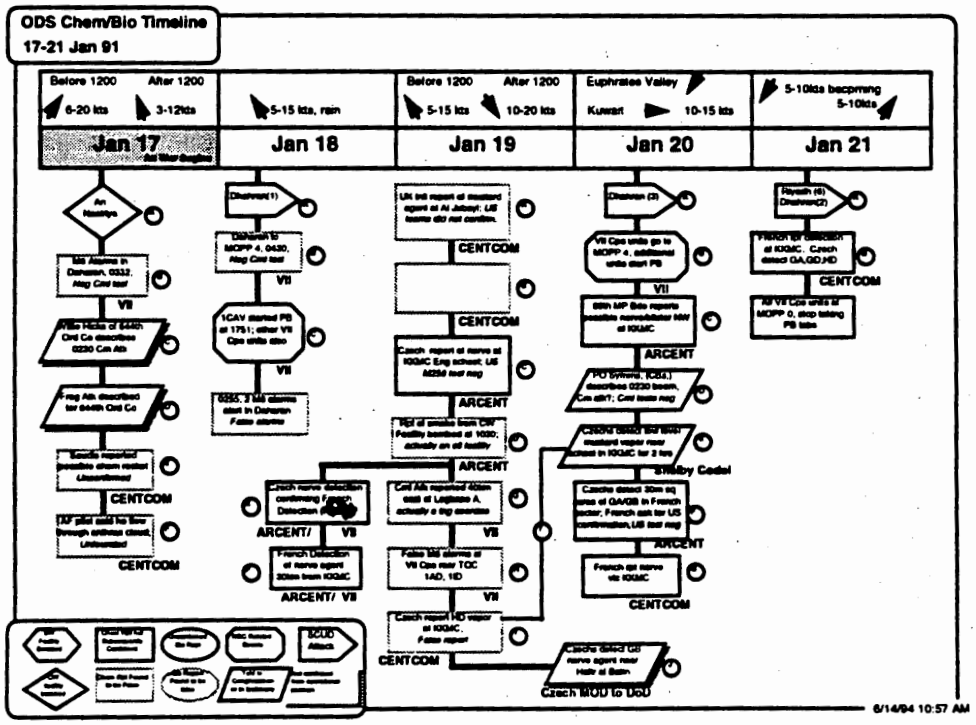
-PB Follow-up
-Dead Animals/Sanitation/Insecticides
-VA Update

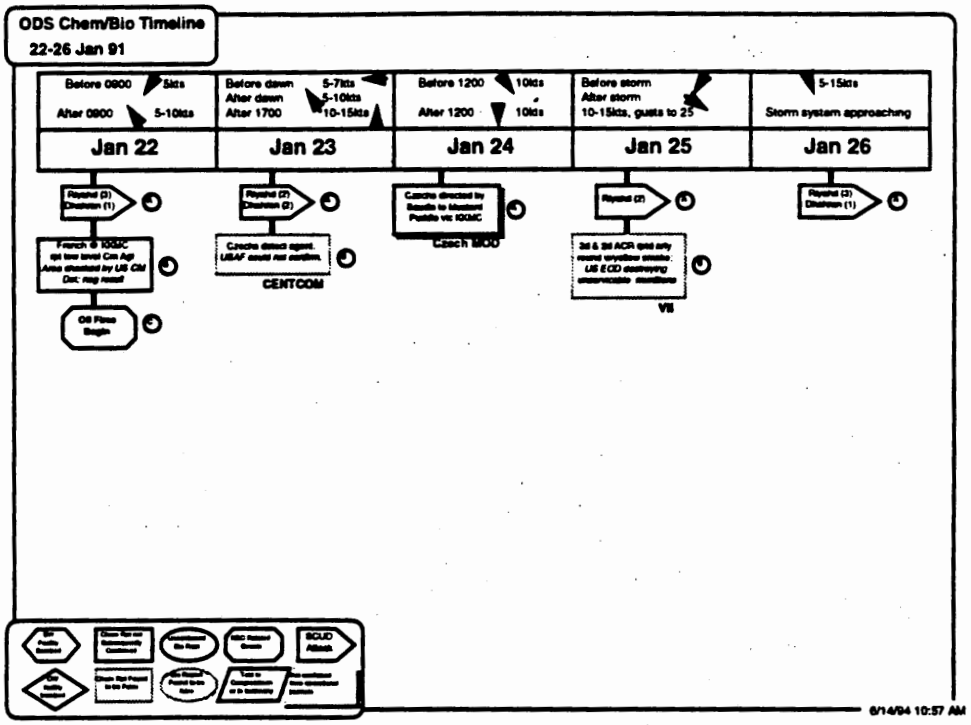
February 24-25, 1994 (Medical Panel)
-CW/BW Panel Update
-Chronic Fatigue Syndrome
-Proposed Persian Gulf Illness Case Definition
-Gulf War Disease Diagnosis and Treatment (Dr. Hyman)
-Veterans Illness Profile (Mr. Haines)
-Infectious Disease Wrap-up
-VA Epidemiological Review
-Senator Riegle's Study (Mr. Tuite)

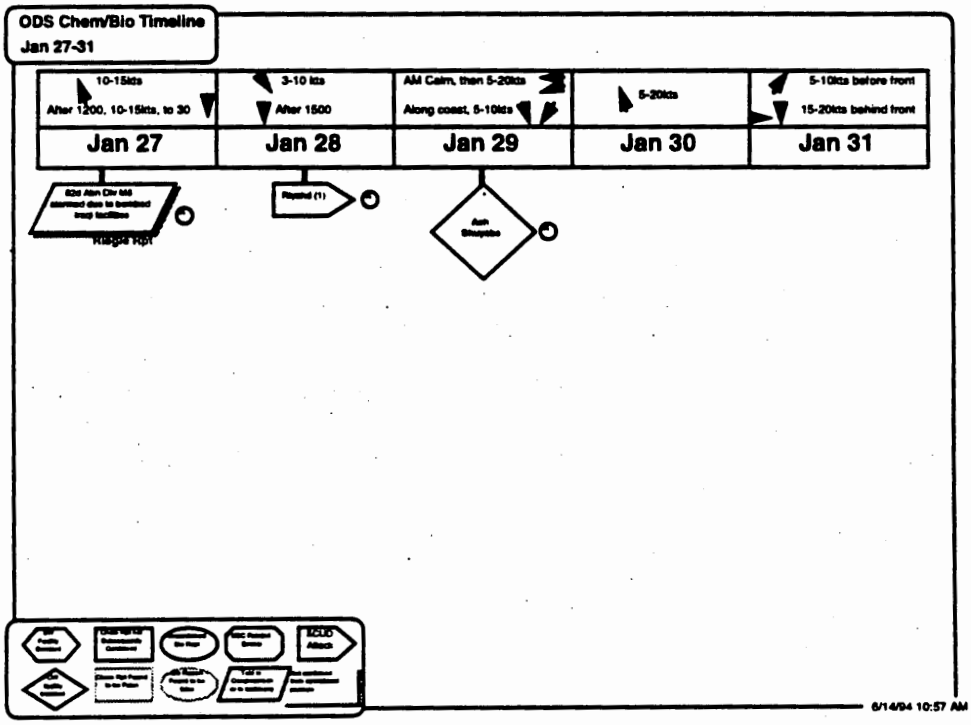
March 24-25, 1994
-Normal Incidence of Disease
-Chronic Fatigue Syndrome Case Definition Efforts
-Congressman Browder
-ODS Chem/Bio Event Timeline
-Executive Session

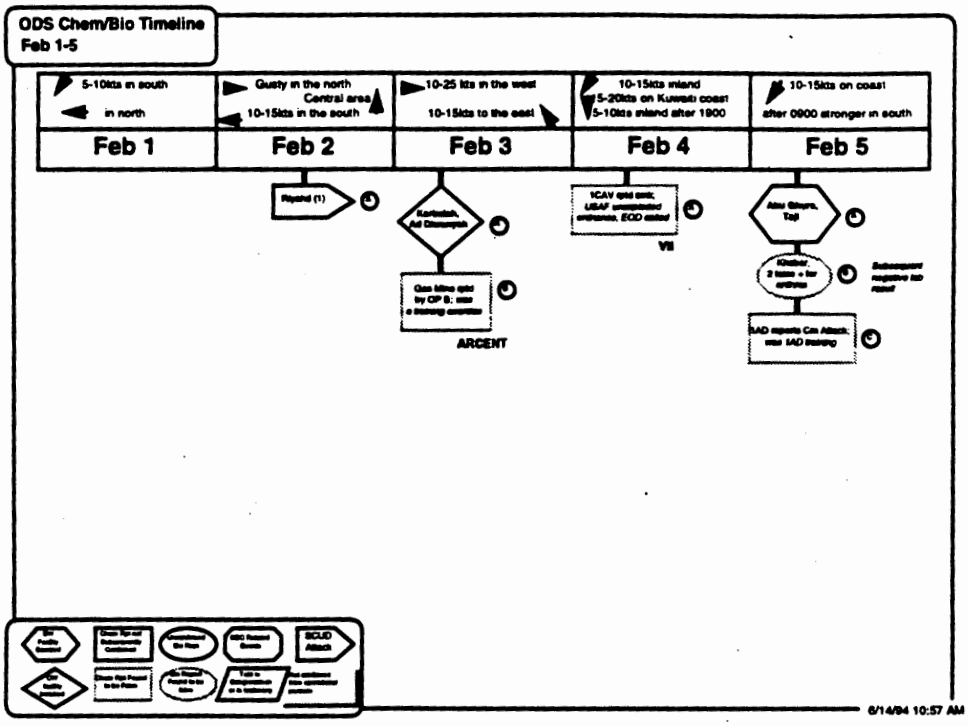
APPENDIX B

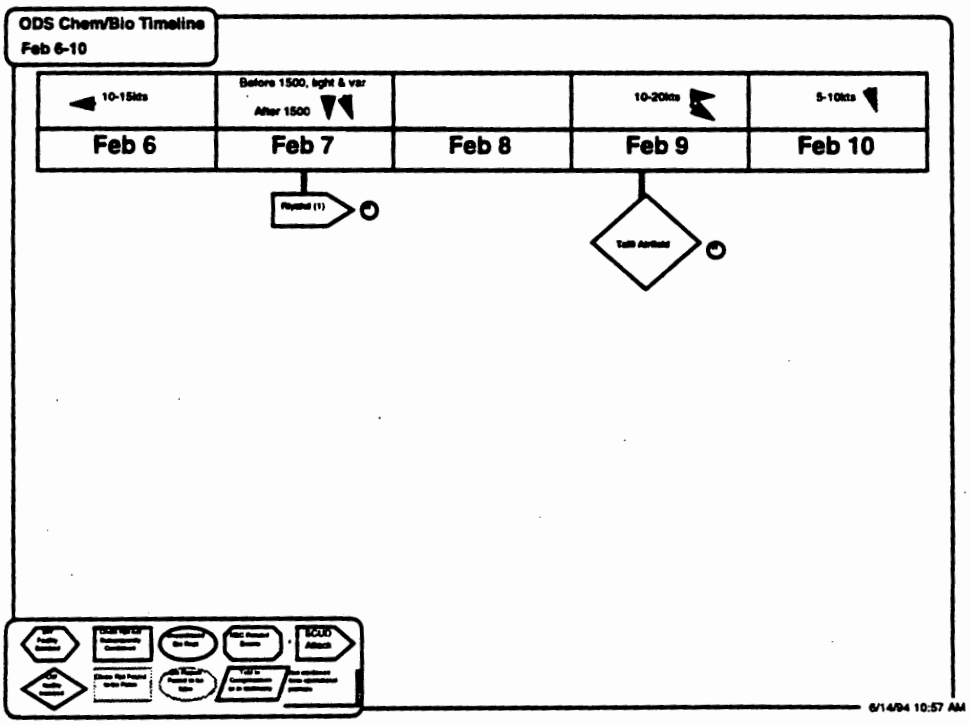

ODS Chem/Bio Timeline
13-16 Jan 91
Jan 12
Jan 13
Jan 14
Jan 15
Jan 16
14th MP Brigade False M-8 Alarm
VII
SCUD Attack
6/14/94 10:57 AM

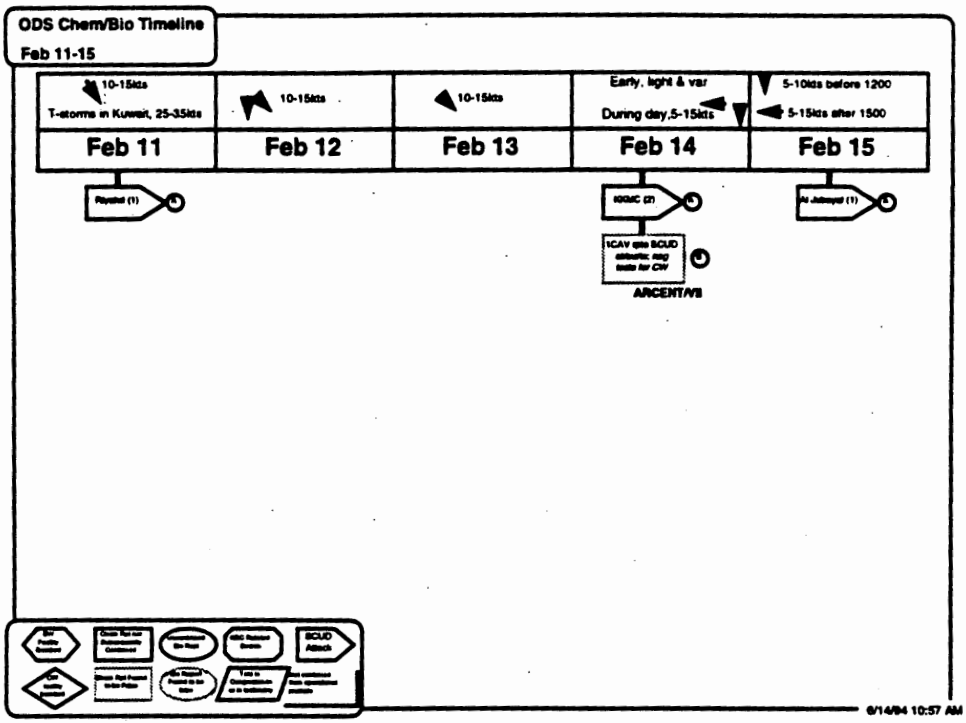

ODS Chem/Bio Timeline
17-21 Jan 91
Before 1200
After 1200
6-20 kts
3-12kts
5-15 kts, rain
Before 1200
After 1200
5-15 kts
10-20 kts
Euphrates Valley
Kuwait
10-15 kts
5-10kts becoming 5-10kts
Jan 17
Jan 18
Jan 19
Jan 20
Jan 21
CENTCOM
ARCENT
VII
Standby Cadel
Czech MOD to DoD
6/14/94 10:57 AM

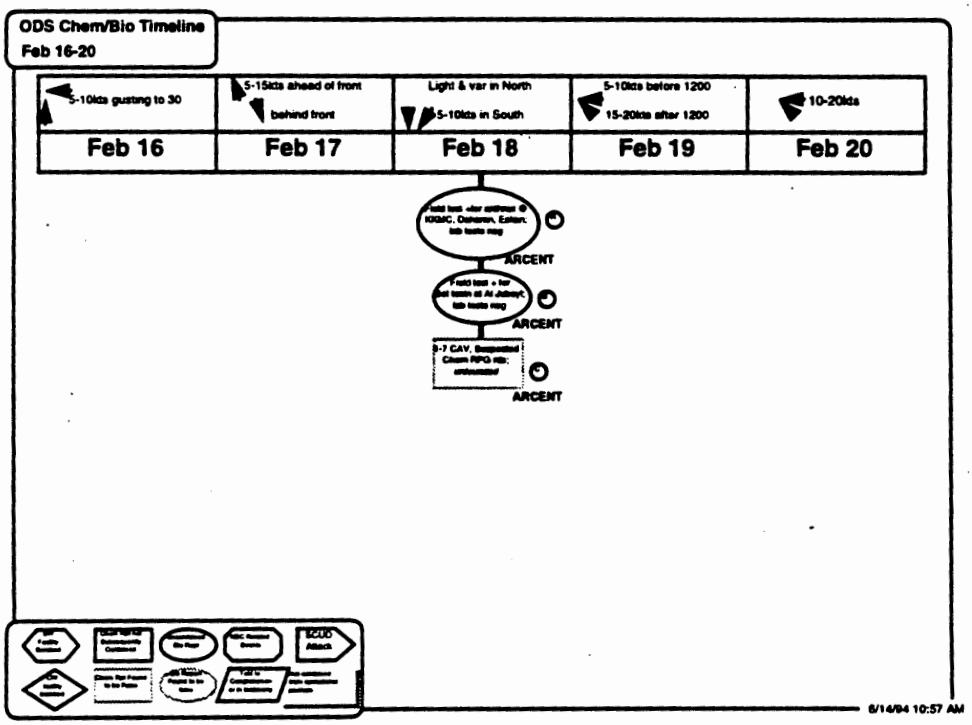

ODS Chem/Bio Timeline
22-26 Jan 91
Before 0900
5kts
After 0900
5-10kts
Before dawn
5-7kts
After dawn
5-10kts
After 1700
10-15kts
Before 1200
10kts
After 1200
10kts
Before storm
After storm
10-15kts, gusts to 25
5-15kts
Storm system approaching
Jan 22
Jan 23
Jan 24
Jan 25
Jan 26
Czech MOD
CENTCOM
VII
6/14/94 10:57 AM

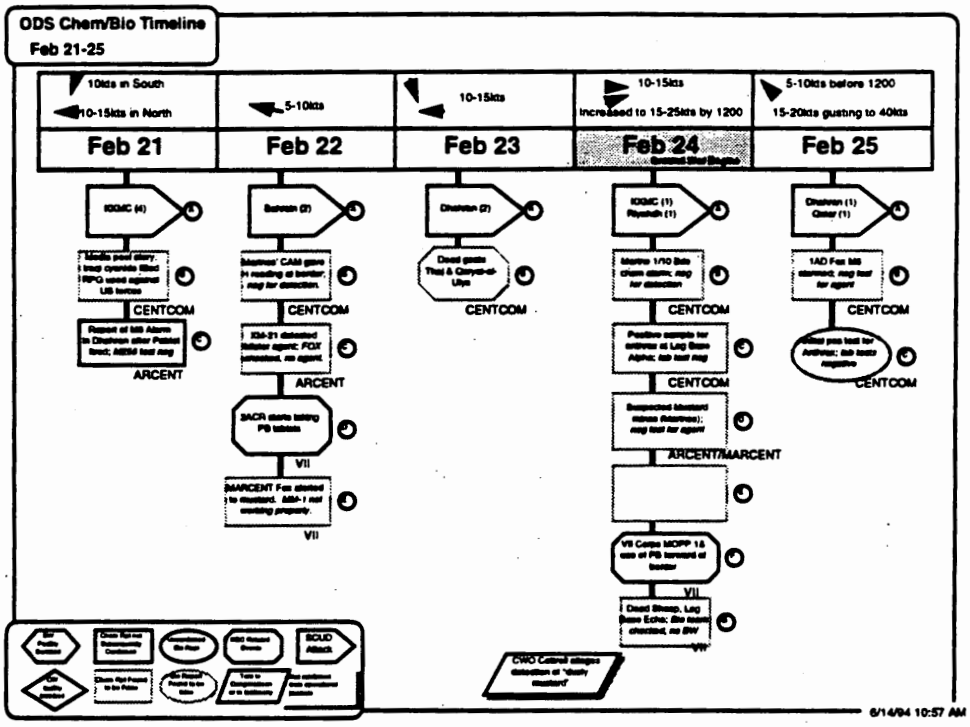

ODS Chem/Bio Timeline
Jan 27-31
10-15kts
After 1200, 10-15kts, to 30
3-10 kts
After 1500
AM Calm, then 5-20kts
Along coast, 5-10kts
5-20kts
5-10kts before front
15-20kts behind front
Jan 27
Jan 28
Jan 29
Jan 30
Jan 31
6/14/94 10:57 AM

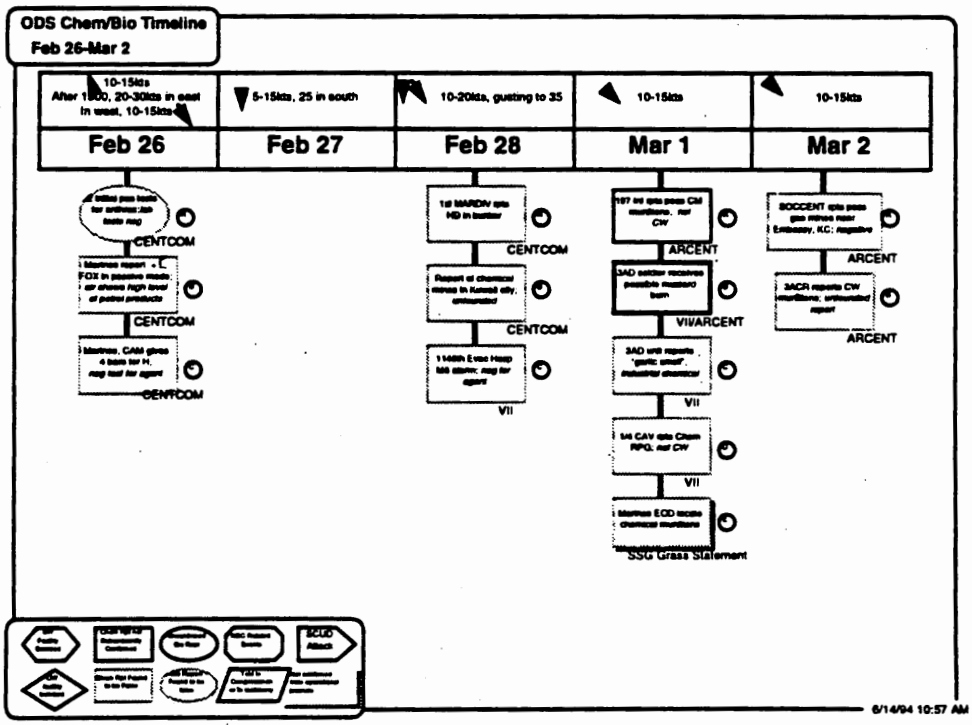

ODS Chem/Bio Timeline
Feb 1-5
5-10kts in south
in north
Gusty in the north
Central area
10-15kts in the south
10-25 kts in the west
10-15kts to the east
10-15kts inland
5-20kts on Kuwaiti coast
5-10kts inland after 1900
10-15kts on coast
after 0900 stronger in south
Feb 1
Feb 2
Feb 3
Feb 4
Feb 5
ARCENT
VII
6/14/94 10:57 AM

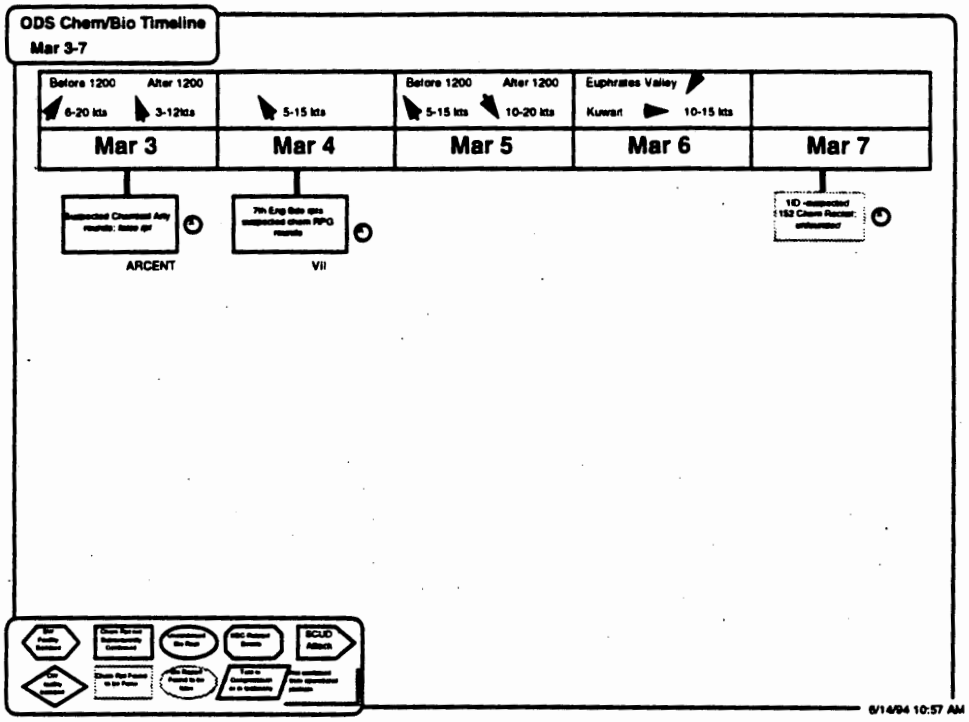

ODS Chem/Bio Timeline
Feb 6-10
10-15kts
Before 1500, light & var
After 1500
10-20kts
5-10kts
Feb 6
Feb 7
Feb 8
Feb 9
Feb 10
6/14/94 10:57 AM


ODS Chem/Bio Timeline
Feb 11-15
10-15kts
T-storms in Kuwait, 25-35kts
10-15kts
10-15kts
Early, light & var
During day,5-15kts
5-10kts before 1200
5-15kts after 1500
Feb 11
Feb 12
Feb 13
Feb 14
Feb 15
ARCENT/VII
6/14/94 10:57 AM


ODS Chem/Bio Timeline
Feb 16-20
5-10kts gusting to 30
5-15kts ahead of front
behind front
Light & var in North
5-10kts in South
5-10kts before 1200
15-20kts after 1200
10-20kts
Feb 16
Feb 17
Feb 18
Feb 19
Feb 20
ARCENT
ARCENT
ARCENT
6/14/94 10:57 AM


ODS Chem/Bio Timeline
Feb 21-25
10kts in South
10-15kts in North
5-10kts
10-15kts
10-15kts
Increased to 15-25kts by 1200
5-10kts before 1200
15-20kts gusting to 40kts
Feb 21
Feb 22
Feb 23
Feb 24
Feb 25
CENTCOM
ARCENT
VII
ARCENT/MARCENT
SCUD Attack
6/14/94 10:57 AM


ODS Chem/Bio Timeline
Feb 26-Mar 2
10-15kts
After 1800, 20-30kts in east
In west, 10-15kts
5-15kts, 25 in south
10-20kts, gusting to 35
10-15kts
10-15kts
Feb 26
Feb 27
Feb 28
Mar 1
Mar 2
CENTCOM
ARCENT
VII/ARCENT
VII
SSG Grass Statement
SCUD Attack
6/14/94 10:57 AM


ODS Chem/Bio Timeline
Mar 3-7
Before 1200
After 1200
6-20 kts
3-12kts
5-15 kts
Before 1200
After 1200
5-15 kts
10-20 kts
Euphrates Valley
Kuwait
10-15 kts
Mar 3
Mar 4
Mar 5
Mar 6
Mar 7
ARCENT
VII
SCUD Attack
6/14/94 10:57 AM

APPENDIX C

Persian Gulf Veterans Coordinating Board

Research

DoD Research Activities

Review of the Health Consequences of Service During the Persian Gulf War.
Action: National Academy of Sciences (NAS) - Medical Follow-up Agency
Purpose: As directed by P.L. 102-585, the NAS will review existing scientific, medical and other information on the health consequences of military service in the Persian Gulf theater of operations during the Persian Gulf War.
Coordinations: DoD, VA and HHS.

Cooperative DoD/VA Research.
Action: DoD and VA Medical Scientists.
Purpose: Support for partial funding of research on the health consequences of exposure to environmental hazards during the Persian Gulf War. Some of this research will take place at VA Medical Centers.
Coordination: DoD, VA and HHS.

Leishmania Research.
Action: US Army Medical Research and Development Command.
Purpose: Develop a blood assay for leishmania.
Coordinations: DoD, VA and HHS.

Epidemiologic Assessment of Suspected Outbreak of an Unknown Disease Among Veterans of ODS at the Request of the 123d Army Reserve Command, FT. Benjamin Harrison, Indiana.
Action: US Army Medical Research and Development Command.
Purpose: Conducted medical examinations and in-depth surveys of 79 soldiers with symptoms or concerns potentially linked to service in ODS.
Coordinations: DoD, VA and HHS.

Stress-Related Survey of Soldiers Deployed in ODS.
Action: US Army Medical Research and Development Command.
Purpose: To identify correlations between post ODS symptoms and occupational and environmental stresses. These questionnaires were completed by active duty and reserve Army, Navy and Air Force personnel in Hawaii and Pennsylvania. Data analysis is in progress.
Coordinations: DoD, VA and HHS.

Retrospective Studies Involving Military Use of Pyridostigmine as a Pretreatment for Nerve Agent Poisoning.

Action: US Army Medical Research and Development Command.
Purpose: Obtain safety data for pending New Drug Application to FDA.
Coordinations: DoD, FDA and VA.

Retrospective Survey of Troops Who Received Clostridium Botulinum Toxoid in the Gulf War.

Action: US Army Medical Research and Development Command.
Purpose: To conduct a retrospective survey of troops who received clostridium botulinum toxoid in the Gulf War after troops returned to the US.
Coordinations: DoD, VA and HHS.

Environmental Toxicology Studies.

Action: Armed Forces Institute of Pathology and Army Environmental Hygiene Agency.
Purpose: To conduct a series of studies in environmental and toxicologic pathology relating to exposures during the Persian Gulf War.
Coordinations: DoD, VA and HHS.

Monitoring Gulf War Veterans With Imbedded Depleted Uranium Fragments.

Action: Armed Forces Radiobiology Research Institute.
Purpose: Conduct clinical follow-up of ODS patients with known or suspected imbedded depleted uranium fragments and assess health risks from imbedded depleted uranium fragments.
Coordinations: DoD, VA and HHS.

Working Group to Establish a Working "Case Definition" for Post-ODS/DS Unexplained Illness.

Action: Walter Reed Army Medical Center.
Purpose: Review and analyze medical records of ODS/DS veterans with unexplained symptoms to establish a working "case definition" for post-ODS/DS unexplained illness.
Coordinations: DoD, VA and HHS.

Persian Gulf Veterans Coordinating Board

Research

VA Research Activities

Children of PG Veterans in Mississippi.
Action: VAMC Jackson.
- Purpose: An examination of children born to Persian Gulf veterans for evidence of possible genetically determined health effects related to their parents' service.
Coordinations: VA, DoD and HHS.

Review of the Health Consequences of Service During the Persian Gulf War.
Action: National Academy of Sciences (NAS) - Medical Follow-up Agency
Purpose: As directed by P.L. 102-585, the NAS will review existing scientific, medical and other information on the health consequences of military service in the Persian Gulf theater of operations during the Persian Gulf War.
Coordinations: VA, DoD and HHS.

Pilot Program to Investigate Medical and Psychological Effects of Exposure to Toxic Hazards.
Action: VAMC Birmingham.
Purpose: Conduct pilot program to investigate medical and psychological effects of exposure to toxic hazards. Results of examinations provided to about 11,000 veterans on VA's PG Registry are also being reviewed to determine if these individuals should be called back for testing.
Coordinations: VA, DoD and HHS.

Examining Neuropsychological-Psychological Profiles of Veterans Returning from the Persian Gulf Theater.
Action: VAMC Boston.
Purpose: Conduct a small-scale pilot program examining neuropsychological-psychological profiles of veterans returning from the Persian Gulf Theater.
Coordinations: VA, DoD and HHS.

Environmental Hazards Research Centers.
Action: Three VAMCs (to be determined).
Purpose: A request for proposals to establish up to three, VA-based, research centers for the study of the medical consequences of exposure to environmental and toxic hazards, initially focused on the problems cited by personnel in the PG conflict.
Coordinations: VA, DoD and HHS.

Persian Gulf Interagency Research Coordinating Council.

Action: VA, DoD and HHS.

Purpose: VA, DoD and HHS, make up the newly formed Persian Gulf Interagency Research Coordinating Council. The council, established by the Persian Gulf War Veterans' Health Status Act, will coordinate all research activities undertaken or funded by the Executive Branch of the Federal Government on the health consequences of military service in the Persian Gulf theater of operations during the Persian Gulf War. As an initial step, the council members agreed to organize a conference of experts from within and outside the federal agencies, with a goal of reaching a consensus definition of "Persian Gulf Syndrome."

Coordinations: VA, DoD and HHS.

Persian Gulf Advisory Committee.

Action: VA.

Purpose: A 16 member panel composed of experts in environmental and occupational medicine and related fields from both government and the private sector and representatives from veterans service organizations chartered to address issues related to the diagnosis, treatment and research of PG related health conditions.

Coordinations: VA, DoD and HHS.

Investigation of the Relation Between the Experience of ODS and Post-War Adjustment.

Action: VAMC Clarksburg.

Purpose: Assess difficulties in post-war adjustment among ODS soldiers.

Coordinations: VA, DoD and HHS.

Early Intervention with Appalachian Marine Reservists in ODS.

Action: VAMC Mountain Home, TN.

Purpose: To provide an early intervention debriefing to Marine reservists about the stresses of deployment and combat. Follow-up contacts and tests indicated a high degree of PTSD.

Coordinations: VA, DoD and HHS.

Desert Storm Reunion Survey.

Action: VAMC Boston.

Purpose: Study a broad range of combat and non-combat experiences associated with deployment during ODS. The study will delineate and quantify those experiences and determine their impact on subsequent patterns of adjustment.

Coordinations: VA, DoD and HHS.

Psychological Assessment of Operation Desert Storm Returnees.

Action: VAMC New Orleans.

Purpose: Conduct comprehensive psychological assessments and debriefings of troops mobilized in ODS.

Coordinations: VA, DoD and HHS.

Operation Desert Storm Follow-Up Survey.

Action: VAMC Salt Lake City.

Purpose: A survey designed to elicit VA medical center employees perceptions of ODS activation, deployment, and reintegration experiences.

Coordinations: VA, DoD and HHS.

Psychological Adjustment in ODS Veterans.

Action: VAMC Gainesville.

Purpose: A study of 542 National Guard and Reserve members was conducted with one group being actively involved in ODS and a Control group. Psychological tests were given to determine if differences existed between the service veterans and the control group in terms of overall mental health.

Coordinations: VA, DOD and HHS

APPENDIX D

Figure 1

Persian Gulf Registry Participation Rate

Excluding Those Who Were Still on Active Duty as of September 30, 1993--by Branch and Unit Status

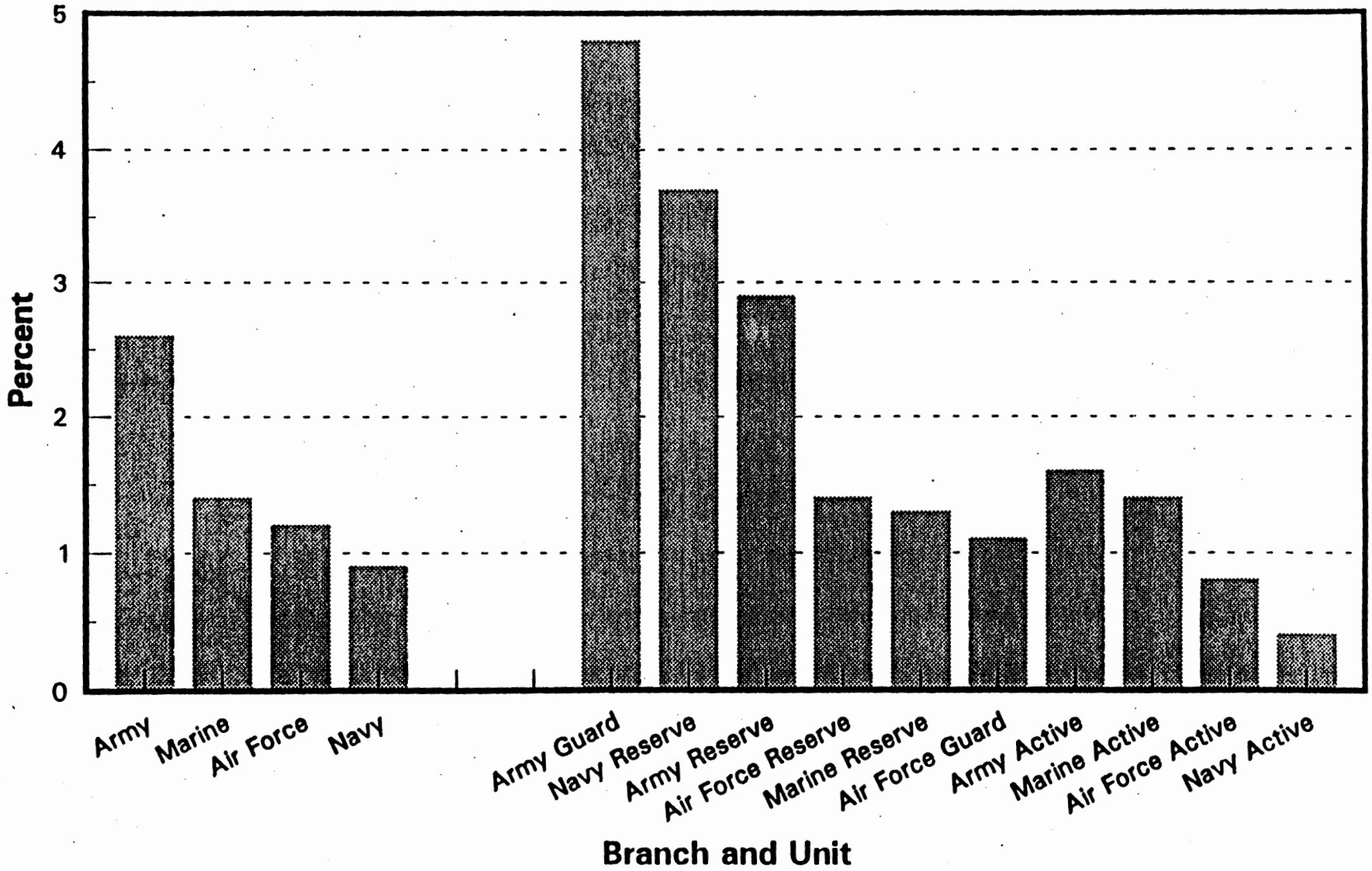


Figure 2

Distribution of Month of Arrival in the Persian Gulf Area for 6,979 Veterans in the Registry Through November 1993

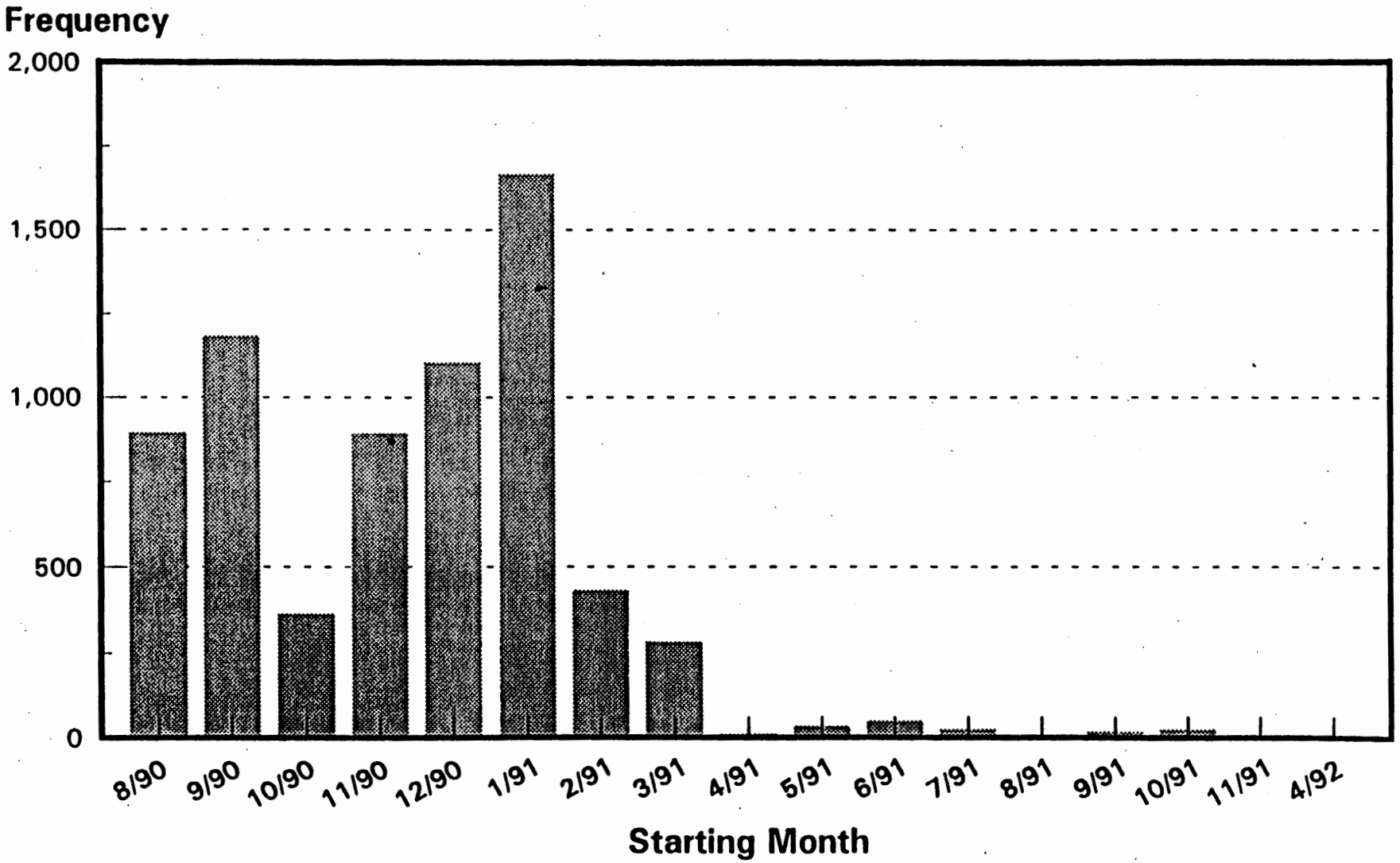


Figure 3
Distribution of Month of Departure from the Persian Gulf Area for 6,979 Veterans in the Registry Through November 1993

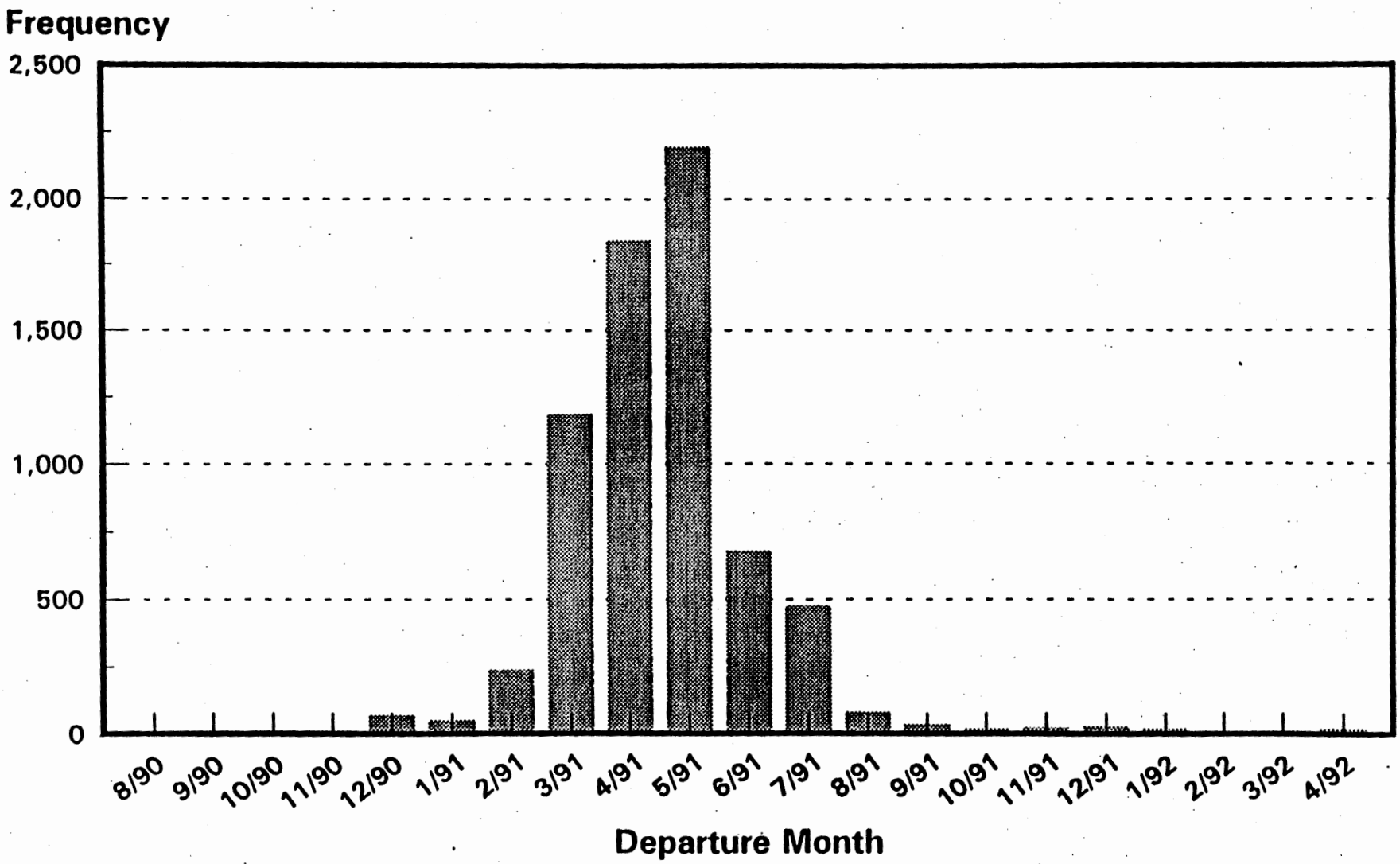
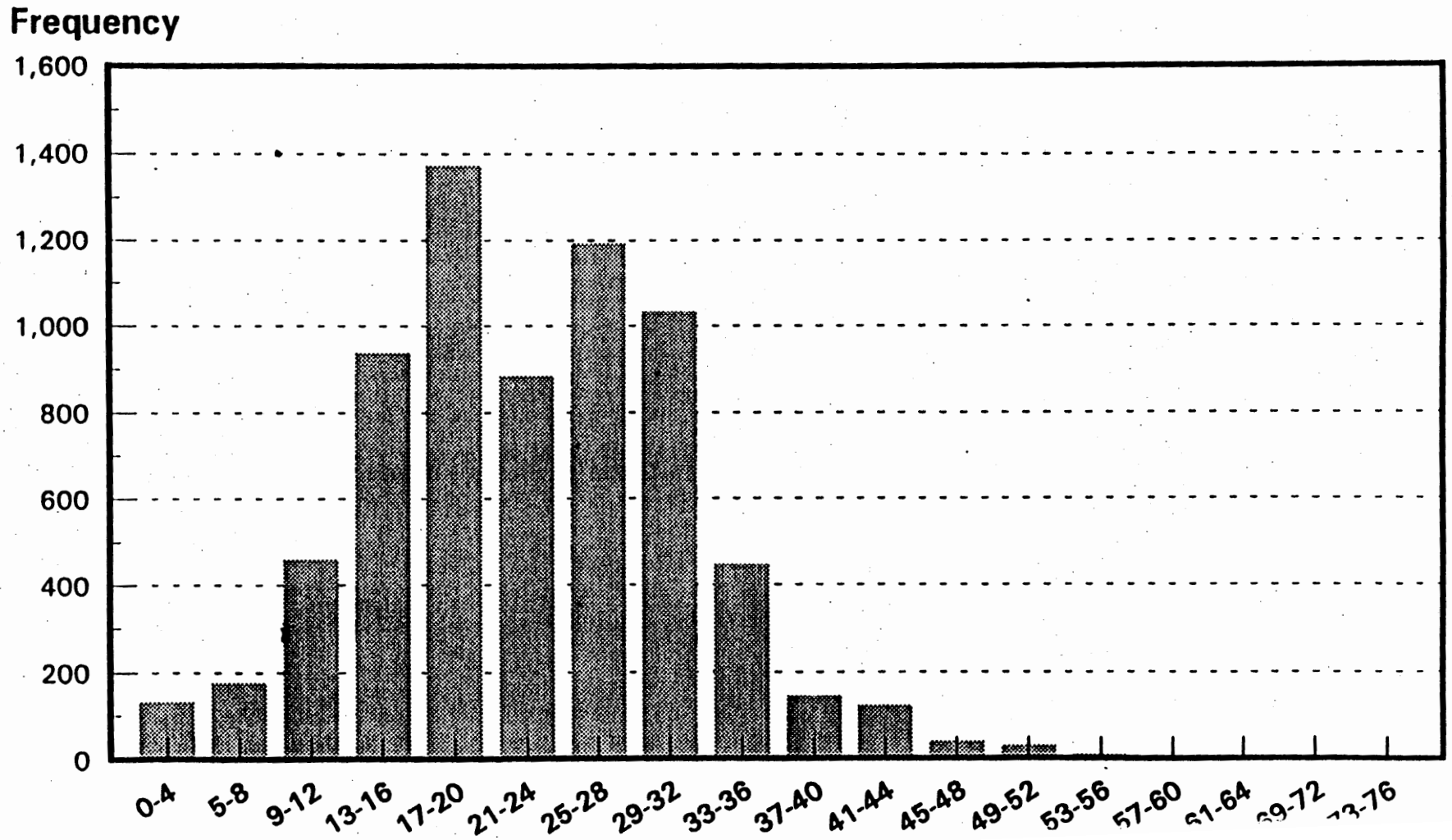
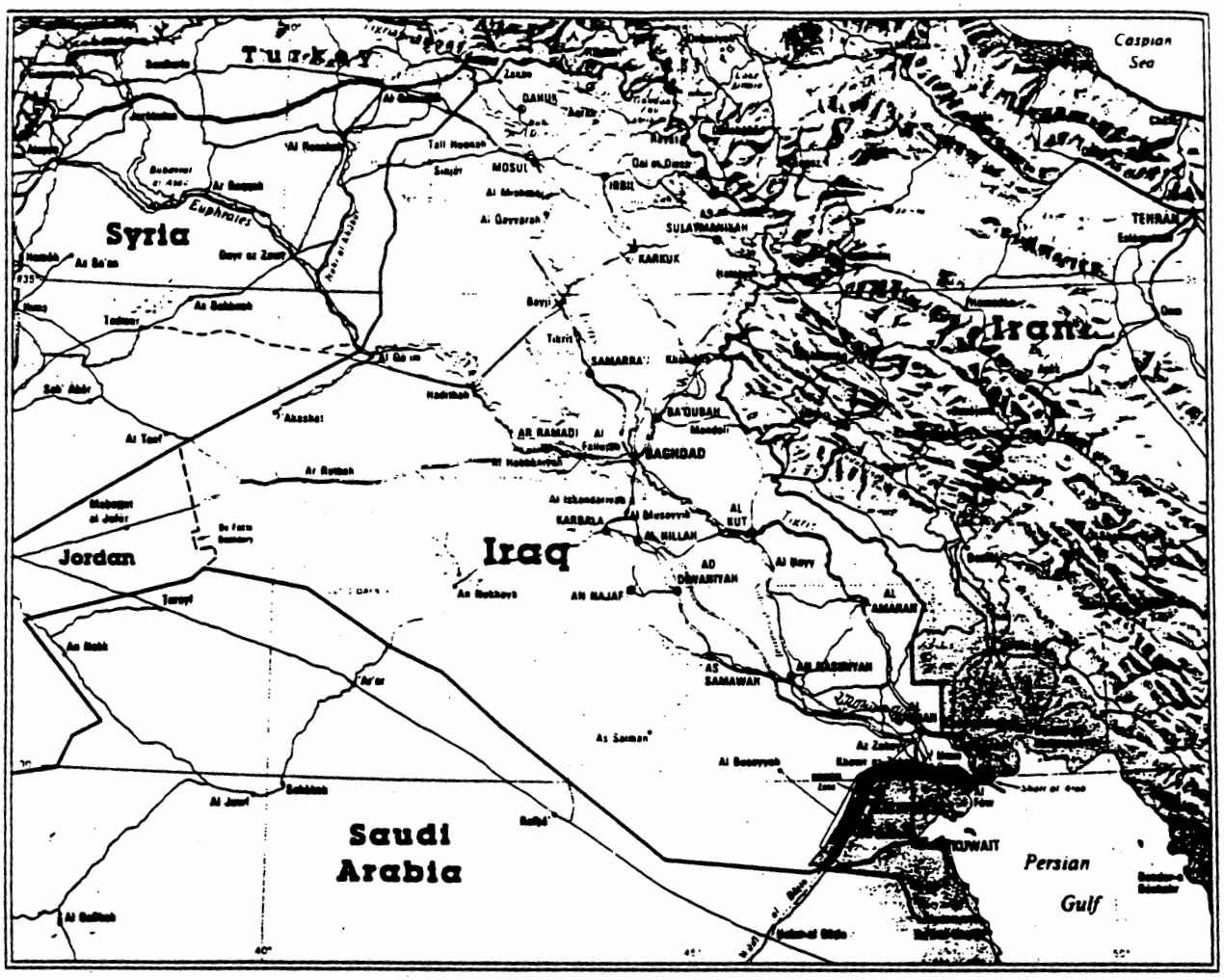


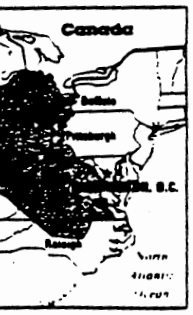
Figure 4
Distribution of Duration of Stay in the Persian Gulf Area for 6,979 Veterans in the Registry Through November 1993

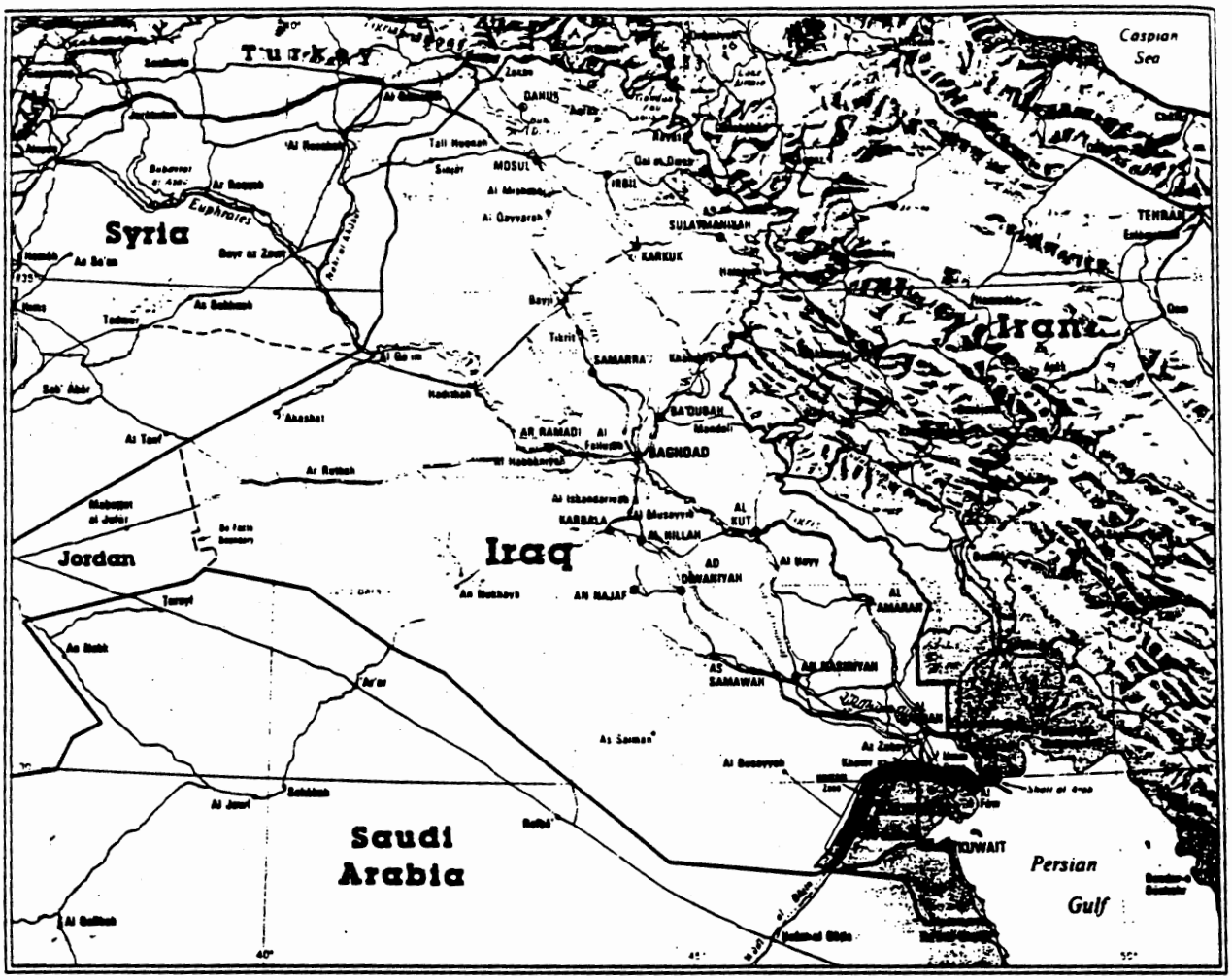


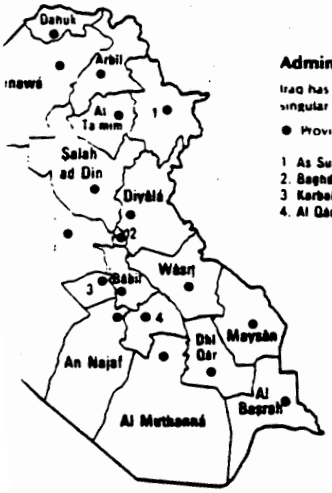
APPENDIX E


Turkey
Caspian Sea
Syria
Iran
Iraq
Jordan
Saudi Arabia
Persian Gulf
Euphrates
MOSUL
DAHUK
IRBIL
SULAYMANIYAH
KARKUK
TEHRAN
SAMARRA
BA'QUBAH
BAGHDAD
AR RAMADI
KARBALA
AL HILLAH
AL KUT
AD DIWANIYAH
AN NAJAF
AL AMARAH
AS SAMAWAH
AL BASRIYAH
KUWAIT
Tadmur
Tikrit
Al Qa'im
Hadithah
Akashat
Ar Rutbah
Al Ashandarwah
Al Musayyib
Al Qayyarah
Al Hadithah
Al Bayy
Al Basiyah
Al Zubayr
Al Faw
Al Jawf
Rafha
Al Qaisumah
As Salman
Al Ghadfah
Tarayf
Al Ibah
Al Ja'ar
Sakakah
Sal' Abir
Al Ta'if
Mahayat al Jufar
Al Ba'ath
Al Qa'im
Ar Ruwaysah
Al Ashkhayrah
Al Hadithah
Al Qayyarah
Al Musayyib

APPENDIX E







Administrative Divisions

Iraq has 18 provinces (muhāfazat, singular muhāfazah)

● Province capital

1. As Sulaymāniyah
2. Baghdād
3. Karbalā'
4. Al Qādisiyah

International boundary
★ National capital
● Province capital
Railroad
Expressway
Road
Track

SCALE 1:6 450 000

0 50 100 150 200 Kilometers

0 50 100 150 200 Miles

Lambert Conformal Conic Projection, standard parallels 12°N and 38°N

Report to The Congress
on the

Health Consequences of the Exposure of Persian Gulf Force Members to the Fumes of Burning Oil

The Department of Defense
1993

TABLE OF CONTENTS

	Page
Paragraph	
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3. Summary of Service Health Assessments	3
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B. Study Results - U. S. Army	B-1
C. Study Results - U. S. Navy	C-1
D. Study Assessment - U. S. Air Force	D-1

1. Purpose. The purpose of this report is to provide the Congress with the results of ongoing studies relating to the health consequences of the exposure of Persian Gulf force members to the fumes of burning oil.

2. Background. The burning of hundreds of oil wells during the conflict in the Persian Gulf region raised concerns about potential health effects to DoD troops and civilians exposed to the oil fumes. This concern, coupled with the experience gained during Vietnam with exposure to Agent Orange, prompted the Secretary of Veterans Affairs to request information from the Department of Defense to assist him with potential medical treatment and disability compensation claims by Desert Storm veterans. In a letter dated 2 October 1991, the Secretary of Veterans Affairs requested that the Department of Defense:

a. Construct a roster of troops assigned to each military unit that served in the areas affected by the Kuwait oil well fires, and

b. Construct a file of daily unit locations for the period 15 January 1991, through the date of the last unit withdrawal from the Persian Gulf region, and

c. Create and maintain a central file containing information of air pollutant levels from a number of locations where troops were stationed at different times.

As a result of public concerns and the uncertainty of any potential health consequences associated with the exposure to burning oil fumes, the Congress on 5 December 1991 enacted Public Law 102-190 requiring that the Secretary of Defense:

a. Establish and maintain a special record relating to members of the Armed Forces who, as determined by the Secretary, were exposed to the fumes of burning oil in the Desert Storm Theater of Operations during the Persian Gulf Conflict, and

b. Submit to the Congress the results of all ongoing studies on the health consequences (short- or long-term) of members of the Armed Forces who were exposed to the fumes of burning oil in the Desert Storm Theater of Operations during the Persian Gulf conflict. The report should also address the need for any additional studies relating to this exposure.

On 13 July 1992, the Deputy Secretary of Defense designated the Secretary of the Army as DoD Executive Agent for accomplishing the requirements of Public Law 102-190 and for assisting the Secretary of Veterans Affairs by performing data collection and analyses pertaining to the exposure of members of the U. S. Armed Forces to fumes of burning oil during Operation Desert Storm. A copy of the Executive Agent designation is attached at Appendix A.

As the DoD Executive Agent, the Secretary of the Army and his designees are responsible for constructing and maintaining the required data, developing the exposure model, and coordinating the submission of an annual Report to the Congress.

3. Summary of Service Health Assessments. Each Military Medical Department was tasked with providing information on any ongoing studies relating to the health consequences of the exposure of Persian Gulf force members to the fumes of burning oil. A summary by Service is provided below:

a. U. S. Army. The Army's report is attached at Appendix B. It provides the preliminary conclusions on three main areas -- environmental monitoring, with subsequent health risk assessment; industrial hygiene evaluation; and biological surveillance. These three efforts were integrated to obtain a complete picture of the environmental situation in the gulf region and the resultant health consequences to DoD personnel. The draft, full text, report of the Army's health risk assessment has been undergoing scientific peer review since late summer. Upon receipt of the peer review comments and recommendations, it will be available for general release.

b. U. S. Navy. The Navy's report is attached at Appendix C. It presents the final results of an illness and injury survey conducted among U. S. Marines in the Kuwait Theater of Operations during 28-31 March 1991. The short time line was dictated by the acute concern over the health effects of exposure to smoke from the oil well fires and the need to administer the questionnaires before the return of USMC units to the United States which occurred in late March and early April of 1991. During the 4-day period, the self-administered questionnaire was completed by 2,715 Marines who represented a conservatively estimated 5 percent sample of land based USMC personnel in the Kuwait Theater of Operations. Although no major health concerns were identified, the report recommends a follow-up survey to determine the health status of the Marines who participated in this survey.

c. U. S. Air Force. The Air Force did not conduct any studies based on the fact that most Air Force personnel who participated in Operation Desert Storm were assigned to locations which were far from the burning Kuwait oil well fires. Further, Air Force medical facilities have reported no unusual disease patterns consistent with exposure to oil fire fumes. Accordingly, at the present time, the Air Force believes that current efforts involving the Persian Gulf War Health Veteran's Registry, the Environmental Support Group, and the Kuwaiti Risk Assessment Team are the appropriate activities to address Persian Gulf health concerns. A copy of the Air Force response is attached at Appendix D.

4. Registry Efforts. Last Fall, the U. S. Army and Joint Services Environmental Support Group was assigned the mission of maintaining the Registry and developing a combat unit tracking data base.

With regard to the Registry, initial research indicates that there were approximately 5,000 combat units containing over 550,000 active duty service members and over 100,000 reservists. The 650,000 figure is based on a listing provided to the Defense Manpower Data Center (DMDC) by the Military Departments in late 1991. The DMDC listing is approximately 98 percent complete, requiring only minimum collection and verification to identify additional members who served in Southwest Asia.

As DMDC consolidated its listing, the Environmental Support Group was beginning its efforts to develop a unit location data base which identifies and tracks the exact daily locations for all U. S. Armed Forces serving in the Desert Storm Theater of Operations from the period 15 January 1991 through the date of the last unit withdrawal from the Persian Gulf region. Since approximately 5,000 combat units were involved, tracking the units will be a comprehensive process that includes: locating the relevant records, abstracting the grid coordinate locations from automated and hard copy combat records, and verifying the data. Based on experience gained with data collection for Agent Orange exposure, it is estimated that the successful development of the combat unit tracking system will require approximately 30 manyears of effort over a 2-year period. Due to unexpected fiscal and personnel constraints, the initial efforts have not progressed as quickly as originally envisioned. However, personnel are being hired, joint representation has been solicited, and a completed data base is expected by early 1995.

Concurrently, the U. S. Army Environmental Hygiene Agency is developing an air pollutant exposure model which will provide information on air pollutant levels on numerous dates and locations throughout the Desert Storm Theater of Operations. This model exposure data, coupled with the unit location data, will be used to provide an estimate of an individual's exposure.

5. Future Plans.

a. Studies. The continuing efforts of the Army Medical Department will include updating the health risk assessment to:

(1) include air modeling study results for DoD troop sites where no monitoring was conducted.

(2) continue trying to separate natural and anthropogenic (industrial) background risk from oil fire related risk as more background, modeling, and particle analysis information becomes available.

(3) assess new toxicologic information as cancer and non-cancer risk assessment methodology becomes available.

(4) incorporate the biological surveillance initiative information to refine the findings and conclusions of the health risk assessment.

b. Registry and Unit Tracking System. Sustaining the data bases and responding to inquiries on exposure are continuing requirements. Although it is impossible to predict with any certainty the number of Desert Storm inquiries, it is estimated that at least 1,000 inquiries will be received per year for the next 10 to 15 years. This estimate is based on the fact that the Environmental Support Group has averaged 3,500 Agent Orange and Post Traumatic Stress Disorder inquiries per year for the last 10 years. Although the health consequences relating to the exposure to Agent Orange and those to the fumes of burning oil differ, the public attention which was focused on Desert Storm has created an increased health awareness. Consequently, even an assignment in the Desert Storm Theater of Operations has created sufficient cause to generate health concerns, making the level of future inquiries difficult to predict.

THE DEPUTY SECRETARY OF DEFENSE
WASHINGTON, D.C. 20301-1000

13 JUL 1992

MEMORANDUM FOR: SECRETARIES OF THE MILITARY DEPARTMENTS
CHAIRMAN OF THE JOINT CHIEFS OF STAFF
UNDER SECRETARIES OF DEFENSE
DIRECTOR OF DEFENSE RESEARCH AND ENGINEERING
ASSISTANT SECRETARIES OF DEFENSE
COMPTROLLER
GENERAL COUNSEL
INSPECTOR GENERAL
DIRECTOR OF OPERATIONAL TEST AND EVALUATION
ASSISTANTS TO THE SECRETARY OF DEFENSE
DIRECTOR OF ADMINISTRATION AND MANAGEMENT
DIRECTORS OF THE DEFENSE AGENCIES

SUBJECT: Environmental Health Matters in Operation Desert Storm

Section 734 of the National Defense Authorization Act for Fiscal Years 1992 and 1993 (Public Law 102-190) provides for a Registry of members of the armed forces exposed to fumes of burning oil in connection with Operation Desert Storm. Also, by letter of October 2, 1991, the Secretary of Veterans Affairs requested the following assistance from the Department of Defense:

"1. Construction of a roster of troops assigned to each military unit that served in the areas affected by the Kuwaiti oil well fires. The roster should include basic demographic data and military personnel data.

"2. Construction of a file of daily unit locations for the period January 15, 1991 through the date of the last unit withdrawal from the Persian Gulf area.

"3. Creation and maintenance of a central file containing information on air pollutant levels from a number of locations where troops were stationed over different times. Aerial photographs for smoke plume behavior and daily weather reports, etc., may be useful."

To carry out Section 734 and to assist the Secretary of Veterans Affairs, I direct as follows:

a. The authorities and duties of the Secretary of Defense under Section 734 (a), (b) and (e) of the National Defense Authorization Act for Fiscal Years 1992 and 1993 (Public Law 102-190) are hereby delegated and assigned to the Secretary of the Army as the Executive Agent of the Department of Defense. The Secretary of the Army shall prepare and forward to the Assistant Secretary of Defense for Health Affairs for transmittal to Congress the reports required by Section 734(c).

b. The Secretary of the Army shall be the Executive Agent of the Department of Defense to provide the assistance requested by the Secretary of Veterans Affairs in his letter of October 2, 1991.

c. The Secretaries of the Military Departments and the heads of other components of the Department of Defense shall provide such information to the Secretary of the Army as may be necessary to implement this memorandum.

d. The Comptroller of the Department of Defense shall ensure that the appropriations of the Military Departments bear equitably the costs of implementing this memorandum.

The Secretary of the Army should coordinate the exercise of authority under this memorandum as appropriate with the Secretaries of the Military Departments, the Chairman of the Joint Chiefs of Staff, the Assistant Secretary of Defense for Health Affairs, and the Assistant Secretary of Defense for Force Management and Personnel.

Donald J Atwood

REPORT TO CONGRESS
1992

KUWAIT OIL FIRES
HEALTH RISK ASSESSMENT
U.S. ARMY MEDICAL DEPARTMENT

A. Introduction.

The destruction of more than 700 oil wells during the conflict in the Persian Gulf region raised concerns about potential health effect to DoD troops and civilians exposed to the oil fire smoke. Initial reports from the area by groups conducting monitoring activities, such as the U.S. Environmental Protection Agency (USEPA), the French, the Norwegians, and the Kuwait Environmental Protection Department, did not find significant quantities of pollutants that would cause acute or chronic health effects, except for particulates, which are naturally high in the region. However, the groups conducting the monitoring did stress that the long-term health effects to individuals that were exposed to the pollution could not be determined because of insufficient data. It was the concern with potential long term health effects, as well as the need to identify and evaluate any acute health effects at troop locations, that prompted the DoD to initiate this study. At the request of DoD Health Affairs, the U.S. Army Office of the Surgeon General (OTSG) was tasked to chair a Tri-Service medical working group to evaluate the potential health effects of the oil smoke on DoD personnel. The group consisted of medical personnel from each military service, in addition to representatives from the Veterans Administration, DoD Health Affairs, and DoD Environment. As part of the working group's effort a team from the U. S. Army Environmental Hygiene Agency (USAEHA) was dispatched on 1 May 1991 to collect environmental samples and assess the potential health effects among DoD personnel who deployed to South West Asia.

B. Project Scope.

This project consisted of three main areas, environmental monitoring, with subsequent health risk assessment, industrial hygiene evaluation, and biologic surveillance. These three efforts are being integrated to obtain a complete picture of the environmental situation in the gulf region and the resultant health consequences to DoD personnel.

1. Environmental Monitoring. The environmental monitoring study attempted to characterize the concentration of pollutants that DoD personnel were exposed to during their stay in the gulf region. The time period of exposure and the location where that exposure occurred were very variable for the large number of DoD personnel in-theater (approximately 550,000). As of

the end of February there were a total of 605 oil wells on fire and 46 gushing oil. The USAEHA monitoring effort commenced on 5 May 1991 and continued until 3 December 1991. At the start of environmental monitoring there were still 558 oil wells on fire and the data collection continued until all the fires were extinguished on approximately 6 November 1991, and as stated above, continued until 3 December 1991 to obtain one month of background data. The area occupied by troops during their stay in the gulf region was extensive, approximately 880,000 square miles within Kuwait, Saudi Arabia, and Iraq. This made quantification of exposure by troop location very difficult. Therefore as a starting point for exposure measurement, permanent ambient air monitoring stations were established at four locations in Saudi Arabia and six locations in Kuwait, although two in Kuwait were quickly abandoned due to logistical difficulties. The locations were selected based on the fact they were major sites where DoD troops were stationed long term. To augment the fixed location sampling, air modeling will be conducted with assistance from the National Oceanic and Atmospheric Administration (NOAA), to predict pollutant concentrations at locations and times in which no sampling was being conducted. In addition, soil sampling was done at the air monitoring sites to insure that all potential exposure pathways and media were evaluated. The data generated from the environmental monitoring activities were used to calculate the exposure point concentrations for the health risk assessments. Risk assessments were conducted for each of the seven permanent air/soil monitoring sites where DoD personnel were located.

2. Industrial Hygiene Evaluation. The industrial hygiene (IH) air evaluation monitored and characterized occupational exposures of DoD personnel who had potential high risk exposure to oil fire emissions. The IH air sampling was conducted from 3 May 1991 to 17 June 1991 at various locations within Kuwait and Saudi Arabia. The focus was on individuals working outdoors and on worst-case situations within the oil fields next to Kuwait City. The IH air sampling results were compared to recognized occupational health standards to assess the health risk to exposed individuals.

3. Biologic Surveillance. The Biologic Surveillance Initiative (BSI) was conducted to refine the results obtained from the health risk assessment. When completed, the results from BSI and the health risk assessment (HRA) will be compared and integrated. The predictive results from the HRA, which were generated from environmental data, will be compared to the BSI results from actual biologic samples of potentially exposed troops. This comparison will lend validity to the HRA, or show that its predictions are either too conservative or not conservative enough.

C. Risk Assessment.

The methodology selected for the risk assessment is EPA guidance developed for Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) sites, also known as "Superfund". The calculations result in a quantitative estimate of health risk (cancer and non-cancer) based on the contaminant concentrations and the site exposure characteristics. Cancer risks are determined using cancer slope factors and non-cancer effects are calculated using chronic and subchronic reference doses. Assessments conducted using Superfund guidance are based on the reasonable maximum exposure (RME) scenario. The RME is defined as the highest exposure that is reasonably expected to occur at the site. The methodology does not use the absolute worst case scenario, but is nevertheless very conservative in the data that is selected for use and the exposure and risk factors that are incorporated into the assessment. The result of this is the production of risk numbers that generally over estimate health risk by several orders of magnitude.

D. Results.

1. Health Risk Assessment. The draft site specific Kuwait Oil Fire Health Risk Assessment was transmitted to The Office of the Army Surgeon General on 19 June 1992. This report covered the period 5 May - 15 September 1991 and included the health risk assessments for 7 permanent air/soil monitoring sites in Kuwait and Saudi Arabia. This document is currently under peer review by USEPA, U.S. Public Health Service, The Committee on Toxicology, The Veterans Administration, and the various services. After analysis and incorporation of appropriate peer review comments a final site specific assessment will be published. Data covering the entire monitoring period of 5 May - 3 December 1991, is currently being analyzed for the final health risk assessment. There are over 4000 environmental and industrial hygiene samples, representing over 36,000 laboratory data points for the contaminants of concern, that require validation and interpretation for the final report.

a. Based on the results of the air and soil pathway analysis, for the period 3 May 1992 through 15 September 1992, the total predicted excess cancer risk resulting from exposure to the Persian Gulf environment ranged from 2 excess cancers per 10,000,000 individuals (2E-7) to 5 excess cancers per 10,000,000 individuals (5E-7). These risk levels are for the seven permanent monitoring sites and include the inhalation and incidental ingestion routes of exposure. These cancer risk levels are below the EPA range of concern of 1 per 10,000 (1E-4) through 1 per 1,000,000 (1E-6).

b. Cancer risk levels do not appear to differ significantly between the monitoring sites in Kuwait, near the oil fires, and the monitoring sites in Saudi Arabia. In fact, there is very little difference in the cancer risk levels between any of the sites monitored.

c. The total predicted noncancer risk is calculated by summing the hazard quotients (HQs) for the individual contaminants of concern which results in a hazard index (HI). The noncancer hazard quotient assumes there is a level of exposure or reference dose (RfD) below which it is unlikely for even sensitive populations to experience adverse health effects. Thus, if the exposure level (E) exceeds the threshold (i.e., if E/RfD exceeds unity), there may be concern for potential noncancer health effects. As a general rule, the more you exceed the reference dose, the more the level of concern for noncancer risk rises. The HIs for the inhalation and incidental ingestion routes of exposure for personnel in the Persian Gulf environment, for the period 3 May 1992 through 15 September 1992, ranged from two times unity (2E+0) to four times unity (4E+0). Again, as with cancer risk levels, the noncancer risk levels do not appear to differ a great deal between any of the monitoring sites in Kuwait and Saudi Arabia. The HIs for noncancer risk did exceed the EPA level of concern at all the monitoring sites in Kuwait and Saudi Arabia. The majority of noncancer risk at all the monitoring sites comes from the inhalation of metals, in particular chromium, which represents over 99 percent of the risk. This chromium contamination is believed to be from natural and anthropogenic (i.e., industrial) sources, not from the oil fires. It is important to recognize that the reference dose is developed with a significant safety factor.

d. Background and historical environmental monitoring data from the Persian Gulf region, combined with data on industrial pollution from various areas of the world, indicate that much of the risk associated with the region is not oil fire related, but is the result of regional background contamination.

2. Air Pathway Analysis.

a. Ambient air sampling in Kuwait and Saudi Arabia was completed in December 1991 after 7 months of monitoring for pollutants associated with the oil well fires. Nearly 4,000 air samples were collected during this period from 10 fixed, ground-based sampling sites.

b. Based on the analysis so far, the database of air quality measurements collected during this project does not suggest that the oil fires made a significant contribution to degradation of pre-war air quality at the troop location ground level sampling sites. In fact, comparing air quality data when the fires were burning with historical data indicates the air quality at ground level at some of the sampling sites was *better* in 1991 than in previous years for some

pollutants. Although the percent contribution to air pollution levels from fire and non-fire sources cannot be presently determined from this database, it may be concluded, based on the limited data evaluated, that the fire pollutants may not have had a significant contribution.

c. Mean concentration values observed in Kuwait and Saudi Arabia for organic compounds were comparable to levels observed in Houston and Philadelphia, which are industrialized oil industry or petrochemical storage regions. Concentrations of carcinogens, such as Polycyclic Aromatic Hydrocarbons, in most cases were below the detection limit or at very low levels. Predictably high levels of particulate matter were measured at all sampling locations, but the concentration levels were considered "normal" for this area of the Middle East. Relatively high concentrations of naturally-occurring metals associated with wind blown surface soils were also observed.

d. The data indicates that while certain pollutants were found at elevated concentrations relative to U.S. air quality standards, the pollutant levels at ground level, where sampling occurred, were not as high as first predicted. This fact is somewhat surprising considering the magnitude of pollution released to the atmosphere from the damaged oil wells and the abundance of petroleum refining and petrochemical plants in the areas near sampling sites. The data demonstrates that regional air quality trends, as measured during this project, were more strongly influenced by site-specific factors such as terrain, geography, atmospheric dispersion, source characteristics, chemical fate, and meteorology and were not as strongly influenced by the extent of contamination (i.e., the emission rate) of the sources.

3. Soil Pathway Analysis.

a. There is no consistent increase in soil metals concentrations between sampling rounds one and two at the monitoring sites in Kuwait and Saudi Arabia.

b. The few increases in metals concentrations that occurred were mainly for metals not associated with Kuwait crude oil and are therefore probably not fire related, but natural or anthropogenic background.

c. There were very few semi-volatile target analytes detected in soil samples at the monitoring sites in Kuwait and Saudi Arabia. When detections occurred they were related to common laboratory contaminants and usually were also present in the laboratory method blanks.

d. There were no semi-volatile organics in soil selected as contaminants of concern. This was due to the extremely small number of detections of target analytes and because those detected were considered laboratory contaminants.

4. Industrial Hygiene Air Sampling.

a. Industrial hygiene air sampling is the application of personal (i.e., soldier breathing zone) and/or general area air monitoring in order to characterize concentrations of the contaminants of concern.

b. The industrial hygiene air sampling results showed no statistical difference between Saudi Arabia's and Kuwait's outdoor occupational environment.

c. The oil well fires in and around Kuwait City did impact on the occupational environment in specific circumstances, based on local weather conditions and proximity to oil fire plumes. This impact was measurable by standard industrial hygiene air sampling methods used in the ambient environment. The magnitude of the measurable exposures were low compared to recognized occupational health standards. Adverse health effects are not expected based on the assumptions inherent in those standards.

5. Biologic Surveillance Initiative

a. Recognizing that the scope of this health risk assessment is far beyond that normally encountered by U.S. agencies, USAEHA scientists applied a battery of biologic tests of exposure to predicted oil well fire pollutants. These tests were administered to small groups from the 11th Armored Cavalry Regiment in June, August, and October, 1991, before, during, and after their 90-day deployment to Kuwait, respectively. Results of the tests employed will provide objective validity checks for the modeled exposure assessments in the health risk assessment.

b. Testing included questionnaires which dealt with medical history, mood, workplace history and exposures, subjective report of health, and climactic conditions. Other tests measured pulmonary function, trace metals in serum and urine, volatile compounds in blood, metabolites of benzo-a-pyrene in urine, and blood cell tests for genetic material damage or presence of pollutants.

c. The results of this set of measurements will yield objective, quantitative description of the exposure of the soldiers of the 11th Armored Cavalry Regiment to pollutants in the Kuwait environment and will allow direct comparison with modeled exposure information derived from the ambient monitoring done for the health risk assessment. This description of exposure is

different from a description of the health status or experience of these soldiers and few or no personal health related conclusions will be possible from this surveillance.

d. As of 21 December 1992, no quantitative results can yet be reported from the biologic testing. Some qualitative information is available. These should be regarded as very tentative results.

(1) Questionnaires. Final data sets for analysis are nearly complete. Tentative exploration of the data does not reveal any outcome measures which vary before or after deployment to Kuwait.

(2) Pulmonary function testing. The testing done pre-deployment suffers from technical deficiencies. The data quality may be so poor as to be unusable. The mid-deployment and post-deployment testing yielded normal values for the group, and do not show changes in pulmonary status in the soldiers tested. However, the applicability of this statement is very limited, because of the small sample size, the short time interval for comparison, and the healthy state of the surveillance population.

(3) Trace metals analyses (serum and urine). No elevations of metals known to be in Kuwaiti crude oil (Nickel and Vanadium) above unexposed normals has been detected. No elevations of other metals (Lead, Mercury, et. al.) have been detected.

(4) Volatile organic compounds (VOC's) in blood. Of a battery of 33 volatiles assayed, only one, perchlorethylene, varied positively with movement to Kuwait. The highest blood level detected was on the order of 2 parts per billion. No known health prognosis can be derived from this low a level. The source of the perchlorethylene has not been definitely established, but it is not felt to be from Kuwaiti crude oil or oil well fires. Among the other volatiles assayed, some were found at higher levels <u>before</u> deployment to Kuwait than in U.S. "unexposed" normals: chlorobenzene, ethylbenzene and styrene. Two analytes, o-xylene and m/p-xylene, showed <u>lower</u> levels in Kuwait than in Germany. Again, no health significance can be attached to the extremely low levels measured, on the order of tenths of parts per billion. The decay rate in the body is very fast. The half-life of VOC's in the body is estimated by the U.S. Centers for Disease Control and Prevention to be 10-30 minutes after short-term exposure

(5) Tests of genetic material. Sister Chromatid Exchange Frequency Assay are complete, but results have not yet been analyzed for trend. Assay of adducts of Benzo-a-pyrene with genetic material are nearing laboratory completion.

(6) Urine markers of benzo-a-pyrene exposure are nearing laboratory completion.

E. Future Work Efforts. The continuing efforts of the Army Medical Department will include the following work.

1. Update the site health risk assessment, to include the monitoring data from 15 September 1991 to 6 December 1991 and the dermal route of exposure from the soil pathway, now that new guidance is available from USEPA.

2. Update the health risk assessment, to include air modeling study results for DoD troop sites where no monitoring was conducted and for the February, March, and April time period when no monitoring was conducted. In addition to the health risk assessment report, USAEHA is also involved in a joint effort with DA Environmental Support Group (ESG). At the request of The Secretary of Defense the ESG has been tasked to compile a roster of all Desert Storm veterans and units who deployed to the Persian Gulf. This will include when the unit entered theater, when they left, and where they were during their tour. The USAEHA will then be called upon to conduct health risk assessments for various groups of troops that may experience health problems. The National Oceanic and Atmospheric Administration (NOAA) will be assisting the USAEHA to conduct air pollution modeling to predict contaminant concentrations where there were no monitoring sites. This data will be used to conduct the health risk assessments for the various troop elements.

3. Continue trying to separate natural and anthropogenic (industrial) background risk from oil fire related risk as more background, modeling, and particle analysis information becomes available.

4. Continue to update the health risk assessment as new toxicologic information and cancer and noncancer risk assessment methodology becomes available.

5. Incorporate the Biologic Surveillance Initiative information with the health risk assessment results to refine the findings and conclusions of the study.

FINAL REPORT

Illness and Injury among US Marines during Operation Desert Storm

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January 18, 1993

BACKGROUND

When Operation Desert Shield began, the need for disease surveillance among the troops deployed to the Middle East was recognized. In mid-August of 1990, a U.S. Navy preventive medicine physician/epidemiologist established a surveillance system to track illness and injury patterns among U.S. Marine Corps (USMC) personnel deployed with the First Marine Expeditionary Force (IMEF). As each Marine Corps unit arrived in country, they were added to the surveillance system. Statistics were accumulated and reported on a weekly basis in order to track the occurrence of diseases and injuries that were not the result of combat (disease and non-battle injuries (DNBIs)). After the air war began, record keeping and reporting of DNBIs was less consistent. When the ground war started and units were on the move, communication became increasingly difficult and documentation of medical visits diminished further. As the conflict intensified for the ground units, individuals with minor illnesses and injuries were less likely to seek medical attention in the face of greater threats to survival. Due to the above factors, there were significant gaps in the DNBI statistics beginning on January 17, 1991, when Operation Desert Shield was transformed by the air war into Desert Storm.

With the declaration of a cease fire for Desert Storm on February 28, 1991, marking the end of armed hostilities between the Coalition Forces and Iraq, a new and potentially serious hazard filled the skies over Kuwait and northeastern Saudi Arabia. Smoke billowed from 611 oil wells in Kuwait deliberately set afire by retreating Iraqi forces[1]. Numerous international efforts were undertaken to rapidly assess the types and levels of pollutants being discharged by the burning oil[2,3]. Parallels were drawn between the Agent Orange exposures of the Vietnam era and the unknown threat of "Agent Oil".

To assess the disease, injury and exposure experience of USMC personnel during Operation Desert Storm, a questionnaire survey was designed by members of the Navy's Preventive Medicine Augmentation Team (PMAT) in consultation with members of the EPA Interagency Task Force[2]. The PMAT was based in Al Jubayl, Saudi Arabia, during the Desert Shield/Storm operation in 1990-91 and was tasked with providing preventive medicine (PM) assistance beyond the capabilities of organic USMC PM assets (Appendix A). The team included preventive medicine physicians, environmental health officers, entomologists, industrial hygienists and preventive medicine technicians.

This report presents the final results of the Desert Storm Survey conducted among U.S. Marines in the Kuwait Theater of Operations (KTO) during March 28-31, 1991. A preliminary report summarizing the results of the survey was presented to the Armed Forces Epidemiology Board on June 21, 1991 at the Walter Reed Army Institute of Research (WRAIR), Washington,D.C.

GOALS/OBJECTIVES

The two major goals of the Desert Storm Survey were:

(1) to provide information on the magnitude and severity of acute health problems possibly related to the air pollution from the oil fires;

(2) to complement the ongoing epidemiologic surveillance program for monitoring illness and injury, and to reconstruct the health-related problems encountered during a period of intense conflict by sampling a large number of Marine Corps personnel.

METHODS

The Desert Storm Survey was developed, field-tested and administered over an 18-day period from March 14-31, 1991. The short time line was dictated by the acute concern over the health effects of exposure to smoke from the oil well fires and the need to administer the questionnaires before the return of USMC units to the United States. During the four-day period from March 28-31, the self-administered questionnaire was completed by 2,715 Marines who represented a conservatively estimated five percent sample of USMC personnel based on land in the KTO.

Three groups of Marines participated in the cross-sectional survey. The first group (Group I) of 897 Marines had the longest exposure (approximately five weeks at the time of the survey) and were located closest to the burning oil wells. Marines in Group I entered Kuwait from Saudi Arabia during the latter part of February, moved north through the oil fields of Kuwait and then remained on the outskirts of Kuwait City up to and beyond the time of the survey. At this location, burning oil wells were visible at night. Depending on the winds, this area was periodically enveloped in smoke to the extent that flashlights were required to read during the day. This encampment was located in the fields of an agricultural research area.

The second group (Group II) of 987 Marines had short-term exposure to the oil fires. Members of Group II moved through the oil fields of southern Kuwait during the ground war period which occurred the last week of February and then withdrew to Manifah Bay, Saudi Arabia, following the cease fire on February 28th. Located about 120 kilometers south of the Kuwait border, Manifah Bay is a coastal site where, depending on wind conditions, smoke from the southern oil fields of Kuwait was clearly visible. Floating oil on the

waters of the gulf and oil-soaked shoreline were also present at this site.

The third group (Group III) of 831 Marines had no direct exposure in or near the oil fields, having spent the entire Desert Storm period in Al Jubayl, Saudi Arabia, which is located approximately 200 kilometers south of the nearest oil fields in southern Kuwait. At this location, a distant smoky haze was visible on the northern horizon.

From the 2715 Marines, the responses of 47 participants were eliminated from the final analysis yielding a total of 2668 responses (Group I - 892, Group II - 978, Group III - 798). Females were excluded due to their small number (N=36) and the possibility of their differential rate of self-reporting of disease symptoms[4]. Additionally, the responses of two Red Cross workers and nine persons who provided an answer other than "male" or "female" to the sex identifier were not analyzed.

The questionnaire asked about illness and injury which had occurred since Operation Desert Storm began on January 17, 1991 to minimize recall bias and to achieve the goal of retrieving information for the conflict period (Appendix B). Demographic information on the age, sex, unit, military occupational specialty (MOS), principal job during this period, total length of deployment since the beginning of Desert Shield, and years of total military service was collected on each answer sheet. Information on use of sick call, influenza (flu) vaccination status and use of chemical/biological warfare (CBW) protective medications was also collected. Smoking status (current, ex-smoker, never smoked) and history of previous diagnosis of asthma, hay fever, medication allergies, emphysema or bronchitis were ascertained. Questions on health status were grouped into four categories: 1) injuries; 2) respiratory (wheezing, cough, chest pain, etc.); 3)

gastrointestinal (loose stools, stomach cramps, nausea or vomiting); and 4) other (skin rash and ocular effects). Experiences with irritation from blowing dust and sand as well as from oil fire smoke were ascertained in separate questions.

In order to evaluate outcomes experienced by different occupations, it was necessary to group the various military occupational specialties (MOS) into larger categories. The six major categories used were Administration (e.g., personnel clerk, aviation supply clerk); Field (e.g., rifleman, mortarman, field radio operator); Maintenance (e.g., small arms repairer/technician, helicopter mechanic); Pilot/Naval Flight Officer; Navy; and Food Service. The Navy category was primarily composed of hospital corpsmen (HMs) and religious programs assistants (RPs). Comparisons of illness and injury experience were made among occupational categories within Groups I, II or III. However, comparisons of illnesses and injuries by occupation between groups were avoided, because the more usual roles of different specialties are often redefined in combat.

Instructions were read to all the participants prior to completion of the questionnaire in order to minimize problems with interpretation and completion of the survey (Appendix B). Personnel were told that participation in the survey was voluntary. A small number of individuals chose not to participate.

Data from the questionnaires were initially entered into a DBASE III* file for initial analysis and were later converted to SAS format, version 6.4, for more extensive analysis.

For the purposes of analysis, the "NO" response for a variable was defined as a reply of "none" or "mild" for that symptom, to reduce the number

of false positive replies. A "YES" was coded for a reply of "moderate" or "severe". Furthermore, inconsistent replies to different questions about the same symptom were treated as negative responses for that symptom. For example, if a positive response was given for question #5, which asked whether a person had "three or more loose (unformed) bowel movements in a 24 hour period," and a negative response was given for question #22, which asked about the duration of diarrhea, then the subject was assigned a negative value for diarrhea.

For the respiratory symptoms (wheeze, cough, chest pain, fever with cough, runny nose, sore throat, and cold), logistic analysis was used to compare prevalence rates among exposure groups after adjusting for smoking status, previous respiratory disease (asthma, hay fever, emphysema, or bronchitis), and flu inoculation. First, for each respiratory symptom, the two-way interactions with each group (smoking status by group, previous disease by group and flu inoculation by group) were tested simultaneously using the likelihood ratio test. If this test was not significant, the interactions were removed from the model, and a likelihood ratio test was used on the resulting main effects model to test for differences among groups. If significant differences were found, the Wald test was used to compare Group I to Group III, and Group II to Group III.

For the non-respiratory symptoms, logistic analysis was used to compare prevalence rates among exposure groups. First, a likelihood ratio test was used to test for differences among groups. Again, if significant differences were found, the Wald test was used to compare Group I to III, and Group II to III. All testing was performed using α=.05. Wald-type confidence intervals were also computed.

FINDINGS

Data from a total of 2,668 questionnaires were analyzed. The mean age of all respondents was 24.8 years; the average length of service was 5.5 years; and the mean number of days of deployment in the KTO was approximately 120 days. Marines in Group III tended to be slightly older, have more years of service, and a greater length of deployment at the time of the survey (Table 1).

The distribution of job assignments was distinctly different among the three groups (Table 1). In Groups I and II, 79% and 74% of the respondents, respectively, were in the "Field" category. In contrast, the majority (55%) of Marines in Group III were assigned to the "Maintenance" category.

The prevalence of risk factors for respiratory disease such as smoking status, history of asthma, hay fever, and emphysema/bronchitis, and the receipt of influenza vaccination were examined for all three Groups (Table 2). Overall, 35.3% of Marines were current smokers, with the highest proportion (40.2%) in Group I. Approximately 4.9% of Marines noted a previous history of asthma; 14.6% gave a history of hay fever; and 8.6% had a previous diagnosis of either emphysema or bronchitis. Overall, 86.6% of respondents reported receiving the flu vaccine. No significant differences in reported risk factors associated with respiratory disease were found among the three groups.

Self-reported illnesses, injuries and symptoms were classed into four groups: 1) gastrointestinal (e.g., diarrhea, nausea/vomiting, stomach cramps); 2) respiratory (e.g., wheezing, cough, chest pain, sore throat, cold); 3) injuries (medically and non-medically attended); and 4) other (burning eyes, red eyes, skin rash). During the survey period, 25% of Marines in Group I experienced one or more significant diarrheal episodes, compared to

approximately 13% of the Marines in Groups II and III (Table 3). Marines in Group I reported experiencing the greatest frequency of respiratory symptoms followed by Group II, with Marines in Group III reporting the fewest symptoms with the exception of colds. A similar pattern of symptoms was noted for burning and red eyes, with Group I reporting the greatest frequency. For injuries, Group III had the highest proportion of medically attended injuries (20.2%) while Group I had the most injuries that were not medically attended.

Respiratory Symptoms

The prevalence of reported respiratory symptoms was examined according to: 1) smoking status; 2) history of previous respiratory disease; 3) individual response to blowing dust/sand or oil fire smoke; and 4) receipt of the flu vaccine. Adjusting for flu vaccination, history of respiratory disease, and smoking status, Group I reported wheezing, cough, runny nose, and sore throat significantly more frequently than Group III (Table 4). Examining the interactions between groups using a logistic model, the prevalence odds ratios did not vary significantly among the three smoking groups, between influenza vaccination groups, and between groups with a previous history of respiratory disease. No differences were noted between Groups I and III for the prevalence of colds, chest pain, or fever with cough. Group II had significantly fewer reported colds than Group III. When the prevalence of respiratory symptoms within groups by job class was examined, no prominent patterns were observed (Table 5). Group III personnel in maintenance assignments tended to report symptoms more frequently.

For wheezing, cough, sore throat and runny nose, when stratified by flu inoculation and smoking status, Marines in Group I generally reported higher prevalences of symptoms compared to Groups II and III (Figures 1A-D). Current

smokers, regardless of group, consistently reported more frequent respiratory symptoms (Figures 2A-B).

One third of the Marines in Groups I and II (36.5% and 32.3%, respectively) found blowing sand and dust to be moderately to severely irritating compared to 13.2% of Marines in Group III (Table 6). In all three groups, a greater proportion of smokers than nonsmokers found the sand and dust irritating. Respondents in Groups I and II (41.2% and 42.3%, respectively) found the oil fire smoke moderately to severely irritating, compared to 5.8% of Marines in Group III. In all three groups, a smaller proportion of smokers complained of oil fire smoke irritation than nonsmokers. Individuals from all groups who found either the dust/sand or oil smoke irritating were more likely to report respiratory symptoms (Table 7).

Gastrointestinal Symptoms

Group I experienced a significantly greater prevalence of diarrhea, stomach cramps, nausea and vomiting, and blood in the feces than Group III (Table 8). No differences were noted between Groups II and III. Similarly, no differences were observed among all the Groups for symptoms of fever with diarrhea and gas from CBW medication.

Most of those with diarrhea (72.3%) were living in the field with no running water or flush toilets (Table 9). Group I experienced diarrhea almost twice as frequently as the other two groups (43.3% compared to 29.8% for Group II and 26.9% for Group III). Living quarters, however, did not appear to account for the difference observed in the prevalence of diarrhea, as 93% of diarrheal cases in Group I lived in the field, compared to 89% of cases in Group II. No sick call or laboratory records are available to corroborate these reports or to shed light on the etiology of the diarrhea.

Injuries

Examining the prevalence odds ratios and the likelihood ratios, Group III had significantly more injuries than Group I and Group II (Table 8). This relationship was noted for all injuries and for those which received medical attention.

Of the injuries experienced that were medically attended, 54% were related to noncombat job performance, 40% to physical training, sports and other free time activities, and 6% were directly related to combat (Table 10). As anticipated, the combat injuries occurred exclusively in Groups I and II, with Group III experiencing the highest proportion of noncombat job injuries. The distribution of injuries overall was similar to the distribution of personnel assigned to those job groups. Maintenance personnel reported 60% of injuries in Group III and they constituted 55% of that group (Table 1). Field personnel reported 78% and 71% of injuries in Groups I and II respectively while accounting for 79% and 74% of all job assignments. Physical training and sports activities accounted for between 28% and 42% of injuries regardless of severity (Table 11).

STRENGTHS AND LIMITATIONS

The large number of personnel (N = 2715) surveyed and the fact that the exposure groups were of comparable size are major strengths of this survey, increasing the stability of the prevalence estimates and facilitating intergroup comparisons. The four day period over which the survey was administered also enhances intergroup comparisons. Each group responded based on experiences which occurred during the same period. Participants were asked to recollect symptoms which occurred during an approximate ten week period

between January 17th and the end of March 1991, rather than their entire deployment periods to lessen recall bias. The survey population was young, healthy and relatively homogeneous with an expected low rate of chronic health problems. The survey format enabled rapid assessment to be conducted.

The chief limitation of this survey is that it relies on the self-reporting of symptoms. There were neither the means nor the facilities to validate the complaints by physical examination or performing medical testing. A medical record review was not feasible in this field situation.

No detailed information was gathered on the movements and interim locations of the many units that participated. Although the personnel in Group I and Group II were surveyed in specific locations, the various units that made up these groups took a variety of routes through northeastern Saudi Arabia and Kuwait to reach their destinations. There are no measurements of exposure levels for oil smoke, dust or pollens that can be correlated with troop locations.

The questionnaire was designed, tested, printed and administered to all 2715 participants in a period of 18 days! The main factor which influenced this time period was the rapid return of troops to the U.S. which occurred in late March and early April of 1991. Some of the units scheduled to be surveyed departed on short notice before they could participate. This problem affected the sample size of Group III, which had the smallest number of participants.

Although field testing eliminated some problem areas, subsequent analysis revealed that some of the questions could be misinterpreted. In some cases, the available answer choices did not include all of the important factors, and thus were unsuitable for detailed analysis (e.g., question 24,

response B, does not indicate the sanitary conditions at warehouse sites).

CONCLUSIONS

1. Marines in Group I who were stationed in Kuwait at the time of the survey reported significantly greater proportions of wheezing, cough, runny nose, and sore throat than Marines in Group II (who had spent a short time in Kuwait) and Group III (stationed in Saudi Arabia). This constellation of symptoms is consistent with respiratory irritation. Risk factors examined in the survey, including smoking, history of respiratory disease, or receipt of flu vaccination, could not account for the observed differences. Conditions in Kuwait, where the Marines were located--including blowing sand and dust, increased pollen from the agricultural site and/or air pollution from the oil fires--may have accounted for the observed differences. Marines in both Groups I and II did find the sand and oil smoke moderately to severely irritating. High levels of airborne particulates due both to blowing sand and pollution from the oil fires during this period have been reported[2]. The respiratory irritation reported by the Marines in Group I is consistent with these measurements. The limitations of this survey make a more precise attribution of the source of the differences in reported respiratory symptoms impossible.

2. Marines in Group I reported a significantly greater proportion of diarrhea, stomach cramps, nausea and vomiting, and bloody stools than either Groups II or III. Differences in living conditions such as lack of running water or flush toilets did not appear to account for this observation. Whether a diarrheal outbreak occurred during this time in

Group I could not be independently corroborated. Flies were a problem at all sites. They may have been a greater source of disease transmission for Groups I and II living in the field without enclosed dining facilities. Preventive medicine surveillance during Desert Shield identified outbreaks of diarrheal disease related to contaminated food sources. Sufficient information was not available from this survey to identify the potential source of the increased reports of gastrointestinal symptoms.

3. Job-related, noncombat injuries accounted for majority of all injuries that required medical attention, followed by physical training/sports activity/free time injuries. Combat injuries constituted 5.9% of all injuries requiring medical attention. Overall, Group III experienced the greatest frequency of injury for which medical attention was sought. This difference may be explained in part by the fact that access to medical care in the Group III area remained relatively stable throughout the Desert Storm period. The facilities were fixed and the troops were not on the move. Thus, injured personnel in Group III would have found it easier to get medical attention for an injury.

4. This survey demonstrates the ability of preventive medical units to conduct field epidemiology in the post-war situation to provide commanders and policy makers current information on health risks and outcomes.

RECOMMENDATIONS

1. A follow-up survey to determine the health status of the Marines who participated in this survey should be conducted. Despite the limitations of this survey, recent concerns regarding the health status of military personnel who served in the KTO suggest the value of using the information gained in this survey to determine whether or not experiencing symptoms in February/March 1991 is related to current health status. This cohort of Marines may provide valuable information regarding the potential for long-term health effects of service in the KTO.

2. Provisions should be made to institute preventive medicine surveillance early in all future conflicts and deployments. Such surveillance is valuable in monitoring the health of troops, in identifying and controlling the sources of disease outbreaks and injury problems, and in responding to unexpected problems such as environmental sabotage.

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1. United States General Accounting Office: "Kuwaiti Oil Fires -- Chronic Health Risks Unknown but Assessments Are Under Way." GAO/RCED-92-80BR, January 1992.

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3. Environmental Protection Agency: "Report to Congress -- United States Gulf Environmental Technical Assistance." Undated.

4. Petersen M, Castellan RM: Prevalence of chest symptoms in nonexposed blue-collar workers. J of Occup Med 26:367-374, 1984.

TABLE 1 - Group Characteristics, Desert Storm Survey, U.S. Marines, March 1991

Variable	Group I	Group II	Group III	Total
	(N=892)	(N=978)	(N=798)	(N=2668)
Age - years*	24.1 (4.0)**	24.8 (5.3)	25.6 (5.4)	24.8 (5.0)
Service - years*	4.7 (3.6)	5.5 (5.0)	6.5 (5.2)	5.5 (4.7)
Deployment - days*	92.8 (35.8)	113.5 (56.3)	156.9 (72.5)	119.6 (61.9)
Job Group	# (%)	# (%)	# (%)	
Administration	23 (2.6)	85 (8.7)	168 (21.1)	--
Field	704 (78.9)	720 (73.6)	145 (18.2)	--
Maintenance	105 (11.8)	87 (8.9)	438 (54.9)	--
Pilot/NFO	2 (0.2)	1 (0.1)	21 (2.6)	--
Navy (HMs & RPs)	55 (6.2)	77 (7.9)	12 (1.5)	--
Food Service	3 (0.3)	8 (0.8)	14 (1.7)	--

*means
**standard deviation

TABLE 2 - Risk Factors, Desert Storm Survey, U.S. Marines, March 1991

Risk Factor	Group I # (%)	Group II # (%)	Group III # (%)	Total # (%)
Smoking				
Current	359 (40.2)	321 (32.8)	262 (32.9)	942 (35.3)
Former	85 (9.5)	109 (11.1)	117 (14.7)	311 (11.7)
Never	448 (50.2)	548 (56.0)	418 (52.4)	1414 (53.0)
Asthma	41 (4.6)	47 (4.9)	41 (5.2)	129 (4.9)
Hay Fever	140 (15.7)	146 (14.9)	103 (12.9)	389 (14.6)
Emph/Bronchitis	88 (9.9)	80 (8.2)	60 (7.5)	228 (8.6)
Flu Shot*	805 (90.8)	809 (82.9)	685 (86.6)	2299 (86.6)

Just before or during deployment

TABLE 3 - Prevalence of Symptoms, Desert Storm Survey, U. S. Marines, March 1991

Symptoms	Group I (%)	Group II (%)	Group III (%)	Total (%)
Gastrointestinal				
Diarrhea	25.0	12.9	13.2	17.0
Stomach Cramps	14.1	8.3	8.3	10.2
Nausea/Vomiting	6.7	3.6	3.6	4.6
Blood/Mucus/Feces	3.0	1.1	2.1	2.1
Fever/Diarrhea	3.6	2.2	2.3	2.7
Gas with CBW*	22.2	18.4	20.8	20.4
Respiratory				
Wheezing	8.9	4.0	3.0	5.3
Cough	18.9	15.5	12.5	15.7
Chest Pain	5.2	3.4	4.1	4.2
Fever/Cough	2.0	1.9	2.0	2.0
Runny Nose	27.6	23.4	20.6	24.0
Sore Throat	11.6	9.2	8.2	9.7
Cold	24.7	19.7	26.3	23.3
Other				
Burning Eyes	6.3	5.3	4.5	5.4
Red Eyes	1.9	1.9	1.8	1.9
Skin Rash	8.1	4.0	6.2	6.0
Injury				
Medical	9.0	12.0	20.2	13.4
No Medical**	44.1	32.5	37.6	37.9

*CBW - Chemical/Biological Warfare medications (pyridostygmine, ciprofloxacin)
**Minor injury not requiring medical attention

TABLE 4 - Respiratory Symptoms: Desert Storm Survey, U.S. Marines, March 1991

Symptom	Group	POR*	95% CI**	Likelihood Ratio	Interactions
Wheezing	I vs. III	3.08	1.92 - 4.95	p<.01	NS***
	II vs. III	1.30	0.77 - 2.18	NS	--
Cough	I vs. III	1.54	1.17 - 2.02	p<.01	NS
	II vs. III	1.27	0.96 - 1.67	NS	--
Chest pain	I vs. III	1.24	0.78 - 1.96	NS	NS
	II vs. III	0.82	0.50 - 1.34	NS	--
Fever/Cough	I vs. III	0.96	0.48 - 1.92	NS	NS
	II vs. III	0.98	0.50 - 1.93	NS	--
Runny nose	I vs. III	1.48	1.17 - 1.86	p<.01	NS
	II vs. III	1.18	0.94 - 1.48	NS	--
Sore throat	I vs. III	1.45	1.05 - 2.02	p<.05	NS
	II vs. III	1.11	0.80 - 1.56	NS	--
Cold	I vs. III	0.91	0.73 - 1.13	NS	NS
	II vs. III	0.68	0.54 - 0.86	p<.01	--

*prevalence odds ratio, adjusted for smoking, history of respiratory disease, and receipt of influenza vaccine
**95% confidence interval
***non-significant

TABLE 5 - Prevalence of Respiratory Symptoms by Job Class, Desert Storm Survey, U. S. Marines, March 1991

Symptom	Group I (%)			Group II (%)			Group III (%)		
	Field N=704	Maint N=105	Others* N=83	Field N=720	Maint N=87	Others N=170	Field N=145	Maint N=438	Others N=215
Wheezing	8.0	10.5	14.3	3.3	0.0	8.8	3.5	3.4	1.9
Cough	16.5	30.5	24.1	12.4	19.5	26.3	10.3	13.3	12.6
Chest Pain	5.0	5.7	6.0	3.6	1.2	3.5	3.5	4.6	3.7
Fever/Cough	2.0	1.9	2.4	1.1	3.5	4.7	3.5	2.1	0.9
Runny Nose	26.7	34.6	26.5	20.3	25.3	34.9	9.7	25.5	17.7
Sore Throat	11.6	14.4	8.4	8.1	9.2	14.0	6.3	9.9	6.0
Cold	24.5	24.8	26.5	16.5	17.2	34.3	16.6	31.8	21.4

*Others = Administration, Pilot/NFO, Navy and Food Service

TABLE 6 - Effects of Sand and Oil Fire Smoke; Desert Storm Survey, U.S. Marines, March 1991

	Group I (%)	Group II (%)	Group III (%)	Total (%)
Blowing Dust/Sand*				
Smoker	38.7	35.2	14.5	30.7
Never Smoked	34.8	30.7	12.6	26.7
Total	36.5	32.3	13.2	28.0
Oil Fire Smoke*				
Smoker	40.1	39.4	3.8	29.7
Never Smoked	41.9	42.8	6.3	31.8
Total	41.2	42.3	5.8	31.0

*Reporting moderate or severe irritation

TABLE 7 - Respiratory Symptoms by Response to Dust/Sand or Oil Smoke; Desert Storm Survey, U.S. Marines, March 1991

SYMPTOMS	GROUP I				GROUP II				GROUP III			
	DUST		OIL SMOKE		DUST		OIL SMOKE		DUST		OIL SMOKE	
	Yes*	No	Yes*	No	Yes*	No	Yes*	No	Yes*	No	Yes*	No
Wheezing	17.8	3.7	18.8	1.9	8.9	1.7	7.0	1.8	11.4	1.7	13.0	2.4
Cough	29.8	12.6	28.3	12.3	26.3	10.3	21.7	11.0	30.5	9.8	23.9	11.9
Chest Pain	9.2	2.8	8.7	2.7	6.4	2.0	6.1	1.4	12.4	2.9	8.7	3.9
Fever/Cough	3.4	1.2	3.5	1.0	4.1	0.9	3.2	1.1	5.7	1.4	8.7	1.6
Runny Nose	40.6	20.1	37.3	20.8	36.0	17.4	30.3	18.3	35.6	18.3	30.4	20.0
Sore Throat	17.8	8.0	16.3	8.3	16.5	5.7	13.3	6.2	20.2	6.4	17.4	7.6
Cold	35.9	18.2	36.2	16.7	27.0	16.2	23.2	17.1	37.1	24.6	37.0	25.6

*Reported moderate or severe irritation from dust/sand or smoke exposure

TABLE 8 - Gastrointestinal, Skin & Eye Symptoms and Injuries: Desert Storm Survey
U.S. Marines, March 1991

Symptom	Group	POR*	95% CI**	Likelihood Ratio***	Wald Test
Diarrhea	I vs.III	2.19	1.70 - 2.83	p<.01	I>III
	II vs. III	0.98	0.74 - 1.29	NS	--
Stomach cramps	I vs. III	1.82	1.33 - 2.50	p<.01	I>III
	II vs. III	1.00	0.71 - 1.41	NS	--
Nausea/vomiting	I vs. III	1.91	1.21 - 3.01	p<.01	I>III
	II vs. III	0.99	0.60 - 1.63	NS	--
Blood in feces	I vs. III	1.43	0.78 - 2.65	p<.05	***
	II vs. III	0.52	0.24 - 1.12	NS	--
Fever w/ diarrhea	I vs. III	1.61	0.90 - 2.90	NS	--
	II vs. III	1.00	0.53 - 1.88	NS	--
Gas with CBW	I vs. III	1.09	0.86 - 1.37	NS	--
	II vs. III	0.86	0.68 - 1.09	NS	--
Burning eyes	I vs. III	1.42	0.92 - 2.18	NS	--
	II vs. III	1.18	0.77 - 1.83	NS	--
Red eyes	I vs. III	1.09	0.53 - 2.22	NS	--
	II vs. III	1.10	0.55 - 2.22	NS	--
Skin rash	I vs. III	1.34	0.92 - 1.95	NS	--
	II vs. III	0.63	0.41 - 0.97	p<.01	II<III
Injuries - all	I vs. III	0.82	0.68 - 1.00	p<.01	I<III
	II vs. III	0.58	0.48 - 0.71	p<.01	II<III
Injuries - medical	I vs. III	0.39	0.29 - 0.52	p<.01	I<III
	II vs. III	0.54	0.41 - 0.70	p<.01	II<III

*prevalence odds ratio; unadjusted
**95% confidence interval
***overall test significant at p<.05 using likelihood ratio test, but pairwise Wald test was not significant

TABLE 9 - Diarrhea by Living Conditions; Desert Storm Survey, U.S. Marines, March 1991

Living Condition	Group I #	Group II #	Group III #	Total # (%)
Ware House	13	9	7	29 (2.9)
Field (No Running H_2O)	395	262	57	714 (72.3)
Camp (H_2O & Flush Toilets)	5	8	181	194 (19.6)
Other Living Quarters	15	15	21	51 (5.2)
Total	428 (43.3)	294 (29.8)	266 (26.9)	988 (100.0)

TABLE 10 - Injuries Requiring Medical Attention by Source of Injury; Desert Storm Survey, U.S. Marines, March 1991

	PT* # (%)	Job NC** # (%)	Combat # (%)	Total # (%)
Group I	34 (42.5)	39 (48.8)	7 (8.7)	80 (22.3)
Group II	40 (34.2)	63 (53.8)	14 (12.0)	117 (32.7)
Group III	70 (43.5)	91 (56.5)	0.0	161 (45.0)
Total	144 (40.2)	193 (53.9)	21 (5.9)	358 (100.0)

*Physical training, sports activities, free time injuries
**Job, non-combat injuries

TABLE 11 - Source of Injury by Job Group; Desert Storm Survey, U. S. Marines, March 1991

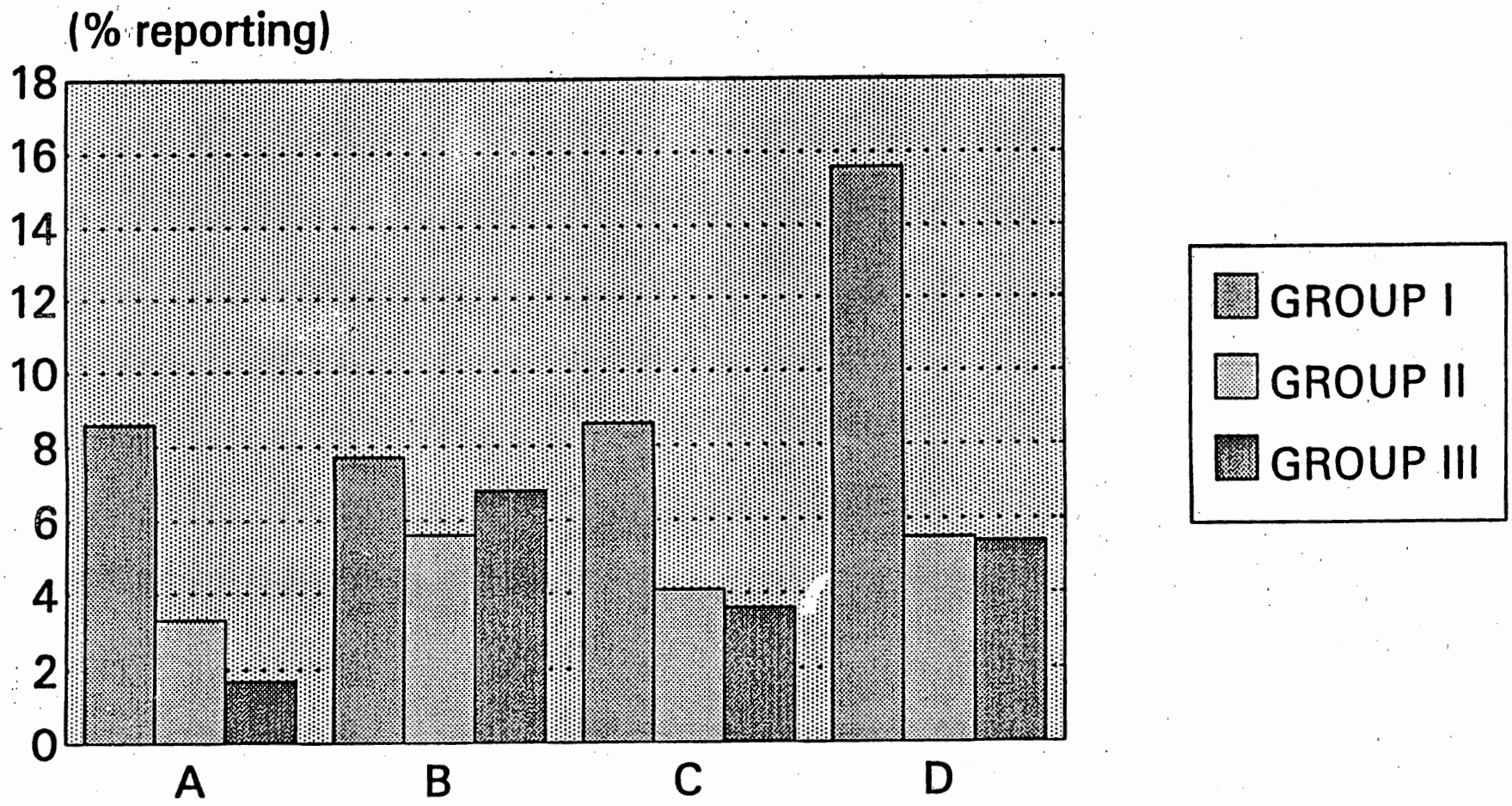
Site	Job Group	PT* #(%)	Job NC** #(%)	Combat #(%)	Total #(%)
I	Field	158 (43.1)	177 (48.2)	32 (8.7)	367 (77.6)
	Maintenance	10 (14.1)	50 (70.4)	11 (15.5)	71 (15.0)
	Others	20 (57.1)	14 (40)	1 (2.9)	35 (7.4)
	Total	188 (39.8)	241 (50.9)	44 (9.3)	473 (100.0)
II	Field	97 (31.6)	162 (52.8)	48 (15.6)	307 (70.9)
	Maintenance	11 (21.2)	36 (69.2)	5 (9.6)	52 (12.1)
	Others	15 (20.3)	54 (73.0)	5 (6.7)	74 (17.0)
	Total	123 (28.4)	252 (58.2)	58 (13.4)	433 (100.0)
III	Field	21 (31.8)	45 (68.2)	0	66 (14.3)
	Maintenance	113 (40.8)	160 (57.8)	4 (1.4)	277 (60.1)
	Others	60 (50.8)	58 (49.2)	0	118 (25.6)
	Total	194 (42.1)	263 (57.0)	4 (0.9)	461 (100.0)

*Physical training, sports activities, free-time injuries
**Job, but not in combat, injuries

FIGURE 1-A

Prevalence of Wheezing

Desert Storm Survey, US Marines, March 1991

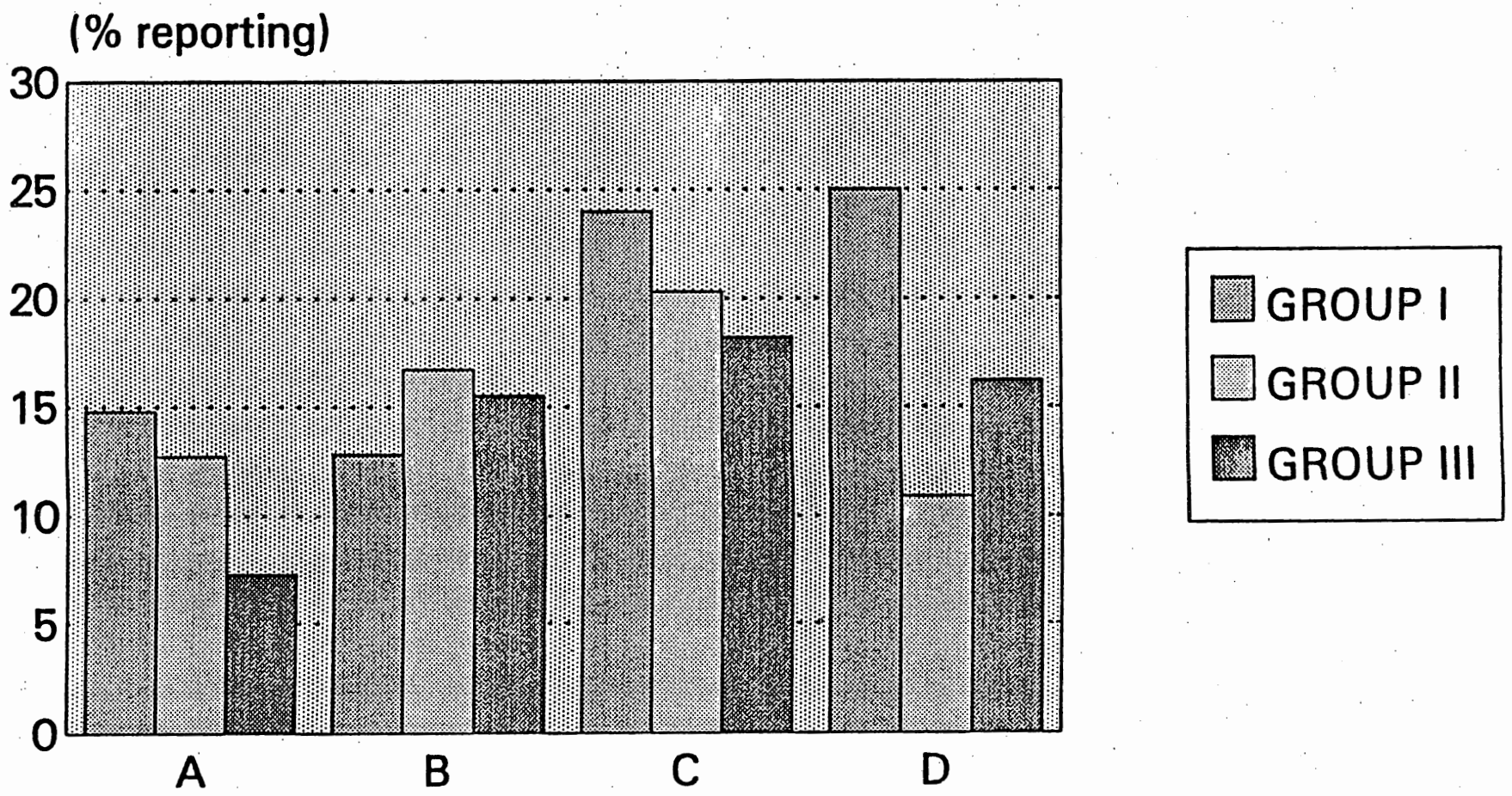


A = inoculated nonsmokers B = uninoculated nonsmokers
C = inoculated smokers D = uninoculated smokers

FIGURE 1-B

Prevalence of Cough

Desert Storm Survey, US Marines, March 1991

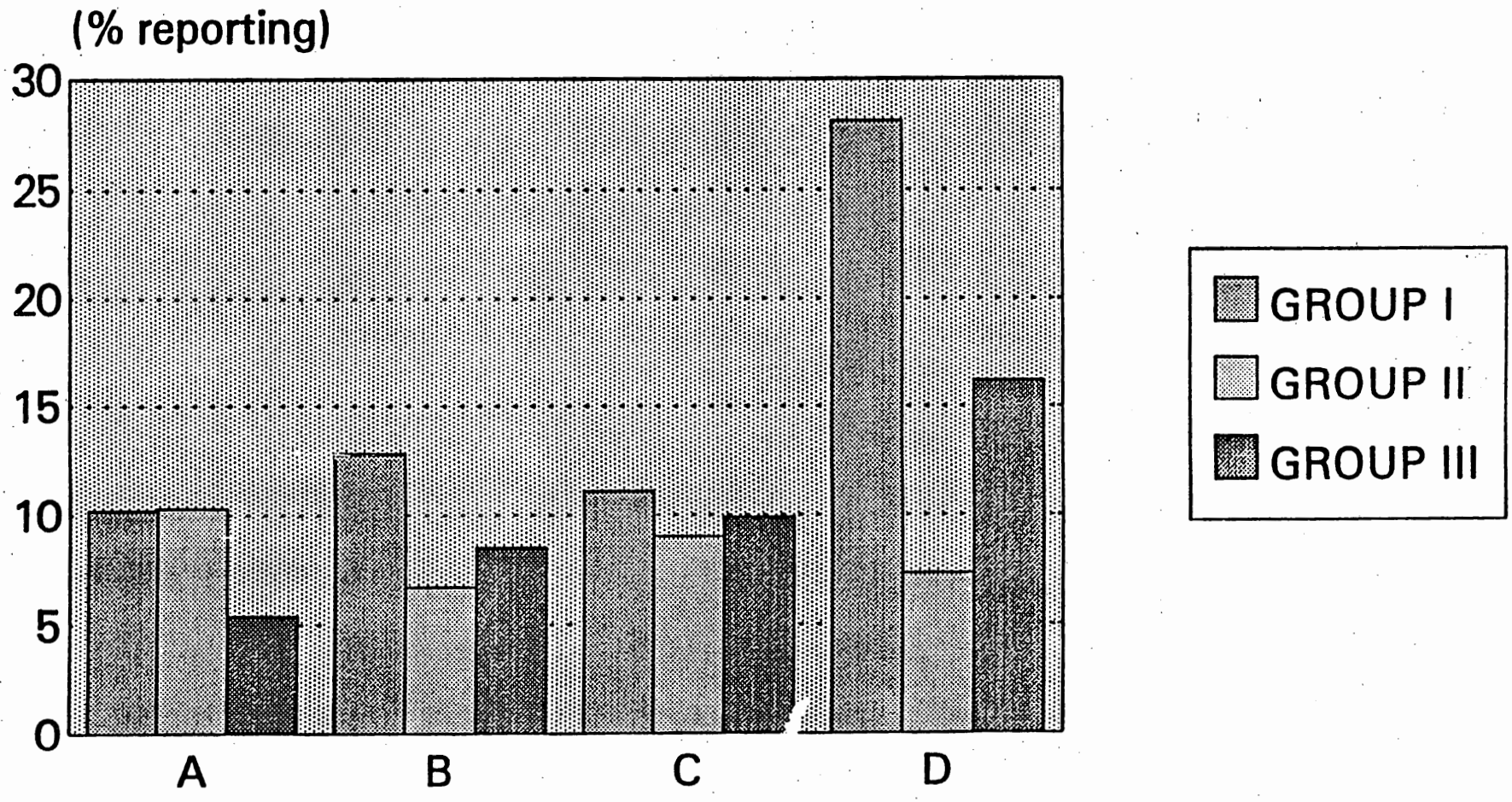


A = inoculated nonsmokers B = uninoculated nonsmokers
C = inoculated smokers D = uninoculated smokers

FIGURE 1-C

Prevalence of Sore Throat

Desert Storm Survey, US Marines, March 1991

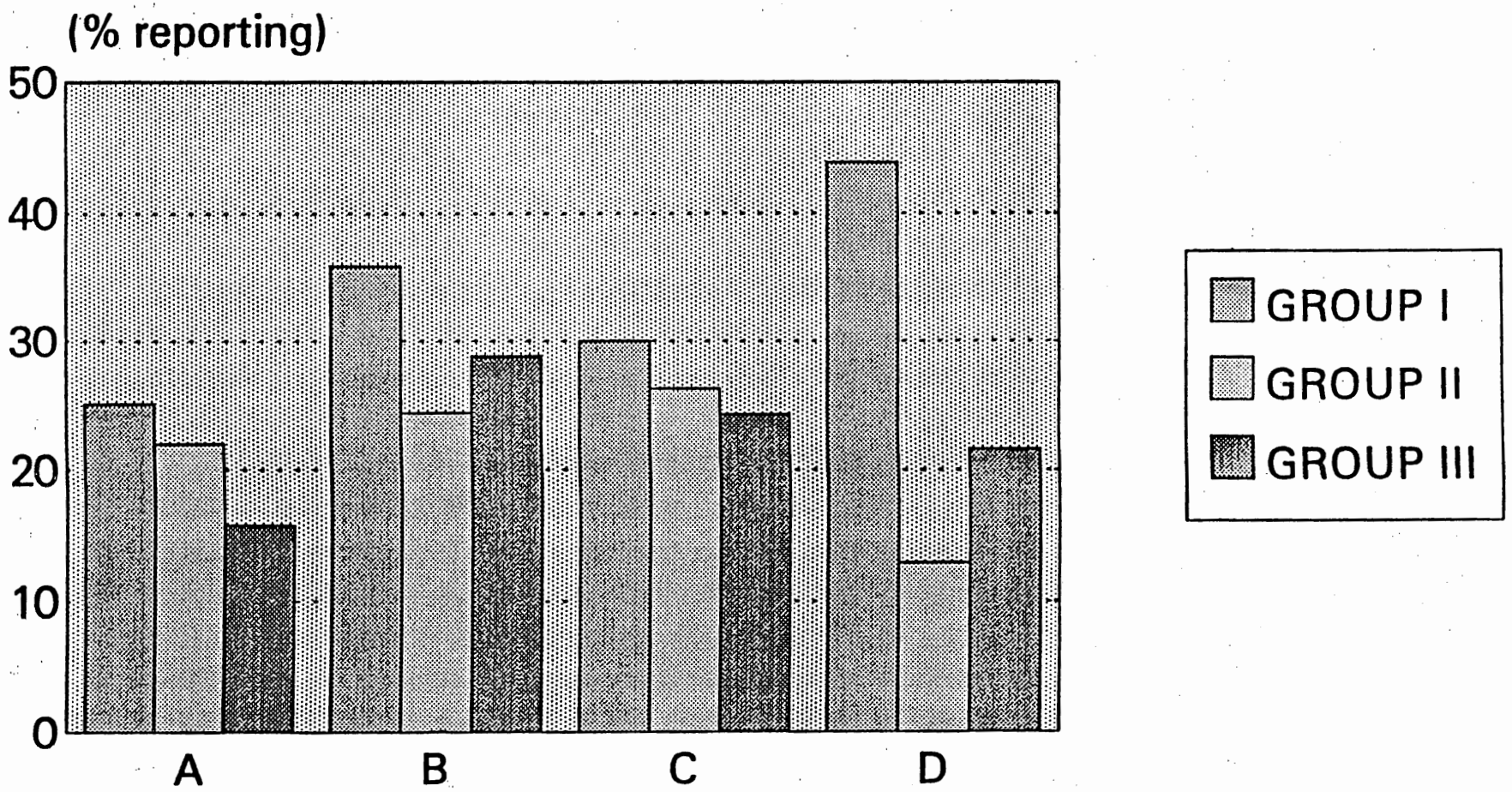


A = inoculated nonsmokers B = uninoculated nonsmokers
C = inoculated smokers D = uninoculated smokers

FIGURE 1-D

Prevalence of Runny Nose

Desert Storm Survey, US Marines, March 1991

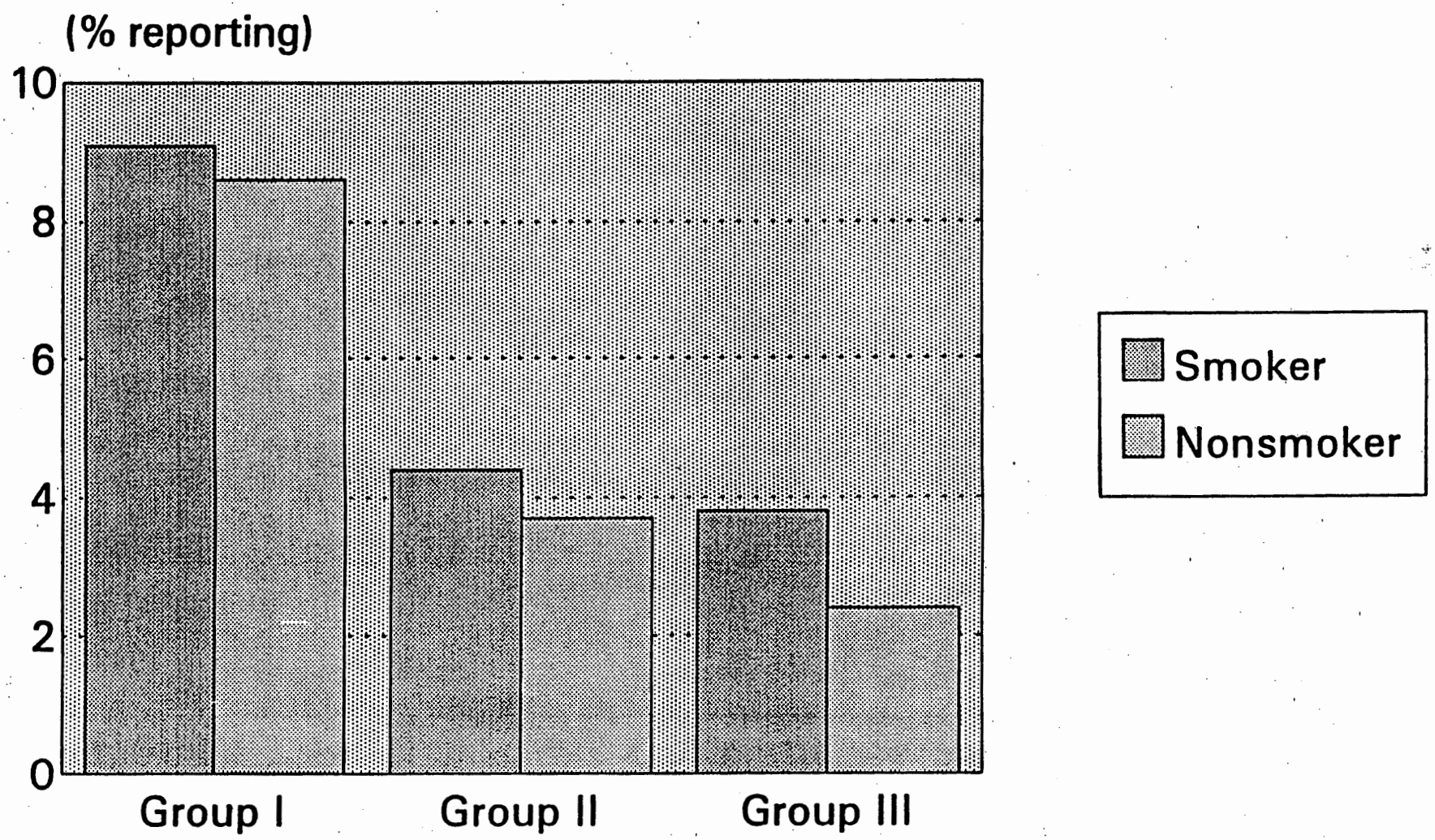


A = inoculated nonsmokers B = uninoculated nonsmokers
C = inoculated smokers D = uninoculated smokers

FIGURE 2-A

Prevalence of Wheezing by Smoking

Desert Storm Survey, US Marines, March 1991

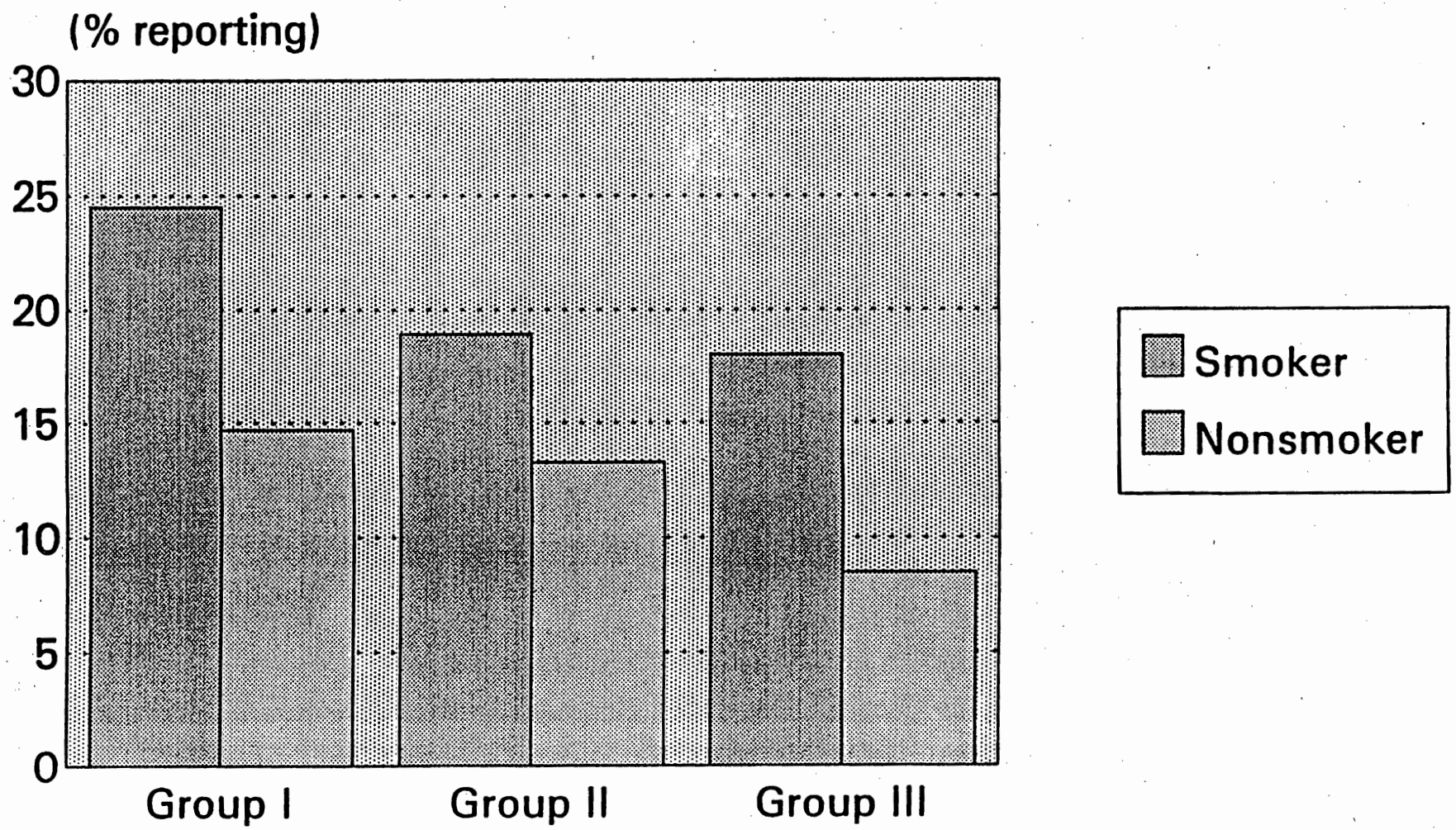


Self-reported symptoms

FIGURE 2-B

Prevalence of Cough by Smoking

Desert Storm Survey, US Marines, March 1991



Self-reported symptoms

APPENDIX A

PREVENTIVE MEDICINE AUGMENTATION TEAM

AFTER ACTION REPORT

FSSG/pm-fsw
28 March 1991

MEMORANDUM

From: Preventive Medicine Augmentation Team Leader
To: Group Surgeon, 1st FSSG

Subj: PREVENTIVE MEDICINE AUGMENTATION TEAM AFTER ACTION REPORT

Ref: (a) MSG CNO//932// WASHINGTON, DC 262001Z DEC 90

1. The following Preventive Medicine Augmentation Team members were deployed to Operations Desert Shield and Desert Storm:

NEPMU#6, Pearl Harbor	NEPMU#7, Naples	NEPMU#2, Norfolk
CAPT F.S. Wignall- Team Leader	LCDR R. Sanderson	CAPT W. Butler
LCDR G. Schultz	LT M. Lluberas	CDR M. Anderson
LCDR R. Linville	HMC T. Johnson	LTJG T. Krausz
HMC C. Inverso	HMC M. McMahon	HM1 A. Cardwell
HM1 E. Broy		HM2 S. Gelles
HM1 N. Gross		

NEPMU#5, San Diego	NEHC	DVECC, Alameda
HMCS R. Hall	HMC D. Mickey	LT D. Bruce
HM1 R. Vasinda	HM1 D. Wilson	HM1 R. Congo
HM1 R. Lacanfora		HM1 V. Berger
HM1 J. Pedraza		
HM2 S. Martin		

2. BACKGROUND: In December, 1990, as battle plans began to unfold, it was apparent to the Group and MEF Surgeons that a half million civilians and as many Iraqi soldiers, potential enemy prisoners of war (EPWs), were living in Kuwait. The possible displacement of large numbers of civilians into camps in Kuwait and NE Saudi Arabia as well as internment of EPWs raised the possibility of large scale public health emergencies if adequate preventive medicine (PM) personnel were not available to manage such situations. Given that organic PM assets were already burdened in support operational units over a large area, a PM augmentation team was proposed by BUMED in reference (a) to respond to these potential public health requirements.

3. MISSION: To provide PM assistance beyond the capabilities of organic USMC PM assets deployed in support of combat units in the

PREVENTIVE MEDICINE AUGMENTATION TEAM AFTER ACTION REPORT

Arabian Gulf during Operations Desert Shield and Desert Storm. This contribution would focus on EPW's and displaced civilians (DC's) in the US Marine Corps area of responsibility. The team would attempt to mitigate the impact of communicable disease in these groups, on nearby Marines and on USMC emergency medical capabilities though the prompt initiation of public health measures.

4. ACTIONS:

a. In the days prior to team deployment every effort was made to obtain as much information as possible on public health issues and general demographic and topographic information on Saudi Arabia, Kuwait, Iraq, Jordan, Bahrain, Oman, United Arab Emirates, Yemen, Qatar, and Iran. AMAL's were inspected, inventoried, updated, and stocked as necessary to meet the projected mission. Contact was established on a routine basis with the Preventive Medicine Officer for NAVCENT and MARCENT to obtain current information and status of public health issues.

b. Advance Party members, CAPT Wignall and LCDR Linville, departed Pearl Harbor on 31 December 1990 and were joined by LCDR Sanderson of Naples, Italy in Bahrain. On reporting to the First Marine Expeditionary Force (1MEF), Jubail, Saudi Arabia, on 3 January, the team was assigned to Group Surgeon, 1st FSSG.

c. On direction by the Group surgeon, the Preventive Medicine Augmentation Team advance party immediately pursued EPW and DC issues, establishing contact with USMC organic Preventive Medicine personnel at 1MEF, 1st FSSG, 1st MARDIV, 2nd FSSG, and 2nd MARDIV. Additional liaison was made with USMC 3rd Civil Affairs Group (CAG), International Committee of Red Cross (ICRC), the Kuwait Red Crescent Society, the League of Red Cross and Red Crescent Societies, ARCENT G5 and ARCENT Preventive Medicine personnel.

d. While pursuing its taskings, the team also coordinated activities with the NAVCENT Preventive Medicine Officer supporting the I MEF to ensure that all needs of Marine units operating in the Kuwait Theater of Operations (KTO) were met.

e. As the threat of armed conflict increased and the need for personnel to address EPW and DC public health issues was evident, the request for deployment of remaining team members was sent. An immediate request was placed for the deployment of an EHO and PMT to accompany the 4th MEB CAG Detachment as described below and LT Bruce and EM1 Lacanfora were deployed from CONUS. Those remaining members from EPMU#7, Naples arrived Saudi Arabia on 15 January 1991. All other team members reported to 1st FSSG, Camp Pendleton for staging and transportation, and arrived in country on 22 January.

PREVENTIVE MEDICINE AUGMENTATION TEAM AFTER ACTION REPORT

f. PM team EPW and DC efforts were directed at assuring the continued health of captured Iraqi personnel and any civilians displaced from their normal surroundings if either of these populations became a USMC responsibility in its AOR. As well, while not specifically a preventive medicine issue, a concerted attempt was made to guarantee the early entry of civilian medical relief agencies into the KTO in the event that emergency surgical support for the civilian population were necessary as a result of the combat environment.

g. Given the three issues in paragraph 4.f. as priorities, the following actions were taken:

(1) EPWs:

(a) Written recommendations concerning EPW and DC preventive medicine issues were provided to the Health Services Support Element, 1st FSSG, for inclusion in the USMC theater OPLANS.

(b) Contact was established with the USN Seabee unit responsible for constructing the USMC EPW Camp to be built at Kibrit, Saudi Arabia. Plans called for a camp large enough to hold 40K EPW's. Camp blueprints were reviewed and recommendations for change provided. On site surveys were made as the camp was being built. Liaison was also made with 1MEF and 1st FSSG personnel responsible for running the EPW camp and public health recommendations were provided.

(c) Liaison was established with US Army 800th M.P. Brigade and the 105th Medical Detachment concerning an exchange of information involving the operation of the Army's EPW camp at Al Sarrar and that of the Marine Corps. A visit to the Army camp was conducted.

(d) All information obtained and recommendations provided to or from all contacts were passed on to 1st FSSG Group Surgeon and organic Preventive Medicine personnel who had the ultimate responsibility for preventive medicine support to the EPW camp.

(2) DCs:

Prior to the initiation of the ground campaign and the taking of significant numbers of EPWs, organic FSSG PM personnel assumed full responsibility for supporting the primary EPW camp in the Marine AOR near Al Kibrit. At this point, team efforts were directed towards developing a strategy to deal with the potential of large numbers of DCs in Kuwait City and its environs should Marines enter the city.

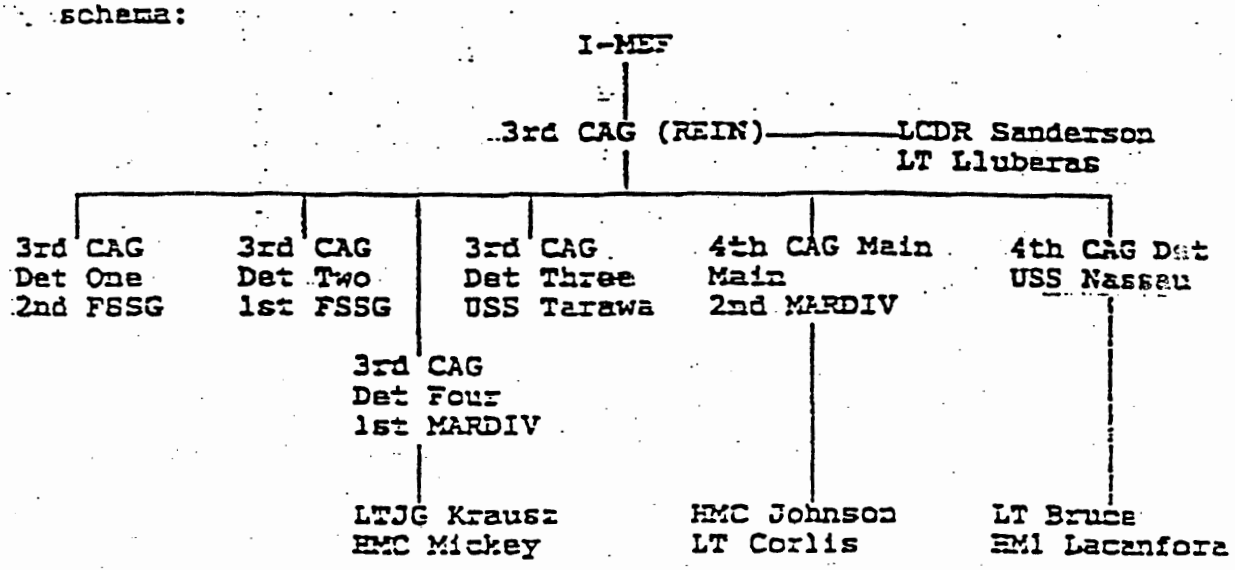
PREVENTIVE MEDICINE AUGMENTATION TEAM AFTER ACTION REPORT

(a) The 3rd Civil Affairs Group (3rd CAG), I MEF, had two major roles in support of the combat forces of the U.S. Marines. The major emphasis was to move or direct civilians out of the line of fire and away from the battlefield and then to assist in collecting and processing enemy prisoners of war.

(b) In order to accomplish the two mission elements, Civil Affairs (CA) personnel were attached to forward combat units to deal with any civilian populations encountered in the course of battle. The Marine Corps CA effort was directed toward supporting tactical operations on a short term basis. Long term CA efforts such as nation building is left to civil affairs units of the U.S. Army.

(c) The 3rd CAG responsibilities for civilians made them the first interface between the USMC and civilian populations in their homes or on the move in the Marine AOR. In consultation with CAG Commander and the PM team advance party, it was determined that the addition of PM personnel to the forward deployed CAG detachments would allow immediate public health consultation and implementation of sound public health guidelines as soon as civilian groups were encountered by US Marine forces. As well, these individuals would serve as the forward eyes and ears of main body of the PM team, alerting it of public health problems and drawing on it for reinforcements.

(d) LCDR R. D. Sanderson and Lt M. Lluberas were attached to the 3rd CAG at I MEF to coordinate activities between PM team main body, the forward deployed PM team members and the CAG. Teams of two PM personnel were deployed with each of the Marine Divisions and with the 4th MEB according to the following schema:



PREVENTIVE MEDICINE AUGMENTATION TEAM AFTER ACTION REPORT

(e) Mission of the Navy Preventive Medicine Team members assigned to the Civil Affairs units was to provide general preventive medicine support to the civil affairs unit; provide advice and recommendations concerning public health issues involving displaced civilian and EPW's; provide preventive medicine training to civil affairs personnel and contact local health officials on matters of mutual concern.

(f) Workload for Preventive Medicine personnel assigned to the 3rd CAG personnel included: performance of water availability assessment for Kuwait City using maps and overlays; maintained liaison with local health officials of the Royal Commission in Jubail concerning chemical analysis capabilities for water; attended numerous meeting and planning sessions for EPW and DC public health mission with Marines and Army personnel. A five day course on civil affairs was attended by the majority of the team.

(3) Civilian Relief Agency Issue:

(a) An initial liaison meeting with Dr. Ebrahim Bahbahani of the Kuwaiti Red Crescent Society (KRCS) was arranged by the Kuwaiti military liaison office at I MEF to discuss the public health situation in Kuwait. The KRCS ultimately was to function as the representative of the Ministry of Health during the emergency phase of the restoration of Kuwait. A series of meetings were held between the KRCS, the International Committee for the Red Cross and the League of Red Cross and Red Crescent Societies

(b) The KRCS provided valuable information on the Kuwait Government Emergency Medical Plan, the current condition of medical facilities, the estimated numbers of civilians living in Kuwait and what their expected condition might be and where they might flee, the public health infrastructure and what its current status may be and the Government of Kuwait's plan for handling displaced civilians.

(c) One of the tasks of the team was to ensure that the absolute minimum of civilian casualties entered the US military casualty receiving system from either injury or from communicable disease. Surge emergency surgical capability for civilians would only have been available through international medical relief efforts. Key to the entry of international organizations into Kuwait in the immediate post combat period was the early entry of the International Committee of the Red Cross (ICRC) in the immediate post-combat period to make a needs assessment and legitimize the entry of other organizations should a need be established. PM team members quickly took the lead in establishing relationships with the ICRC and ensuring that their early admission was part of civil affairs planning.

PREVENTIVE MEDICINE AUGMENTATION TEAM AFTER ACTION REPORT

(4) Deployment into Kuwait:

The air campaign against Iraqi forces commenced on 17 January 1991. During the time period between the team's arrival and deployment to Kuwait City every piece of pest control equipment received preventive maintanance and inspection to assure proper operation when required. Daily in-service training was conducted covering topics of public health import to the teams future activities in Kuwait. Cargo containers were obtained and pre-packed for the purpose of moving team supplies and equipment to whatever site designated or required.

(a) The original mission of the Preventive Medicine Augmentation Team deployed in support of Operations Desert Shield/Storm was to assist in the management of public health related problems in populations of displaced persons in the Marine Corps AOR. Planning and training was based on the assumption that a prolonged state of conflict could result in large numbers of civilians deprived of adequate water, food or shelter. The very short and successful ground war did not result in large numbers of displaced civilians in Kuwait or Saudi Arabia.

(b) Plans were also made to augment the organic Marine Corps preventive medicine assets in the event that additional personnel would be required to manage health and sanitation issues for large numbers of (EPW's). Over 20,000 EPW's were quickly transferred to US Army and Saudi Arabian jurisdiction and additional preventive medicine assets were not required by the Marine Corps.

(c) Given no requirement for the team in the Marine Corps AOR and, as a result of coordination with the I MEF 3rd Civil Affairs Group and prior discussion with the 352nd Civil Affairs Command of the U.S. Army, arrangements were made to divert the assets of the team to provide assistance in support of US Army Civil Affairs relief efforts in Kuwait City.

(d) The ground war to liberate Kuwait commenced on 24 February 1991. On 28 February an advance party of CAPT Wignall, HMC Inverso, and EM1 Cardwell deployed to Kuwait City with the 352nd CAG main body. The remaining Preventive Medicine team members along with those individuals who had been attached to the various CAG DETS moved forward on 1 March.

(e) The Preventive Medicine Augmentation Team divided into Water, Vector Control, and Epidemiology teams to address those specific issues within Kuwait City and its surrounding communities.

PREVENTIVE MEDICINE AUGMENTATION TEAM AFTER ACTION REPORT

(1) Water Team:

The water team focused its activities on the immediate restoration of municipal water supplies by examining existing reservoir stores of over 1 billion gallons for evidence of chemical contamination by Iraqi personnel and assisting in the rapid reestablishment of water quality assessment services by the Ministry of Water and Electricity. The water desalination plants were all severely damaged, but some of the water reservoirs were above the city elevation. Based upon the negative test results provided by the Navy team, water was released to the Kuwait City distribution system via gravity flow. During their stay in Kuwait the water team:

a. Conducted a damage assessment survey at the Shuwaykh Water Desalination Treatment Plant, Kuwait City along with Army Corp of Engineers personnel.

b. Coordinated activities with Mr. Nasser, Deputy of the Kuwaiti Ministry of Electricity and Water (MEW), and with Dr. Fatima Al Awad, Director of the Water Resources Development Center.

c. Established a plan to test all of the reservoirs which provide water to Kuwait City and surrounding communities. Water in the reservoirs would be tested for lewisite, mustard, cyanide, and nerve agent using the US Army M-272 Water Chemical Test Kit and for arsenic using a commercial test kit specific for arsenic.

d. Visited the water testing laboratory at the Water Resources Development Center. Laboratory facilities and equipment had sustained major damage, destruction, and theft of equipment by occupying Iraqi forces.

e. Collected, and tested water samples from Mutla Low, Mutla High, and West Funaites reservoirs west and south of Kuwait City. All samples tested negative for chemical contamination except for one sample which was taken from one of the Mutla High reservoirs. The sample which tested positive for lewisite was thought to be an error in sample collection as a whirl bag containing sodium thiosulfate was used.

f. Collected and tested 15 additional samples from reservoirs at Doha and Subhan, and retested the "positive" reservoir at Mutla High. All samples from both teams tested negative for chemical agent content. All water test results were provided the MEW daily.

PREVENTIVE MEDICINE AUGMENTATION TEAM AFTER ACTION REPORT

g. Trained 5 of the water resources laboratory staff on the use of the M-272 Water Chemical Test Kit and the Millipore Filter Water Bacteriological Field Test Kit.

h. Transferred seven M-272 kits, one Water Bacteriological kit from the Army team, and one Water Bacteriological kit from the Navy team to Dr. Awad, Director of the Water Resources Development Center, for humanitarian purposes in the restoration efforts for Kuwait.

(ii) Epidemiology Team:

a. The Epidemiology Team objectives were redirected to address problems that might be encountered in Kuwait City. The goals were to:

(1) Assess the status of communicable disease in Kuwait City and its environs.

(2) Determine the status of water availability, food supplies and other basic emergent needs.

(3) Coordinate with the Water Assessment Team and the Vector Control Team to address problems of water-borne or vector-borne disease.

b. The Epidemiology team participated in the following activities:

(1) All major Kuwait city hospitals were visited and their immediate needs were assessed in conjunction with 352nd CAC personnel. Staff physicians were interviewed regarding the communicable disease experience during the Iraq occupation and in the immediate post-combat period.

(2) Arrangements were coordinated for the delivery of water to the hospitals. In some cases, supplies of bottled water were delivered to the outlying hospitals such as the Infectious Disease Hospital which had a very small in-patient census.

(3) Meetings were held with Ministry of Public Health and their disease surveillance and immunization programs were discussed.

(4) Delivery of supplies requested by the hospitals was accomplished.

(5) Epidemiology team members participated in other activities of the 352nd Civil Affairs Command

PREVENTIVE MEDICINE AUGMENTATION TEAM AFTER ACTION REPORT

such as the identification of sites where animal herds were without water, assessment of displaced civilians returning from Iraq and evaluation of problem areas such as refuse disposal.

c. The Epidemiology Team was prepared to do household surveys to assess the burden of communicable disease and to estimate the quantity and quality of food and water supplies. On site evaluation, however, revealed that epidemiological support and further assessment was not necessary for a variety of reasons.

(1) The overall health of the population of Kuwait City was good as a result of optimal health care during the period preceding the occupation.

(2) The relatively short duration of the occupation and the ground war was a factor in the minimal degradation of the health and nutritional status of the population. People had stored water and food in anticipation of a long period of deprivation. The cool season of the year, which limited, the opportunity for vector breeding, helped to minimize the potential for vector-borne disease.

(3) Although the ability to conduct health surveillance had been degraded during recent months due to severe limitations on communication and transportation, the reporting mechanisms were still intact.

(4) The efforts to keep up with immunization and basic public health services in spite of the many constraints imposed by the occupying power was impressive.

d. It was apparent that as soon as the basic services of electricity, water and communication were restored that mechanisms were in place for resuming health care and public health services at a high level. The Ministry officials and physicians are among the most highly trained public health professionals in the world. They were appreciative of initial assistance efforts, but it was clear that they were anxious to resume their own programs and policies without interference from outside agencies.

(iv) Vector Control Team:

a. The Vector Control Team deployed with the assumption that all pest control activities in Kuwait would have ceased and that there would be no staff or equipment available to continue those duties. It was assumed that there would be large filth fly and rodent problems because of the accumulation of

PREVENTIVE MEDICINE AUGMENTATION TEAM AFTER ACTION REPORT

garbage and the potential for large populations of other vectors was considered.

b. Prior to departure the team visited pesticide distributors in Dammam, Saudi Arabia and obtained availability and price information for the Government of Kuwait Ministry of Health. A list of pesticides was developed with amounts that the contractor should purchase to restock the Kuwait Pesticide Garage.

c. Similar to the other teams, the Vector Control Team found conditions different than they expected. The team very quickly:

(1) Visited hospitals and interviewed doctors on prevalence of vector-borne diseases. No vector-borne diseases were reported in Kuwait during the occupation and they gave no indication that any would be a likely problem.

(2) Performed assessment of the Pest Control Garage. Reviewed their activities for the past 7 months. Of special note was removal of their pesticide mixing equipment which was flown to Iraq. Also noted was the nearly complete removal of their pesticide supplies and vehicles used for spraying by the Iraqi military.

(3) Assisted the Ministry of Health in an overall assessment of the pest and vector situation.

(4) Provided vector control in morgues for flies, and at the U. S. Embassy and airport for mosquitos.

(5) Acquired body bags and delivered them to several hospitals in which morgue storage facilities had been exceeded and fly populations had burgeoned.

(6) Transferred approximately $55k worth of pesticides, pesticide spraying equipment, and general laboratory equipment from the team to the Kuwait Pest Control Garage.

c. Mr. Osama El-Ruby, head of the rodent control division, reported that on 09 MAR about 120 previous employees would be returning to work. These are experienced pest control workers averaging about 15 years on the job.

d. Since during the occupation most of the pesticides and equipment were stolen, the decision was made that the greatest help we could provide was to transfer our pest control supplies and equipment to them.

PREVENTIVE MEDICINE AUGMENTATION TEAM AFTER ACTION REPORT

e. At the request of the Department of Public Health the priorities for the pest control team were reviewed. Pest control priorities were discussed and it was agreed that there should be fly control in areas where garbage had been previously piled. Mosquito, roach and rodent control would be responded to on the basis of public complaint. Sanitation was stressed as the key to returning things back to normal.

(6) Retrograde Agricultural Inspections:

On return from Kuwait City, the team was tasked by CG, 1st FSSG to provide support for the initial phase of retrograde agricultural and customs inspections for units returning to the mainland US.

a. Team entomologists and preventive medicine technicians received refresher training from US Department of Agriculture and US Customs personnel in the performance of agriculture and customs inspections.

b. Team PM personnel were designated senior inspectors and coordinated with FSSG G3 to provide oversight for approximately 200 Marine Corps Agricultural inspectors supervising the wash-down of thousands of vehicles and thousands of tons of equipment, gear, and personal belongings returning to the United States. Similarly, the team provided Customs Inspections for during the start up period for the retrograde until Marine Corps personnel could be adequately trained.

c. Team personnel conducted their washdown duties in Jubail, Saudi Arabia and in Sheik Isa and Manama, Bahrain.

(7) Health Effects of Petroleum Fire Smoke in Deployed Marine Corps Personnel in the KTO:

(a) The potential hazard of oil fire smoke exposures from damaged wells and Iraqi obstacles recognized and information from the Naval Environmental Health Center, the Bureau of Medicine and Surgery and the Assistant Secretary Of Defense Office of Health Affairs on petroleum fire hazards was reviewed by PM team epidemiologists. MEF level guidance on protection for US Marines deployed in high risk areas was provided prior to the initiation of the ground campaign and after.

(b) Recommendations for MARCENT policy on protection and documentation were formulated in conjunction with USCINCCENT and BUMED.

PREVENTIVE MEDICINE AUGMENTATION TEAM AFTER ACTION REPORT

(c) A plan for assessment of acute health effects was developed to include a health survey and a redoubling of surveillance efforts for disease. The survey will be administered to over 3000 personnel exposed and unexposed to the oil fire smoke in Kuwait. The results will be compared with sick call information and sureveillance data to determine the extent, if any, of acute health effects from smoke exposures.

(d) Coordination between the US Interagency Task Force dispatched to assess health risks was established. An agreement was reached to share information on acute health effects and actual data regarding environmental data collected by the team.

F. S. Wignall

APPENDIX B

OPERATION DESERT STORM DEPLOYMENT QUESTIONNAIRE

IDENTIFICATION AND ANSWER SHEET

INSTRUCTIONS FOR ADMINISTRATION

OPERATION DESERT STORM DEPLOYMENT QUESTIONNAIRE

The Medical Department would like to ask a few questions about your experiences in the Desert Storm theater of operations. As you know, this is the first time that such large numbers of American personnel have been stationed in the Middle East. Some of the conditions here are quite different from other operational sites. Please help us to assess your health-related experiences by answering the following questions. THANK YOU.

YOUR ANSWERS ARE COMPLETELY CONFIDENTIAL IN ACCORDANCE WITH THE PRIVACY ACT OF 1974.

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1. Which of the following best describes your MAIN job during OPERATION DESERT STORM.
   A. Worked in my usual MOS.
   B. Mess duty.
   C. Guard duty.
   D. Other.

2. Did you receive a "flu" shot just before or during this deployment?
   A. Yes
   B. No

3. Which of the following best describes your experience since Operation Desert Storm began on 17 JAN 91?
   A. I HAVE NOT BEEN SICK at any time during the operation.
   B. I had some MINOR SYMPTOMS, but I was able to work and DID NOT go to sick call.
   C. I felt SICK (more than just minor symptoms) but DID NOT go to sick call.
   D. I felt SICK (more than just minor symptoms), went to sick call and continued to work.
   E. I felt SICK and was officially placed SICK IN QUARTERS or HOSPITALIZED.

SINCE OPERATION DESERT STORM BEGAN (17 JAN 91), DID YOU DEVELOP ANY OF THE FOLLOWING SYMPTOMS? Please rate each one for severity.

A. No, none B. Yes, mild C. Yes, moderate D. Yes, severe

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4. Fever.

5. Three or more loose (unformed) bowel movements in a 24 hour period.

6. Increased gas or loose stools associated with taking chemical/biological warfare (CBW) protective medications.

A. No, none B. Yes, mild C. Yes, moderate D. Yes, severe

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7. Stomach cramps.

8. Nausea or vomiting.

9. Blood or mucus in bowel movements.

10. Fever or chills associated with loose bowel movements.

11. Wheezing.

12. Dry cough.

13. Cough producing mucus or phlegm.

14. Cough producing blood.

15. Pain or burning in the chest.

16. Fever or chills associated with cough.

17. Runny nose lasting more than 1 day.

18. Burning or watery eyes lasting more than 2 days.

19. Red eyes or pus drainage from the eyes ("pink eye").

20. Sore throat.

21. Skin rash.

THE FOLLOWING QUESTIONS ARE ABOUT SYMPTOMS YOU MIGHT HAVE HAD DURING THIS OPERATION. PLEASE READ AND ANSWER ALL OF THE QUESTIONS (WHETHER YOU WERE SICK OR NOT).

22. Which of the following best describes your experience with DIARRHEA during Operation Desert Storm (since 17 JAN 91)? (If you had 3 or more loose/watery bowel movements in 24 hours, you had diarrhea).

A. I DID NOT HAVE ANY DIARRHEA.
B. I had only one episode (24 hours or more).
C. I had two separate episodes of diarrhea (each 24 hours or more), but recovered in between.
D. I had three or more separate episodes (each 24 hours or more), but recovered in between.

23. How long did your DIARRHEA last during Operation Desert Storm? (Total of all episodes combined).

A. I DID NOT HAVE DIARRHEA.
B. Diarrhea lasted 1 to 2 days.
C. Diarrhea lasted 3 to 5 days.
D. Diarrhea lasted 6 or more days.

24. Where were you living when you had diarrhea?
    A. I DID NOT HAVE DIARRHEA.
    B. I was living in a warehouse.
    C. I was living in the field without running water.
    D. I was living in a camp with running water and flush toilets.
    E. None of the above applies.

25. How long did your COUGH last during Operation Desert Storm?
    A. I DID NOT HAVE A COUGH.
    B. I had one period of coughing which lasted up to 7 days.
    C. I had one period of coughing lasting more than 1 week.
    D. I had two or more short periods (up to 7 days) of cough.
    E. I had two or more long periods (1 wk. or more) of cough.

26. Where were you living when you developed your COUGH?
    A. I DID NOT HAVE A COUGH.
    B. I was living in a warehouse.
    C. I was living in the field.
    D. I was living in a camp with trailers for housing.
    E. None of the above applies.

27. Did you develop "COLD" symptoms (runny nose, etc.) during Operation Desert Storm?
    A. I DID NOT HAVE "COLD" symptoms at any time.
    B. I had one cold which lasted up to 7 days.
    C. I had one cold which lasted more than 1 week.
    D. I had two or more colds which lasted up to 7 days.
    E. I had two or more colds which lasted more than 1 week.

28. Which of the following best describes any INJURY you had.
    A. I WAS NOT INJURED.
    B. Minor cut, scrape, or strain NOT requiring medical attention.
    C. Cut, scrape, sprain or fracture REQUIRING MEDICAL ATTENTION.
    D. Injury other than cut, scrape, sprain or fracture, NOT requiring medical attention.
    E. Injury other than cut scrape, sprain or fracture, REQUIRING MEDICAL ATTENTION.

29. Which of the following describes HOW you were INJURED?
    A. I WAS NOT INJURED.
    B. I was injured during PT, sports activities or free time.
    C. I was injured doing my job, but NOT in combat.
    D. I was injured doing my job DURING combat.

30. Which of the following best describes your smoking?
    A. I HAVE NEVER SMOKED.
    B. I AM AN EX-SMOKER
    C. I currently SMOKE less than 1 pack per day.
    D. I currently SMOKE 1 to 2 packs per day.
    E. I currently SMOKE more than 2 packs per day.

31. How many years have you smoked? (Please answer even if you are an ex-smoker.)
    A. I HAVE NEVER SMOKED.
    B. Less than one year.
    C. 1 to 5 years.
    D. 6 to 10 years
    E. Over 10 years.

Do you have (or have you ever had) a history of any of the following prior to Operation Desert Storm.

32.	Asthma (doctor's diagnosis)	YES	NO	Don't Know
33.	Hay fever	YES	NO	Don't Know
34.	Allergies to medication	YES	NO	Don't Know
35.	Emphysema or bronchitis	YES	NO	Don't Know
36.	Persistent <u>night</u> cough	YES	NO	Don't Know

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37. Did you develop EYE IRRITATION during Operation Desert Storm?
    A. I DID NOT HAVE EYE IRRITATION.
    B. I had eye irritation which lasted 1 to 2 days.
    C. I had eye irritation which lasted 3 to 7 days.
    D. I had eye irritation which lasted 1 to 2 weeks.
    E. I had eye irritation which lasted more than 2 weeks.

38. Did you develop SKIN IRRITATION during Operation Desert Storm?
    A. I DID NOT HAVE SKIN IRRITATION.
    B. I had skin irritation which lasted 1 to 2 days.
    C. I had skin irritation which lasted 3 to 7 days.
    D. I had skin irritation which lasted 1 to 2 weeks.
    E. I had skin irritation which lasted more than 2 weeks.

39. What was your experience with exposure to blowing dust and sand during Operation Desert Storm?
    A. I WAS NOT EXPOSED TO BLOWING DUST AND SAND.
    B. I was exposed to blowing dust and sand, but did NOT find it irritating.
    C. I was exposed to blowing dust and sand and found it mildly irritating.
    D. I was exposed to blowing dust and sand and found it moderately irritating?
    E. I was exposed to blowing dust and sand and found it severely irritating.

40. What was your experience with smoke from the oil well fires in Kuwait?
   A. I WAS NOT EXPOSED to the smoke from oil well fires.
   B. I was exposed to the smoke but did NOT find it irritating.
   C. I was exposed to the smoke and found it mildly irritating.
   D. I was exposed to the smoke and found it moderately irritating.
   E. I was exposed to the smoke and found it severely irritating.

Please indicate if you are experiencing any of the following problems TODAY.

41.	Diarrhea	YES	NO
42.	Cough	YES	NO
43.	Cold	YES	NO
44.	Skin irritation	YES	NO
45.	Eye irritation	YES	NO

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46. Which of the following best describes the MEDICAL BRIEFING you received about the Middle East?
   A. I DID NOT RECEIVE any medical briefing about the area.
   B. I received a medical briefing, but I DON'T REMEMBER what it was about.
   C. I received a medical briefing, but the information WAS NOT USEFUL to me.
   D. I received a medical briefing and the information was USEFUL to me.

47. How well do you feel the Medical Department prepared you to protect your health in the Middle East?
   A. I was VERY WELL PREPARED by the Medical Department to protect my health.
   B. I was ADEQUATELY PREPARED by the Medical Department to protect my health.
   C. I was POORLY PREPARED by the Medical Department to protect my health.
   D. The Medical Department DID NOT PREPARE ME AT ALL to protect my health.

YOU HAVE FINISHED! THANK YOU VERY MUCH FOR YOUR COOPERATION.

Record #_____
Date_____

OPERATION DESERT STORM DEPLOYMENT QUESTIONNAIRE
IDENTIFICATION AND ANSWER SHEET

NAME:_____ RANK:_____

SS#_____ MOS:_____ DOB:_____ SEX:___

PRESENT COMMAND:_____

PARENT COMMAND:_____

HOME ADDRESS:_____

YEAR ENTERED SERVICE:_____ DATE ARRIVED IN MIDEAST:_____

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1. A B C D	17. A B C D	33. YES NO ?
2. A B	18. A B C D	34. YES NO ?
3. A B C D E	19. A B C D	35. YES NO ?
4. A B C D	20. A B C D	36. YES NO ?
5. A B C D	21. A B C D	37. A B C D E
6. A B C D	22. A B C D	38. A B C D E
7. A B C D	23. A B C D	39. A B C D E
8. A B C D	24. A B C D E	40. A B C D E
9. A B C D	25. A B C D E	41. YES NO
10. A B C D	26. A B C D E	42. YES NO
11. A B C D	27. A B C D E	43. YES NO
12. A B C D	28. A B C D E	44. YES NO
13. A B C D	29. A B C D	45. YES NO
14. A B C D	30. A B C D E	46. A B C D
15. A B C D	31. A B C D E	47. A B C D
16. A B C D	32. YES NO ?	

INSTRUCTIONS FOR ADMINISTRATION OF
OPERATION DESERT STORM DEPLOYMENT QUESTIONNAIRE

1. DISTRIBUTE QUESTIONNAIRE BOOKLETS, ANSWER SHEETS AND PENCILS.

2. REMIND PARTICIPANTS NOT TO WRITE IN THE BOOKLETS BUT ONLY ON THE ANSWER SHEETS.

3. TELL PARTICIPANTS THAT SURVEY IS VOLUNTARY AND THAT THE INFORMATION IS COVERED BY THE PRIVACY ACT OF 1974.

4. INSTRUCT PARTICIPANTS TO FILL OUT IDENTIFICATION PORTION OF ANSWER SHEET:

A. NAME, RANK, SS#, MOS, DOB, SEX = SELF-EXPLANATORY.
B. PRESENT COMMAND = ATTACHED TO NOW.
C. PARENT COMMAND = IF SAME AS PRESENT COMMAND, WRITE "SAME". IF TAD FROM ANOTHER COMMAND, WRITE THE NAME OF ORIGINAL COMMAND.
D. HOME ADDRESS = USE BEST ADDRESS FOR FUTURE CONTACT.
E. YR ENTERED SVC AND DATE ARRIVED ME = SELF EXPLANATORY.

5. INSTRUCT PARTICIPANTS TO WRITE THE FOLLOWING INFORMATION CONCERNING THE USE OF THE CHEMICAL BIOLOGICAL WARFARE MEDICATIONS IN THE LOWER RIGHT HAND CORNER OF THE ANSWER SHEET:

A. CBW = YES (IF THEY TOOK THE MEDICATIONS)
B. CBW = NO (IF THEY DID NOT TAKE THE MEDICATIONS)

6. EXPLAIN THAT FOR QUESTIONS 32 - 36, THE QUESTION MARK ON THE ANSWER SHEET MEANS "DON'T KNOW".

7. ADVISE PARTICIPANTS THAT YOU WILL EXPLAIN ANY UNFAMILIAR TERMS TO THEM.

8. REMIND PARTICIPANTS THAT THE PERIOD COVERED IS OPERATION DESERT STORM 17 JANUARY TO PRESENT.

9. AS EACH PERSON FINISHES WITH THEIR ANSWER SHEET, REVIEW IT FOR COMPLETENESS.

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10. PLACE THE ANSWER SHEETS IN AN ENVELOPE LABELED WITH THE TESTING SITE AND DATE.

11. ALSO PUT A SHEET OF PAPER IN THE ENVELOPE ON WHICH YOU HAVE RECORDED THE FOLLOWING:

A. NAMES OF UNIT COMMANDER, YOUR POINT OF CONTACT AND THE UNIT'S MEDICAL REPRESENTATIVE.

B. A BRIEF SUMMARY OF THEIR LOCATIONS DURING DESERT STORM.

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS UNITED STATES AIR FORCE
20332-6188

24 DEC 1992

MEMORANDUM FOR THE ADMINISTRATIVE ASSISTANT TO THE SECRETARY, DEPARTMENT OF THE ARMY

SUBJECT: Report to Congress - Exposure of Persian Gulf Members to Fumes of Burning Oil - INFORMATION MEMORANDUM

We reviewed your request for Air Force input for the Report to Congress. The Air Force does not have any studies in progress concerning possible adverse health consequences from exposures to fumes of burning oil. We do not believe, based on our clinical experience to date, that there is a need to initiate additional epidemiologic research at the present time.

Most Air Force personnel who participated in Operation DESERT STORM (ODS) were assigned to locations which were far from the burning Kuwaiti oil fires. We have had no reports of diagnosed conditions caused by inhalation of oil fire fumes occurring among Air Force personnel. The interim findings of the Kuwaiti Oil Fire Health Effects Working Group corroborate our observations that the oil fires posed minimal health risks to the majority of ODS personnel. In August 1992, an Expert Panel convened at the Uniformed Services University of the Health Sciences and discussed the issue of petrochemical toxicity. The panel concluded that reported symptoms among ODS veterans were unlikely to have been caused by exposure to petrochemical or other environmental risk factors.

We support development of the Persian Gulf War Health Veteran's Registry. The registry will maintain the essential demographic and exposure information required to support future epidemiologic research. The Air Force is cooperating with the Joint Services Environmental Support Group (JSESG), and is providing information concerning U.S. Air Force ODS personnel rosters, unit locations, meteorological data, and satellite imagery.

We believe that the JSESG and Kuwaiti Risk Assessment Team should continue their respective activities, and these operations should receive adequate congressional support. Our current policy of reporting any unusual illnesses associated with ODS deployment will remain in effect indefinitely. My point of contact is Lt Col Relford E. Patterson, HQ AFMOA/SGPA, 5681 Luke Avenue, Bolling AFB DC 20331-6188, DSN 297-1837 or (202) 767-1837.

ALEXANDER M. SLOAN
Lieutenant General, USAF, MC
Surgeon General