



## U.S. Military Health Survey

Carla Bann  
Vince Iannacchione  
RTI International

February 24, 2009

[www.rti.org](http://www.rti.org)

RTI International is a trade name of Research Triangle Institute

## Topics to be Discussed

1. Overview of National Survey design and data collection
2. Highlights of preliminary findings
3. Fit of original Factor case definition to national survey data
4. Overlap of case definitions: Factor, Kansas and CDC
5. Comparison of case definitions and their overlap areas
6. Search for new case definition with latent class analysis and other approaches
7. Remaining study design decisions

2

[www.rti.org](http://www.rti.org)

5/8/2009



## Study Design Overview

### ***Three-Phase Study of Gulf War Era (1990-91) Veterans***

Phase 1: Telephone Interviews (CATI)

Phase 2: Blood Specimens

Phase 3: Clinic Exams (Neuroimaging & Biomarker Study)

3

## Survey Population

### ***Target Population***

3.75M Gulf War Era veterans:

- 752K veterans who were deployed to KTO
- 3M non-deployed veterans

### ***Sampling Frame***

- Created by Defense Manpower Data Center (DMDC)
- Updated KTO unit deployment locations (CHPPM)

4

## Primary Analytic Objectives

- Estimate the prevalence of syndromes based on the Factor Case definition
- Test for differences between those who were:
  - Deployed to KTO  
versus  
Not deployed to KTO (but deployable)
  - Deployed to Northern KTO during the Air War  
versus  
Deployed elsewhere in KTO

5

## Secondary Analytic Objectives

- Validate and refine the factor analysis model used to derive original factor case Definitions
- Estimate magnitude of the “Healthy Warrior Effect”  
  
*“Bias caused by the disproportionate concentration of pre-war illness in the non-deployed population.”*

6

## Stratified Sampling Design

### **Strata for CATI Phase**

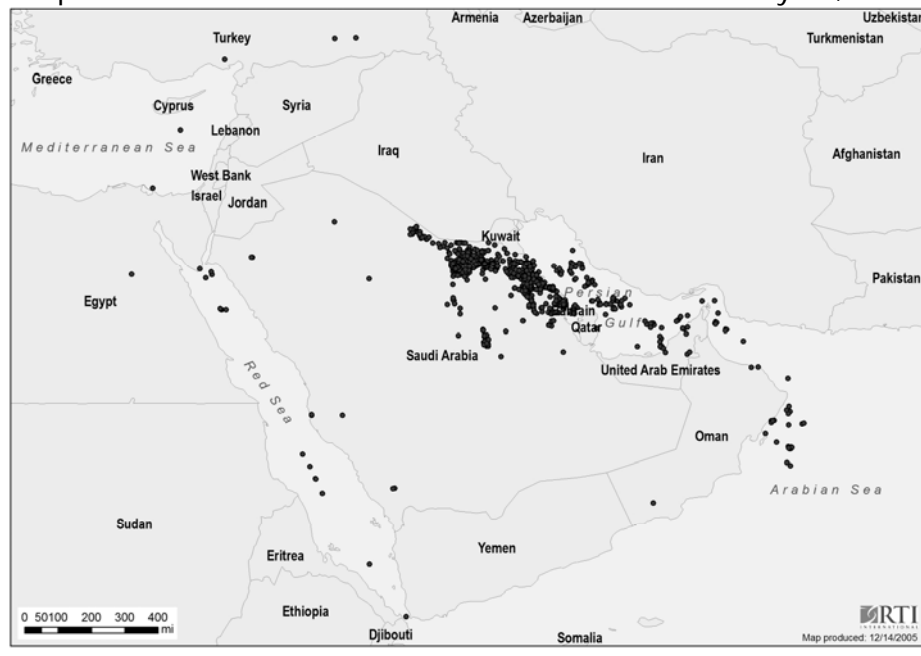
- Deployed to KTO
- Location during the Air War
- Age Group, Race, and Gender
- Active or Reserve status
- Special Strata

### **Strata for Blood Specimen Phase**

- Syndromic (Factor or Kansas)
- Subsyndromic
- Non-Syndromic

7

## Troop Locations – Start of Desert Shield Air War – January 16, 1991



## Phase 1 – CATI Questionnaire

### ***Questionnaire includes three modules***

- Symptoms (771 questions)
- Exposures (244 questions)
- Family Issues (76 questions)

### ***Average length of interview***

- 60 minutes for those healthy and not deployed to KTO
- 2.5 hours for those deployed with health issues

9

## Telephone Interviewing Protocol

### ***Advance Materials***

- Lead Letter
  - Participation is important but voluntary
  - \$10 bill included
  - \$40 for completing CATI questionnaire
- Letters of Endorsement
- Map of KTO
- Document containing FAQs and Answers

10

## CATI Performance Rates

	Target	Actual
<b>Eligibility Rate</b>	98.1%	92.9%
<b>Contact Rate</b>	90.0%	71.2%
<b>Cooperation Rate</b>	74.5%	82.4%
<b>RR4 Response Rate<sup>2</sup></b>	67.1%	58.7%

<sup>2</sup>Contact rate times cooperation rate.

11

## CATI Performance Rates

	Contact Rate	Cooperation Rate	Response Rate
<b>Males</b>	71%	82%	58%
<b>Females</b>	71%	85%	60%
<b>Age &lt; 49</b>	67%	81%	55%
<b>Age &gt;= 49</b>	81%	85%	69%
<b>White</b>	76%	82%	62%
<b>Non-White</b>	62%	83%	51%
<b>Southern KTO</b>	70%	83%	58%
<b>Northern KTO</b>	72%	85%	61%
<b>Not Deployed</b>	72%	77%	55%
<b>Overall</b>	71%	82%	59%

12

## Measures Taken to Improve Response Rates

### Non-Contacts:

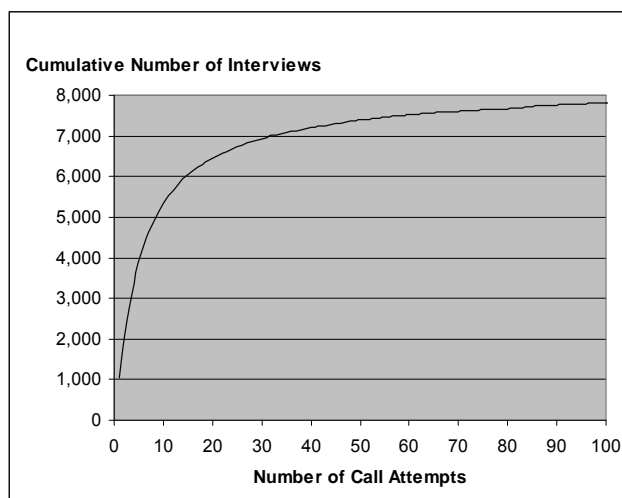
- Intensive tracing for majority of cases: 1.5 to 2.5 hours
- Obtained addresses from the IRS (no phone numbers)
- Mailed a letter with a toll-free call-in number
  - Sent a voicemail from Dr. Haley

### Initial Refusals:

- Sent refusal conversion letters
- Specially trained TIs attempted to convert
- Increased the incentive to \$65

13

## Measures Taken to Improve Response Rates



14

## Target Versus Actual CATI Interviews

	Initial Sample Size	Target		Actual	
		CATI Interviews	Response Rate	CATI Interviews	Response Rate
Not Deployed to KTO	2,321	1,273	58.6%	1,194	55.6%
Deployed to KTO	10,623	7,169	68.2%	5,695	58.3%
Twins Study	1,239	804	66.3%	646	58.4%
Seabees	594	450	76.7%	453	78.2%
Parents of Goldenhars	43	41	78.8%	28	73.4%
<b>Total</b>	<b>14,820</b>	<b>9,737</b>	<b>67.0%</b>	<b>8,016</b>	<b>58.7%</b>

15

## Sampling Weights

### ***Sampling weights needed to adjust for***

- Selection bias
- Nonresponse bias

### ***Weights calculated in a three-step process***

1. Initial weight = inverse of selection probability
2. Adjustment applied for non-contact
3. Adjustment applied for non-cooperation

16



## Adequacy of the Sample for Testing Hypotheses

### Deployable Non-Deployed

	Percent Syndromic		Effective Sample Size	
	Assumed	CATI	Target	Achieved
<b>Male</b>	5%	3%	111	342
<b>Female</b>	10%	6% *	200	226
<b>Age &lt; 49</b>	5%	3% *	111	892
<b>Age &gt;= 49</b>	10%	6% *	200	417
<b>White</b>	5%	3% *	111	1,009
<b>Non-White</b>	15%	6% *	298	177
<b>Active Duty</b>	5%	4%	111	493
<b>Reservists</b>	10%	4% *	200	380

\* Significant at  $\alpha=0.05$

17

## Adequacy of the Sample for Testing Hypotheses

### Deployed to Northern KTO During Air War

	Percent Syndromic		Effective Sample Size	
	Assumed	CATI	Target	Achieved
<b>Male</b>	20%	16% *	496	1,321
<b>Female</b>	25%	21%	601	554
<b>Age &lt; 49</b>	20%	15% *	496	1,635
<b>Age &gt;= 49</b>	25%	21% *	601	1,253
<b>White</b>	20%	14% *	496	1,674
<b>Non-White</b>	30%	20% *	688	1,145
<b>Active Duty</b>	20%	16% *	496	1,809
<b>Reservists</b>	25%	17% *	601	822

\* Significant at  $\alpha=0.05$

18

## Adequacy of the Sample for Testing Hypotheses

### Deployed to Southern KTO During Air War

	Percent Syndromic		Effective Sample Size	
	Assumed	CATI	Target	Achieved
<b>Male</b>	15%	12%	496	759
<b>Female</b>	20%	14%	601	179
<b>Age &lt; 49</b>	15%	13%	496	1,149
<b>Age &gt;= 49</b>	20%	12% *	601	568
<b>White</b>	15%	10% *	496	1,964
<b>Non-white</b>	25%	18% *	688	287
<b>Active Duty</b>	15%	12%	496	799
<b>Reservists</b>	20%	13% *	601	350

\* Significant at  $\alpha=0.05$

19

## Adequacy of the Sample for Testing Hypotheses

### Special Strata

	Percent Syndromic		Effective Sample Size	
	Assumed	CATI	Target	Achieved
<b>Dep Air Crews</b>	20%	2% *	46	249
<b>DND Air Crews</b>	5%	0% *	46	280
<b>Dep Aircraft Main.</b>	20%	6% *	46	528
<b>DND Aircraft Main.</b>	5%	4%	46	61
<b>Dep Army Special Forces</b>	20%	19%	46	61
<b>DND Army Special Forces</b>	5%	2%	46	47
<b>Camp Doha</b>	20%	16%	496	278
<b>Dep not at Camp Doha</b>	15%	13%	496	1,091

\* Significant at  $\alpha=0.05$

20

## Twins Study

	Number of Twin Pairs	
<b>One or both not a twin</b>	10	2%
<b>One or both ineligible</b>	91	15%
<b>Both non-interview</b>	246	40%
<b>One Interview</b>	86	14%
<b>Both fraternal</b>	80	13%
<b>One fraternal, One identical</b>	10	2%
<b>Both identical</b>	<u>96</u>	<u>16%</u>
<b>Total</b>	619	100%

21

### **Purpose**

Determine association between GW syndrome and PON level

### **Protocol**

- Phase 2 participants selected from CATI respondents
  - All identified as syndromic using the Factor or Kansas case definition and from groups of special interest
  - A random 10% sub-sample from others
- Contract with EMSI to collect samples
- Samples sent to UT-Southwestern for analysis

22

	<b>Target</b>	<b>Current</b>	<b>Projected</b>	
<b>Syndromic</b>	1,131	417	817	72%
<b>Non Syndromic</b>	961	342	728	76%
<b>Total</b>	<b>2,092</b>	<b>759</b>	<b>1,545</b>	<b>74%</b>

23

***Original Purpose***

- Test external validity of findings from the Seabees pilot studies

***Protocol***

- Phase 3 selected after Phase 2 completed from respondents
  - Case/control sample balanced on characteristics
- RTI will recontact Veterans by phone to gain cooperation
- UTSW will finalize appointments/transportation
- Clinic exams take place at UTSW and last 7 full days

24

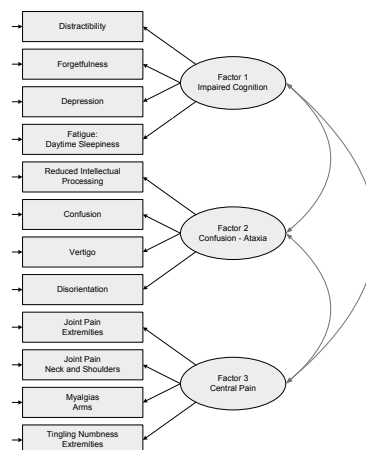
## Case Definitions

- Current case definitions:
  - Factor-based case definition (Haley et al., 1997, 2001)
  - Kansas case definition (Steele et al., 2000)
  - CDC case definition (Fukuda et al., 1998)
- Exploring possible alternative case definitions:
  - Latent class analysis
  - Other approaches (e.g., correspondence analysis, logistic regression analyses)
- Presentation of preliminary analyses

25

## Factor-Based Case Definition: Confirmatory Factor Models (1 of 2)

- Confirmatory factor analyses to test model presented by Haley et al. (*Psychiatry Research* 2001) in new sample
- 3 factors representing the 3 primary factor syndromes
- Randomly split sample into thirds to allow for cross-validation



26

## Factor-Based Case Definition: Confirmatory Factor Models (2 of 2)

Model	CFI	TLI	SRMR	RMSEA
Deployed only	.956	.941	.039	.068
Non-deployed only	.966	.954	.033	.057
Deployed & Non-deployed (unequal)	.958	.948	.038	.063
Deployed & Non-deployed (equal)	.955	.949	.042	.063

Fit statistics indicate a good fit of the model to the national sample.

27

## 24<sup>th</sup> Reserve Naval Mobile Construction Battalion

- Factor syndromes were originally derived from analyses of 249 veterans of the 24th Reserve Naval Mobile Construction Battalion (Haley et al., 1997)
- Sample for current study included all 587 eligible veterans of the battalion
- 200 of the 249 respondents in the 1994 study also responded to the USMHS
- Compared factor structure for those in 1994 study to those who were not in the earlier study
- Conducted longitudinal analyses to compare syndrome status from 1994 to current study for 200 in both studies

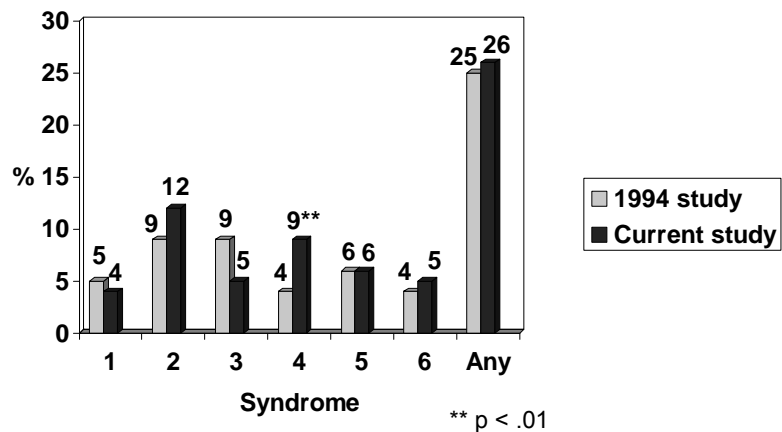
28

## Naval Mobile Construction Battalion: Confirmatory Factor Models

Model	CFI	TLI	SRMR	RMSEA
In 1994 study	.928	.902	.054	.096
In current study	.967	.956	.037	.064
1994 & Current (unequal)	.941	.932	.052	.079
1994 & Current (equal)	.946	.933	.047	.078

29

## Naval Mobile Construction Battalion: % of Respondents with Factor Syndromes



30

## Naval Mobile Construction Battalion: Mean Factor Syndrome Scores

Syndrome	1994	Current	p	ICC
1: Impaired cognition	0.0 (0.9)	-0.2 (0.9)	.007	0.46
2: Confusion-ataxia	0.0 (0.9)	0.2 (1.0)	.005	0.48
3: Andro-myo-neuropathy	0.0 (0.9)	0.1 (0.8)	.043	0.43
4: Phobia-apraxia	0.0 (0.9)	0.4 (1.0)	< .001	0.28
5: Fever-adenopathy	0.0 (0.9)	0.1 (0.8)	.487	0.37
6: Weakness-incontinence	0.0 (0.9)	0.0 (0.8)	.769	0.39
Maximum syndrome score	1.0 (1.1)	1.0 (1.1)	.768	0.72

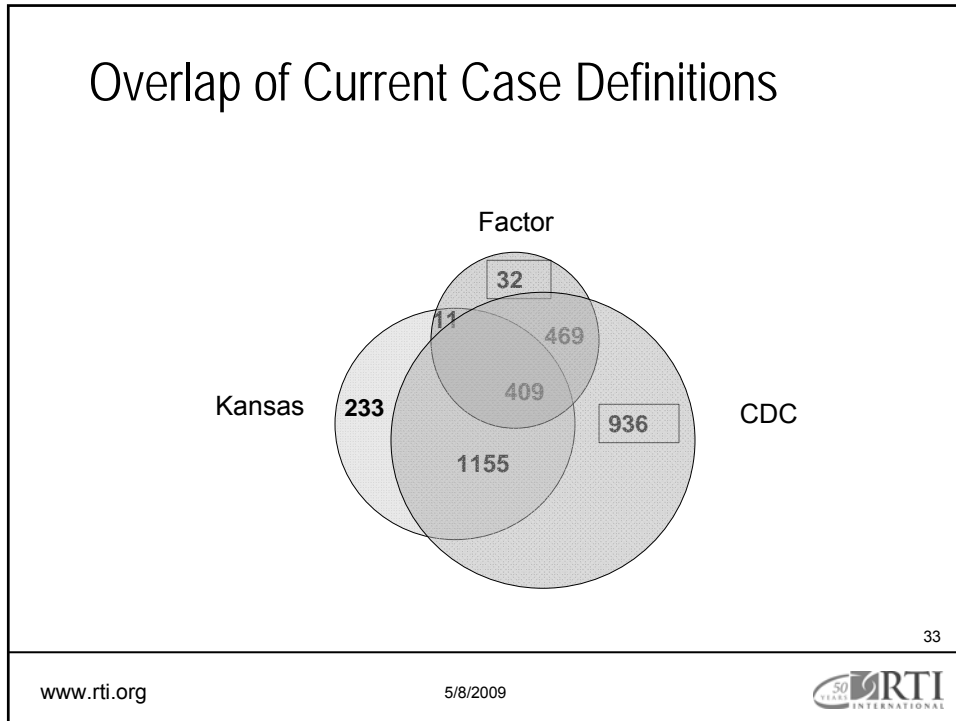
31

## Prevalence of Current Case Definitions in USMHS

Case Definition	N	%
Factor	921	12
Kansas	1,808	23
CDC	2,969	37

32





## Comparison of Current Case Definitions and their Overlap Areas

Which case definition best measures Gulf War Illness?

- How much higher are their rates in deployed vs. non-deployed veterans?
- How strong is their association with multiple risk factors?

34

www.rti.org      5/8/2009

## Strength of Association of Current Case Definitions with Deployment Status

Definition	Deployed	Non-Deployed	Relative Risk
Factor (any syndrome)	13.3%	3.7%	3.62
Kansas	25.5%	10.6%	2.41
CDC	41.4%	18.7%	2.22
Factor & Kansas	6.1%	1.6%	3.82
Factor (not Kansas)	7.2%	2.1%	3.48
Kansas (not Factor)	19.4%	9.0%	2.17
Factor only	0.5%	0.2%	2.16
Kansas only	3.2%	1.5%	2.12
CDC only	12.5%	7.9%	1.58

35

## Current Case Definitions: Exposure Risk Factor Models (1 of 4)

- Stepwise model:
  - Large pool of potential risk factors
- A priori model (Subset of risk factors):
  - Depleted uranium (Capstone scoring)
  - Camp Doha fire
  - Saw Khamasiyah smoke plume
  - Pesticide use (Avon, Off, Military issue)
  - Chemical weapons alarm went off
  - Ordered to put on MOPP gear
  - Pyridostigmine side effects
  - Vaccines (Anthrax, Botulism, Plague)
  - Petroleum (Petro-soaked roads, Burning fuel in tents)
  - Combat exposure scale
  - Experienced a chemical weapons attack

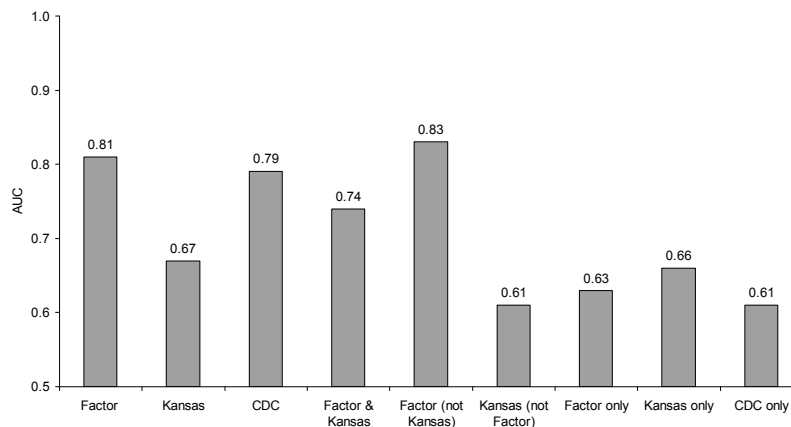
36

## Current Case Definitions: Exposure Risk Factor Models (2 of 4)

Definition	Stepwise model	A priori model
	AUC	AUC
Factor (any syndrome)	0.81	0.80
Kansas	0.67	0.68
CDC	0.79	0.78
Factor & Kansas	0.74	0.74
Factor (not Kansas)	0.83	0.80
Kansas (not Factor)	0.61	0.64
Factor only	0.63	0.78
Kansas only	0.66	0.67
CDC only	0.61	0.61

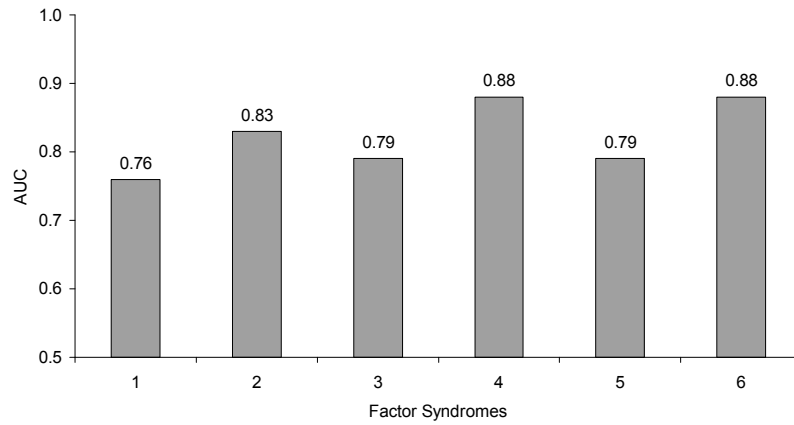
37

## Current Case Definitions: Exposure Risk Factor Models (3 of 4)



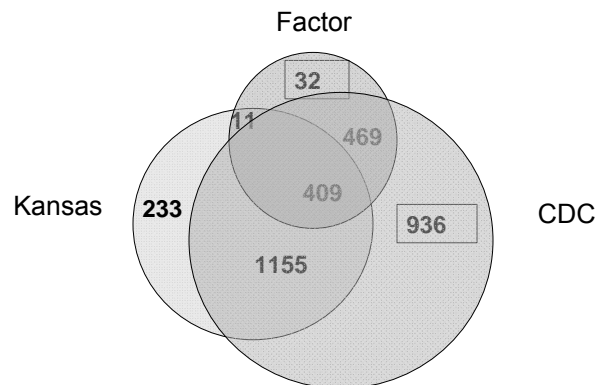
38

## Current Case Definitions: Exposure Risk Factor Models (4 of 4)



39

## Overlap of Current Case Definitions



40

## Next Steps for Case Definitions

- Exploratory factor analyses
  - Identify best fitting factor structure on first 1/3 of sample (development sample)
  - Test factor structure on second 1/3 of sample (validation sample)
- Other approaches to developing case definitions:
  - Correspondence analysis (next presentation)
  - Logistic regression models predicting deployment status
  - Latent class analyses grouping respondents by patterns of symptoms

41