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Name of Principal Author and all other author(s):

James Zouris
Amber Wade

Principal Author's Organization and address:

Naval Health Research Center
PO Box 85122
San Diego, CA 92186-5122

Phone: (619) 553-8389

Fax:

Email: zouris@nhrc.navy.mil

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Injury and Illness Casualty Distributions during Operation Iraqi Freedom



**James Zouris
Amber Wade
Cheryl Magno**

Naval Health Research Center Department
Medical Modeling, Simulation and Mission Support
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and The Bureau of Medicine and Surgery (BUMED), Washington, DC

Objectives



- Background
- Methods
- Results
- Summary
- Transitioning data

Background



- Examining and **understanding the epidemiology of combat casualty outcomes** is essential to improving military medical planning.
- Reliable estimates of casualties and of threats to the Health Service Support system are necessary to **forecast medical resource requirements for military operations.**
- Casualty estimates consist of absolute numbers, surges in casualty admissions, evacuation patterns, and the **distribution of types of injuries and illnesses.**
- Hospitalization estimates and other support requirements are derived from these data and are **then incorporated into HSS planning tools to provide the planners the best course of action.**

Methods



- First Hospitalization record of US Marines and Soldiers Personnel Identified in support of OIF
- TRAC2ES¹
 - OIF-1 Major Combat Phase (21 MAR - 30 APR 2003)
- JPTA²
 - OIF-2 Support and Stability Phase II (01 MAR 2004 – 30 APR 2005)
- Chi-square tests of independence and adjusted standardized residuals were used to identify relationships among the data

¹TRAC2ES - TRANSCOM Regulating and Command and Control Evacuation System

²JPTA – Joint Patient Tracking Application

Hypothesis



- Do ICD-9 distributions vary by phase of operation?
 - WIA
 - DNBI
- Do ICD-9 distributions vary by service?
 - WIA
 - DNBI
- Do ICD-9 distributions vary by gender?
 - DNBI
 - NBI

CHARACTERISTICS OF US MARINE CORPS AND ARMY CASUALTIES DURING OIF-1 AND OIF-2

	OIF-1		OIF-2		Total	
	No.	%	No.	%	No.	%
Casualty type						
DNBI	867	63.4	8,941	76.4	9,808	75.0
WIA	501	36.6	2,762	23.6	3,263	25.0
Branch of service						
Army	915	66.9	9,998	85.4	10,913	83.5
Marine Corps	453	33.1	1,705	14.6	2,158	16.5
Gender						
Male	1,255	91.7	10,511	89.8	11,766	90.0
Female	113	8.3	1,192	10.2	1,305	10.0
Total	1,368	100.0	11,703	100.0	13,071	100.0

OIF-1 (21 MAR 2003 – 30 APR 2003)

OIF-2 (01 MAR 2004 – 30 APR 2005)

DISTRIBUTION OF WIA CASUALTIES BY INJURY CATEGORY DURING OIF-1 AND OIF-2

Injury Category	OIF-1			OIF-2			Total	
	No.	%		No.	%		No.	%
Amputations	12	2.4		132	4.8		144	4.4
Burns	20	4.0		163	5.9		183	5.6
Dislocations	11	2.2		23	0.8		34	1.0
Fractures	111	22.2		845	30.6		956	29.3
Intracranial	7	1.4		72	2.6		79	2.4
Nervous system	13	2.6		95	3.4		108	3.3
Sprains/strains	23	4.6		42	1.5		65	2.0
Musculoskeletal	20	4.0		69	2.5		89	2.7
Open wounds	240	47.9		1,087	39.4		1,327	40.7
Other	44	8.8		234	8.5		278	8.5
Total	501	100.0		2,762	100.0		3,263	100.0

WIA, wounded in action
 $\chi^2 = 60.77$, $df = 9$, $p < .001$.
 hearing and visual impairment.
 excludes amputations.

DISTRIBUTION OF DNBI CASUALTIES BY ICD-9 DIAGNOSTIC CATEGORY DURING OIF-1 AND OIF-2

ICD-9 Category	OIF-1			OIF-2			Total	
	No.	%		No.	%		No.	%
Infectious	7	0.9		175	1.9		182	1.9
Neoplasms	7	1.5		141	1.6		148	1.5
Endocrine	10	1.3		165	1.8		175	1.8
Blood	2	0.2		13	0.2		15	0.2
Mental disorders	66	7.9		501	5.6		567	5.8
Nervous system	38	4.3		556	6.2		594	6.1
Circulatory	32	4.0		409	4.6		441	4.5
Respiratory	34	3.7		250	2.8		284	2.9
Digestive	66	7.1		1,005	11.2		1,071	10.9
Genitourinary	52	5.8		563	6.3		615	6.3
Pregnancy	13	1.5		38	0.4		51	0.5
Skin	20	2.3		251	2.8		271	2.8
Musculoskeletal	89	10.8		1,716	19.2		1,805	18.4
Congenital	6	0.8		51	0.6		57	0.6
Ill-defined	75	9.2		958	10.7		1,033	10.5
Injury	338	37.4		1,978	22.1		2,316	23.6
Supplementary	12	1.4		171	1.9		183	1.9
Total	867	100.0		8,941	100.0		9,808	100.0

$\chi^2 = 187.86$, $df = 16$, $p < .001$

DISTRIBUTION OF WIA CASUALTIES BY INJURY CATEGORY FOR US ARMY AND MARINE CORPS DURING OIF-1 AND OIF-2

Injury Category	OIF-1				OIF-2			
	Army		Marine Corps		Army		Marine Corps	
	No.	%	No.	%	No.	%	No.	%
Amputations	4	1.5	8	3.4	99	5.4	33	3.6
Burns	13	4.9	7	3.0	121	6.6	42	4.6
Dislocations	5	1.9	6	2.6	16	0.9	7	0.8
Fractures	59	22.2	52	22.1	540	29.4	305	33.0
Intracranial	1	0.4	6	2.6	42	2.3	30	3.3
Nervous system	9	3.4	4	1.7	74	4.0	21	2.3
Sprains/strains	14	5.3	9	3.8	26	1.4	16	1.7
Musculoskeletal	12	4.5	8	3.4	47	2.6	22	2.4
Open wounds	113	42.5	127	54.0	701	38.1	386	41.8
Other	36	13.5	8	3.4	173	9.4	61	6.6
Total	266	100.0	235	100.0	1,839	100.0	923	100.0

OIF-1 ($\chi^2 = 27.87$, $df = 9$, $p < .01$)

OIF-2 ($\chi^2 = 27.28$, $df = 9$, $p < .01$)

COMPARISON OF ARMY AND MARINE CORPS WIA CASUALTIES BY ANATOMICAL LOCATION FOR OPEN WOUND INJURY CATEGORY

	Army	Marines
Abdomen	5.7%	2.9%
Buttock	3.2%	3.6%
Eye/Ear	8.1%	2.9%
Face/Neck	8.5%	10.9%
Foot/ankle	5.7%	7.2%
Arm	11.7%	18.1%
Hand/wrist	5.7%	5.1%
Head	2.8%	2.2%
Leg	27.5%	29.7%
Multiple	5.7%	1.4%
Shoulder	3.6%	6.5%
Thorax	11.7%	9.4%
Value = 14.93	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	11	p=0.19
N of Valid Cases	240	

DISTRIBUTION OF DNBI CASUALTIES BY ICD-9 DIAGNOSTIC CATEGORY AND BRANCH OF SERVICE DURING OIF-1 AND OIF-2

ICD-9 Category	OIF-1					OIF-2					
	Army			Marines		Army			Marines		
	No.	%		No.		%	No.		%	No.	%
Infectious	6	0.9		1	0.5		162	2.0		13	1.7
Neoplasms	7	1.1		0	0.0		132	1.6		9	1.2
Endocrine	5	0.8		5	2.3		155	1.9		10	1.3
Blood	2	0.3		0	0.0		13	0.2		0	0.0
Mental disorders	58	8.9		8	3.7		457	5.6		44	5.6
Nervous system	31	4.8		7	3.2		496	6.1		60	7.7
Circulatory	24	3.7		8	3.7		392	4.8		17	2.2
Respiratory	30	4.6		4	1.8		237	2.9		13	1.7
Digestive	41	6.3		25	11.5		929	11.4		76	9.7
Genitourinary	39	6.0		13	6.0		527	6.5		36	4.6
Pregnancy	11	1.7		2	0.9		37	0.5		1	0.1
Skin	13	2.0		7	3.2		222	2.7		29	3.7
Musculoskeletal	76	11.7		13	6.0		1,619	19.8		97	12.4
Congenital	5	0.8		1	0.5		48	0.6		3	0.4
Ill-defined	63	9.7		12	5.5		893	10.9		65	8.3
Injury	226	34.8		112	51.4		1,682	20.6		296	37.9
Supplementary	12	1.8		0	0.0		158	1.9		13	1.7
Total	649	100.0		218	100.0		8,159	100.0		782	100.0

TOP 10 MUSCULOSKELETAL DISORDERS AMONG ARMY AND MARINE CORPS PERSONNEL DURING OIF-2

Army

LUMBAGO
BACKACHE NOS
PAIN IN LIMB
JOINT PAIN-SHLDER
JOINT PAIN-L/LEG
JOINT PAIN-ANKLE
LUMBAR DISC DISPLACEMENT
DISC DISPLACEMENT NOS
BACK DISORDER NOS
CERVICALGIA

Marine Corps

LUMBAGO
BACKACHE NOS
INT DERANGEMENT KNEE NOS
PAIN IN LIMB
RUPTURE ACHILLES TENDON
JOINT PAIN-SHLDER
OTHER BACK SYMPTOMS
LUMBOSACRAL NEURITIS NOS
BACK DISORDER NOS
RECUR DISLOCAT-SHLDER

TOP 10 NONBATTLE INJURIES AMONG ARMY AND MARINE CORPS PERSONNEL DURING OIF-2

Army

TEAR MED MENISC KNEE-CUR
FRACTURE NOS-CLOSED
SPRAIN OF KNEE LEG NOS
TEAR MENISCUS NEC-CURREN
DISLOC SHOULDER NOS-CLOS
FX ANKLE NOS-CLOSED
SPRAIN OF ANKLE NOS
SPRAIN SHOULDER/ARM NOS
TEAR LAT MENISC KNEE-CUR
BURN, UNSPECIFIED DEGREE

Marine Corps

FRACTURE NOS-CLOSED
TEAR MED MENISC KNEE-CUR
DISLOC SHOULDER NOS-CLOS
FX ANKLE NOS-CLOSED
SPRAIN OF ANKLE NOS
TEAR MENISCUS NEC-CURREN
FX TIBIA NOS-CLOSED
FX PHALANX, HAND NOS-CL
DISLOCATION ANKLE-CLOSED
FX FOOT BONE NOS-CLOSED

DISTRIBUTION OF NBI CASUALTIES BY GENDER DURING OPERATION IRAQI FREEDOM

ICD-9 Category	Men		Women		Total	
	No.	%	No.	%	No.	%
Infectious	171	2.0	11	1.1	182	1.9
Neoplasms	114	1.4	34	2.9	148	1.5
Endocrine	152	1.8	23	2.0	175	1.8
Blood	10	0.2	5	0.6	15	0.2
Mental disorders	471	5.7	96	9.0	567	5.9
Nervous system	536	6.3	58	5.2	594	6.2
Circulatory	404	4.8	37	3.5	441	4.6
Respiratory	237	2.8	47	4.5	284	3.0
Digestive	997	11.6	74	6.6	1,071	11.2
Genitourinary	333	3.9	101	9.0	434	4.5
Skin	239	2.8	32	2.9	271	2.8
Musculoskeletal	1,597	18.8	208	18.3	1,805	18.8
Congenital	48	0.5	9	0.7	57	0.6
Ill-defined	877	10.5	156	14.4	1,033	10.8
Injury	2,140	25.2	176	16.4	2,316	24.2
Supplementary	148	1.7	35	3.0	183	1.7
Total	8,474	100.0	1,102	100.0	9,576	100.0

$\chi^2 = 201.90$, $df = 15$, $p < .001$

Note: ICD-9 diagnoses associated with childbirth, diseases of the male genital organs, inflammatory disease of female pelvic organs, and other disorders of the female genital tract were excluded.

DISTRIBUTION OF DNBI CASUALTIES BY GENDER AND ICD-9 DIAGNOSTIC CATEGORY DURING OIF-1 AND OIF-2

ICD-9 Category	OIF-1					OIF-2						
	Men			Women			Men			Women		
	No.	%		No.			%	No.		%	No.	%
Infectious	7	0.9		0	0.0		164	2.1		11	1.0	
Neoplasms	3	0.4		4	3.7		111	1.4		30	2.6	
Endocrine	8	1.1		2	1.8		144	1.8		21	1.8	
Blood	1	0.1		1	0.9		9	0.1		4	0.4	
Mental disorders	54	7.1		12	11.0		417	5.3		84	7.4	
Nervous system	33	4.4		5	4.6		503	6.4		53	4.7	
Circulatory	30	4.0		2	1.8		374	4.8		35	3.1	
Respiratory	29	3.8		5	4.6		208	2.7		42	3.7	
Digestive	64	8.4		2	1.8		933	12.0		72	6.3	
Genitourinary	40	5.3		12	11.0		379	4.9		184	16.2	
Pregnancy	0	0.0		13	11.9		0	0.0		38	3.3	
Skin	20	2.6		0	0.0		219	2.8		32	2.8	
Musculoskeletal	82	10.8		7	6.4		1,515	19.4		201	17.6	
Congenital	8	0.8		0	0.0		42	0.5		9	0.8	
Ill-defined	61	8.0		14	12.8		816	10.5		142	12.5	
Injury	312	41.2		26	23.9		1,828	23.4		150	13.2	
Supplementary	8	1.1		4	3.7		140	1.8		31	2.7	
Total	758	100.0		109	100.0		7,802	100.0		1,139	100.0	

DISTRIBUTION OF NONBATTLE INJURIES AMONG DNBI CASUALTIES BY GENDER DURING OIF

Nonbattle Injury Category	Men			Women			Total	
	No.	%		No.	%		No.	%
Burns	74	5.1		9	3.5		83	3.6
Dislocations	178	5.0		17	4.2		195	4.3
Fractures	721	16.6		54	17.9		775	17.8
Heat	37	1.8		5	1.1		42	1.2
Sprains/strains	649	18.0		48	19.8		697	19.7
Open wounds	304	10.5		23	11.6		327	11.5
Other	177	10.2		20	7.6		197	7.8
Total	2140	100.0		176	100.0		2316	100.0

DNBI, disease and nonbattle injury.
 $\chi^2 = 5.62$, $df = 6$, $p = .47$.

Results



- WIA and DNBI distributions varied by phase of operation
- WIA and DNBI distributions varied by service
- WIA and DNBI distributions varied by gender
- Non-battle Injuries among US Marines is significantly higher than the other services
- NBI casualties were similar among gender
- Distribution of diagnoses within the ICD-9 categories are similar among the USA and USMC

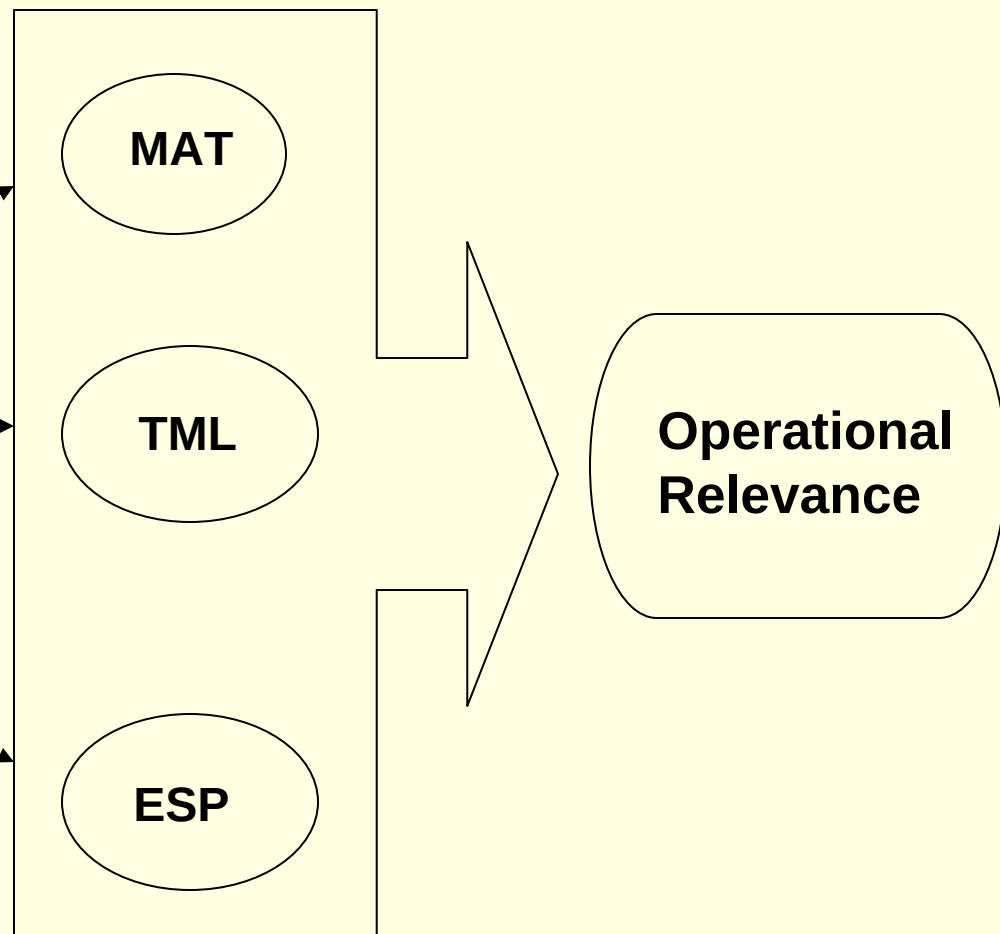
TRANSITIONING THE DATA

PCOF Tool

OIF-1	OIF-1
OIF-1	
OIF-2	
Mogadishu	
Vietnam	
MAT - Marines	

OPERATION SELECTION	OIF-1
INPUT PERCENTAGE	100.0%

TRAUMA CATEGORIES	Baseline
Amputations upper	1.7%
Amputations lower	2.3%
Burns	3.2%
Intracranial Injuries (Concussions)	2.1%
Crush injuries	1.6%
Dislocation	2.0%
Fractures	22.7%
Sprains/strains	6.3%
All Wounds/Single/Multiple	54.6%
Hearing Impairment	2.4%
Visual Disturbances	0.8%
Miscellaneous	0.3%
MUST EQUAL 100	100.00%
*Multiple Injury Wound (10-50)%	20.0%
*MIW ESTIMATED	



PCOF – Patient Condition Occurrence Frequency Tool

MAT – Medical Analysis Tool

ESP – Estimation Supplies Program

TML – Tactical Medical Logistics Program

Summary



- The ICD-9 distributions varied among the services and by the phases examined of OIF.
- In addition, further research is required to help explain why these variations exist.
- It is essential when estimating resources that these factors are recognized and approaches and methodologies are developed to provide the best estimation for our military personnel.