

Combat-Related Shrapnel Injuries in Contemporary Warfare: Outcomes Supporting Early Evacuation

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Disclosures

- Major Danielle Akler, MD has no conflict to report.
- This study was performed as part of the Israel Defense Forces Trauma and Combat Medicine Branch effort to improve the quality of combat casualty care and received no external funding or support.





Henry Shrapnel (1761–1842), British Army officer and inventor of the **shrapnel shell**



Introduction – What do we know?

Shrapnel Injuries on Regions of Head and Neck in Syrian War

Ucak, Murat MD

Author Information

Journal of Craniofacial Surgery 31(5):p 1191-1195, July-August 2020. | DOI:

The most important cause of mortality was not the destruction, tissue loss caused by shrapnel injury, or experience of the surgeon, but the severe states of sepsis or multiple different trauma when brought for treatment from long range from the war zone.

Blast Injury Patterns Among Israel Defense Forces Fatalities

Josef Daniel Shakargy, Sami Gendler, Tomer Talmy, Guy Shushan, Irina Radomislensky, Avishai M. Tsur, Ofer Almog, Guy Avital, Avi Benov, Shaul Gelikas

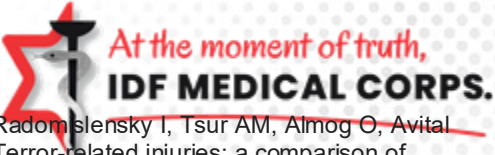
Terror-Related Injuries: A Comparison of Gunshot Wounds Versus Secondary-Fragments—Induced Injuries from Explosives

Nadav Sheffy, MD, Yoav Mintz, MD, Avraham I Rivkind, MD, FACS, Shmuel C Shapira, MD, MPH

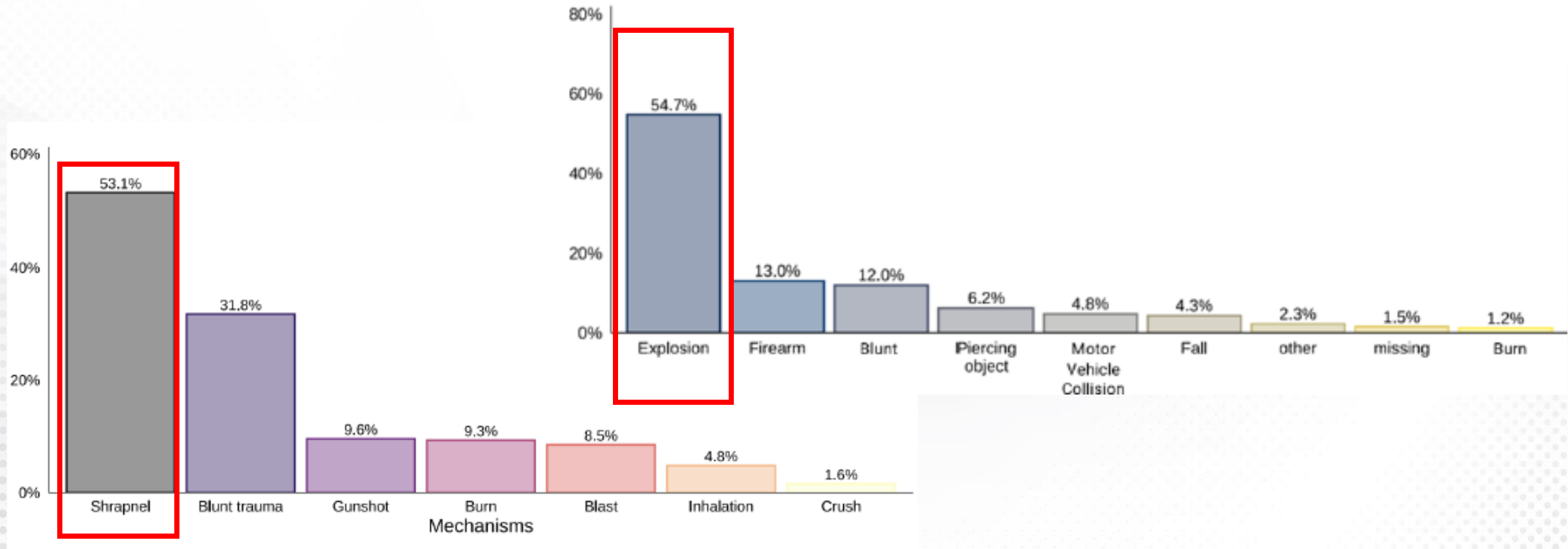
Table 2. Abbreviated Injury Scale Scores

	Secondary fragments		Gunshot wound		p Value
	Mean	SD	Mean	SD	
Glasgow Coma Scale	13.14	3.9	13.2	3.8	NS
Revised Trauma Score	7.19	1.5	7.06	1.8	NS
Injury Severity Score (median)	13	14	9	10.1	< 0.001
Maximal Abbreviated Injury Scale (mean)	2.98	1.3	2.84	1.1	NS

	Overall (n = 222)	Available postmortem CT or autopsy (n = 47)
Sex, male (%)	217 (97.7)	47 (100)
Age, median (IQR)	22 (20, 26)	21 (20, 23)
Median casualties per event (IQR)	6 (4, 11)	4 (3, 8.5)
Penetrating (%)	176 (79.3%)	40 (85.1%)
Involved body regions (AIS ≥ 1)		
Head (%)	121 (57.1%)	34 (72.3%)
Face (%)	75 (35.4%)	24 (51.1%)
Neck (%)	54 (25.5%)	12 (25.5%)
Thorax (%)	120 (56.6%)	36 (76.6%)
Abdomen (%)	72 (34.0%)	20 (42.6%)
Spine (%)	12 (5.7%)	7 (14.9%)
Upper extremity (%)	135 (63.7%)	37 (78.7%)
Lower extremity (%)	141 (66.5%)	32 (68.1%)
External (%)	63 (29.7%)	5 (10.6%)
Injury Severity Score		
1-8 (%)	22 (10.4%)	1 (2.1%)
9-14 (%)	16 (7.5%)	2 (4.3%)
16-24 (%)	14 (6.6%)	4 (8.5%)
25+ (%)	160 (75.5%)	40 (85.1%)
Mean number of body regions involved (IQR)	4 (2, 6)	4 (3, 6)



Swords of Iron Casualties Characteristics



IDF Medical Corps Guidelines

All shrapnel injuries = Urgent evacuation

Except for clearly isolated distal limb injuries without neurovascular involvement.



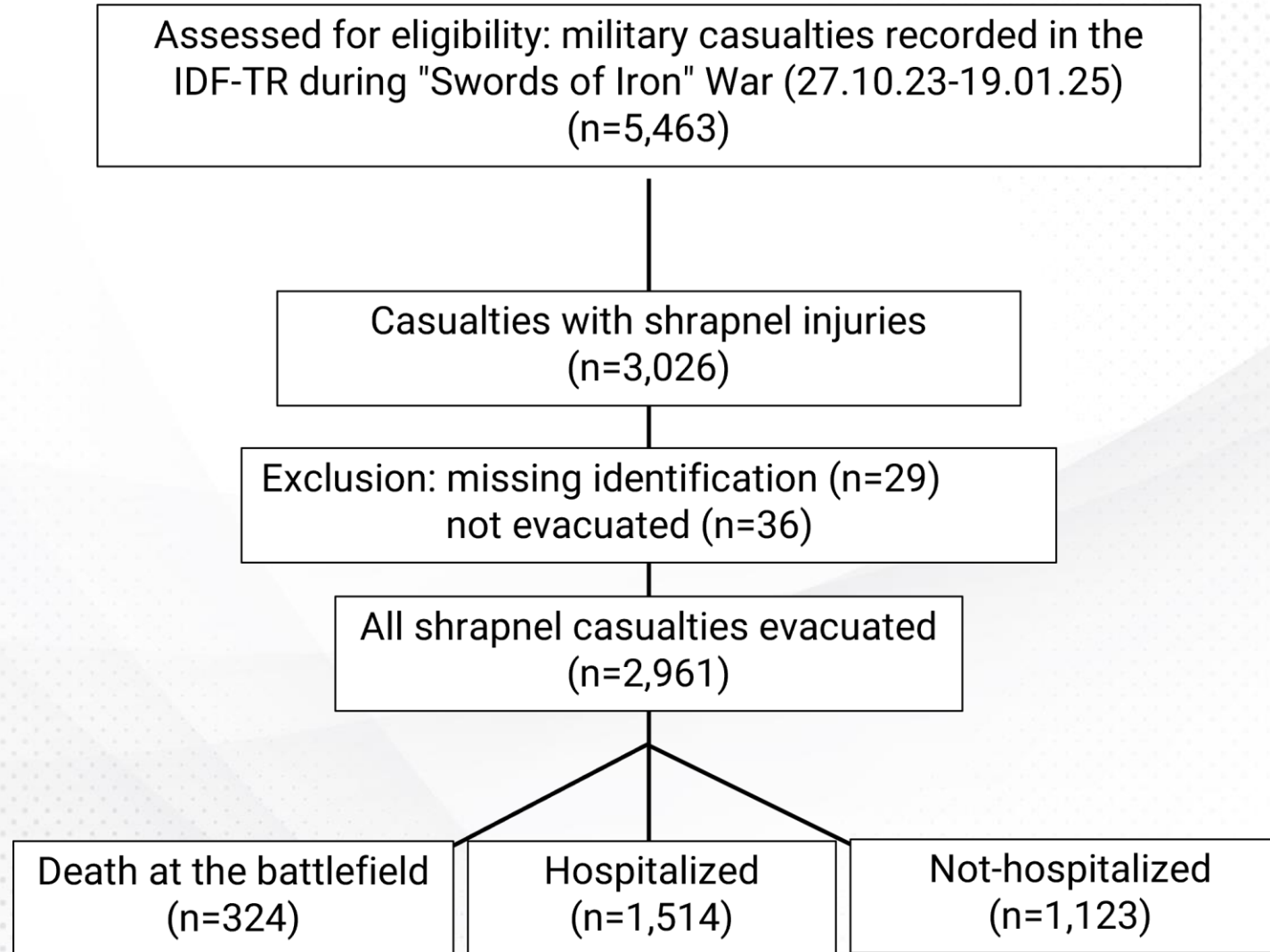
Study Aim

Characterize the shrapnel injuries sustained during the Israeli Swords of Iron war

Evaluate the continued relevance of IDF Medical Corps evacuation and treatment guidelines in the context of modern warfare.



Study population



Methods



Profound Shock



Multi-Casualty Event



Body Regions



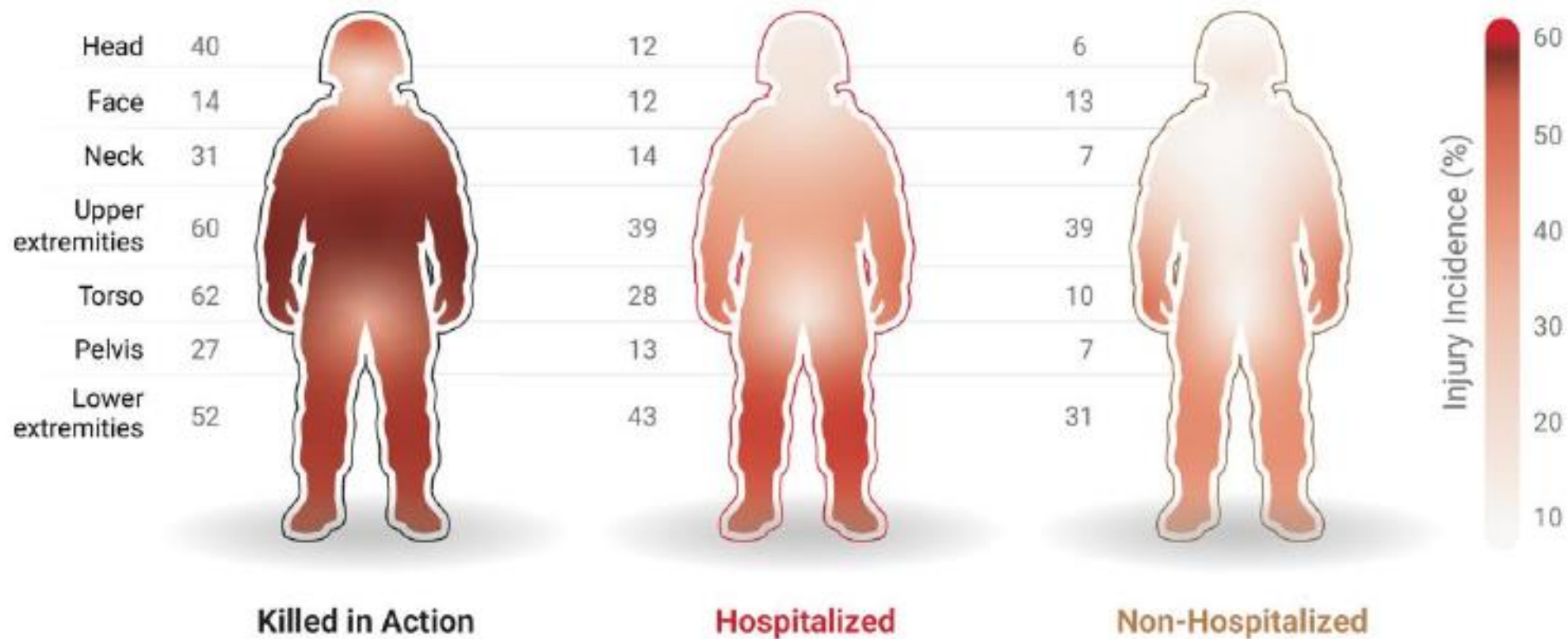
Widespread Injury

Severe Injury (ISS $\geq$ 16)

Need for In-Hospital Care



Results



Results – widespread injury

more explosion

more multi-casualty events involving ≥ 4 casualties

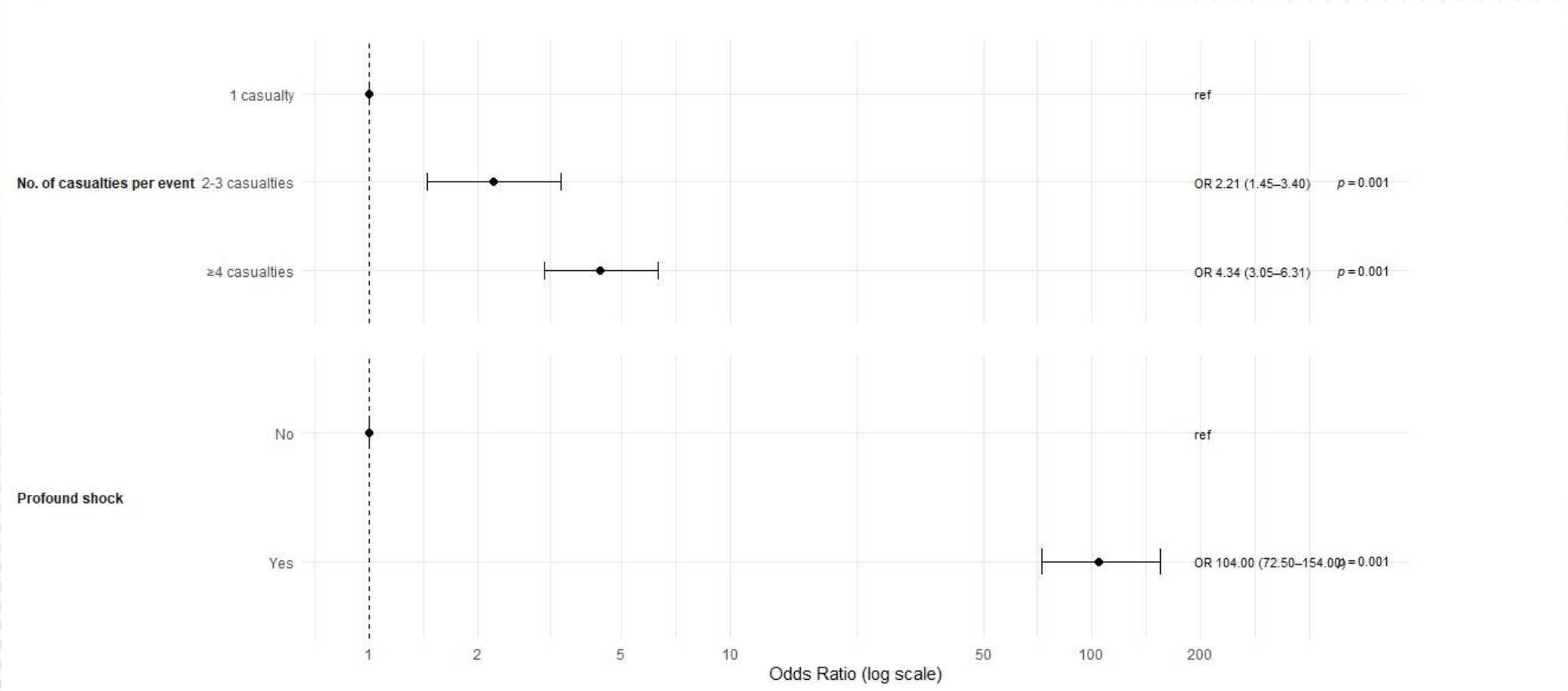
more profound shock and altered level of consciousness

more prehospital interventions

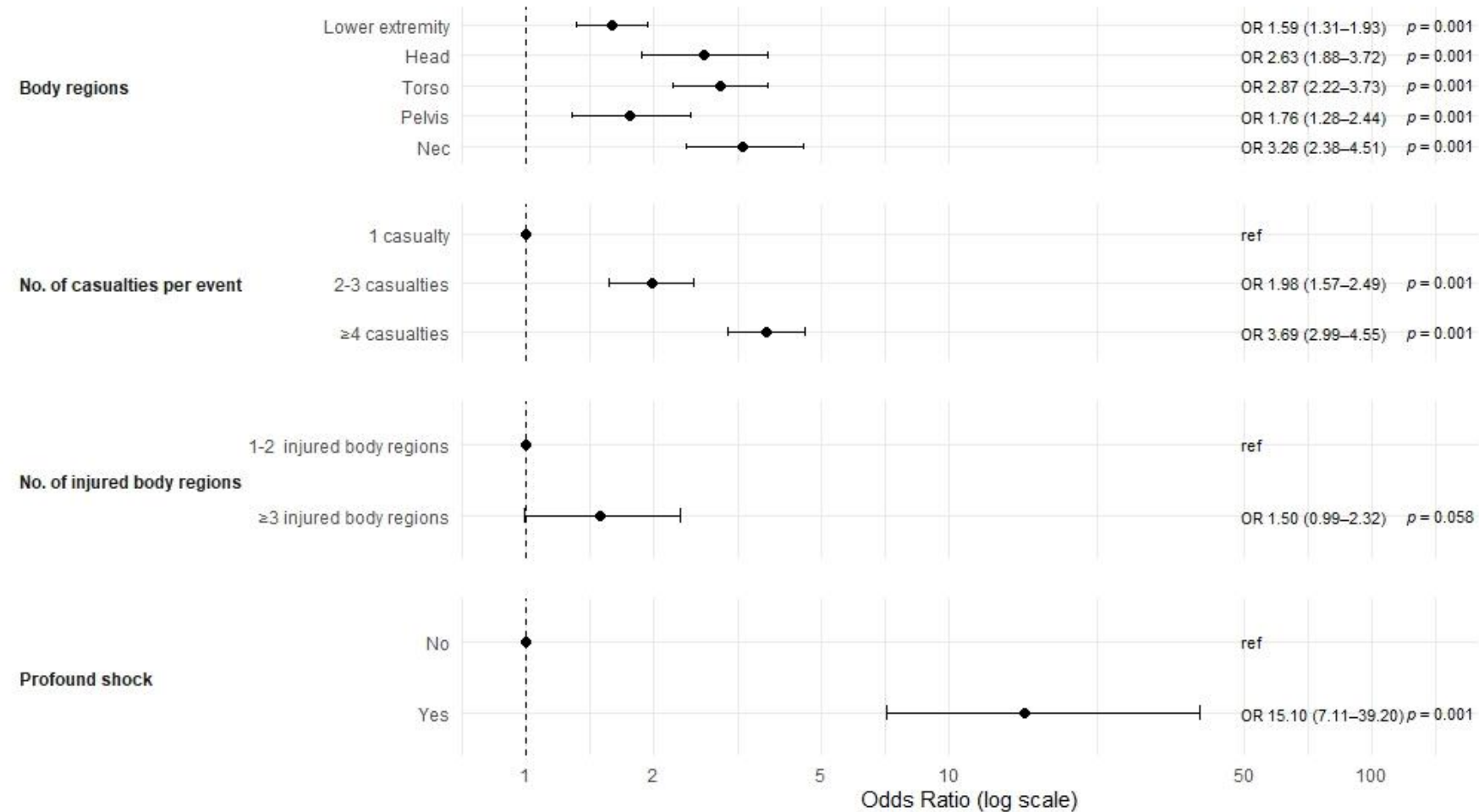
	Total (n=2,961)	≤2 injured regions (n=2,500)	≥3 injured regions (n=461)	P value
Age, Median (IQR)	23 (21,28)	23 (21,28)	23 (21,29)	0.30
Male (%)	2,944 (99)	2,487 (99)	457 (99)	0.30
Event Type				
Explosion (%)	2,305 (78)	1,894 (76)	411 (89)	<0.001*
Firearm (%)	352 (12)	310 (12)	42 (9)	
Other (%)	304 (10)	296 (12)	8 (2)	
Number of Casualties Per Event				
1 (%)	822 (28)	776 (31)	46 (10)	<0.001*
2-3 (%)	687 (23)	601 (24)	86 (19)	
4+ (%)	1,452 (49)	1,123 (45)	329 (71)	
Level of Consciousness				
Alert (%)	2,343 (82)	2,120 (88)	223 (50)	<0.001*
Responsive for vocal (%)	57 (2)	40 (2)	17 (4)	
Responsive for pain (%)	43 (2)	33 (1)	10 (2)	
Unresponsive (%)	403 (14)	209 (9)	194 (44)	<0.001*
Profound shock (%)	458 (16)	262 (11)	196 (44)	
Pre-hospital Treatment				
Tourniquet (%)	522 (18)	374 (15)	148 (32)	<0.001*
Wound Packing (%)	116 (4)	86 (3)	30 (7)	0.002*
Tranexamic Acid (%)	406 (14)	298 (12)	108 (23)	<0.001*
Pain management (%)	1,081 (37)	912 (36)	169 (37)	>0.9
Whole Blood (%)	199 (7)	138 (6)	61 (13)	<0.001*
Freeze Dried Plasma (%)	84 (3)	60 (2)	24 (5)	<0.001*
Injury Severity Score (ISS)				
1-8 (%)	856 (57)	760 (60)	96 (38)	<0.001*
9-14 (%)	316 (21)	262 (21)	54 (21)	
16-24 (%)	156 (10)	109 (7)	47 (19)	
25+ (%)	186 (12)	131 (10)	55 (22)	
Clinical Outcome				
Death at the battlefield (%)	324 (11)	152 (6)	172 (37)	<0.001*
Hospitalized (%)	1,514 (51)	1,262 (50)	252 (55)	0.1
Non hospitalized (%)	1,123 (38)	1,086 (43)	37 (8)	<0.001*



Multivariable Model for Severe Injury



Multivariable Model for Hospitalization

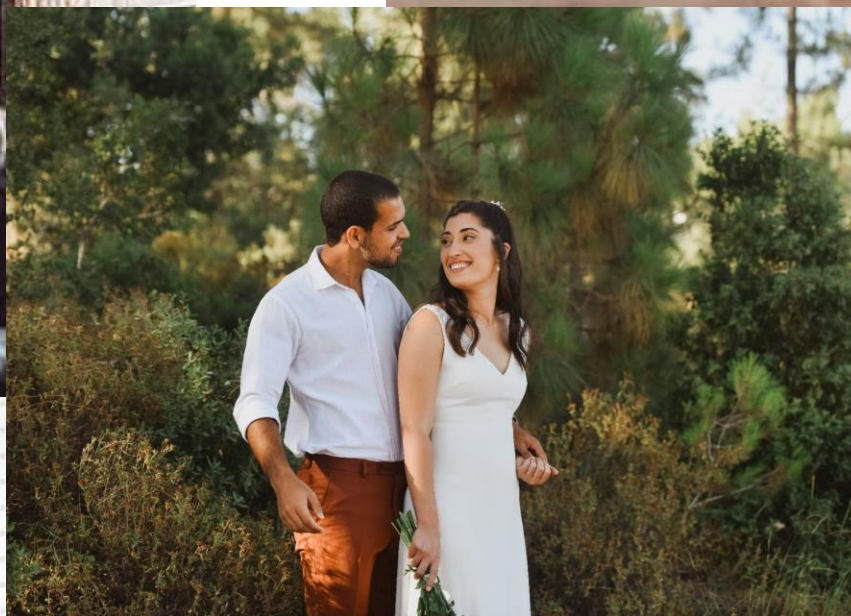


Conclusions and Summary

- Shrapnel injuries are a defining feature of modern battlefield trauma.
- Event context, shock, and injury location are associated with severe injury and hospitalization.
- Currently, there is not enough data to support a change in the IDF evacuation and management guidelines.



In Memory of Dr. Ori Silvester





Thank you!



At the moment of truth,
IDF MEDICAL CORPS.

