

## **ABSTRACT**

**Background:** The U.S. DOD Golden Hour policy (15 June 2009) led to improved warfighter survivability during the Global War on Terror. The Policy's success is well-documented, but a categorical evaluation and stratification of medical evacuation (MEDEVAC) times based on combat injury is lacking. We evaluated the MEDEVAC time for penetrating neck trauma. Our analyses illustrate the importance of specific MEDEVAC times based on combat injury and lay the groundwork for future analysis of other battlefield injuries.

**Methods:** We queried the Prehospital Trauma Registry (PHTR) for all casualties with documented penetrating neck trauma (according to ICD 9/10 and AIS injury codes) requiring battlefield MEDEVAC from June 15, 2009, through February 1, 2021. Casualties were excluded if their injuries were not listed in the database as battle injuries or if the time from point of injury (POI) to reaching higher level medical care (i.e., a military treatment facility [MTF]) was not documented, listed as zero, or exceeded four hours. Composite injury severity score (ISS), patient demographics, and abbreviated injury scale (AIS) were also evaluated. PHTR casualties were linked to the DoDTR for our primary outcome: survival at time of final discharge.

We designed a logistic regression model incorporating maximum AIS 1 (AIS for the head, neck, and cervical spine body region), composite ISS, POI to MTF time, and mortality status at time of discharge from MTF (alive or dead). The reliability of our model was calculated as the area under the curve (AUC) = 59.1. We established a baseline survival probability for battlefield penetrating neck trauma based on the shortest MEDEVAC time (one minute) and lowest severity composite ISS score (one) in our data set.

Planning military operations that require mortar employment often requires ground force commanders (GFCs) to reference established guidelines that use 0.1% and 10% probability of incapacitation. We chose a common language to make our conclusions more useful to GFCs making operational decisions, calculating MEDEVAC times associated with 0.1%, 1% and 10% increased risk of death for an incapacitated casualty with penetrating neck trauma.

**Results:** Our initial dataset included 1147 encounters, of which 477 casualties met inclusion criteria. Of these casualties, 476 (99.8%) were male, 448 (94.0%) were injured in Afghanistan, and 338 (70.9%) were U.S. military or coalition forces; 463 (97.1%) survived to discharge. Most (n=290, 60.8%) reached a Role 3 facility, followed by Role 2B (n=184, 36.6%) and Role 2A (n=3, 0.6%). For casualties surviving to discharge, 57.9% (n = 268) reached a MTF within the Golden Hour with a median time from POI to MTF of 59.0 minutes (IQR 40-89.5) and median ISS of 13 (IQR 5-25). For casualties who did not survive to discharge, 28.6% (n = 4) reached a MTF within the Golden Hour with a median POI to MTF time of 73.0 minutes (IQR 62.3-117) and median ISS of 25.5 (15.75-29). The median AIS 1 for all casualties in our population with a listed maximum AIS 1 (290 casualties) was 2 (IQR 2-4). Mode of MEDEVAC did not appear to impact survival, as 298 of 308 (96.8%) air MEDEVAC casualties and 36 of 37 (97.3%) ground MEDEVAC casualties survived to discharge.

Comparative analysis of our baseline logistic regression model to our survival curve showed that MEDEVAC times  $\geq 45$  minutes,  $\geq 69$  minutes, and  $\geq 234$  minutes are associated with a 0.1%, 1%, and 10% increased risk of mortality from baseline, respectively.

**Conclusions:** Our data characterize the maximum MEDEVAC times associated with 0.1%, 1%, and 10% increased risk of death from baseline survivability for penetrating battlefield neck trauma. Further analysis of the associations between MEDEVAC time and survivability for other combat injury patterns is imperative. Nesting illustrations of this data within established protocols used by GFCs to estimate risk in other ways will facilitate comprehension and optimize decisions made on the battlefield.