

# Postdischarge Cause-of-Death Analysis of Combat-Related Burn Patients

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Combat operations in Iraq and Afghanistan have resulted in up to 8.8% of combat-related casualties suffering burns. From World War I through Desert Storm, burns have been associated with approximately 4% of the combat-related deaths. Experiencing a blast injury and exposure to killing and death while deployed has been shown to increase suicide risk. Although several studies of military populations have investigated risk factors for death among burn patients during the acute phase, no studies have reported mortality rates, cause-of-death, or the prevalence of suicide after hospital discharge. This study examined the case fatality rate, causes of death, and the prevalence of suicide among 830 combat burn patients discharged from the sole burn center in the U.S. Department of Defense, between March 7, 2003 and March 6, 2013. Cause-of-death was determined through the Armed Forces Medical Examiner's Office and the Office of the Secretary of Defense's National Death Index. A total of 11 deaths occurred among the 830 burn survivors, for an overall case fatality rate of 1.3%. Of the 11 who died, five deaths were related to accidental poisoning by exposure to drugs; three were related to operations of war (two after returning to the war zone), and the remaining three died from other accidental causes (one explosion and two vehicle crashes). There was no indication of suicide or suspicion of suicide as a cause-of-death for the former patients included in this study, suggesting that combat burn injury did not appear to increase the risk of death by suicide in our study population. Further research is needed to understand the factors that contribute to the apparent resilience of combat burn survivors. (*J Burn Care Res* 2017;38:e158–e164)

Combat operations in Iraq and Afghanistan have resulted in as many as 8.8% of all combat-related casualties experiencing burn injuries, a statistic that is consistent with prior conflicts.<sup>1–3</sup> Approximately 4%

of the combat-related burn casualties die as a result of their injuries.<sup>4–6</sup> The vast majority of combat-related burn injuries are the result of blasts and explosions that add to the complexity of care required to manage not only the medical issues associated with burns but also the associated wide array of additional bodily insults.<sup>6</sup> Recent advances in acute military burn care have resulted in improved survival among combat-related burn patients.<sup>7–9</sup> As a result, a larger pool of combat-related burn survivors is living with the chronic sequelae of burns.<sup>8,9</sup>

For the past decade, the overall survival after combat-related injuries has been steadily improving; however, death by suicide in the military has increased, and for the first time in history surpassed the civilian rate in 2008. By 2013, suicide rose from the third leading cause-of-death for the military population to the second leading cause-of-death, after accidental deaths, among all military personnel.<sup>10,11</sup> Exposure to killing and death while deployed has been shown to increase suicide risk by 43%.<sup>11</sup> Post-traumatic stress disorder (PTSD) and major depressive disorder significantly increase the risk of suicidal

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*The authors have no conflicts of interest to declare. No funding was received from the National Institutes of Health, Wellcome Trust, and the Howard Hughes Medical Institute. The opinions or assertions contained herein are the private views of the authors and are not to be construed as official or as reflecting the views of the Department of the Army or the Department of Defense.*

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1559-047X/2015

DOI: 10.1097/BCR.0000000000000319

ideation (SI) for veterans of combat operations in Iraq and Afghanistan.<sup>12-15</sup> Service members who were wounded by improvised explosive devices and primary blast injuries have a prevalence of PTSD between 17% and 25%.<sup>16,17</sup> In addition, as many as 18% to 45% of burn survivors experience moderate to severe depression symptoms years after their initial burn injuries have healed.<sup>20</sup> Psychological problems such as anxiety, depression, SI, and PTSD can exist among combat-related burn-injured patients and potentially increase their risk of death by suicide post hospital discharge.<sup>16-21</sup> Therefore, it is extremely relevant to look at associations with psychological problems when examining combat-related burn-injured service members because of the complexity of their injuries often being related to a blast injury.

Episodes of acute pain related to surgical procedures performed to facilitate recovery from their initial injuries may continue to occur months to years later. These episodes of recurrent acute pain postinjury can lead to acute stress reactions and anxiety and increase a patient's risk of developing PTSD.<sup>19</sup> Edwards et al<sup>21</sup> found that 25% to 33% of burn patients reported some form of SI at 6 to 12 months after discharge indicating that pain severity was the most robust predictor of later SI. In addition, an examination of risk factors for suicide in the army found significant roles for physical pain and disability as precipitants of suicide.<sup>22</sup>

Because of the unique physical trauma that may occur from experiencing a war-related burn injury, which may also include other severe and complex physical injuries such as amputations, as well as the recovery process and potential associated psychological trauma, combat-related burn injury survivors may be at greater risk of death by suicide. In addition, these injuries can lead to greater disabilities and increased risk for psychological problems and chronic pain. Thus, the objective of our study was to examine post hospital discharge mortality and cause-of-death among our combat-related burn patients injured in Iraq and Afghanistan specifically to examine the suicide rate.

## METHODS

### Participants

The USAISR Burn Center registry—a limited access, password protected registry of all current and former Burn Center patients—was used to identify the list of combat burn patients for potential inclusion into our study. Our overall sample included 830 combat-related burn injury patients admitted to and

discharged from the USAISR Burn Center from March 7, 2003 to March 6, 2013. We included only patients injured during combat operations in Iraq and Afghanistan who were U.S. military service members when they received initial care at the USAISR Burn Center. Burn patients who died while hospitalized at the USAISR Burn Center were excluded.

### Procedures

The first step was to determine which patients were still living. Patients were determined to be alive if one of the following criteria was met: (1) evidence of clinical care or contact within the past 12 months as noted in their USAISR Burn Center medical records; (2) evidence of clinical care or contact with individual Burn Center staff within the past 12 months, eg, communication by email; (3) evidence that they were alive within the past 12 months according to information found through commonly used Internet search engines and media. Patients who met these criteria were deemed to be alive and were excluded.

For patients who could not be confirmed to be alive using the approach described above, the second step was to search for a death certificate from both the Armed Forces Medical Examiner System (AFMES) and the Centers for Disease Control and Prevention's National Death Index (NDI). The NDI database contains data for U.S. Department of Defense (DoD) service members that are provided to the Defense Suicide Prevention Office of the Office of the Secretary of Defense. The AFMES contains information on service members who died while on active duty or within 120 days of discharge. We found there was a lag of approximately 2 years for death certificates to be received by the DoD from the NDI (data currently available are only updated to December 2011); therefore, we requested updated death certificate information from the DoD Surveillance Center. The DoD Surveillance Center utilized our list of burn survivors whose status was unknown and compared it with the Defense Casualty Analysis System casualty file produced on April 21, 2015 and the Limited Access Death Master File (DMF) from the Social Security Administration (SSA) current as of March 31, 2015.<sup>23,24</sup> The Defense Casualty Analysis System casualty file contains in-service deaths, and the SSA DMF contains retired and postservice deaths. As of March 31, 2015, no additional combat-related burn patient deaths were found to have occurred during the study period.

For the combat burn patients who were found to have died after their discharge from the USAISR Burn Center, the cause-of-death was then sought

using one or more methods. First, the AFMES was used to determine cause-of-death for service members who died while on active duty or within 120 days of discharge. Second, the Defense Suicide Prevention Office of the Office of the Secretary of Defense provided cause-of-death information for individuals for whom they had death certificates. Finally, for individuals whose cause-of-death was not available by the first two methods additional Internet searches were conducted.

The study was approved by the Institutional Review Board of the U.S. Army Medical Research and Materiel Command.

## RESULTS

### Mortality and Fatality Rates

A total of 11 deaths occurred after discharge of 830 burn survivors for an overall case fatality rate of 1.3%. All 11 deaths involved male patients with a reported thermal mechanism of burn whose patient, injury, and hospitalization characteristics have been presented (Tables 1 and 2). The average age at death was 25.5 years. The cause-of-death report for nine individuals came from the AFMES and was confirmed in the NDI. The 10th death was unique to the NDI, and the remaining one from a published obituary. Of the 11 who died, five deaths were related to accidental poisoning by an exposure to drugs; three were related to operations of war (two after returning to

the war zone), and the remaining three died through accidents (one explosion and two vehicle crashes). The overall average length of life after discharge for all combined was 1 year and 9 months. It should be noted that with such small numbers in the categories that the average length of life postdischarge is provided as a reference point that may not be indicative of a larger population average.

### Associated Causes of Mortality

Of the five combat-related burn patients' deaths were related to accidental poisoning by and exposure to drugs and other biological substances, one was because of fentanyl intoxication, one was because of methadone intoxication, and one was because of mixed drug toxicity. One death was related to accidental poisoning by and exposure to other and unspecified drugs, medicants, and biological substances with the specific drug being benzodiazepine. In addition, one death was determined to be because of a fall related to mixed drug and alcohol toxicity. For the three service members whose deaths were related to operations of war, one was because of blast injuries, one was because of complications of burn and blast injuries, and one was because of multiple gunshot wounds. In regards to those whose deaths were related to accidents, one was an occupant in a vehicle that was involved in a collision with another motor vehicle, one was listed as other and unspecified motor vehicle accident, and one death was because of an accidental explosion with probable cause of death listed as cardiac arrhythmia.

**Table 1.** Demographic Characteristics of 11 Burn Patients who Died Postdischarge from the USAISR Burn Center, March 7, 2003 to March 6, 2013

Patient characteristic	n
Gender	
Male	11
Service	
Army	7
Marines	4
Conflict	
Iraq	9
Afghanistan	2
Discharge disposition	
Return to duty	8
Medically retired	3
Months from injury to discharge	
<10	3
10–19	3
>20	4
Mechanism of burn	
Thermal	11

## DISCUSSION

Our military has experienced a tragic increase in the number of completed suicides over the past 13 years. During the first 4 weeks after service, veterans are at higher risk for suicide and would benefit from intensive monitoring and case management.<sup>25</sup> The severity of traumatic injury and exposure to a war zone might seem to predispose many combat-related burn survivors to commit suicide.<sup>11</sup> In this study, however, there was no evidence of suicide, or even suspicion of suicide, as a cause-of-death among military combat-related burn survivors. Perhaps, because of the intense nature of the care and duration of admissions, burn center staff often maintained personal contact with families of most soldiers who died after discharge. Feedback from family members has not revealed any suspicion of suicide among the deceased in this report (Dr. Even Renz, Director of BAMC, personal communication via email, 2015). It may

**Table 2.** Injury and Hospitalization Characteristics Among 11 Burn Patients who Died Postdischarge from the USAISR Burn Center, March 7, 2003 to March 6, 2013

	Median	Interquartile Range
TBSA	12.0	33
Full thickness burn (n = 8)	9.0	40
Injury severity score	9.0	33
Length of stay (days)	15.0	132

be important to note that certification of the cause-of-death as suicide demands considerable scrutiny and careful consideration by the medical examiner and by the military Chain of Command. The decision to declare a death because of suicide is based on extensive investigation and clear evidence of the affirmative, eg, evidence of hanging, self-inflicted gunshot wound, presence of a suicide note, or text message.<sup>26,27</sup>

Ten (91%) of the deaths reviewed in our study occurred 1 to 3 years after discharge from the hospital. This is certainly beyond the 4 week timeframe described as high risk by the Veterans Health Administration. Moreover, two deaths involved service members who were physically and mentally cleared for duty, served additional overseas deployments, and later died from new injuries received in a war zone unrelated to their previous burn injuries.

Five individuals (45%) fall in the category of drug-related deaths. These deaths all occurred within 1 year after discharge with the cause of death being listed as accidental poisoning by an exposure to drugs. When discussing deaths related to accidental poisoning, the word “overdose” is often used mistakenly when discussing drugs and suicide in relation to medication and can incorrectly suggest the possibility of an unidentified death by suicide. The term “accidental poisoning” is routinely used to classify the unintended or improper use of medications and/or substances combined with a lack of compelling evidence to support that the overdose of medications was intentional or malicious in nature; therefore, it is determined not to be related to suicide.

Between 1991 and 2002, there was an increase in the use of prescription opioids in the United States and, by 2007, it was the second leading cause of unintentional injury as cause-of-death after motor vehicle accidents.<sup>28</sup> Within the military population, the potential for misuse or overuse of opioids by combat casualties, especially by those who sustained complex injuries such as burns or blast injuries is very real. Narcotics are often a first-line or second-line choice for the management of both acute and chronic pain

in this population, and the potential for misuse is great. This reality can become especially challenging in an environment where a patient may receive care, and prescriptions, from several providers.

By 2006, the U.S. Army had implemented a robust medication reconciliation process that provided a formal method for communication among all healthcare providers and patients during various transitions in care.<sup>29</sup> This process increased knowledge of a patient’s medication regimen, and allergies or hypersensitivities, before any changes or new medications were prescribed to a patient. Additionally, the Medication Restriction Program had been implemented. This Medication Restriction Program allowed providers to identify service members who may exhibit drug-seeking behaviors or that are considered high risk for harm to themselves from accidental or intentional narcotic medication overdose and determine if there is a need to restrict access to particular medications.<sup>29</sup> Although it is possible there may have been other factors that contributed to the decline in this particular category of deaths, it is possible that deaths by accidental poisoning were decreased because of the widespread implementation of this program, and it appears these programs had a desirable effect on how medications were prescribed at our military hospitals and the Burn Center.

Because of the small sample size and limited number of deaths, it is difficult to compare our results with the reported civilian rates of accidental or violent deaths. It is distinctly possible that any of the accidental deaths may have actually been an unidentified suicide rather than related to risk-taking behaviors. However, taking into account the relatively young age of our study population, our finding that 3 of 11 deaths were because of accidental causes is not unexpected considering that service members are more likely to engage in risky behaviors postdeployment when compared with predeployment.<sup>30,31</sup> For example, a decrease in the frequency of helmet use for motorcycle riders coupled with an increase in the frequency of alcohol could lead to potentially hazardous consequences.<sup>30</sup> After their experiences during deployment to a war zone, a possible return to risk-taking behaviors once they have adapted to their new life situation may be an important concern for service members.<sup>32</sup>

When discussing risk-taking behaviors, the topic of substance abuse and/or dependency as a contributing factor to unexpected death must be considered, even if impossible to prove. Polypharmacy, in addition to alcohol and other substances, presents a unique challenge in and of itself. In conversation with family members of one of the combat-related burn survivors, it was noted that the deceased appeared

happy, relishing life, but in their assessment the war veteran was using alcohol to excess (Dr. Even Renz, Director of BAMC, personal communication via email, 2015). Alcohol use coincident with the use of prescribed medications may increase the effects of the medications. A review of postmortem data revealed that high levels of alcohol were present in combination with medications in several cases.

There are several factors that may, at least partially, explain the strikingly low incidence of death by suicide among a severely injured population such as those who sustained combat-related burns. This population received close monitoring and support from a multidisciplinary burn team which resides at the very core of successful burn centers.<sup>9</sup> Many combat-related burn survivors continue to receive regularly scheduled clinic follow-up by their medical providers many months to years after their injury. This care is typically offered in the outpatient burn clinic from the time of discharge until they are released to return-to-duty. The medical providers at the outpatient burn clinic are typically fully invested in the patient's program for successful recovery throughout the entire episode of inpatient care and beyond. The clinic provides necessary therapies and with the added benefit of continued contact with a military environment. Close follow-up along with good communication allows medical providers the ability to identify risk for self-harm early and refer the service member to the appropriate services or interventions, as needed.

Another factor that may mitigate the risk of suicide for this population is the increase in social support developed through the connection with a peer group of service members who are burn survivors and service members with other combat-related injuries. In addition, burn survivors often experience an increase in family support networks because of the increased level of care they often require in the immediate period after discharge. An increase in social support networks of family and friends has been found to be a protective factor against suicide.<sup>33</sup> Increased social support may reduce the likelihood of avoidance and isolation as well as provide early recognition by family and friends of symptoms often experienced with PTSD, anxiety, and depression. Early recognition and intervention for psychological symptoms have been found to improve pain-related long-term outcomes which affect suicidality.<sup>35</sup> Burn survivors benefit greatly from specialized social work professionals, adept at providing both routine and specialized support, who facilitate the transition to life after medical retirement.

Our results suggest that having a combat-related burn injury does not contribute to an increased risk

of death by suicide post hospital discharge. The multiple factors discussed likely all contribute to mitigating suicide risk factors for combat-related burn survivors post hospitalization. In summary, the burn center environment and services offered likely contribute to risk mitigation because of the high level of commitment and support received from the highly trained and dedicated medical staff.

### Limitations

We were pleased that the number of deaths among the 830 combat-related burn injury patients we reviewed was so small; however, such a small sample size limits the generalizability of our findings to other populations. Because of the retrospective nature of this study, the small number of deaths by accidental drug poisoning and limitations placed by the Health Insurance Portability and Accountability Act, we were unable to provide additional detailed information on the drug ingestions occurrences. We acknowledged this as a weakness to this study because of the possibility that some of the deaths may have been suicides rather than accidental drug poisonings. In addition, this study was limited by the lack of access to psychosocial variables related to the deceased former patients. The presence of an accidental drug poisoning or even increased risk-taking behaviors can provide doubt or questions concerning the possibility of suicide. Additional data on psychosocial variables may have allowed us to draw more specific conclusions regarding intentional death by suicide vs accidental drug poisoning death.

Furthermore, there are limitations related to scanning databases to determine whether a person is living or deceased since a certified record of death may not be on file in all cases. Problems related to locating individuals in a high mobile military population limit the ability to remain in contact and provide verified contact with all former patients, particularly when there is little if any desire to maintain follow-up on the part of the former patient.

Despite completion of the steps previously outlined, the survival status for 50 former patients could not be confirmed. These individuals were not listed in the NDI, though it is possible they died within the most recent year for which NDI data were not yet available. In addition, they may have passed in the days before the SSA DMF was updated and were not captured by that database as well. Although the NDI is considered to be more comprehensive than the SSA DMF, the SSA DMF remains a reliable source used to verify deaths, to prevent fraud, and to comply with the U.S. Patriot Act; it is updated

monthly and weekly.<sup>23</sup> Additional Internet searches using search engines such as Google were also conducted in an attempt to find information on these former patients.

### Future Research

On the basis of the results of this study, further research is warranted to examine factors that influence resiliency in postdischarge combat burn patients. Such an examination should include the roles medical providers and staff may have in allaying the suicide risk. In addition, comparing military and civilian burn patient populations, posthospitalization should be an important future goal. Another possibility is to develop a research program that uses the biopsychosocial model that emphasizes self-management. Self-management could be an important factor for a combat burn injury patient's long-term recovery and wellbeing. Moreover, it would allow us to further examine the roles that biological, psychological, and social factors play in building the resilience of this population. Finally, another area of future research is in the area of the unintentional death by drug poisoning to examine trends in prescription drug abuse and factors that influence unintentional death and continue to monitor long-term outcomes for the burn population.

### CONCLUSION

In our study of post hospital discharge combat burn patients, suicide was not listed as the cause-of-death for any of the service members with combat-related burn injuries reported in this study, despite the suicide rate being at an all-time high among the general military population. There have been important programs implemented by the U.S. army that may have reduced the number of deaths because of accidental poisoning by an exposure to drugs. The findings regarding accidental and violent deaths, although difficult to compare with reported civilian rates, were consistent with the research on accidental or violent deaths for the young age group of our study population.<sup>30,31</sup> The burn center environment and services it offered seem to be key components in mitigating risk factors for suicide and risk-taking behaviors for combat-related burn injury service members.

### ACKNOWLEDGMENTS

The authors would like to recognize and thank the U.S. Army Institute of Surgical Research Burn Center Registry staff for their assistance and use of data for this study. We thank members of the Armed Forces Medical Examiner

Office and Defense Suicide Prevention Office of the Office of the Secretary of Defense for their assistance with life or death determinations and cause-of-death results. We thank Ms. Katie Tyrell who served as a Licensed Clinical Social Worker in the USAISR Burn Center and interacted with all the combat burn patients. Finally, a special thanks to Ms. Sue Walker for going above and beyond for her efforts in helping us to complete this study. This research was supported in part by an appointment to the Research Participation Program at the U.S. Army Institute for Surgical Research administered by the Oak Ridge Institute for Science and Education through an interagency agreement between the U.S. Department of Energy and USAMRMC.

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