Resource Utilization and Disability Outcome Assessment of Combat Casualties From Operation Iraqi Freedom and Operation Enduring Freedom

Brendan D. Masini, MD, Scott M. Waterman, MD,* Joseph C. Wenke, PhD,* Brett D. Owens, MD,† Joseph R. Hsu, MD,‡ and James R. Ficke, MD‡*

Objectives: Injuries are common during combat operations. The high costs of extremity injuries both in resource utilization and disability are well known in the civilian sector. We hypothesized that, similarly, combat-related extremity injuries, when compared with other injures from the current conflicts in Iraq and Afghanistan, require the largest percentage of medical resources, account for the greatest number of disabled soldiers, and have greater costs of disability benefits.

Design: Descriptive epidemiologic study and cost analysis.

Methods: The Department of Defense Medical Metrics (M2) database was queried for the hospital admissions and billing data of a previously published cohort of soldiers injured in Iraq and Afghanistan between October 2001 and January 2005 and identified from the Joint Theater Trauma Registry. The US Army Physical Disability Administration database was also queried for Physical Evaluation Board outcomes for these soldiers, allowing calculation of disability benefit cost. Primary body region injured was assigned using billing records that gave a primary diagnosis International Classification of Diseases Ninth Edition code, which was corroborated with Joint Theater Trauma Registry injury mechanisms and descriptions for accuracy.

Results: A total of 1333 soldiers had complete admission data and were included from 1566 battle injuries not returned to duty of 3102 total casualties. Extremity-injured patients had the longest average inpatient stay at 10.7 days, accounting for 65% of the $65.3-million total inpatient resource utilization, 64% of the 464 patients found "unfit for duty," and 64% of the $170-million total projected disability benefit costs. Extrapolation of data yields total disability costs for this conflict, approaching $2 billion.

Conclusions: Combat-related extremity injuries require the greatest utilization of resources for inpatient treatment in the initial postinjury period, cause the greatest number of disabled soldiers, and have the greatest projected disability benefit costs. This study highlights the need for continued or increased funding and support for military orthopaedic surgeons and extremity trauma research efforts.

Key Words: combat wounds, cost, disability, extremity, resources

(*J Orthop Trauma* 2009;23:261–266)

INTRODUCTION

Injuries are common during combat operations. The casualties of the current conflicts in Iraq and Afghanistan have been the subject of reports on the character of combat wounds and their associated management.[1,2] However, beyond quantifying these wounds, there has been no large-scale assessment of which wounds have the greatest impact on military medical care. The intent of this study was to examine a large previously described cohort of combat-wounded patients and assess the impact of these injuries on military medical resource utilization and soldier disability relative to body region injured.

Recent publications have demonstrated the burden of extremity injuries on the US civilian health care system.[3–8] Protection of the head and chest in motor vehicle collisions has contributed to increased survival of patients but also has increased the number of survivors with lower extremity trauma.[9–11] Body armor may have a similar effect in combat patients.[12–17] We hypothesize that combat-related extremity injuries in the current conflicts in Iraq and Afghanistan have the greatest requirement for medical resources, lead to the greatest number of disabled soldiers, and have the greatest projected disability benefit costs of any combat-injured body region.

METHODS

The patient population for this study was adopted from a previous large-scale investigation of the spectrum of injuries in the current conflicts, which consisted of 3102 casualties,

Accepted for publication January 26, 2009.

From the *US Army Institute of Surgical Research, Regenerative Medicine Task Area, Fort Sam Houston, TX; †Department of Orthopaedics, William Beaumont Army Medical Center, El Paso, TX; and ‡US Army Institute of Surgical Research, Fort Sam Houston, TX.

The authors did not receive grants or outside funding in support of their research or preparation of this article.

The opinions or assertions contained herein are the private views of the authors and are not to be construed as official or reflecting the views of the Department of Defense or the US government.

The authors are employees of the US government.

This article does not contain information about medical devices.

Reprints: Brendan D. Masini, MD, US Army Institute of Surgical Research, 3400 Rawley Chambers Rd, Fort Sam Houston, TX 78234 (e-mail: brendan.masini@amedd.army.mil).

Report Documentation Page

Form Approved
OMB No. 0704-0188

1. REPORT DATE	2. REPORT TYPE	3. DATES COVERED
APR 2009		**00-00-2009 to 00-00-2009**

4. TITLE AND SUBTITLE	5a. CONTRACT NUMBER
Resource Utilization and Disability Outcome Assessment of Combat Casualties From Operation Iraqi Freedom and Operation Enduring Freedom	5b. GRANT NUMBER
	5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)	5d. PROJECT NUMBER
	5e. TASK NUMBER
	5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **US Army Institute of Surgical Research,Regenerative Medicine Task Area,Fort Sam Houston,TX**	8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSOR/MONITOR'S ACRONYM(S)
	11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution unlimited

13. SUPPLEMENTARY NOTES

14. ABSTRACT

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			
unclassified	**unclassified**	**unclassified**	**Same as Report (SAR)**	**6**	

approximately 27% of the estimated casualties for the period studied.[1] The subjects were identified from the Joint Theater Trauma Registry (JTTR), which was queried for service members consecutively injured in Operation Iraqi Freedom and Operation Enduring Freedom from October 2001 through January 2005.[1,2] The JTTR is a registry that collects information on soldiers injured in the theater of operations and follows their care until arrival at a military medical treatment facility in the United States. The results of the query were limited to include injured soldiers treated and evacuated to tertiary care facilities and those classified as died of wounds. Excluded were soldiers classified as killed in action, soldiers returned to duty within 72 hours, and soldiers sustaining nonbattle injuries. These classifications of wounded are routinely recorded and were obtainable from the JTTR database. The remaining cohort approximated those soldiers wounded in action.[18]

Data relating to patient's hospital admissions were queried from the Military Health System Executive Information/Decision Support Medical Metrics (M2) database, which is a central repository of detailed clinical, financial, and beneficiary information for Military Health System operations.[19] Data points collected for each of the identified soldiers were the diagnosis-related group (DRG), International Classification of Diseases Ninth Edition (ICD 9) coding for primary diagnosis, and length of stay for each inpatient admission. Only consecutive admissions from the date of injury were included; subsequent hospitalizations were not counted in this study. This typically included an admission at Landstuhl Regional Medical Center in Germany followed by an admission at a military treatment facility within the continental United States.

The Department of Defense (DoD) uses the DRG prospective payment system for determining the charges associated with inpatient hospitalization. This DRG billing system was accepted for use by Medicare in 1983 to set levels of reimbursement for inpatient admissions[20] and subsequently adopted by the DoD. A DRG is a grouping of ICD 9 diagnoses that are similar in resource utilization required during hospital admission. The dollar value billing charge generated in this model encompasses all treatment-related resources for the entire hospital stay, including but not limited to surgical costs; radiographs; medications; and physician, nursing, and ancillary personnel support. In this model, the calculated billing charge is equivalent to the resource utilization required for the treatment of injured soldiers.

The DRG for a particular admission is determined by a grouping algorithm that takes several admission characteristics into account, including the patient's primary diagnosis (identified by ICD 9 code), secondary diagnoses, surgical procedures, age, sex, and discharge disposition. These data points are extracted from hospital charts by coders, and the DRG is determined independent of the treating physicians. This system adjusts for complexity of disease or injury by having 3 levels of severity for each group and adjusting for lengths of stay.

Our model for determining billing charges was in accordance to procedures set forth for DoD and Veterans Affairs. This begins with adjusted standard amount (ASA), which is a dollar value specific to each medical treatment facility and based upon local wage differences and related medical education costs. To eliminate variation in the calculation of charges for the same injury due to different treatment facilities, the ASA for each of these calculations was standardized to the Brooke Army Medical Center rate for the fiscal year 2008. Each DRG has a specific ASA multiplier that gave a base rate. That rate in this billing model is modified for outlier admissions requiring greater or less resources as determined by the patient's length of stay.

Disability outcomes in this patient population were assessed using results of the US Army Physical Disability Evaluation System. This evaluation process is used to determine the fitness of injured soldiers for continued military service. After the treatment of injured soldiers, if the condition improves to the point that they are able to return to full military duty, they are returned to their unit. However, if the treating physician or the soldier's unit leaders believe that the soldier is unable to perform full military duty or is unlikely to be able to do so within a reasonable amount of time (normally 12 months), the soldier begins the Physical Evaluation Board (PEB) process with the ultimate outcome being a determination of fitness for duty and eligibility for disability benefits. If found "unfit for duty," the board will rate the percentage of disability, from 0% to 100%, using the Veterans Affairs Schedule for Rating Disabilities.[21–23] The US Army Physical Disability Evaluation System database was queried for medical boards processed on the soldiers in our cohort and for the outcomes of those boards with percentage of disability ratings. The disability ratings determined by the board can be directly converted into a disability benefit cost using the guidelines set forth by the US Army, which state that the soldiers whose disability is rated below 30% receive a onetime severance payment, whereas soldiers at or above 30% receive a monthly disability retirement pay, as well as maintaining medical benefits. The severance payment is equal to 2 months of base pay times the number of years of eligible service time. The disability retirement pay is a monthly pay equal to the base pay times the percentage of disability to a maximum of 75%. Severance payment and disability retirement pay estimates were made using the information for the typical soldier in our cohort. This soldier had an average age of 26 years and a median rank of E4.[1] For our calculations, this soldier in 2008 had a monthly base pay equal to $1949.10 and an arbitrarily assumed 75-year life expectancy. No adjustments were made for cost of living or inflation over time.

The results from the inpatient billing model and the disability benefit calculation were extrapolated to the current combat-injured population that meets the inclusion criteria for this study. This was accomplished using available casualty data as of May 8, 2008, which counted 14,564 soldiers wounded in action and not returned to duty.[24] We validated our extrapolation model by comparing the injured population meeting inclusion criteria for our cohort as a percentage of total casualties from 2001 to 2005 with the 2008 data yielding a relatively constant percentage at 50% and 46%. Additionally, our cohort of 1333 is 9% of the total 2008 wounded in action and not returned to duty group, which we feel is a sufficient

sample to project to the whole population assuming no significant change in wounding patterns.

Analysis of this data was performed by body region injured according to the criteria described by Churchill.[25] Previous study of this cohort identified an average of 4.2 wounds per casualty, often in different body regions.[1] For this reason, it was necessary to determine a primary body region injured to associate with each set of admission data. For billing purposes, at each hospital admission, a patient is assigned a primary injury ICD 9 code and DRG. This assignment is made to most accurately reflect the resources used in the care of the patient, or from the billing perspective, to maximize reimbursement. Despite the multiple injuries of these patients, each patient is assigned a single primary injury code. With corroboration with the JTTR injury mechanism and description, it was from this primary injury code determined by the hospital coders that the body region–injured groupings were made. Each soldier was assigned to 1–4 groups: soldiers with primary diagnoses of head/neck, thorax, abdomen, or extremity injury. This primary body region injured was also associated with the disability rating for each soldier.

RESULTS

The cohort used for this study and previously published by Owens et al[1] contained 1566 soldiers with battle injuries. Of these, 1333 soldiers had complete admission data and were included. These 1333 soldiers accounted for 22,200 inpatient days for their initial hospitalizations. The total resource requirement associated with these admissions was $65,733,282. Results by body region are found in Table 1. Soldiers with a primary diagnosis of extremity injuries accounted for 65% of all resources required for treatment (Fig. 1).

Of the 1333 soldiers in this study, 464 (35%) were ultimately found unfit for duty due to disability from their injuries. The distribution of these medical board findings by body region and the average, median, and mode (with number of soldiers at that rating) of disability ratings are found in Table 2. Soldiers with a primary diagnosis of extremity injuries accounted for 64% of all soldiers found unfit for duty (Fig. 2).

The total projected cost of disability benefits for the cohort was $170,025,060. The distribution of benefits by body region is found in Table 3. Also, shown are the percentage of soldiers who received a onetime severance payment of approximately $15,593 (for the average E4 rank soldier in our cohort[1]) versus the percentage of soldiers receiving a monthly disability retirement pay and the average projected lifetime benefit for soldiers found unfit for duty. Soldiers with a primary diagnosis of extremity injuries accounted for 64% of total disability costs calculated. The average projected lifetime benefit for soldiers with primary extremity injuries is exceeded only by that for the primary head/neck injury group.

Extrapolation of these findings to the total injured population as of May 2008 of 31,708 patients, of which 14,564 meet the inclusion criteria of this study, yields a resource requirement of $718 million in the initial hospitalization period, of which $463 million was required for patients with primary extremity injuries. The total projected cost of disability benefits is $1.9 billion of which $1.2 billion will be required for patients with a primary diagnosis of extremity injury.

DISCUSSION

Understanding the impact of these combat injuries on military medical resource utilization and on patient disability is paramount for planning future resource distribution and implementing methods to improve care. We have provided a descriptive analysis of resource utilization for combat casualty care through the initial inpatient hospitalization and an analysis of patient disability ratings and cost from these injuries.

When the primary diagnosis for admission was compared with the incidence of injury by body area, it was seen that although extremities make up 54% of all injuries,[1] they represent 63% of the primary diagnoses for admission. Understanding that there are an average of 4.2 wounds per soldier,[1] this suggests that for soldiers with injuries to multiple body regions, extremity injuries are likely to be the primary cause for inpatient hospitalization and the injury that requires evacuation of the soldier from theater.

In addition to being the most likely primary diagnosis in patients admitted to a hospital or evacuated, we found that the total number and average number of inpatient days for treatment of patients with a primary diagnosis of an extremity injury were greater than for injuries to other body regions. The requirement for greater length of hospital stay coupled with the quantity of extremity wounds dictates that most of the resources used for combat casualty care be directed to soldiers with combat-wounded extremities. Extrapolation of the resource requirement to the total current population of evacuated combat-wounded soldiers approaches a half billion dollars for extremity injuries alone. This is striking but may be a conservative estimate as resources not discussed in this study including outpatient visits, prosthetics, and rehabilitation can reasonably be expected to be greater for extremity injuries.

With respect to disability that results from these injuries, there are similar rates of referral to PEB and findings of unfit for duty among each body region, approximately 35%.

TABLE 1. Injuries, Admissions, Average Inpatient Days, and Resource Costs by Body Region Injured

Body Region	Injury Incidence, No. (%)[1]	Admissions, No. (%)	Average Inpatient Days, d (SEM)	Resource Utilization, $ (%)
Head/neck	1946 (29)	309 (23)	14.4 (1.2)	13,334,162 (20)
Thorax	376 (6)	68 (5)	13.1 (2.1)	3,416,233 (5)
Abdomen	709 (11)	114 (9)	13.9 (1.5)	6,627,491 (10)
Extremity	3575 (54)	842 (63)	17.9 (0.7)	42,355,395 (65)

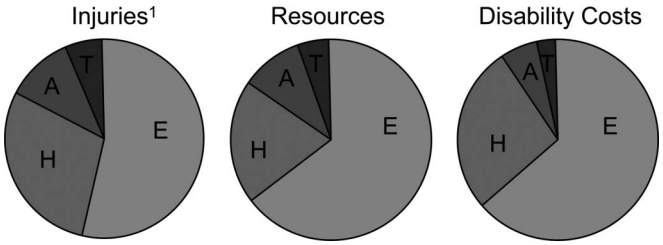

FIGURE 1. Distribution of injuries, resources, and disability costs by body region. A, abdomen; E, extremity; H, head/neck; T, thorax.

However, due to the disproportionate number of soldiers with a primary diagnosis of extremity injuries, 65% of all soldiers going through the PEB had extremity injuries as their primary diagnoses for admission. Thus, the burden of wartime disability is overwhelmingly due to extremity injuries.

The average disability ratings for injuries to all body regions were dissimilar with the head/neck group having the highest average disability rating at 52% followed by the extremity group at 42%. We found even lower average disability ratings for the thorax and abdomen groups. These averages are difficult to interpret as the ratings do not have a normal distribution. Although 52% is the average disability rating for the head/neck group, there are very few soldiers who actually have a rating near that amount. They are more likely to have a rating of 30% or 100%. The median and mode are effective statistics for understanding these rating distributions. The primarily extremity-injured group had a median and a mode of 40%, which was similar to the mean. The primarily head/neck-injured group had a median of 40% and a mode of 30%, indicating that outliers at the high end of the disability ratings are skewing the mean. This is indicative of the devastating effect of severe craniofacial injuries but masks the true disability of the typical primarily head/neck-injured soldier, which is less than the typical extremity-injured soldier. The thorax and abdomen groups had a similar pattern to the head/neck group, but with lower ratings. We can conclude from the mode that the typical or most prevalent soldier in the primarily extremity-injured group is more disabled than the typical soldier in the primarily head/neck group, although the number of soldiers in the primarily head/neck-injured group with 100% disability ratings was larger. With the much larger number of soldiers in the extremity group and the high level of disability ratings, these data support the claim that extremity injuries are the cause of the greatest quantity of disability among combat casualties.

To further evaluate the disability of soldiers, we assessed the projected award of disability benefits. This method effectively discounts injuries that have low disability ratings as the disability severance pay does not approach the value of disability retirement pay. Both the thorax and abdomen groups had greater than 50% of their soldiers rated below the threshold for disability retirement pay when found unfit for duty. The decreased level of disability lessens the impact of these injuries on the military medical system. In contrast, the primarily head/neck-injured and primarily extremity-injured groups were more likely to have higher disability ratings and higher disability benefit costs. The primarily head/neck-injured group had a higher proportion of patients with 100% disability ratings than the other body regions. This led to higher projected disability benefit costs on a per soldier basis. However, with the previously demonstrated high number of disabled soldiers in the extremity group and their relatively high average disability benefit cost, primarily extremity-injured soldiers had the greatest total projected cost of disability. The extrapolation of total disability benefit costs yielded $1.2 billion in projected disability compensation for extremity injuries. This is impressive both in its magnitude and by the degree that it exceeds costs for acute treatment resources.

This study was limited by simplifications and assumptions made with each of our models. Analysis of the resources dedicated to the care of a soldier would ideally be carried out for the entire duration of care to include subsequent hospitalizations, outpatient visits, and ancillary therapies and rehabilitation costs. Unfortunately, no databases currently exist for war-injured soldiers that capture these data. Furthermore, we could not account for the prosthetic-related costs of our amputees. A civilian publication evaluating amputee costs due to trauma demonstrated a lifetime prosthetic cost of a half million dollars per amputee.[26] In addition, for the soldiers who receive disability benefits, the health care includes all medical concerns and not just the complications or aftercare from the original injury. These limitations likely underestimated the health care cost of combat-related extremity injuries.

We recommend that further database development efforts continue, particularly in the area of extremity trauma outcomes. We feel that these data justify the need for further research support to optimize treatment of extremity injuries. Civilian studies have demonstrated a significant negative impact on long-term outcome by rehospitalization for a complication after trauma.[27,28] Therefore, basic science and clinical research aimed at minimizing posttraumatic complications has the potential to significantly impact our patient's

TABLE 2. PEB Finding and Rating Statistics by Body Region Injured

Body Region	Found Unfit for Duty, No. (%)	Mean Disability Rating, % (SEM)	Median Disability Rating, %	Mode Disability Rating, % (No.)
Head/neck	105 (23)	52 (2.9)	40	30 (20)
Thorax	24 (5)	32 (6.1)	20	10 (8)
Abdomen	38 (8)	36 (4.5)	30	10 (9)
Extremity	297 (64)	42 (1.5)	40	40 (54)

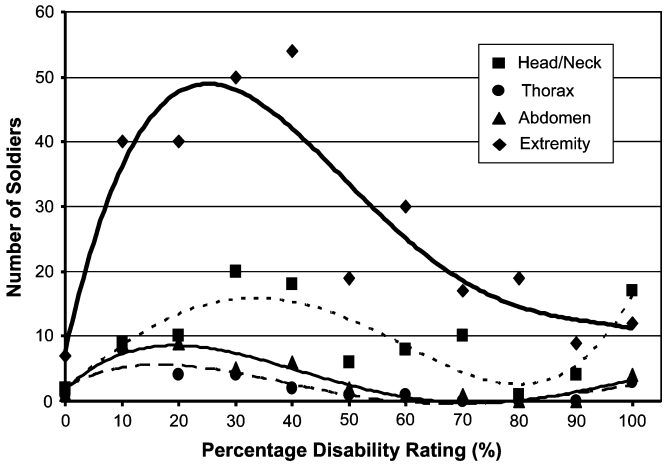

FIGURE 2. Distribution of PEB disability ratings by body region injured with trendlines.

long-term functional outcome and impact of their injuries on the military medical system.

The PEB process assigns disability ratings to each individual injury that the board finds incompatible with continued service. We were able to gather disability ratings for each boarded soldier; however, we were not able to identify the specific injury that resulted in the rating for each soldier. Our model accounted for this by assigning the disability rating to the body area that was the primary diagnosis for each soldier's admission. We believe that the effect of this simplification on the data to be minimal; however, we recognize that further investigation into PEB results would be beneficial, and these records remain an excellent source for outcome data on injured soldiers.

The PEB process does assess traumatic brain injury in its disability rating, which was reflected in this study. However, the impact and disability of traumatic brain injury on soldiers over the long term may not yet be completely understood and should be an emphasis for continued research.

The greatest strength of this study is the cohort size. To our knowledge, there has been no larger study assessing the impact of combat injuries on military medical resources or evaluating disability outcomes from injuries in this conflict. These data should be used to determine future funding and resource distribution for those caring for and researching combat trauma.

TABLE 3. Projected Disability Benefit Costs by Body Region Injured

Body Region	Severance, %/ Disability Pay, %	Mean Projected Benefit Per Soldier, $ (SEM)	Total Projected Benefit Costs, $ (%)
Head/neck	20/80	442,445 (29,503)	46,456,799 (27)
Thorax	54/46	244,823 (63,735)	5,875,757 (3)
Abdomen	50/50	255,106 (49,842)	9,694,044 (6)
Extremity	29/71	363,631 (17,652)	107,998,462 (64)

With the available data and assumptions applied, we accept our hypothesis and conclude that combat-wounded extremities require the greatest utilization of resources for inpatient treatment in the initial postinjury period and cause the greatest disability by volume of disabled soldiers and by the projected cost of disability benefits.

REFERENCES

1. Owens BD, Wenke JC, Macaitis J, et al. Combat wounds in Operation Iraqi Freedom and Operation Enduring Freedom. *J Trauma*. 2008;64: 295–299.
2. Owens BD, Kragh JF, Macaitis J, et al. Characterization of extremity wounds in Operation Iraqi Freedom and Operation Enduring Freedom. *J Orthop Trauma*. 2007;21:254–257.
3. Dischinger PC, Read KM, Kufera JA, et al. Consequences and costs of lower extremity injuries. *Annu Proc Assoc Adv Automot Med*. 2004; 48:339–353.
4. Fern KT, Smith JT, Zee B, et al. Trauma patients with multiple extremity injuries: resource utilization and long-term outcome in relation to injury severity scores. *J Trauma*. 1998;45:489–494.
5. Holbrook TL, Anderson JP, Sieber WJ, et al. Outcome after major trauma: 12-month and 18-month follow up results from the Trauma Recovery Project. *J Trauma*. 1999;46:765–771.
6. Michaels AJ, Madey SM, Krieg JC, et al. Traditional injury scoring underestimates the relative consequences of orthopaedic injury. *J Trauma*. 2001;50:389–395.
7. Mkandawire NC, Boot DA, Braithwaite IJ, et al. Musculoskeletal recovery 5 years after severe injury: long term problems are common. *Injury*. 2002; 33:111–115.
8. Zelle BA, Brown SR, Panzica M, et al. The impact of injuries below the knee joint on the long-term functional outcome following polytrauma. *Injury*. 2005;36:169–177.
9. Burgess AR, Dischinger PC, O'Quinn TD, et al. Lower extremity injuries in drivers of airbag-equipped automobiles: clinical and crash reconstruction correlations. *J Trauma*. 1995;38:509–516.
10. Loo GT, Siegel JH, Dischinger PC, et al. Airbag protection versus compartment intrusion effect determines the pattern of injuries in multiple trauma motor vehicle crashes. *J Trauma*. 1996;41: 935–951.
11. Richter M, Pape HC, Otte D, et al. Improvements in passive car safety led to decreased injury severity—a comparison between the 1970s and 1990s. *Injury*. 2005;36:484–488.
12. Greer MA, Miklos-Essenberg ME, Harrison-Weaver S. A review of 41 upper extremity war injuries and the protective gear worn during Operation Enduring Freedom and Operation Iraqi Freedom. *Mil Med*. 2006;171:595–597.
13. Kosashvili Y, Hiss J, Davidovic N, et al. Influence of personal armor on distribution of entry wounds: lessons learned from urban warfare fatalities. *J Trauma*. 2005;58:1236–1240.
14. Mabry RL, Holcomb JB, Baker AM, et al. United States Army Rangers in Somalia: an analysis of combat casualties on an urban battlefield. *J Trauma*. 2000;49:515–528.
15. McNeil JD, Pratt, JW. Combat casualty care in an air force theater hospital: perspectives of recently deployed cardiothoracic surgeons. *Semin Thorac Cardiovasc Surg*. 2008;20:78–84.
16. Paquette EL. Genitourinary trauma at a combat support hospital during Operation Iraqi Freedom: the impact of body armor. *J Urol*. 2007;177: 2196–2199.
17. Peleg K, Rivkind A, Aharonson-Daniel L, et al. Does body armor protect from firearm injuries? *J Am Coll Surg*. 2006;202:643–648.
18. Holcomb JB, Stansbury LG, Champion HR, et al. Understanding combat casualty care statistics. *J Trauma*. 2006;60:397–401.
19. Funk W. Military health system data overview. In: *Working Information Systems to Determine Optimal Management (WISDOM) Notebook*. TRICARE Management Agency, Department of Defense; 2004.
20. Congress of the United States. *Diagnosis Related Groups (DRGs) and the Medicare Program: Implications for Medical Technology—A Technical Memorandum. Medical Technology and Costs of the Medicare Program*.

Available at: http://govinfo.library.unt.edu/Ota_4/DATA/1983/8306.PDF. 1983. OTA-TM-H-17.
21. U.S. Army. Personnel separations: physical evaluation for retention, retirement, or separation. http://www.army.mil/usapa/epubs/pdf/r635_40.pdf. *Army Regul*. 2006;635–640.
22. U.S. Army. Medical services: standards of medical fitness. http://www.army.mil/usapa/epubs/pdf/r40_501.pdf. *Army Regul*. 2007; 40–501.
23. U.S. Army. Medical services: patient administration. http://www.army.mil/usapa/epubs/pdf/r40_400.pdf. *Army Regul*. 2008;40–400.
24. American Forces Press Service. Casualty Data [Department of Defense Web Site]. Available at: http://www.defenselink.mil/news/casualty.pdf. Accessed May 08, 2008.
25. Beebe GW, Debakey ME. Location of hits and wounds. In: *Battle Casualties*: Incidence, Mortality, and Logistic Considerations. Springfield, IL: Charles C. Thomas; 1952:165–205.
26. MacKenzie EJ, Jones AS, Bosse MJ, et al. Health-care costs associated with amputation or reconstruction of a limb-threatening injury. *J Bone Joint Surg Am*. 2007;89:1685–1692.
27. Bosse MJ, MacKenzie EJ, Kellam JF, et al. An analysis of outcomes of reconstruction or amputation after leg-threatening injuries. *N Engl J Med*. 2002;347:1924–1931.
28. Holbrook TL, Hoyt DB, Anderson JP. The impact of major in-hospital complications on functional outcome and quality of life after trauma. *J Trauma*. 2001;501:91–95.

