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## **Updated Death and Injury Rates of U.S. Military Personnel During the Conflicts in Iraq and Afghanistan**

Matthew S. Goldberg

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## **Abstract**

In Operation Iraqi Freedom, which ended on August 31, 2010, some 3,482 hostile deaths occurred among U.S. military personnel and 31,947 people were wounded in action (WIA). More than 1,800 hostile deaths occurred during Operation Enduring Freedom (in Afghanistan and surrounding countries) through November 2014; about 20,000 more people were wounded in action.

In the Iraq conflict, a larger proportion of wounded personnel survived their wounds than was the case during the Vietnam War, but the increased survival rates are not as high as some studies have asserted. Prior to the surge in troop levels that began in early 2007, the survival rate was 90.4 percent in Iraq—compared with 86.5 percent in Vietnam.

Amputation rates are difficult to measure consistently, but I estimate that 2.6 percent of all WIA and 9.0 percent of medically-evacuated WIA from the Iraq and Afghanistan theaters combined resulted in the major loss of a limb.

An elevated non-hostile death rate (including deaths from accidents, illnesses, or suicides) in Iraq before the surge resulted in about 220 more deaths during the first four years of that conflict (March 2003–March 2007) than would have been expected in peacetime among a population the size of the one that deployed to Iraq. Relative to such a peacetime benchmark, I find essentially no additional non-hostile deaths in Iraq after March 2007. For the conflict in Afghanistan, I estimate about 200 additional non-hostile deaths relative to a comparable benchmark through December 2013.

## Introduction

Operation Enduring Freedom (OEF) began in Afghanistan in October 2001 as an immediate reaction to the terrorist attacks on the United States on September 11 of that year. More than 1,800 hostile deaths and about 20,000 wounded-in-action (WIA) incidents among U.S. military personnel in the Afghanistan theater had been recorded through November 2014.<sup>1</sup> On May 27, 2014, President Barack Obama announced his plan to reduce the U.S. military presence to 9,800 by the beginning of 2015, eventually tapering down to a smaller number for normal embassy presence and security assistance by the end of 2016.

Operation Iraqi Freedom (OIF) began with the U.S. invasion of Iraq on March 19, 2003. OIF officially closed on August 31, 2010 with a final tally of 3,482 hostile deaths and 31,947 WIA.<sup>2</sup> Elements of the U.S. military remained in Iraq to advise and assist Iraqi security forces as part of Operation New Dawn (OND), which itself officially closed on December 15, 2011, with the withdrawal of essentially all remaining U.S. military personnel.

In an earlier paper, I examined the death and injury rates in OIF through 2008.<sup>3</sup> That paper compared the rates before and during the surge in Iraq that took place between February 2007 and July 2008; it also compared the pre-surge rates in Iraq to those that had prevailed during the course of the Vietnam War. Now that OIF is over and the conflict in Afghanistan is, apparently, nearly over, in this paper I look back over the conflicts in Iraq and Afghanistan (2003–2010 and 2001–2013, respectively), focusing on the periods of the troop surges in those theaters, and present final (or nearly final) statistics relating to hostile and non-hostile deaths, WIA incidents, and amputations.

## DoD's Casualty Classification System

The Department of Defense (DoD) defines a casualty as any soldier who is lost to his or her unit in the theater of operations for medical reasons. (Although members from all service branches have been killed or injured in Iraq and Afghanistan, I use the term “soldiers” to include not only Army personnel but also sailors, airmen, and marines.) DoD classifies a casualty as hostile if it is the direct result of combat between U.S. forces and opposing forces, or if it occurs on the way to or from a combat mission; that definition excludes injuries or deaths caused by natural elements, self-inflicted wounds, or combat fatigue.<sup>4</sup>

DoD further distinguishes three categories of hostile casualties, depending on whether and where the injured soldiers die:

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<sup>1</sup> Department of Defense: Defense Casualty Analysis System, Operation Enduring Freedom (OEF). Available at [www.dmdc.osd.mil/dcas/pages/casualties\\_oef.xhtml](http://www.dmdc.osd.mil/dcas/pages/casualties_oef.xhtml); accessed December 12, 2014.

<sup>2</sup> Department of Defense: Defense Casualty Analysis System, Operation Iraqi Freedom (OIF). Available at [www.dmdc.osd.mil/dcas/pages/casualties\\_oif.xhtml](http://www.dmdc.osd.mil/dcas/pages/casualties_oif.xhtml); accessed December 12, 2014.

<sup>3</sup> Goldberg, MS: Death and Injury Rates of U.S. Military Personnel in Iraq. *Mil Med* 2010; 175(4): 220–6.

<sup>4</sup> Department of Defense: DoD Dictionary of Military and Associated Terms, Joint Publication 1-02 (as amended through March 15, 2014). Available at [www.dtic.mil/doctrine/dod\\_dictionary](http://www.dtic.mil/doctrine/dod_dictionary); accessed December 12, 2014.

**Figure 1.**  
**Classification of U.S. Military Casualties, Injuries, and Disease**

Hostile Events	Non-Hostile Events	
Killed in action (KIA)	Death	Non-fatal injury and disease
Died of wounds (DOW)		
Wounded in action (WIA)		
<b>Casualties</b>		

- Killed-in-action (KIA): those who die immediately on the battlefield;
- Died-of-wounds (DOW): those who survive injury on the battlefield, but die after admission to a forward surgical station or a combat support hospital; and
- Wounded-in-action (WIA): those who survive their injuries beyond initial hospital admission.<sup>5</sup>

KIA and DOW are often combined as hostile deaths, and I will do so henceforth. DoD also reports non-hostile deaths, which it treats as an additional category of casualties (see **Figure 1**). Finally, although non-fatal incidents of disease and non-battle injury (DNBI) are not considered casualties, DoD does tabulate the more serious incidents—those that require evacuation from the combat theater.

## The Surges in Iraq and Afghanistan

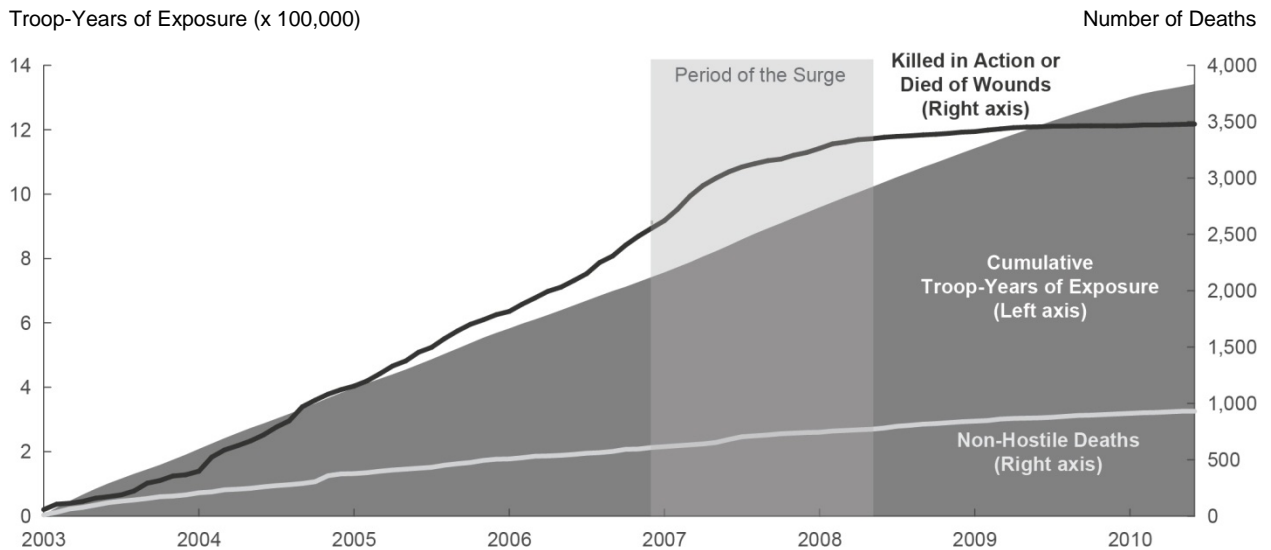
### Timeline in Iraq

The surge in the Iraq theater began in February 2007 and ended in July 2008 when President George W. Bush declared that all additional troops had returned to the U.S.<sup>6</sup> The surge pushed the number of Army brigade combat teams (BCTs) up from 15 to 20, while also increasing the number of Marine Corps battalions. The precise number of troops associated with the surge has been difficult to determine, in part because the Bush Administration’s announcements in 2007 did not appear to include the support troops that generally accompany combat brigades in theater. Even if there had been no surge, the number of troops is difficult to estimate because brigades and

<sup>5</sup> Holcomb JB, Stansbury LG, Champion HR, Wade C, Bellamy RF: Understanding Combat Casualty Care Statistics. *J Trauma* 2006; 60(2): 397–401.

<sup>6</sup> Bush GW: President George W. Bush’s White House press conference, July 31, 2008. Available at <http://go.usa.gov/FkGm>; accessed December 12, 2014.

**Figure 2.**  
**Troop Levels and Deaths During the War in Iraq, 2003–2010**



Note: A troop-year is the equivalent of a single soldier serving for a period of a year.

their supporting units are rotated into and out of the theater on a seasonal basis. In my earlier paper I estimated the size of the surge in Iraq at 37,000 troops.

I estimated the hostile death (combining KIAs and DOWs) and WIA rates in Iraq using the method developed by the demographers Preston and Buzzell to measure the denominator—the number of troop-years of exposure (a troop-year is the equivalent of a single soldier serving in the wartime theater for a period of a year).<sup>7</sup> The hostile death rate in Iraq increased during the early months of the surge: as shown in **Figure 2**, the cumulative number of hostile deaths climbed faster than cumulative exposure.<sup>8</sup> Later in the surge, the number of hostile deaths leveled off and the rate declined to below the pre-surge level. A similar pattern was observed during the surge for the number of WIAs (see **Figure 3**).

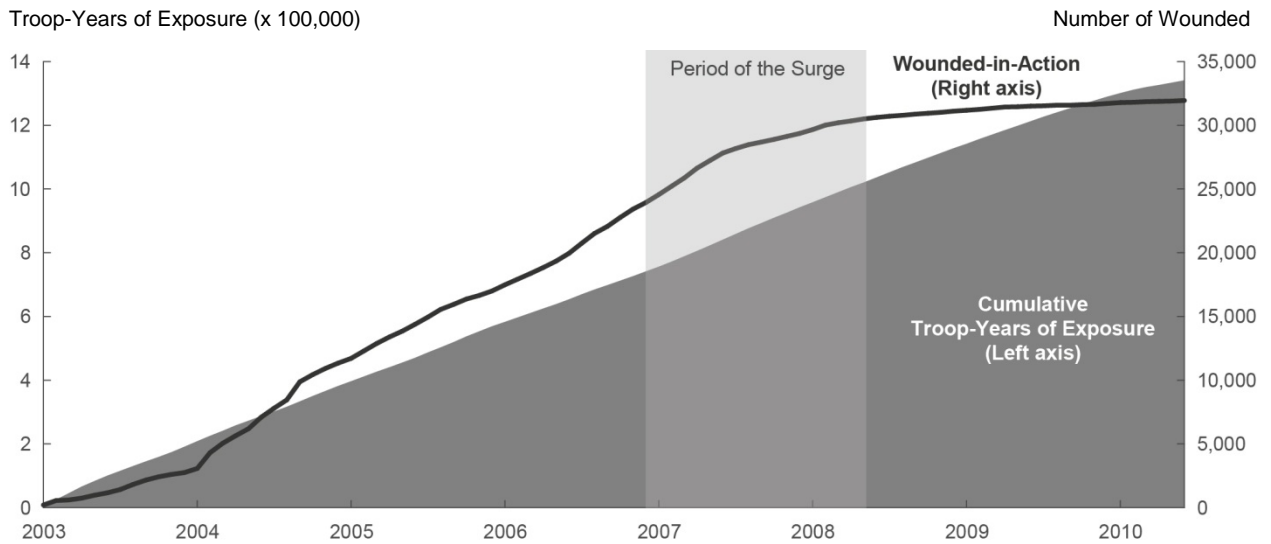
In all, I estimate 1.34 million troop-years of exposure through the end of OIF in August 2010, and 550,000 troop-years in OEF through December 2013. Those totals are broadly consistent with a RAND Corporation estimate of about 1.5 million troop-years for the Army (the service branch that has provided the bulk of U.S. troops to the two conflicts) over the narrower timespan of September 2001 through December 2011.<sup>9</sup>

<sup>7</sup> Preston S, Buzzell E: Mortality of American troops in the Iraq war. *Popul Dev Rev* 2007; 33(3): 555–66.

<sup>8</sup> Department of Defense: Defense Manpower Data Center, Military Personnel Statistics. Available at <http://go.usa.gov/FXYJ>; accessed December 12, 2014.

<sup>9</sup> Baiocchi D: Measuring Army Deployments to Iraq and Afghanistan. RAND Corporation, 2013. Available at [www.rand.org/pubs/research\\_reports/RR145.html](http://www.rand.org/pubs/research_reports/RR145.html); accessed December 12, 2014.

**Figure 3.**  
**Troop Levels and Soldiers Wounded in Action During the War in Iraq, 2003–2010**



Note: A troop-year is the equivalent of a single soldier serving for a period of a year.

### Timeline in Afghanistan

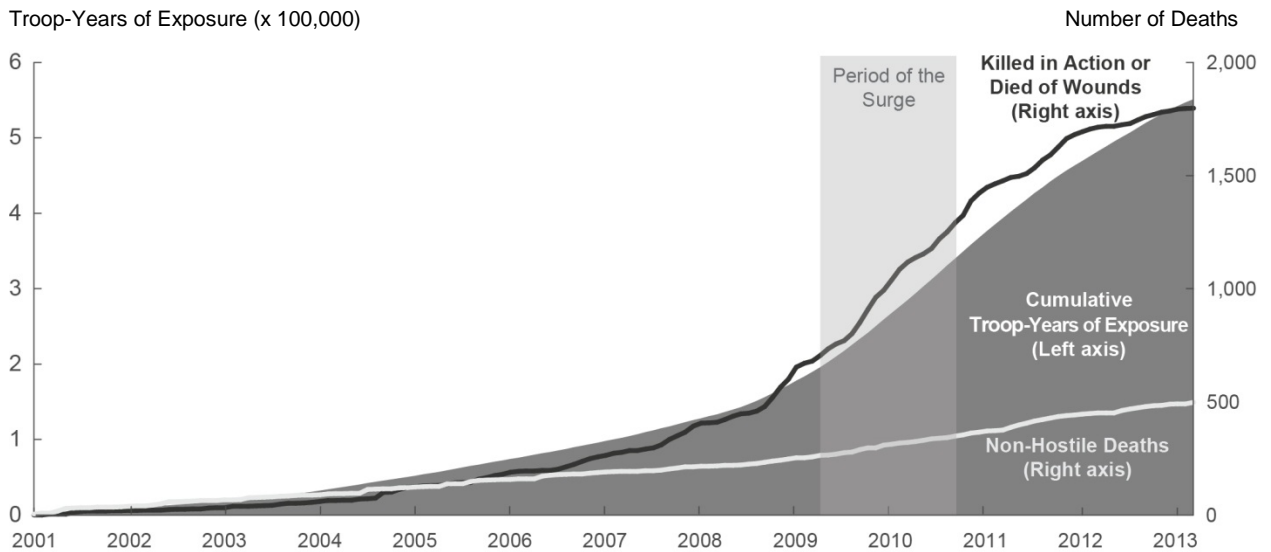
The surge in Afghanistan, which I define as encompassing the 18-month period from January 2010 through June 2011, was more precipitous than the one in Iraq. About 35,000 U.S. troops were deployed to Afghanistan when President Obama took office in January 2009. That number had doubled to 70,000 by December 2009, at which time President Obama announced the surge during a speech at the United States Military Academy (West Point). The plan was to deploy 30,000 additional troops for a duration of 18 months, but the actual level appears to have been a bit higher; the total number of troops in Afghanistan peaked at 110,000 in June 2011. During a televised speech in June 2011, President Obama announced a plan to return 10,000 troops to the U.S. by end of year (achieved in December 2011) and a total of 33,000 by the end of the following summer (achieved in September 2012). As indicated in the President’s State of the Union Address in February 2013 (and reiterated two months later in the Administration’s budget request for fiscal year 2014), the plan was to reduce the number of troops from 68,000 to 34,000 by February 2014. In a White House speech on May 27, 2014, President Obama announced plans to have only 9,800 troops in Afghanistan by the beginning of 2015, roughly half of that amount by the end of that year, and a smaller number for normal embassy presence and security assistance by the end of 2016.<sup>10</sup>

The hostile death rate in Afghanistan increased throughout the surge that took place between January 2010 and June 2011 (see **Figure 4**), and a similar pattern was observed for WIAs (see **Figure 5**).

<sup>10</sup> Obama B: President Obama Makes A Statement on Afghanistan, May 27, 2014. Available at <http://go.usa.gov/Fk7B>; accessed December 12, 2014.



**Figure 4.**  
**Troop Levels and Deaths During the War in Afghanistan, 2001–2013**



Note: A troop-year is the equivalent of a single soldier serving for a period of a year.

### Statistical Analysis of Changes in Casualty Rates

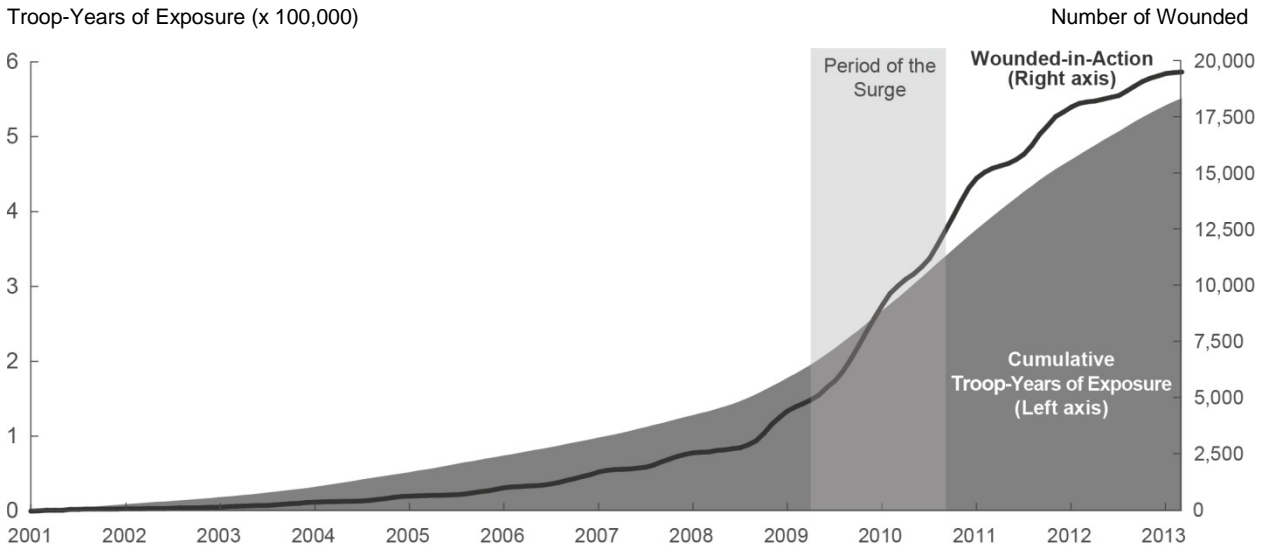
I estimated and compared the casualty rates in the two conflicts over time. I performed statistical tests based on over-dispersed Poisson regression models fit to the monthly casualty data in each conflict, using binary covariates to distinguish the surge periods and the monthly count of troops in each combat theater as an offset variable so that the models describe the casualty rates.<sup>11</sup> Not all of the changes in casualty rates over time were statistically significant. The hostile death rates during the surges in Iraq and Afghanistan were not statistically different from the respective pre-surge rates (two-sided p-values > 0.3; see **Figure 6**, which depicts the average hostile-death rates in each theater and period). However, the declines during the post-surge periods in both theaters were overwhelmingly significant, consistent with the leveling-off in the accumulation of hostile deaths as shown in Figures 2 and 4.

All of the changes in WIA rates over time in both theaters were statistically significant—the modest decline during the surge in Iraq and the much larger post-surge decline as well as the large increase during the surge in Afghanistan and the somewhat smaller post-surge decline, which nonetheless left the post-surge WIA rate in Afghanistan significantly higher than the pre-surge rate (two-sided p-value = 0.02; see **Figure 7**).

It is also possible to estimate how many fewer troops were wounded during the surge in Iraq when the WIA rate was lower than it had been pre-surge, and how many more troops were wounded during the surge in Afghanistan when the WIA rate was elevated. In Iraq, an estimated

<sup>11</sup> Morel JG, Neerchal NK: Overdispersion Models in SAS, pp 66-69. Cary, NC, SAS Publishing, 2012.

**Figure 5.**  
**Troop Levels and Soldiers Wounded in Action During the War in Afghanistan, 2001–2013**



Note: A troop-year is the equivalent of a single soldier serving for a period of a year.

2,410 fewer troops were wounded during the surge because the WIA rate was lower, but 520 more troops were wounded because an average of almost 11,000 more troops per month (peaking at the estimate of 37,000 described earlier) were at risk during the surge.

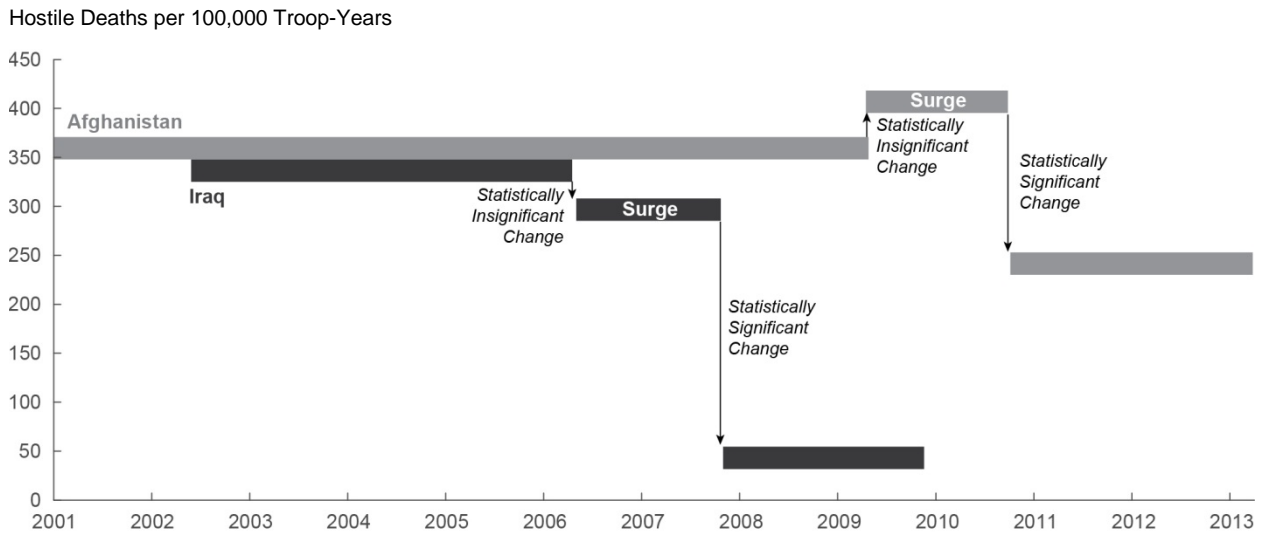
The 7,700 troops wounded during the surge in Afghanistan can be categorized as follows: an estimated 870 would have been wounded at the pre-surge average troop level and WIA rate had that rate continued into the 18 months of the surge; about 3,900 more were wounded during the surge because the WIA rate was elevated; and about 2,930 more were wounded because an average of 77,000 more troops per month were at risk during the surge. (The pre-surge average troop level is computed not from the beginning of the Obama Administration but from the beginning of the conflict in October 2001).

## Comparison of Survival Rates to the Vietnam War

There was considerable discussion among policymakers, especially during the early years of the conflict in Iraq, about whether the Department of Veterans Affairs (VA) would be overwhelmed by recent combat veterans because the percentage of soldiers who were surviving their wounds was much larger than it had been during earlier conflicts. Extending the discussion from my previous paper, I report here that the improvement in survival, although impressive, has been exaggerated in the literature.

Several earlier papers on the subject were problematic because they compared the survival rate among all wounded soldiers in Iraq to the survival rate among only the more-seriously wounded soldiers (those who were hospitalized for treatment of their wounds) in Vietnam. That comparison tends to exaggerate the improvement in survival between the two conflicts because the more-seriously wounded in Vietnam were less likely to survive.

**Figure 6.**  
**Hostile Death Rates Before, During, and After the Surges in Iraq and Afghanistan, 2001–2013**



Note: A troop-year is the equivalent of a single soldier serving for a period of a year.

In addition, rather than using the wounded-to-killed ratio, which is open-ended (on the high end) and very sensitive to small changes in the survival rate, I prefer to use the survival rate itself as a single, composite measure of both the lethality of enemy weapons and the effectiveness of U.S. battlefield medicine and medical evacuation. I define the survival rate as WIA divided by the sum of WIA and hostile deaths. As an example, an improvement in the wounded-to-killed ratio between two conflicts from 9:1 to 19:1 implies a numerically more moderate increase in the survival rate from 90 percent to 95 percent. A minor error of measurement that led to an estimated survival rate of 96 percent would cause the wounded-to-killed ratio to rise sharply to 24:1.

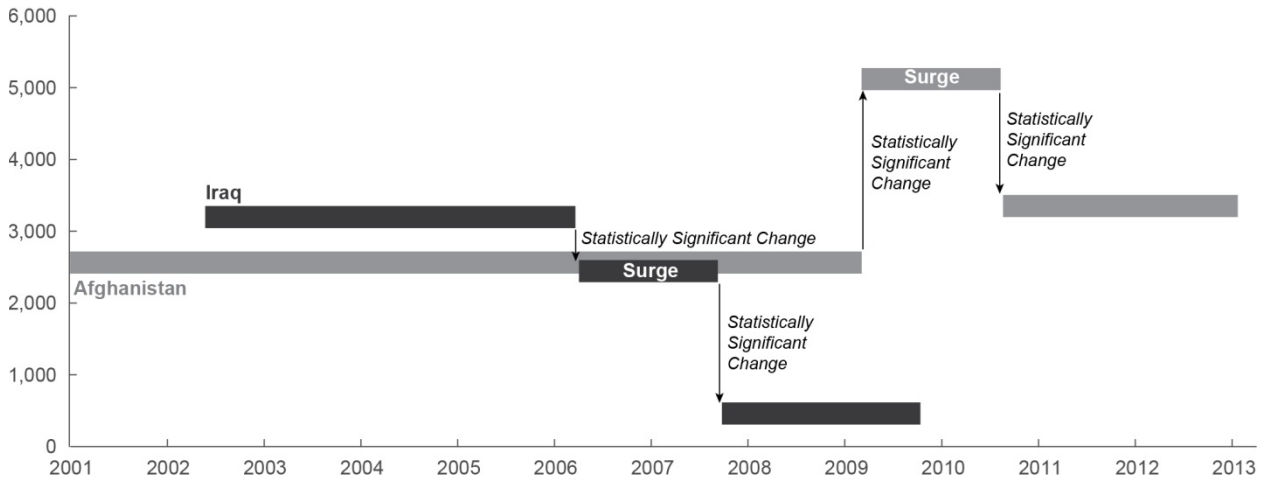
Bilmes, in various reports and editorials, asserted a wounded-to-killed ratio as high as 16:1 in Iraq, implying a survival rate in excess of 90 percent.<sup>12</sup> Gawande, using the same inputs, calculated the survival rates directly and reported rates of 90 percent in Iraq and Afghanistan early in those conflicts (the rates did not vary much in later years) and 76 percent in Vietnam.<sup>13</sup>

<sup>12</sup> Bilmes L: Soldiers Returning from Iraq and Afghanistan: The Long-Term Costs of Providing Veterans Medical Care and Disability Benefits. Harvard Kennedy School Faculty Research Working Paper Series RWP07-001, January 2007. Available at <http://tinyurl.com/lm5mhb4>; accessed December 12, 2014. Bilmes L: The Battle of Iraq's Wounded: The U.S. Is Poorly Equipped to Care for the Tens of Thousands of Soldiers Injured in Iraq. Los Angeles Times, January 5, 2007. Available at [www.hks.harvard.edu/fs/bilmes/paper/bilmes010507.pdf](http://www.hks.harvard.edu/fs/bilmes/paper/bilmes010507.pdf); accessed December 12, 2014.

<sup>13</sup> Gawande A: Casualties of War—Military Care for the Wounded from Iraq and Afghanistan. *N Engl J Med* 2004; 351(24): 2471–5. Available at [www.nejm.org/doi/full/10.1056/NEJMp048317](http://www.nejm.org/doi/full/10.1056/NEJMp048317); accessed December 12, 2014.

**Figure 7.**  
**Wounded-in-Action Rates Before, During, and After the Surges in Iraq and Afghanistan, 2001–2013**

Number of Soldiers Wounded in Action per 100,000 Troop-Years



Note: A troop-year is the equivalent of a single soldier serving for a period of a year.

I estimated a survival rate of 90.4 percent in Iraq prior to the surge, nearly 4 percentage points higher than the survival rate of 86.5 percent during the Vietnam War (see **Table 1**). Gawande’s oft-quoted estimate of 76.4 percent in Vietnam applies only to the more-seriously wounded soldiers—specifically, those who were hospitalized for treatment of their wounds. That figure ignores an additional 150,341 soldiers who were wounded in Vietnam but did not require hospitalization; including those 150,341 soldiers in the calculation of the survival rate (in both the numerator and denominator) would boost the rate to 86.5 percent, the value I calculated. Conversely, it is possible to estimate a roughly comparable survival rate for the soldiers seriously wounded in OIF by identifying the group of soldiers who did not return to duty within 72 hours of sustaining their wounds. The improvement in survival among the seriously wounded, from 76.4 percent in Vietnam to 80.8 percent in Iraq prior to the surge, is again about 4 percentage points.

Confusion on survival rates and how they should be measured, however, persists. For example, Gartner states that “... injured US military personnel have more than a 300% improved rate of surviving in these two recent conflicts than they did previously reflecting a historically improved chance of survival from previous conflicts.”<sup>14</sup> That author measures survival in Vietnam as the ratio of all deaths in theater (47,434 hostile plus 10,786 non-hostile) to wounded soldiers who were hospitalized (153,303, but again neglecting the additional 150,341 wounded soldiers who did not require hospitalization), arriving at a rate of 38 percent. That calculation crudely approximates not survival but rather its complement—lethality. A more refined measure of

<sup>14</sup> Gartner SS: Iraq and Afghanistan Through the Lens of American Military Casualties. Small Wars Journal, posted on-line April 3, 2013. Available at <http://smallwarsjournal.com/print/13959>; accessed December 12, 2014.

**Table 1.**  
**U.S. Military Casualty Statistics for the Wars in Vietnam and Iraq**

	Vietnam War	Operation Iraqi Freedom		
		Pre-Surge	Surge	One Army BCT During the Surge
Wounded in Action per 100,000 Troop-Years	11,640	3,165	2,410	6,990
Hostile Deaths per 100,000 Troop-Years	1,820	335	295	580
Total Deaths per 100,000 Troop-Years	2,230	415	355	675
Survival Rate Among All Soldiers Wounded in Action (Percent)	86.5	90.4	89.1	92.3
Survival Rate Among Soldiers Seriously Wounded in Action (Percent)				
Hospitalized	76.4	n.a.	n.a.	n.a.
Not returned to duty within 72 hours	n.a.	80.8	79.7	75.4

Sources: Wounded and dead in Vietnam are taken from Defense Casualty Analysis System (<http://go.usa.gov/6t9h>); troop-years in Vietnam are taken from Preston and Buzzell; wounded and dead in Operation Iraqi Freedom (OIF) are compiled from Defense Casualty Analysis System (<http://go.usa.gov/6tXk>); troop-years in OIF are derived from Defense Manpower Data Center (<http://go.usa.gov/FXYJ>); and data on the Army BCT in Iraq are adapted from LTC Philip J. Belmont Jr., M.D., et al.

Note: BCT = brigade combat team; n.a. = not applicable.

lethality would include only hostile deaths in the numerator and all of the wounded (whether or not they are hospitalized) in the denominator:  $47,434 / (47,434 + 153,303 + 150,341) = 13.5$  percent, or precisely the complement of the 86.5-percent survival rate reported above.

## Combat Wounds and Non-Battle Injuries

A few studies in the literature report on the detailed epidemiology of combat wounds and non-battle injuries suffered by members of particular combat units in Iraq or Afghanistan. One prominent example is the pair of studies by Army surgeon Dr. Philip Belmont and others on the experience of a single unnamed brigade combat team during a 15-month deployment as part of the surge in Iraq.<sup>15</sup> That BCT apparently faced more intense combat than most of the other 19 BCTs that were present during the surge. The hostile death rate of the BCT in those two studies

<sup>15</sup> Belmont PJ, Goodman GP, Zacchilli M, Posner M, Evans C, Owens B: Incidence and Epidemiology of Combat Injuries Sustained During “The Surge” Portion of Operation Iraqi Freedom by a U.S. Army Brigade Combat Team. *J Trauma* 2010; 68(1): 204-10. Belmont PJ, Goodman GP, Waterman B, DeZee K, Burks R, Owens B: Disease and Nonbattle Injuries Sustained by a U.S. Army Brigade Combat Team During Operation Iraqi Freedom. *Mil Med* 2010; 175(7): 469-76.

was twice as high as the average across the entire population deployed to OIF during the surge; the WIA rate was nearly triple (see **Table 1**).

The studies by Belmont contain much useful information, but they focus on intense combat that was not necessarily representative of all units and all time periods in Iraq. For example, improvised explosive devices (IEDs) were responsible for 77.7 percent of all hostile wounds (fatal and not) for that one BCT, and 7.6 percent of those IED wounds proved to be fatal. Gunshot wounds represented 9.0 percent of all hostile wounds, and 5.7 percent of those gunshot wounds were fatal.

Belmont's studies also describe the disease and non-battle injuries sustained by that single BCT. For example, U.S. Army policy was to remove female soldiers from the wartime theater within 14 days of a determination that they were pregnant.<sup>16</sup> Among 325 female soldiers who ever served in the BCT during its 15-month deployment to Iraq, there were 47 medical evacuations, of which 35 were related to pregnancy.

## **Amputations**

A number of studies have estimated the frequency with which soldiers lost a limb either directly on the battlefield (traumatic amputation) or as a result of a subsequent surgical amputation. DoD occasionally releases tabular reports on the number of amputations, but those reports do not generally distinguish between traumatic and surgical amputations. DoD's Joint Theater Trauma Registry does make that distinction, but that data source was not available for this study. The tabular reports provide a complete census of amputations (albeit with some reporting lag and subject to DoD's policy on public release of such information), cross-classified by theater (Iraq or Afghanistan), battle or non-battle injury and primary mechanism of battle injury (gunshot wound, IED, rocket-propelled grenade, etc.), and affected body parts (number of limbs and severity, e.g., above-the-knee versus below-the-knee leg amputations).

The data on amputations available for this paper, derived from DoD's tabular reports, cover the period from the beginning of the conflicts in the Iraq and Afghanistan theaters of operation through the common reporting endpoint of April 4, 2011. In the Iraq theater, that period spans all of Operation Iraqi Freedom and the first seven months of Operation New Dawn.

DoD defines a major amputation as the loss of limb at or proximal to (at or nearer to the central portion of the body) the wrist or ankle. During the period from the beginning of the two conflicts through April 4, 2011, some 1,186 service members (809 in Iraq and 377 in Afghanistan) from all four branches of service suffered major amputations in Iraq and Afghanistan. The modal case was 600 Army personnel who lost one limb; 182 Army personnel lost two limbs and 182 marines lost one limb. An additional 236 service members suffered minor amputations (those involving the

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<sup>16</sup> Weaver T: U.S. Personnel in Iraq Could Face Court-Martial for Getting Pregnant. Starts and Stripes, December 19, 2009. Available at <http://tinyurl.com/mxyoipb>; accessed December 12, 2014.

**Table 2.**  
**Major Amputations During the Wars in Iraq and Afghanistan, Through April 4, 2011**

Mechanism of Injury	Number of Major Amputations	Rate per All WIA (Percent)	Rate per WIA Who Are Medically Evacuated (Percent)	Rate per 100,000 Troop-years
<b>Iraq (Operation Iraqi Freedom and Operation New Dawn)</b>				
Improvised Explosive Device	534	1.7	6.0	38.3
Gunshot Wound	31	0.1	0.3	2.2
Other Combat Injury	205	0.6	2.3	14.7
Total hostile injuries	770	2.4	8.7	55.2
Non-Hostile Injuries	39	n.a.	n.a.	2.8
Total	809	n.a.	n.a.	58.0
<b>Afghanistan (Operation Enduring Freedom)</b>				
Improvised Explosive Device	274	2.5	8.1	87.8
Gunshot Wound	10	0.1	0.3	3.2
Other Combat Injury	69	0.6	2.0	22.1
Total hostile injuries	353	3.2	10.5	113.1
Non-Hostile Injuries	24	n.a.	n.a.	7.7
Total	377	n.a.	n.a.	120.8

Sources: Number of major amputations (all four service branches) were provided by U.S. Army, Office of the Surgeon General; troop-years are derived from Defense Manpower Data Center (<http://go.usa.gov/FXYJ>); wounded in action are compiled from Defense Casualty Analysis System (<http://go.usa.gov/6tXk>); and WIA medical evacuations are taken from Medical Surveillance Monthly Review, vol. 19, no. 2 (February 2012) and vol. 20, no. 6 (June 2013).

Note: WIA = wounded in action; n.a. = not applicable.

hands or feet). Those totals are consistent with a report from the Congressional Research Service that covered a slightly longer time period, but it did not provide detail on the mechanism of injury.<sup>17</sup>

There are various ways to express amputations as a rate (see **Table 2**). Among all troops who were WIA in Iraq, 2.4 percent suffered major amputations. A more common metric used in the literature expresses major amputations among the seriously wounded, defined in this section as those who required medical evacuation from the combat theater. Over essentially the same time period as the amputation tabulations used in this paper, 28 percent of all WIA in Iraq were medically evacuated, implying an amputation rate of 8.7 percent within that seriously wounded group.<sup>18</sup> The corresponding amputation rates in Afghanistan were 3.2 percent per WIA and 10.5

<sup>17</sup> Fischer H: U.S. Military Casualty Statistics: Operation New Dawn, Operation Iraqi Freedom, and Operation Enduring Freedom. Congressional Research Service, June 12, 2012; CRS Report for Congress RS22452. Available at [www.hsdl.org/?view&did=718040](http://www.hsdl.org/?view&did=718040); accessed December 12, 2014.

<sup>18</sup> Department of Defense: Medical Evacuations from Operation Iraqi Freedom/Operation New Dawn, Active and Reserve Components, U.S. Armed Forces, 2003–2011. Medical Surveillance Monthly Report, February 2012; 19(2): 18. Available at <http://go.usa.gov/FkAH>; accessed December 12, 2014.



percent per medically-evacuated WIA.<sup>19</sup> The rates for both theaters combined were 2.6 percent per WIA and 9.0 percent per medically-evacuated WIA.

The amputation rates published in the literature vary, perhaps because of differences in sources of data or the classification of major amputations, but probably in larger part because of differences in measuring the number of seriously-wounded soldiers. Krueger, et al., report an amputation rate of 3.6 percent among trauma admissions to a forward surgical station or a combat support hospital in Iraq and Afghanistan combined through July 2011.<sup>20</sup> The standard of a trauma admission appears to be intermediate to the standards I have applied of all WIA and medically-evacuated WIA, because some soldiers admitted to theater medical facilities are treated there and returned to duty rather than being evacuated to the U.S. That Krueger's rate lies between my two rates (2.6 percent per WIA and 9.0 percent per medically-evacuated WIA) is, therefore, no surprise. Potter and Scoville report an amputation rate of 2.3 percent for all "combat wounds," and Stansbury et al. report a rate of 5.2 percent for all "serious injuries," variously defined.<sup>21</sup> Although the evidence is mixed, the amputation rates in Iraq and Afghanistan appear to be somewhat higher than Dr. Ralph Bellamy's estimate (as reported in Stansbury, et al.) of 2.6 percent among seriously-wounded ground personnel in Vietnam.

Several hypotheses have been put forward to explain the higher amputation rates in Iraq and Afghanistan than in Vietnam. Soldiers who are attacked with automatic weapons are often struck by multiple gunshots—a common pattern is one or more bullets striking the chest or abdomen and others striking the limbs. Whereas bullets striking the chest or abdomen were more likely to have been fatal during earlier conflicts, those impacts are much more survivable to current soldiers who wear modern body armor. However, the arms and legs are not protected by body armor, so a larger percentage of surviving soldiers now have to contend with the loss of limb. Other factors that raise the overall survival rate may also have the indirect effect of increasing the incidence of amputations. Battle wounds—regardless of the mechanism of injury—are often infected by dirt, shreds of the soldier's clothing, and other debris, but advances have been made in the treatment of infections. Also, new blood-clotting factors have reduced the risk of death from severe loss of blood.<sup>22</sup> Other improvements include the innovative use of forward surgical

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<sup>19</sup> Department of Defense: Medical Evacuations from Afghanistan during Operation Enduring Freedom, active and reserve components, U.S. Armed Forces, 7 Oct 2001–31 Dec 2012. Medical Surveillance Monthly Report, June 2013; 20(6): 2. Available at <http://go.usa.gov/Fks4>; accessed December 12, 2014.

<sup>20</sup> Krueger CA, Wenke JC, Ficke JR: Ten Years at War: Comprehensive Analysis of Amputation Trends. *J Trauma Acute Care Surg* 2012; 73(6 Supplement 5): S438-444.

<sup>21</sup> Potter BK, Scoville CR: Amputation is Not Isolated: An Overview of the US Army Amputee Patient Care Program and Associated Amputee Injuries. *J Am Acad Orthop Surg*. 2006; 14(10 Spec No.): S188-190. Stansbury LG, Lalliss SJ, Branstetter JG, Bagg MR, Holcomb JB: Amputations in U.S. Military Personnel in the Current Conflicts in Afghanistan and Iraq. *J Orthop Trauma* 2008; 22(1): 43-46.

<sup>22</sup> Brown D: Military Medics Combine Ultramodern and Time-Honored Methods to Save Lives on the Battlefield. *Washington Post*, October 17, 2010. Available at <http://tinyurl.com/m3hz5gl>; accessed December 12, 2014.

Brown D: U.S. Military Medics Use Old and New Techniques to Save Wounded in Afghanistan. *Washington Post*, November 1, 2010. Available at <http://tinyurl.com/26j5z5u>; accessed December 12, 2014.



stations located closer to the combat units, and faster aeromedical evacuation of wounded soldiers to higher echelons of medical care.<sup>23</sup>

## Non-Hostile Deaths

Non-hostile deaths result from such causes as terrorist attacks (generally, surprise events distinct from hostile action in an ongoing conflict), accidents, illnesses, homicides, or suicides. In my earlier paper, I estimated the number of non-hostile deaths recorded in Iraq through March 2007 in excess of the number expected in a population the size of that deployed to Iraq if subject to the peacetime death rate for U.S. military personnel. Although all of the non-hostile deaths are treated with the same respect by the military and the public, epidemiologists refer to the difference between the actual number of deaths and the peacetime benchmark as the number of “excess deaths.”<sup>24</sup>

There are some challenges in estimating the peacetime benchmark for military personnel. DoD’s reported data from the OIF/OEF period (calendar years 2001 onward) do not, for example, separate the accidental deaths that occurred in the two wartime theaters from those that occurred in the U.S. The only way to estimate a purely peacetime death rate is to return to the pre-2001 period. Because DoD tabulates non-hostile deaths in Iraq and Afghanistan during all hours of the day, the peacetime benchmark should include off-duty deaths—such as those resulting from commuting or weekend motor-vehicle accidents—as well as training and occupational accidents at the workplace. The average mortality rate (including all causes of death) for military personnel between 1997 and 2000 was 53.0 per 100,000 troop-years.<sup>25</sup>

The non-hostile death rate in Iraq between March 2003 and March 2007 was 81.5 per 100,000 troop-years, indicating an elevation of 54 percent. The difference between that rate and the peacetime benchmark implies 216 excess non-hostile deaths in Iraq through March 2007. (My earlier published estimate was 219 excess deaths, but a recent revision to DoD’s data lowers that estimate to 216.)

For the subsequent period from April 2007 through the end of OIF in August 2010, the non-hostile death rate fell to 54.8 per 100,000 troop-years, virtually equal to the peacetime death rate of 53.0. I therefore estimate essentially no additional excess deaths during the latter period, arriving at a total of 218 excess deaths and a non-hostile death rate of 69.3 per 100,000 troop-years for the entire conflict in Iraq between March 2003 and August 2010 (see **Table 3**).

In Afghanistan, the non-hostile death rate of 90.3 per 100,000 between October 2001 and December 2013 was elevated by 70 percent relative to the peacetime rate of 53.0. Thus, I estimate there were 206 excess non-hostile deaths in Afghanistan during that period.

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<sup>23</sup> Jadick R: *On Call in Hell: A Doctor’s Iraq War Story*. New York, NAL Caliber, 2007.

<sup>24</sup> Checchi F, Roberts L: *Interpreting and Using Mortality Data in Humanitarian Emergencies: A Primer for Non-Epidemiologists*. Humanitarian Practice Network, 2005; Network Paper 52. Available at [www.odihpn.org/documents/networkpaper052.pdf](http://www.odihpn.org/documents/networkpaper052.pdf); accessed December 12, 2014.

<sup>25</sup> Department of Defense: *Defense Casualty Analysis System, Active Duty Military Deaths by Year and Manner*. Available at <http://go.usa.gov/6t63>; accessed December 12, 2014.

**Table 3.**  
**Non-Hostile Deaths in the U.S. Military**

	Active-Duty U.S. Military Personnel, Worldwide (January 1997 through December 2000)	Operation Iraqi Freedom (March 2003 through August 2010)	Operation Enduring Freedom (October 2001 through December 2013)
Number of Non-Hostile Deaths Predicted at the Peacetime Death Rate of 53.0 per 100,000 People	n.a.	711	292
Deaths in excess of the peacetime rate	n.a.	218	206
Total deaths	n.a.	929	498
<b>Memorandum:</b>			
Non-Hostile Death Rate per 100,000 troop-years	53.0	69.3	90.3

Sources: Non-hostile deaths are compiled from Defense Casualty Analysis System (<http://go.usa.gov/6tXk>); troop-years are derived from Defense Manpower Data Center (<http://go.usa.gov/FXYJ>); and the peacetime military death rate is calculated as the 1997–2000 average from Defense Casualty Analysis System (<http://go.usa.gov/6t63>).

Note: n.a. = not applicable.