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Access to Trauma Centers in the United States

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THE SYSTEMS APPROACH TO THE delivery of trauma care is widely accepted as an effective strategy for reducing death due to injury.¹⁻⁵ A critical component of this systems approach is the designation or verification of trauma center hospitals equipped to treat more severely injured patients. Although the overall number of trauma centers has increased over the last decade, recent studies have shown that their geographic distribution varies widely across states. These studies suggest that in many areas of the country residents are without timely access to trauma centers that could save their lives. In other areas, there may be too many trauma centers, possibly leading to inefficiencies, lower patient volumes per center, and reduced quality of care.⁶⁻¹¹

We used 2 new national databases to assess the US trauma system safety-net—where it is absent and where it is well developed. We also assessed the role of helicopters and the sharing of trauma care resources across states.

METHODS

We defined access as the percentage of the population that could reach a trauma center within a certain time (population access) and the percent-

Context Previous studies have reported that the number and distribution of trauma centers are uneven across states, suggesting large differences in access to trauma center care.

Objective To estimate the proportion of US residents having access to trauma centers within 45 and 60 minutes.

Design and Setting Cross-sectional study using data from 2 national databases as part of the Trauma Resource Allocation Model for Ambulances and Hospitals (TRAMAH) project. Trauma centers, base helipads, and block group population were counted for all 50 states and the District of Columbia as of January 2005.

Main Outcome Measures Percentages of national, regional, and state populations having access to all 703 level I, II, and III trauma centers in the United States by either ground ambulance or helicopter within 45 and 60 minutes.

Results An estimated 69.2% and 84.1% of all US residents had access to a level I or II trauma center within 45 and 60 minutes, respectively. The 46.7 million Americans who had no access within an hour lived mostly in rural areas, whereas the 42.8 million Americans who had access to 20 or more level I or II trauma centers within an hour lived mostly in urban areas. Within 45 and 60 minutes, respectively, 26.7% and 27.7% of US residents had access to level I or II trauma centers by helicopter only and 1.9% and 3.1% of US residents had access to level I or II centers only from trauma centers or base helipads outside their home states.

Conclusion Selecting trauma centers based on geographic need, appropriately locating medical helicopter bases, and establishing formal agreements for sharing trauma care resources across states should be considered to improve access to trauma care in the United States.

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age of land area from which a trauma center was reachable within a certain time (land area access). Access to level I or II trauma centers and access to level I, II, or III trauma centers was calculated. Although the precise criteria used in differentiating levels of trauma care varies by state, most are based on the guidelines published by American College of Surgeons Committee on Trauma.¹² Level I and II trauma centers provide comprehensive care for the most critically injured patients and have immediate availability of trauma surgeons, anesthesiologists, and certain other physician specialists. Level III centers provide prompt assessment, resuscitation, surgery, and stabilization, with

transfer to a level I or II center when indicated.

Two different prehospital time periods, 45 and 60 minutes, were used in

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assessing access. We chose 60 minutes because a prehospital time period longer than 60 minutes (the so-called "golden hour"¹³) has been associated with a significant increase in the risk of death for severely injured patients.¹⁴ We chose 45 minutes for comparative purposes and because the golden hour cutoff has little scientific evidence to support it.¹⁵ For purposes of this study, prehospital time is measured from receipt of emergency call to hospital arrival.

To estimate the role of helicopter transport, access to trauma centers was assessed by driving alone and by driving or flying. To estimate the contribution of shared resources (trauma centers and helipads) across state boundaries, access to trauma centers based on in-state trauma care resources only was compared with access based on resources located both in-state and in neighboring states.

Data Sources

Three data sources were used to estimate access to trauma centers. Data on trauma centers were obtained from the January 2005 Trauma Center Inventory.^{10,16} This inventory provides the longitude and latitude coordinates of all level I, II, and III trauma centers that have been designated by a state or regional authority, verified by the American College of Surgeons Committee on Trauma (ACSCOT), or both. No level IV or higher trauma centers were included in our analysis. We also excluded free-standing pediatric trauma centers (n=36) because they would have necessitated separate, age-specific estimates of access.

Air ambulance data were obtained from the January 2005 version of the Atlas and Database of Air Medical Services (ADAMS).¹⁷ This database provides the longitude and latitude coordinates of all helipad base locations operated by air medical service providers that respond to emergency medical and trauma scenes in the 50 states and the District of Columbia. All commercial, not-for-profit, public, and selected military air medical service providers are

listed in the database.^{18,19} We included only rotorwing air medical services in our analysis (ie, no fixed-wing services). Base helipads were typically airports, independent hangars, or designated areas on hospital grounds to which helicopters returned in between calls.

Our main geographic units of analysis were block groups, subdivisions of census tracts that do not cross state boundaries. Each block group's population was used to calculate access by assigning it a point in space, or centroid, that was nearest to most of its residents. The longitude-latitude coordinates of these population-weighted centroid points were then compared with the points representing trauma centers and base helipads. Population estimates and population-weighted centroids for 208 667 block groups were calculated for August 2004 (Claritas Inc, Ithaca, NY) based on data and computational methods from the US Census Bureau,²⁰ local and state estimates, trends in consumer counts, and trends in deliverable addresses from the US Postal Service.²¹ Block groups were aggregated to compute estimates of access for the entire country, the 4 Census Bureau regions (Northeast, Midwest, South, and West), all 50 states and the District of Columbia, and areas of the country defined by urbanicity (urban, suburban, and rural).

Access Calculations

The Trauma Resource Allocation Model for Ambulances and Hospitals (TRAMAH)^{7,22,23} was used as the basis for calculating access given the locations of existing trauma centers and base helipads. Access was calculated by summing either the population or land area of block groups that could reach a trauma center by helicopter or ground ambulance within the specified prehospital time period. The populations or land areas of block groups that could reach a trauma center within the time period specified were never counted more than once in the summation formula for access. All programming code was written, compiled, and tested using Compaq Visual Fortran Version 6.6

(2000 Compaq Computer Corporation, Houston, Tex). Two coders tested separate and independently written versions of the code. Both versions produced the same results.

To calculate ground ambulance driving times, we used an average urban driving speed of 20.1 mph, an average suburban driving speed of 47.5 mph, and an average rural driving speed of 56.4 mph.²⁴ Drives were classified as urban, suburban, or rural by averaging the population densities (residents per square mile) of the scene and trauma center block groups and then determining whether this average population density fell into the highest, middle, or lowest third among all US block groups. The population densities of intervening block groups were not considered. We then added 1.4, 1.4, and 2.9 minutes to account for the average time from receipt of emergency call to departure in urban, suburban, and rural areas, respectively. An additional 13.5, 13.5, and 15.1 minutes in urban, suburban, and rural areas, respectively, was added to account for the average time spent on the scene.²⁴

Although we directly calculated the driving time from scene block group to trauma center, we could not explicitly determine the locations of ground ambulance depots. Therefore, as with the TRAMAH,^{7,22} we estimated the time from ground ambulance depot to the scene. To obtain the total driving time, the time from scene to trauma center was multiplied by an empirically determined²⁴ constant: 1.6, 1.5, and 1.4 for urban, suburban, and rural drives, respectively. All driving distances were estimated using previously validated mathematical models of actual road travel.^{25,26} All speeds and times were previously derived as part of a meta-analysis of empirically determined prehospital care times for trauma.²⁴

To calculate helicopter flying times we used the typical cruise speeds of the helicopters reported in ADAMS for each base helipad and estimated flying distances as straight lines. We then added 3.5 minutes to account for the average time from helicopter receipt of emer-

Table 1. Population Percentages With Trauma Center Access by US Census Regions and States*

	Levels I and II Only, %		Levels I, II, and III, %	
	Within 45 min	Within 60 min	Within 45 min	Within 60 min
United States (total)	69.2	84.1	74.2	88.7
Northeast				
Connecticut	94.1	100.0	94.5	100.0
Maine	47.4	78.9	47.4	81.2
Massachusetts	83.6	96.8	85.3	97.1
New Hampshire	53.8	81.0	73.0	98.8
New Jersey	90.5	100.0	90.6	100.0
New York	87.7	96.8	87.7	96.8
Pennsylvania	88.5	99.3	89.2	99.3
Rhode Island	83.8	100.0	83.8	100.0
Vermont	30.3	66.6	31.3	76.3
Midwest				
Illinois	84.2	92.1	84.4	93.8
Indiana	48.2	90.3	48.2	90.5
Iowa	46.1	67.6	63.8	85.1
Kansas	48.5	62.3	49.2	64.5
Michigan	54.6	84.2	54.6	84.2
Minnesota	60.5	75.5	60.5	75.5
Missouri	65.3	79.4	73.0	89.3
North Dakota	50.5	54.5	53.5	57.6
Nebraska	23.4	74.4	59.6	76.9
Ohio	80.3	96.8	82.3	98.8
South Dakota	25.2	31.7	28.0	35.4
Wisconsin	55.3	82.9	55.4	83.6
South				
Alabama	24.9	47.5	24.9	47.7
Arkansas	1.7	6.1	1.7	14.8
Delaware	62.8	84.6	100.0	100.0
District of Columbia	100.0	100.0	100.0	100.0
Florida	78.4	93.9	78.4	93.9
Georgia	65.5	85.9	65.5	86.1
Kentucky	45.8	72.0	48.4	79.3
Louisiana	34.3	44.9	34.3	48.9
Maryland	87.5	96.7	95.9	100.0
Mississippi	36.9	60.5	54.8	76.7
North Carolina	51.1	80.6	56.0	81.8
Oklahoma	28.4	36.8	76.6	90.2
South Carolina	58.8	79.1	74.5	93.6
Tennessee	54.8	83.9	58.2	85.4
Texas	63.2	74.2	81.1	93.3
Virginia	71.5	90.2	75.3	92.1
West Virginia	39.1	62.1	58.5	78.9
West				
Alaska	42.3	51.7	42.3	51.7
Arizona	60.9	64.1	60.9	64.1
California	87.3	96.4	88.9	96.5
Colorado	80.9	87.3	87.8	92.9
Hawaii	71.8	71.8	71.8	71.8
Idaho	38.8	49.4	49.2	69.9
Montana	33.9	38.4	33.9	38.4
New Mexico	38.4	59.0	51.6	69.6
Nevada	86.5	93.7	86.5	93.7
Oregon	55.6	72.0	86.4	94.3
Utah	74.0	84.7	74.0	84.7
Washington	76.5	83.9	88.9	96.7
Wyoming	29.5	32.5	59.3	67.5

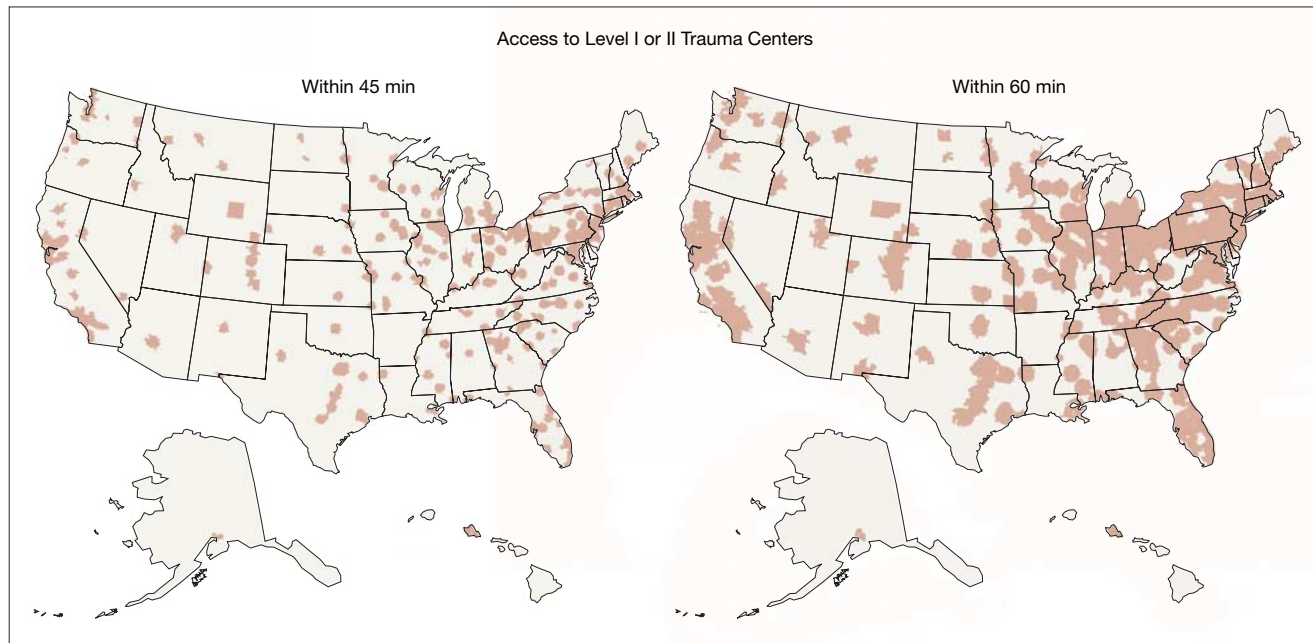
*By either ambulance or helicopter and including the trauma care resources of neighboring states.

gency call to take-off. Our models assumed that helicopters and ground ambulances are simultaneously dispatched to the scene of a trauma incident (which reportedly occurs a majority of the time²⁷) as opposed to ground ambulances responding first and assessing the situation before calling for a helicopter. An additional 21.6 minutes was added to account for the average time spent on the scene (including landing zone ascertainment). These times were previously derived as part of a meta-analysis of empirically determined pre-hospital care times for trauma.²⁴ As with the TRAMAH,^{7,22} base helipads and trauma centers were paired if they were within the specified prehospital time period of one another. Base helipads and trauma centers that were not within the specified prehospital time period of one another were not paired. Paired helipads increased the percentage of residents with access: they could launch a helicopter, pick up patients, and reach at least one trauma center within the specified prehospital time period.^{7,28}

We also performed a sensitivity analysis to judge the extent to which our assumptions about input times would alter estimates of access. Even though the typical prehospital times we used were derived as part of a meta-analysis of empirically determined prehospital care times for trauma,²⁴ specific trauma systems will disagree about what prehospital times are meaningful. We changed our assumptions about different ambulance travel times (urban drives, suburban drives, rural drives, and helicopter flights) in 5-minute increments to see how they ultimately affected our estimates of access.

RESULTS

As of January 2005, there were 190 level I, 255 level II, and 258 level III trauma centers located throughout the United States (ie, 1.5 level I and II and 2.4 level I, II, and III trauma centers per million population). These trauma centers were served by 571 base helipads and 683 helicopters (ie, 1.9 base helipads and 2.3 helicopters per million population).

Figure 1. Areas of the United States With Access to Level I or II Trauma Centers by Ambulance or Helicopter

An estimated 69.2% of all US residents had access to a level I or II trauma center within 45 minutes by ground ambulance or helicopter. When this time parameter was increased to 60 minutes, access increased to 84.1% of the US population (TABLE 1). The Northeast had the greatest access to level I or II centers within both 45 and 60 minutes (85.8% and 96.9%, respectively) followed by the West (76.5% and 86.0%), the Midwest (65.7% and 85.7%), and the South (58.9% and 76.1%). Within 45 minutes, 8.4% of rural, 72.7% of suburban, and 89.4% of urban block groups had access to level I or II trauma centers. These percentages increased to 24.0%, 86.2%, and 95.3% within 60 minutes.

Across the United States, population access increased by 5.0% for 45 minutes and 4.6% for 60 minutes when level III trauma centers were included. Level III centers increased access most heavily in the South for both 45 and 60 minutes (8.5% and 8.5%, respectively) followed by the West (4.7% and 3.6%), Midwest (3.0% and 2.0%), and Northeast (0.8% and 0.7%) (Table 1).

Totals of 9.6% and 25.1% of US land area were located within 45 and 60 minutes, respectively, of a level I or II trauma center (FIGURE 1). The Northeast had the greatest amount of land area located within both 45 and 60 minutes (36.6% and 69.9%, respectively) of level I or II centers, followed by the Midwest (13.1% and 34.5%), the South (12.0% and 35.9%), and the West (4.7% and 12.5%).

Americans had an average of 5.5 level I and II trauma centers and 6.1 level I, II, and III trauma centers accessible by ground ambulance or helicopter within 45 minutes. These averages increased to 10.0 and 11.5 for 60 minutes. The population in the Northeast had the highest average number of level I and II trauma centers accessible within both 45 and 60 minutes (13.0 and 25.1, respectively), followed by the Midwest (6.2 and 11.0), West (4.2 and 7.4), and South (2.0 and 3.5). Within 45 minutes and 60 minutes, respectively, 39.1% and 33.8% of Americans had access to between 1 and 4 trauma centers while 7.7% and 14.6% had access to 20 or more level I or II centers.

Americans were serviced by an average of 5.1 and 9.4 base helipads within 45 and 60 minutes, respectively. The population in the Northeast was serviced by the highest average number of base helipads within both 45 and 60 minutes (12.4 and 24.3, respectively), followed by the Midwest (5.8 and 10.4), West (3.8 and 6.9), and South (1.7 and 3.0). Within 45 and 60 minutes, respectively, 41.0% and 38.7% of Americans were serviced by 1 to 4 base helipads while 7.6% and 12.7% were serviced by 20 or more base helipads.

A total of 26.7% and 27.7% of US residents could access a level I or II trauma center within 45 and 60 minutes, respectively, only if they were flown by helicopter. Helicopters had the greatest impact on access to level I or II centers within 45 minutes in the West (34.0%) followed by the Northeast (28.1%), South (25.8%), and Midwest (22.3%). Helicopters had the greatest impact on access to level I or II centers within 60 minutes in the South (29.8%) followed by the Midwest (29.4%), West (27.4%), and Northeast (23.7%) (TABLE 2).

A total of 1.9% and 3.1% of US resi-

Table 2. Contributions of Helicopters and Neighboring State Resources to Level I and II Trauma Center Access by US Census Regions and States

	Access Added by Helicopters, %*		Access Added by Neighbors, %†	
	Within 45 min	Within 60 min	Within 45 min	Within 60 min
United States (total)	26.7	27.7	1.9	3.1
Northeast				
Connecticut	20.1	9.5	1.3	0.1
Maine	18.1	38.7	0	0
Massachusetts	44.8	31.1	10.5	2.8
New Hampshire	5.8	19.5	2.8	9.2
New Jersey	35.8	23.6	1.4	0.5
New York	14.8	14.9	1.1	3.4
Pennsylvania	42.4	36.9	3.0	0.9
Rhode Island	17.1	15.7	17.1	16.8
Vermont	3.5	32.6	8.1	40.2
Midwest				
Illinois	10.1	10.0	1.9	0.4
Indiana	21.4	51.8	10.5	23.5
Iowa	7.2	23.2	1.1	5.3
Kansas	15.3	20.8	1.4	4.8
Michigan	25.8	36.0	1.7	2.0
Minnesota	26.7	26.7	1.2	3.1
Missouri	10.8	17.9	0.6	1.0
North Dakota	2.3	2.8	0	0
Nebraska	4.9	52.7	1.4	4.9
Ohio	29.8	30.4	1.8	3.1
South Dakota	3.5	7.7	1.0	2.8
Wisconsin	26.3	38.8	4.3	3.9
South				
Alabama	13.8	30.2	8.6	20.8
Arkansas	0.3	4.3	1.3	6.1
Delaware	12.8	23.4	0.0	4.0
District of Columbia	7.0	0	0	0
Florida	38.1	35.6	1.8	2.5
Georgia	23.7	27.9	1.3	3.0
Kentucky	22.6	39.6	11.0	23.3
Louisiana	10.2	16.4	0.0	0.1
Maryland	43.4	34.0	2.6	2.0
Mississippi	10.3	24.8	4.5	11.7
North Carolina	18.4	35.8	0.3	1.8
Oklahoma	8.5	11.6	0.4	1.4
South Carolina	22.9	30.0	7.6	14.5
Tennessee	24.2	41.9	0.1	0.9
Texas	31.9	27.7	0.1	0.6
Virginia	26.2	30.4	1.0	3.7
West Virginia	15.5	30.3	2.3	7.4

(continued)

dents had access to level I or II centers within 45 and 60 minutes, respectively, solely due to trauma centers or base helipads (or both) located outside their home states. Access to level I or II centers within 45 minutes was increased most by the resources of

neighboring states in the Northeast (3.2%) followed by the Midwest (2.8%), South (2.0%), and West (0.2%). Access to level I or II centers within 60 minutes was increased most by the resources of neighboring states in the Midwest (4.6%), followed by the South

(4.4%), Northeast (1.7%), and West (0.8%) (Table 2).

The sensitivity analysis showed that driving times changed the final 45- and 60-minute percentages by less than 1% when up to 10 minutes was added or subtracted. The final 60-minute access percentage for the United States was increased by 5.6% when it was assumed that helicopter flying times took 10 minutes less than expected and decreased by 8.4% when it was assumed that helicopter flying times took 10 minutes more than expected. The final 45-minute access percentage for the United States was increased by 11.0% when assuming that helicopter flying times took 10 minutes less than expected and decreased by 18.8% when assuming that helicopter flying times took 10 minutes more than expected (FIGURE 2).

COMMENT

As of January 2005, the US trauma care system as a whole had evolved to the point where more than four fifths of Americans had access to level I or II trauma centers within an hour. At the same time, however, 46.7 million Americans had no access to a level I or II trauma center within an hour. Most Americans without access lived in rural areas of the country. Given these gaps, our analyses point to several modifiable aspects of the trauma care system that could improve access.

First, 13.6 million Americans had access to level III, but not level I or II, trauma centers within an hour. Level III hospitals provide initial evaluation and assessment of injured patients and transfer the more severely injured to a higher level of care.¹² Since the early 1990s the number of level III centers has increased in both urban and rural areas of the country in an attempt to develop more inclusive systems of care.¹⁰ Although controversy remains as to the appropriate role of level III trauma centers,²⁹⁻³³ access to the trauma care system can be increased by establishing level III centers for communities where no level I or II center is accessible.

Second, 10.3 million Americans had access within an hour via the trauma cen-

ters and helicopters of neighboring states. This is substantial enough to warrant the attention of planners in better preparing for day-to-day volumes of trauma patients as well as mass casualty incidents in which volumes could overwhelm the resources of any one state.^{34,35} To date, 47 states and the District of Columbia have ratified standardized mutual aid agreements to improve interstate cooperation for mass casualty response.³⁶ Only 31 states, however, have standardized protocols for prehospital triage, and special permissions or certificates are sometimes required for out-of-state ambulances.³⁷ Where appropriate, neighboring states should support border crossing arrangements for day-to-day trauma care because of the high number of patients who might benefit and because border crossing for day-to-day volumes of trauma will ultimately help prepare for the execution of larger, interstate mutual aid agreements during mass casualty incidents.³⁸

Third, helicopters provided access for 81.4 million Americans who otherwise would not have been able to reach a trauma center within an hour. This, and the fact that base helipads are more moveable than trauma centers, makes them appealing as modifiable components of the trauma system. Because many trauma centers are in urban areas, the location of new base helipads (preferably as satellites to trauma centers as opposed to at the trauma centers themselves²⁸) could benefit trauma patients in outlying suburban and rural areas. Additional medical helicopter flight programs could be an important, and practical, means of extending trauma center access to populations that currently have none.³⁹

Despite the need to address areas with limited access, our results also showed that 42.8 million Americans had access to 20 or more trauma centers within an hour. These high levels of access were most evident near urban centers such as those in the Northeast. Although it remains uncertain at what point access to multiple trauma centers becomes excessive, placing appropriate limits on the number of trauma centers may produce

higher volumes of severely injured patients per center, enhance the experience of providers, and improve the overall quality of trauma care.^{11,40-42}

Our study has several limitations. Our estimates of access were based on where people lived and not where they were injured. Although people are cer-

tainly injured outside of their residences, no national data exist that provide the locations of all types of severe injuries at a very small level of aggregation (such as block groups).

Nongeographic issues that could have potentially changed access were not considered.⁴³ These issues included areas

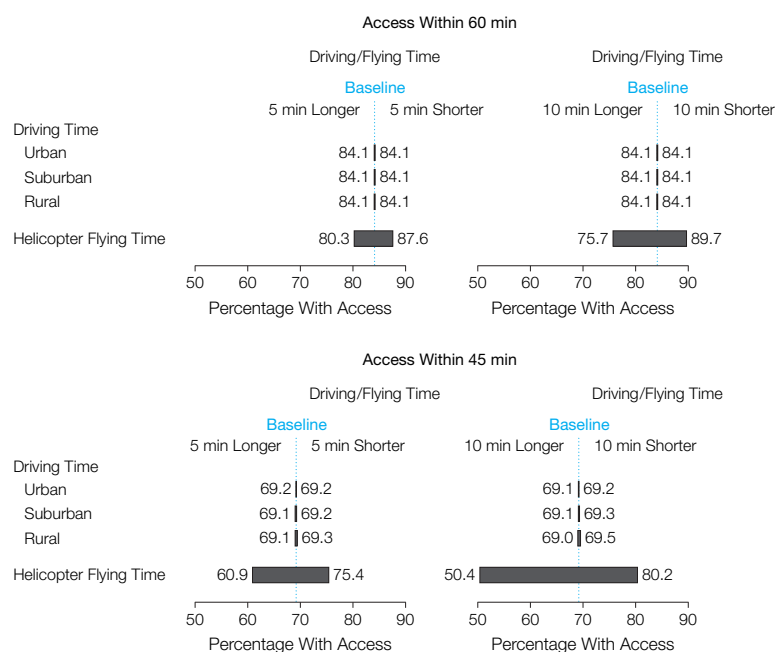
Table 2. Contributions of Helicopters and Neighboring State Resources to Level I and II Trauma Center Access by US Census Regions and States (cont)

	Access Added by Helicopters, %*		Access Added by Neighbors, %†	
	Within 45 min	Within 60 min	Within 45 min	Within 60 min
West				
Alaska	8.4	11.5	0	0
Arizona	43.9	31.5	0	0.5
California	38.4	28.8	0.1	0.1
Colorado	19.0	14.8	0	0
Hawaii	46.7	40.0	0	0
Idaho	13.0	16.5	1.9	8.9
Montana	3.7	5.1	0.0	0.0
New Mexico	17.9	24.8	1.0	9.6
Nevada	26.4	17.2	0.2	0.3
Oregon	13.4	18.6	0.2	0.2
Utah	30.3	27.4	0	0
Washington	45.3	38.9	0.8	0.8
Wyoming	0.8	3.4	0	2.1

*Including the trauma care resources of neighboring states.

†Assuming either ground or air transport.

Figure 2. Sensitivity Analysis of Time Interval Assumptions Used in Estimating Access to Level I and II Trauma Centers in the United States



without 911 telephone service, inappropriate prehospital triage, inclement weather, roadway congestion, and out-of-service times for ambulances and trauma centers. However, the effect of these factors on our results was probably minimal: most people in the United States have 911 access,⁴⁴ relatively few helicopter flights are precluded by weather,^{45,46} traffic conditions reportedly have only minor effects on ground ambulance emergency response speeds,⁴⁷ and helicopters are estimated to be fully out of service only a small percentage of the time.⁴⁸ Other process issues, such as inappropriate prehospital triage, are beyond the scope of this study but have been addressed elsewhere.^{49,50}

A final limitation of our study concerns the precision of our input assumptions about prehospital times and travel speeds. Changes in estimates of helicopter flying times produced the largest shifts in the percentages with access to a trauma center. Because we used individually reported helicopter flying speeds from each base helipad, most of these shifts would likely be due to changes in other helicopter travel inputs, such as the length of warm-up or on-scene time intervals. By comparison, ground ambulance travel inputs generated very small shifts in our estimates of access.

To our knowledge, this is the first national assessment of trauma center access that simultaneously considers the locations of trauma centers, ambulances, and residential populations. Although some work has been completed at the local, state, and regional levels,^{7,51,52} our study has the advantage of estimating access both in terms of prehospital time, as opposed to distance, and in terms of population, as opposed to land area. Distance and land area metrics can lead to potentially misleading impressions of access.⁵³ For instance, on a map, the western United States seemed to have little access to trauma centers when, in fact, its population had a high level of access that was second only to the Northeast.

CONCLUSION

This study demonstrates that should they be seriously injured, 46.7 million

Americans would have no access to a level I or II trauma center within an hour. An approximately equal number of Americans, 42.8 million, would have access to 20 or more level I or II trauma centers within an hour. Judiciously selecting trauma centers based on geographic need, appropriately locating medical helicopter bases, and establishing formal agreements for sharing trauma care resources across states should be considered to improve access to trauma care in the United States.

Author Contributions: As principal investigator, Dr Branas had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

Study concept and design: Branas, MacKenzie, Williams, Schwab, ReVelle.

Acquisition of data: Branas, MacKenzie, Teter, Flanigan, Blatt.

Analysis and interpretation of data: Branas, MacKenzie, Williams, Teter.

Drafting of the manuscript: Branas.

Critical revision of the manuscript for important intellectual content: Branas, MacKenzie, Williams, Schwab, Teter, Flanigan, Blatt, ReVelle.

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The very impulse to write, I think, springs from an inner chaos crying for order, for meaning, and that meaning must be discovered in the process of writing or the work lies dead as it is finished. To speak, therefore, of a play as though it were the objective work of a propagandist is an almost biological kind of nonsense, provided, of course, that it is a play, which is to say, a work of art.

—Arthur Miller (1915-2005)