Supplementary Online Content

Byrne JP, Mann NC, Dai M, et al. Association Between Emergency Medical Service Response Time and Motor Vehicle Crash Mortality in the United States. *JAMA Surg*. Published online February 6, 2019. doi:10.1001/jamasurg.2018.5097

This supplementary material has been provided by the authors to give readers additional information about their work

eMethods. Derivation and Structure of the Final Analytic Dataset

After relevant exclusions (described in Methods and shown in Figure 1) 2,268 US counties were included in the study sample. Data were derived for a three-year study period (2013-2015).

To account for known differences in risk of MVC death between genders and across the spectrum of age, death counts and population estimates for each county were stratified by sex (male=1/0) and age (<15, 15-34, 35-64, ≥65 years), for each study year.

County MVC mortality rates were calculated within each age-sex group, for each study year.

A formula to describe this calculation is as follows:

$$\frac{\underline{Passenger\ Vehicle\ Deaths\ (age\ group, sex, county, year)}}{Population\ (age\ group, sex, county, year)}$$

Therefore, the final analytic dataset was comprised of:

$$2\ sex\ groups\ \times\ 4\ age\ groups\ \times\ 2{,}268\ counties\ \times\ 3\ years\ = 54{,}432\ observations$$

The exposure variable, median county EMS response time, was linked to the crash mortality data at the county-level by the NEMSIS Technical Assistance Center using a random identifier to protect county and EMS agency anonymity.

Potential confounders in addition to age and sex were similarly linked at the county (rurality, EMS on-scene and transport times, and access to trauma resources) and state (traffic safety laws) levels.

eTable 1. Definition of County Rurality using Rural-Urban Continuum Codes (2013 edition)

RUCC	RUCC Description	Rurality Category
1	Counties in metro areas of 1 million population or more	Urban
2	Counties in metro areas of 250,000 to 1 million population	Urban
3	Counties in metro areas of fewer than 250,000 population	Urban
4	Urban population of 20,000 or more, adjacent to a metro area	Suburban
5	Urban population of 20,000 or more, not adjacent to a metro area	Suburban
6	Urban population of 2,500 to 19,999, adjacent to a metro area	Rural
7	Urban population of 2,500 to 19,999, not adjacent to a metro area	Rural
8	Completely rural or less than 2,500 urban population, adjacent to metro area	Wilderness
9	Completely rural or less than 2,500 urban population, not adjacent to metro area	Wilderness

RUCC, rural-urban continuum code

eTable 2. Comparison of counties included in the study compared to those excluded

Parameter	Included Counties (n = 2,268)	Excluded Counties (n = 876)	P-value
Region/Division (%)			<0.001
West			
Mountain	10.2	5.6	
Pacific	5.1	6.0	
Midwest			
East North Central	13.4	15.3	
West North Central	22.7	11.9	
North East			
New England	2.5	1.3	
Middle Atlantic	6.5	0.2	
South			
South Atlantic	24.2	4.5	
East South Central	8.4	19.9	
West South Central	7.1	35.4	
Rurality (%)			<0.001
Urban	39.1	32.1	
Suburban	10.1	8.7	
Rural	32.2	33.8	
Wilderness	18.6	25.3	
Population density, people/mile^2 (%)			<0.001
<16	22.9	30.4	
17 – 42	25.4	24.9	
43 – 108	24.3	26.4	
≥109	27.5	18.2	
Proximity to level I/II trauma center (%)			<0.001
Within county	12.0	5.6	
Adjacent county	36.4	31.8	
No proximate trauma center	51.6	62.6	
Population within 25 miles of HEMS base, median % (IQR)	65 (4 – 99)	61 (1 – 100)	0.402
Total population (person-years) [a]	239,464,121	81,926,897	
MVC-related deaths [a] (passenger vehicles)	16,098	6,034	
Mortality rate (deaths/100,000 person-years)	6.7	7.4	

HEMS, helicopter emergency medical services; IQR, interquartile range; MVC, motor vehicle crash

[a] Population estimates and MVC-related deaths shown are from most the recent study year (2015)

eTable 3. Calculation of the Population Attributable Fraction due to Prolonged EMS Response Time

Rural/Wilderness Counties

| EMS Response Time (minutes)	Population [a]	Deaths [a]	Proportion of Deaths, Pc	MRR	PAF
<10	10,394,760	1,706	0.507	Reference	Reference
≥10	9,658,389	1,657	0.493	1.25 (1.11–1.40)	0.099 (0.048–0.141)
Totals:	20,053,149	3,363	1.00		9.9% (4.8–14.1%)

*Deaths attributable to prolonged EMS response times among rural/wilderness counties = 0.099 x 3,363 = **333 deaths***

Urban/Suburban Counties

| EMS Response Time (minutes)	Population [a]	Deaths [a]	Proportion of Deaths, Pc	MRR	PAF
<7	120,613,977	5,649	0.444	Reference	Reference
≥7	98,796,995	7,086	0.556	1.34 (1.26–1.42)	0.141 (0.115–0.164)
Totals:	219,410,972	12,735	1.00		14.1% (11.5–16.4%)

*Deaths attributable to prolonged EMS response times among urban/suburban counties = 0.141 x 12,735 = **1,796 deaths***

EMS, emergency medical service; MRR, mortality rate ratio; PAF, population attributable fraction
[a] PAF calculated using population estimates and MVC death values from the most recent study year
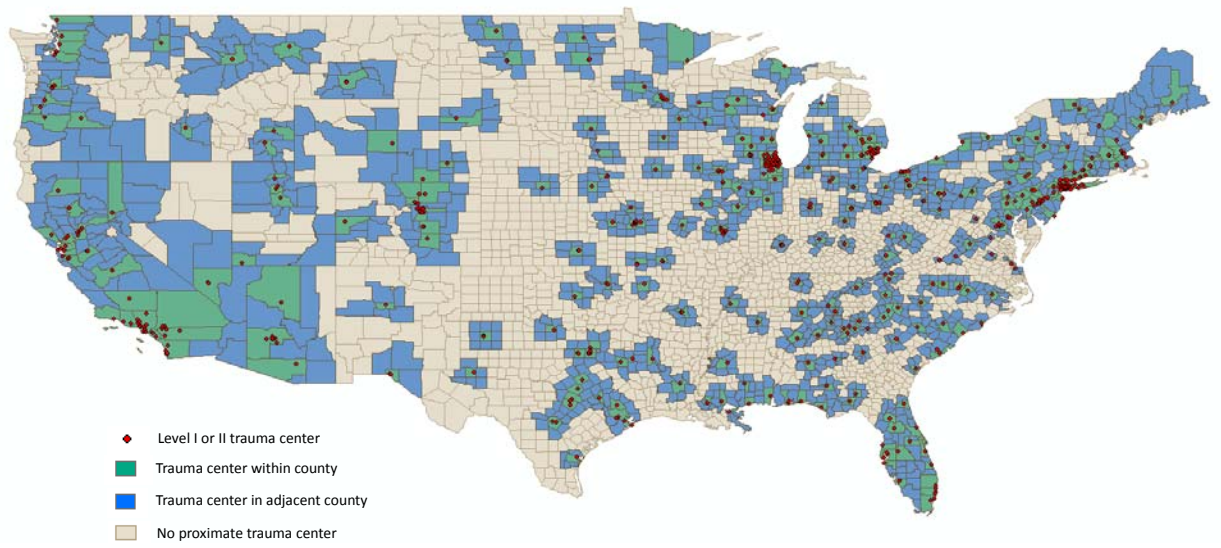
eFigure 1. Distribution of level I and II trauma centers across the United States.
Counties were classified by trauma center location: *within county* (green), *adjacent county* (blue), or *no proximate trauma center*.
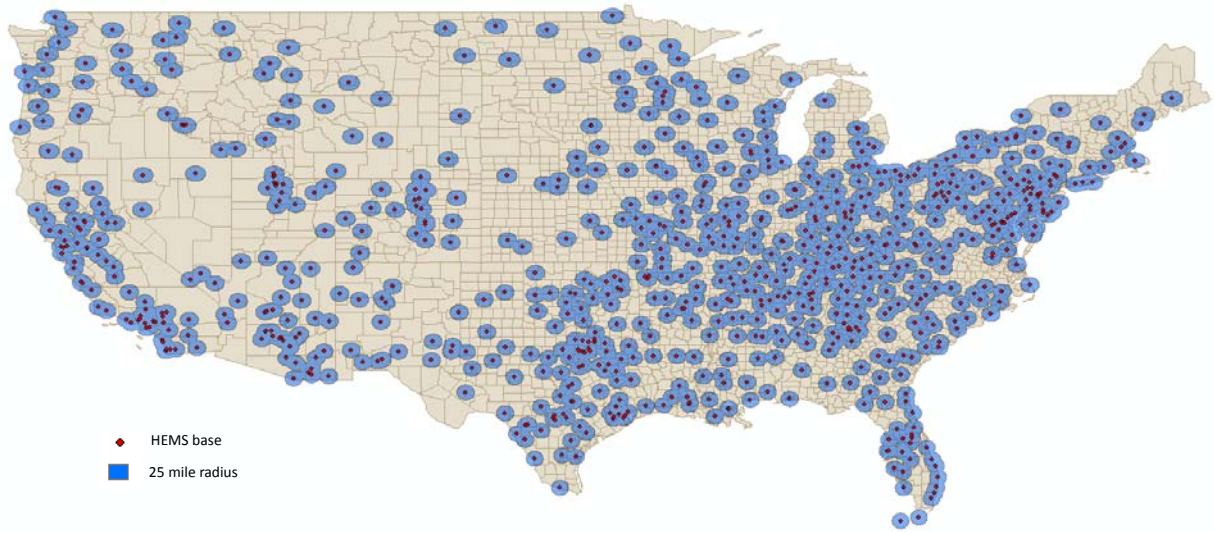
eFigure 2. Distribution of helicopter emergency medical service bases across the United States.
The proportion of the county population within 25-mile flight radii (blue) of a helicopter emergency medical service base was calculated for each county.