

The Demand for EMS Services in Rural Areas

INTRODUCTION

Medical conditions that may require emergency medical services (EMS) include medical emergencies, such as heart attacks, and critical injuries such as those sustained in motor vehicle crashes and occupational accidents. National data on what medical conditions precipitate an EMS call are not available, but some State data suggest that EMS care is needed as frequently, if not more frequently, for medical conditions, such as heart attacks and respiratory distress, as for trauma (tables 3-1 and 3-2). This chapter describes urban and rural differences in demand for EMS services and in injury morbidity and mortality.

Each person is likely to need ambulance service at least twice in his or her lifetime, but a population of 10,000 residents generates only one true emergency call a day (31). Small communities must be prepared for relatively low volumes of calls that may not be well distributed over the year. Severe trauma may occur infrequently, but a community may have to deal with multiple victims of an automobile crash at one time.

The demand for EMS services will increase in a continuous fashion as the size of the service population increases, but the capacity of the EMS system to respond increases in discontinuous steps, especially in small communities. A small community with a two-ambulance system, for example, cannot meet a 20 percent increase in demand with a 20 percent increase in capacity; acquiring a new ambulance and staff would represent an increase in capacity of 50 percent (132).

Many nonmedical factors contribute to the demand for EMS services. Some individuals who need EMS services do not use them because they do not realize that EMS services are required, lack services within their area, don't know how to access the system, or may be unable to pay for the services. Conversely, some individuals use EMS services for

nonemergencies. This may occur if other health services are unavailable or less convenient, or if the public is uninformed of the purpose of EMS.

URBAN AND RURAL DIFFERENCES IN DEMAND FOR EMS SERVICES

There are marked urban/rural differences in EMS service use in three States where statewide, computerized, ambulance-use data are available (Texas, South Carolina, New York).¹ Ambulance-transported patients in rural Texas are more likely to be suffering from a heart condition or stroke than urban residents and less likely to suffer from internal injuries, injuries to the spine or brain, and lacerations or penetrating trauma (table 3-1) (134). The higher demand for EMS intervention for acute medical conditions such as heart attacks or strokes is likely explained by the older age distribution of rural residents.²

Ambulance services are used more frequently by the elderly in rural than urban areas. Over half (54 percent) of ambulance-transported patients in rural Texas were age 65 or older (29 percent were age 80 or older) as compared to 29 percent in urban areas. There are similar findings in New York State where over one-half (54 percent) of patients transported by ambulance in rural counties were age 60 or older, compared to 42 percent for urban counties (42).³ South Carolina, in contrast, had less than one-quarter of patients age 65 or older among urban and rural ambulance transports in 1988.

Rural ambulance calls are more likely to be "urgent," or "critical" in rural than urban areas of Texas and South Carolina (44,134).⁴ In Texas, for example, 44 percent of 1988 rural ambulance runs were categorized as "urgent" and 7 percent "Critical" as compared to 31 percent, and 4 percent, respectively, for urban ambulance runs (134). A large percent of rural calls in both Texas and

¹These States were identified by calling the American Ambulance Association, and participants of the OTA/DOT Rural EMS Workshop. States with statewide, computerized, ambulance data that could be analyzed by metropolitan and nonmetropolitan area provided the tabulations for OTA.

²Thirteen percent of the nonmetropolitan population is elderly (i.e., age 65 or older) while only 11 percent of the metropolitan population is elderly (113).

³Ambulance utilization data were available for selected urban and rural counties (42).

⁴Similar information was not available from New York.

Table 3-1-Prevalence of Injuries and Illness Among Patients Transported by Ambulance in Texas, 1988^a

Type of illness or injury	Percent of transports		
	Total	Metro	Non-metro
<i>Illness:</i>			
Heart complications	12.6	12.2	15.1
Strokes-CVA ^b	4.1	3.6	7.0
Respiratory distress	7.4	6.9	10.9
Diabetic complications	2.7	2.6	3.5
Gastrointestinal illnesses	5.1	4.8	7.2
Convulsions or seizures	3.6	3.7	3.0
Allergic reactions	0.5	0.5	0.5
Fainting	2.0	2.1	1.6
Infectious diseases	1.0	0.9	1.4
Emotional or mental distress	2.6	2.8	1.4
Other illnesses	12.1	12.0	12.6
<i>Injury</i>			
Lacerations or penetrating trauma	9.4	9.7	7.5
internal injuries	2.7	2.8	1.8
Injuries to spine or brain	4.5	4.6	3.4
Multiple injuries	0.5	0.5	0.7
Fracture or dislocation	10.9	10.4	13.7
Scrapes, bruises, or cuts	10.9	11.7	6.1
Sprains or strains	4.3	4.6	2.1
Burns	0.6	0.6	0.4
Drowning, suffocation, or choking	0.3	0.4	0.2
Other injuries	2.5	2.7	1.6
<i>Perinatal care:</i>			
Obstetric or gynecological	1.9	2.0	1.5
High-risk infants	0.2	0.2	0.1
<i>Substance abuse:</i>			
Drug overdose or poisoning	1.6	1.7	0.8
Acute alcohol intoxication	0.8	0.9	0.5
No information available	17.2	16.8	19.8
Total number of patients	51,853	44,527	7,326

^aThese data are based on ambulance run reports of a representative sample of Texas ambulance services. There were an estimated one million ambulance runs in Texas in 1988. More than one condition can be reported for each patient. Numbers in the table represent the percent of ambulance transports for reported types of illness and injury.

^bCVA = Cardiovascular accident.

SOURCE: Texas Department of Health, Austin, TX, August 1989.

South Carolina are for transportation. In South Carolina, for example, about 16 percent of ambulance calls in rural areas are for transportation to medical exams, as compared to 10 percent in urban areas (44)₀.

Injury is a major problem in rural areas, particularly injuries sustained in motor vehicle accidents. Injuries are more likely than other emergency conditions to require specialized services such as trauma centers which are usually not immediately available in rural areas.

Injury

Injury is the leading cause of death among persons 1 to 44 years old (19) and is the leading cause of years of potential life lost before the age of 65 (121). Injuries occur as, or less frequently in rural areas than in urban areas (see table 3-3) and the types of injuries that occur in these areas are similar (table 3-4).⁵ When injuries do occur, however, they appear to be more serious in rural areas; injured rural residents have more restricted-activity days and bed days than injured urban residents (table 3-3). This is especially true for injuries occurring at home.

Death rates from unintentional injuries (both motor vehicle and nonmotor vehicle related) are twice as high in remote rural areas than in the largest cities (figure 3-1) and death rates are inversely related to population density (13). The chance of dying in a rural area, if severely injured, are three to four times higher than in urban areas (19,62). Some evidence suggests that aspects of the EMS system may contribute to the higher death rates. For example, younger and generally healthier adults die from less severe injuries in rural nontrauma center hospitals than in urban trauma center hospitals (66).

Occupational Injuries

While national injury data do not reflect higher injury rates in rural areas, certain rural subpopulations have more injuries because of the types of occupations they practice. Approximately 10 percent of employed rural residents 16 years of age and older are employed in two of the most hazardous occupations in America—farming and underground mining. Farming encompasses a wide range of activities that may pose health hazards, including the use of farm machinery and tools and exposure to chemical fertilizers and pesticides. Mining hazards include cave-ins, explosions, fires, and the inhalation of dust (78). Work-related deaths occur four to five times more frequently among mining and agricultural workers than among workers as a whole, and disabling injuries occur two to three times more often (72) (see table 3-5).

Motor Vehicle Crashes

One-third of all injury-related deaths are attributable to motor vehicles. Among those under age 35, motor vehicle crashes are the leading cause of death (12). There is wide geographic variation in motor

⁵These data are limited insofar as they rely on self-reported injuries reported by phone interview (i.e., National Health Interview Survey).

Table 3-2—Prevalence of Injury and Illness Among Calls for EMS Services in South Carolina, 1988^a(percent)

Primary complaint	Metro			Non-metro		
	Jan.- April	May- July	Aug.- Dec.	Jan.- April	May- July	Aug. - Dec.
Total injury	15	27	27	17	26	27
Fracture	3	5	5	4	6	5
Spinal injury	3	5	6	2	5	5
Laceration	3	5	4	3	4	4
Abrasion/contusion	2	4	3	2	4	3
Head injury	1	2	3	1	3	3
Multitrauma/shock	0	1	2	0	1	2
Hemorrhage	1	1	1	1	1	1
Dislocation	0	1	1	1	1	1
Puncture/stab	0	1	1	0	1	1
Gunshot wound	0	1	1	0	1	1
Burn	0	0	0	0	0	1
Total cardiovascular	14	11	11	14	12	11
Coronary problem	9	7	7	8	7	7
CVA/TIA/stroke	2	2	2	2	2	2
Cardiac arrest	2	1	1	2	2	1
Hypertension	1	1	1	1	1	1
Congestive heart failure	1	0	0	1	1	0
Other medical	19	16	16	17	15	15
Vomiting	1	1	1	1	0	0
Gastro-intestinal problems	2	2	2	2	1	1
Genito-urinary problems	1	1	1	0	0	0
Hyperventilation	1	1	0	0	0	0
Respiratory distress	6	4	5	6	5	5
Seizure	3	3	3	3	3	3
Diabetic reaction	1	1	1	2	2	2
Insulin shock	0	1	0	0	0	0
Fainting	1	1	1	1	1	1
Unknown medical complaint	2	2	2	2	2	2
Total medical	33	27	27	32	27	26
Psychiatric/behavioral/drugs/alcohol:						
Psychiatric/behavioral	2	2	1	1	1	1
Overdose	2	1	2	1	1	1
Alcohol-like impairment	1	1	1	1	1	1
OB/GYN total	2	2	2	2	2	2
Obstetric-prenatal	1	1	1	1	1	1
Obstetric-emergency	1	1	1	1	1	1
Transport for exam	11	11	10	16	15	17
Nonemergency transport	1	1	1	2	1	1
No transport	13	13	13	11	13	11
DOA-total:	3	2	2	3	2	3
DOA—no transport	2	1	2	1	1	1
DOA—transport	1	1	1	1	1	1
Canceled call:	9	6	6	7	6	6
False call	2	2	2	1	1	1
Missing/wrong code	7	6	5	5	4	4
Total number of patients	9,958	12,524	12,888	5,256	7,572	7,016

^aThese data are based on a sample of 192 service providers' ambulance run reports. One primary complaint is reported for each call. Numbers in the table represent the percent of ambulance service calls for primary complaints. Conditions representing less than 1 percent of calls were not listed but are included in totals (e.g., drowning is included in total injury).

KEY: CVA = Cardiovascular accident; DOA = dead on arrival; EMS = emergency medical services, OB/GYN = obstetrics-gynecology, TIA = transient ischemic attack

SOURCE: South Carolina Department of Health and Environmental Control, Columbia, SC, September 1989

vehicle crash mortality (figure 3-2) and there is an inverse relationship between population density and mortality (compare figure 3-2 map showing areas with high motor vehicle crash-related mortality to figure 3-3 map showing population density). Other

evidence suggests that a disproportionate number of motor vehicle-related deaths occur in rural areas in general (i.e., not just rural areas with low population density) (figure 3-4). More than half (56.9 percent) of fatal traffic accidents occur in rural areas (as

Table 3-3-Number of Episodes of Persons Injured and Number of Associated Restricted-Activity Days and Bed Days^a by Whether in Moving Motor Vehicle, Whether at Work, Place of Accident, and Place of Residence: United States, 1987

Type of episode	Number per 100 persons per year				Number of restricted-activity days (per 100 persons per year)				Number of bed days (per 100 persons per year)			
	MSA ^b				MSA				MSA			
	All	Central city	Not central city	Non-MSA	All	Central city	Not central city	Non-MSA	All	Central city	Not central city	Non-MSA
All episodes	26.6	25.8	27.2	24.0	255.2	277.7	239.9	278.1	80.8	89.6	74.8	83.4
Moving motor vehicle:												
Total	2.6	2.1	2.9	2.0	56.5	70.7	46.8	53.1	17.9	23.7	13.9	19.2
Traffic only	2.1	1.6	2.5	1.8	49.3	62.3	40.5	43.8	15.9	20.5	12.8	15.4
Non-moving motor vehicle	24.0	23.7	24.3	21.7	197.0	204.7	191.7	221.9	62.4	65.6	60.3	63.9
At work	5.3	5.0	5.4	5.0	96.8	97.9	96.0	100.4	32.2	39.2	27.4	23.0
Not at work	15.8	16.2	15.4	13.2	170.2	198.2	150.8	216.4	49.3	53.5	46.3	72.0
Place of accident:												
At home	89	9.1	8.7	8.4	56.4	55.9	56.7	85.0	16.7	11.6	20.2	29.6
Street or highway	3.5	3.0	3.8	2.4	62.7	78.5	52.0	53.9	20.6	26.7	16.5	17.0
Industrial place	3.2	2.8	3.4	2.9	52.7	57.8	49.2	53.0	17.5	23.1	13.7	9.3 ^d
Other	6.8	7.1	6.6	6.0	58.5	59.5	57.9	61.1	15.4	16.8	14.5	18.3

^aEstimates of activity restriction and bed days are based on the present effects of the injuries no matter when they occurred

^bMSA = metropolitan statistical area.

^cFor currently employed 18 years of age and over only.

^dFigure does not meet standard of reliability or precision.

SOURCE: U S Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Center for Health Statistics *Current Estimates* from the *National Health Interview Survey: United States*, 1987, Series 10, No. 186, DHHS Pub. No. (PHS) 66-1594, tables 51, 53, and 55, September 1988.

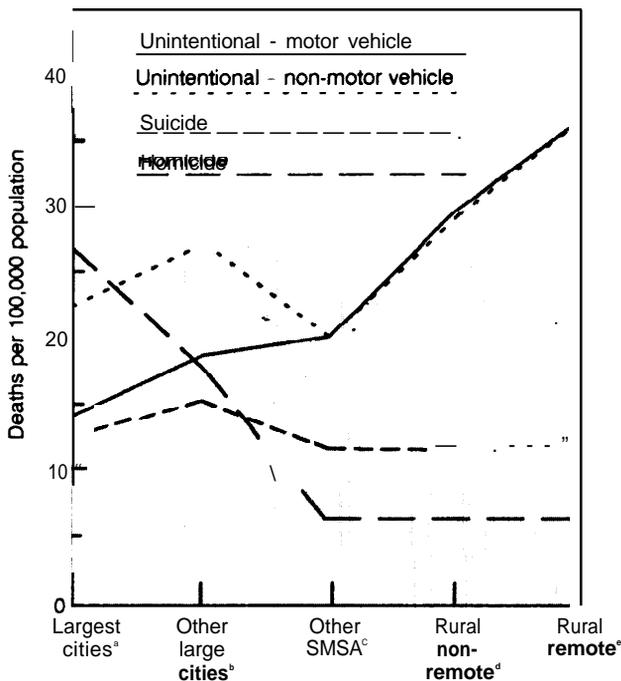
Table 3-4-Average Annual Number of Injuries^a Per 100 Persons Per Year, by Place of Residence and Type of Injury: United States, 1980-81

Type of injury	MSA ^b			
	All	Central city	Not central city	Non-MSA
All injuries	33.2	32.4	34.2	32.6
Skull fractures and intracranial injuries	1.0	1.2	1.0	0.8
Fractures of lower limb	0.9	0.7	1.0	1.0
Fractures of upper limb, neck, and trunk	1.8	1.5	1.9	2.0
Dislocations	0.6	0.6	0.6	0.6
Sprains and strains-total	7.6	8.0	7.9	6.9
Open wounds and lacerations	8.0	7.9	8.4	7.8
Superficial injuries	1.6	1.7	1.6	1.6
Contusions	5.2	4.4	5.7	5.3
Burns	1.0	1.0	0.8	1.2
Toxic effects-nonmedical	0.8	0.9	0.8	0.8
All other injuries	4.6	4.5	4.6	4.7

^aInjuries self-reported in the Health interview Survey.
^bMSA = metropolitan statistical area.

SOURCE: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control National Center for Health Statistics, Types of Injuries and Impairments Due to Injuries: United States, Series 10, No. 159, DHHS Pub. No.(PHS)87-1587, table 6, November 1986

Figure 3-1—Death Rates From Unintentional Injury, Suicide, and Homicide by Place of Residence, 1977-79



^aResidents of cities with 1 million or more Population.
^bResidents of cities with population between 250,000 and 1 million.
^cResidents of Standard Metropolitan Statistical Area (SMSA) counties, excluding residents of cities of 250,000 or more.
^dResidents of nonmetropolitan counties that do not meet the definition of "rural remote."
^eResidents of nonmetropolitan counties that are not adjacent to an SMSA and have no settlement as large as 2,500 persons.

SOURCE: Susan P. Baker, Brian O'Neill, and Ronald S. Karpf, *The Injury Fact Book* (Lexington, MA: D.C. Health & Co., 1984). Reprinted with permission.

defined by DOT) (123) whereas only about one-third of the population resides there.

What accounts for the excess motor-vehicle deaths is unclear. Motor vehicle accidents do not seem to occur more frequently in rural areas. In 1986, nearly one-fifth (18 percent) of people involved in motor vehicle accidents were in rural areas (as defined by DOT) at the time of the accident (table 3-6). Given that approximately one-third of the U.S. population is rural (as defined by DOT), this level of accident occurrence may even be low.

Despite the fact that accidents seem to occur less often in rural areas, persons involved in rural accidents are three times more likely to sustain serious or untreatable injuries than those in urban areas (table 3-6). Many more rural than urban accidents occur in areas with higher speed limits—nearly half (48.7 percent) of the accidents in rural areas took place in areas with speed limits of 55 MPH, compared to 8.7 percent in urban areas (see table 3-6). People involved in accidents in higher-speed-limit rural areas are two to three times as likely to sustain serious or untreatable injuries than those involved in higher-speed-limit urban areas (2.4 percent v. 0.9 percent) (see table 3-6).

Possible explanations for higher rates of motor vehicle-related injury and death in rural areas include (14):

- poorer road conditions and the absence of safety features such as guard rails;

Table 3-5-Death and Disabling Injury Rates Among Workers by Industry, 1988

Industry ^a	Workers ^b (in 1,000s)	Deaths ^c		Disabling injuries ^d	
		Number (in 1,000s)	Rate (per 100,000s)	Number (in 1,000s)	Rate (per 1,000)
All industries	114,300	10,600e	48 ^e	1,800	16
Agriculture	3,100	1,500		140	45
Mining, quarrying	800	200	25	30	38
Construction	6,500	2,200	34	210	32
Manufacturing	19,500	1,100	6	350	18
Transportation and public utilities	5,800	1,400	24	140	24
Trade	27,000	1,100	4	320	12
Services	34,600	1,500	4	330	10
Government	17,000	1,600	9	280	16

^aAgriculture includes forestry and fishing. Mining and quarrying includes oil and gas extraction. Trade includes wholesale and retail. Services includes finance, insurance, and real estate.

^bWorkers are all persons gainfully employed, including owners, managers, other paid employees, the self employed, and unpaid family workers, but excluding private household workers.

^cUnintentional injury death (ICD underlying cause of death codes E-800-E949). Death from accident is a death which occurs within 1 year of the accident.

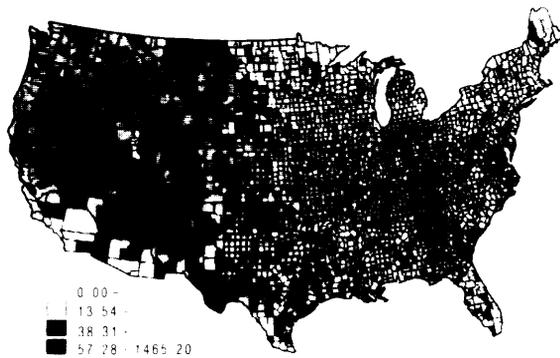
^dDisabling injury is an injury causing death, permanent disability, or any degree of temporary total disability beyond the day of the accident.

^eAbout 3,900 of the deaths and 200,000 of the injuries revolved motor vehicles.

^fAgriculture rate excludes deaths of persons under 14 years of age. Rates for other industry divisions do not require this adjustment. Deaths of persons under 14 are included in the agriculture death total.

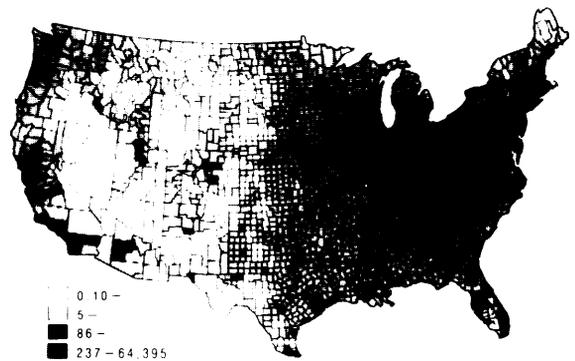
SOURCE: National Safety Council estimates (rounded) based on data from the National Center for Health Statistics, State vital statistics departments, and State industrial commissions. Numbers of workers are based on Bureau of Labor Statistics data and include persons aged 14 and over.

Figure 3-2-Motor Vehicle Related Death Rates



SOURCE Baker et al., NEJM 316(22) page 1385

Figure 3-3-Population Density



SOURCE: Baker et al., NEJM 316(22) page 1385.

- . a greater likelihood of travel at extremely high speeds (65 MPH or greater);
- greater use of utility vehicles (jeep-like vehicles) and pickup trucks, which are associated with high death rates;
- lack of use of seat belts; and
- greater distances between emergency facilities and reduced access to major trauma centers.

Higher death rates in rural counties are not explained by travel in rural areas by residents of more densely settled areas⁶ or by a large volume of

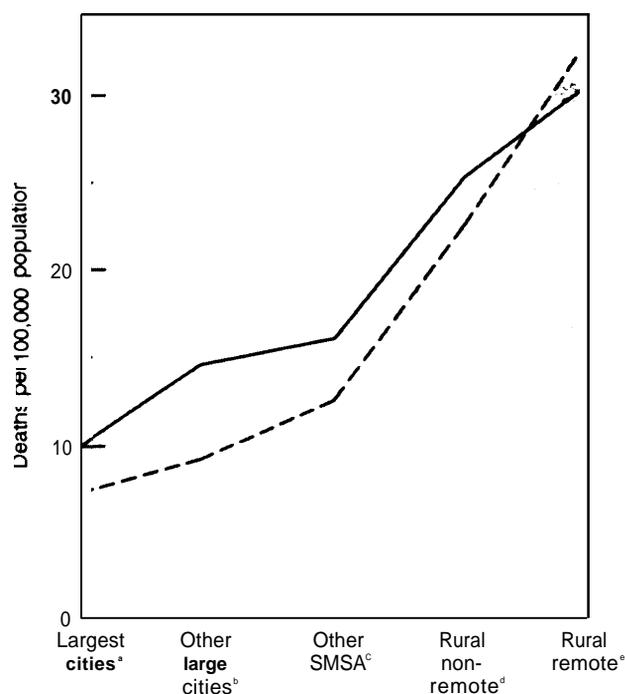
travel on major routes (14). In fact, none of the Federal interstate highways are distinguishable on the map as connecting a string of counties with high death rates (see figure 3-2).

Reducing the motor vehicle fatality rate to no greater than 18.0 per 100,000 population is one of the national 1990 objectives for injury prevention and control (119).⁷ This goal has been achieved in U.S. urban areas, where the motor vehicle accident mortality rate was 17.3 in 1986 (see table 3-7). In contrast, the rate for rural areas was 28.4. The U.S.

⁶Motor-vehicle crash death rates were also highest in rural areas when calculated from National Center for Health Statistics data that records the deceased county of residence instead of the place of accident occurrence.

⁷The goal for the year 2000 is 17.0 per 100,000 population (24).

Figure 3-4--Death Rates From (Motor Vehicle Occupants) Motor Vehicle Crashes by Place of Residence, 1977-79



^aResidents of cities with 1 million or more population

^bResidents of cities with population between 250,000 and 1 million.

^cResidents of Standard Metropolitan Statistical Area (SMSA)

counties excluding residents of cities of 250,000 or more.

^dResidents of nonmetropolitan counties that do not meet the definition of "rural remote."

^eResidents of nonmetropolitan counties that are not adjacent to an SMSA and have no settlement as large as 2,500 persons.

SOURCE Susan P. Baker, Brian O'Neill, and Ronald S. Karpf, *The Injury Fact Book* (Lexington, MA D C Health & Co., 1984) Reprinted with permission

1990 objective would be achieved if there was a 30 percent reduction in the number of rural motor vehicle fatalities (table 3-7). While there is no clear explanation for the dramatically higher mortality rate in rural areas, preventive efforts in rural areas and improving rural EMS systems could prove to be effective means of realizing the Nation's objective.

Table 3-&Passenger Car Occupant Injury by Land Use and Speed Limit, 1986

	Vehicles		Occupants		All injuries (AIS > 1) ^a		Serious to untreatable trauma (AIS > 3) ^a	
	Number (in 1,000s)	Percent	Number (in 1,000s)	Number (in 1,000s)	Percent	Number (in 1,000s)	Percent	
<i>Urban:</i>								
25 MPH or less	1,342	19.6	2,000	349	17.4	8	0.4	
30 to 40 MPH	4,064	59.4	6,140	1,281	20.9	25	0.4	
45 to 50 MPH	839	12.3	1,245	323	25.9	8	0.6	
55 MPH	596	8.7	901	232	25.7	8	0.9	
Total urban	6,841	100.0	10,286	2,185	21.2	49	0.5	
<i>Rural:</i>								
25 MPH or less	161	11.5	252	40	15.9	1	0.4	
30 to 40 MPH	322	23.0	554	152	27.4	3	0.5	
45 to 50 MPH	234	16.7	362	109	30.1	7	1.9	
55 MPH	681	48.7	1,137	349	30.7	27	2.4	
Total rural	1,398	100.0	2,305	650	28.2	38	1.6	
U.S. total	8,239		12,591	2,835	22.5	87	0.7	

^aAIS (Abbreviated Injury Scale) is used to rate the severity of trauma. A score of 1 indicates minor trauma; 2 indicates moderate trauma; 3 serious trauma, 4 severe trauma, 5 critical trauma and 6 maximum trauma (currently untreatable). The scale was developed by the American Association for Automotive Medicine.

SOURCE: U.S. Department of Transportation, National Highway Traffic Safety Administration, *National Accident Sampling System, 1986*, table 111-21.

Table 3-7--Metropolitan (MSA) and Non-Metropolitan (Non-MSA) Motor Vehicle Fatality Rates-1986, and Impact of 30 Percent Reduction in Non-MSA Deaths on Achieving the National 1990 Objective for Injury Prevention (Motor Vehicle Fatality Rate of 18 per 100,000 population)

	1986 U.S. population (in 1,000s)	1986 Motor vehicle accident deaths	1986 Motor vehicle accident death rates (per 100,000)	Motor vehicle accident death rates if 30% reduction in non-metro MVA deaths
U.S. total	241,036	47,865	19.9	17.9
Metropolitan	184,713	31,867	17.3	17.3
Non-metropolitan	56,323	15,998	28.4	19.9

SOURCES: U.S. Department of Commerce, Bureau of the Census, *Statistical Abstract of the United States: 1988, 108th edition* (Washington, DC: U.S. Government Printing Office, 1987); Department of Health and Human Services, Public Health Service, "Vital Statistics of the U.S.: 1986," vol. 2, *Mortality*, Pub No. 88-1114 (Washington, DC: U.S. Government Printing Office, 1988)