Evaluating the Benefits of Advanced Automatic Crash Notification (AACN)

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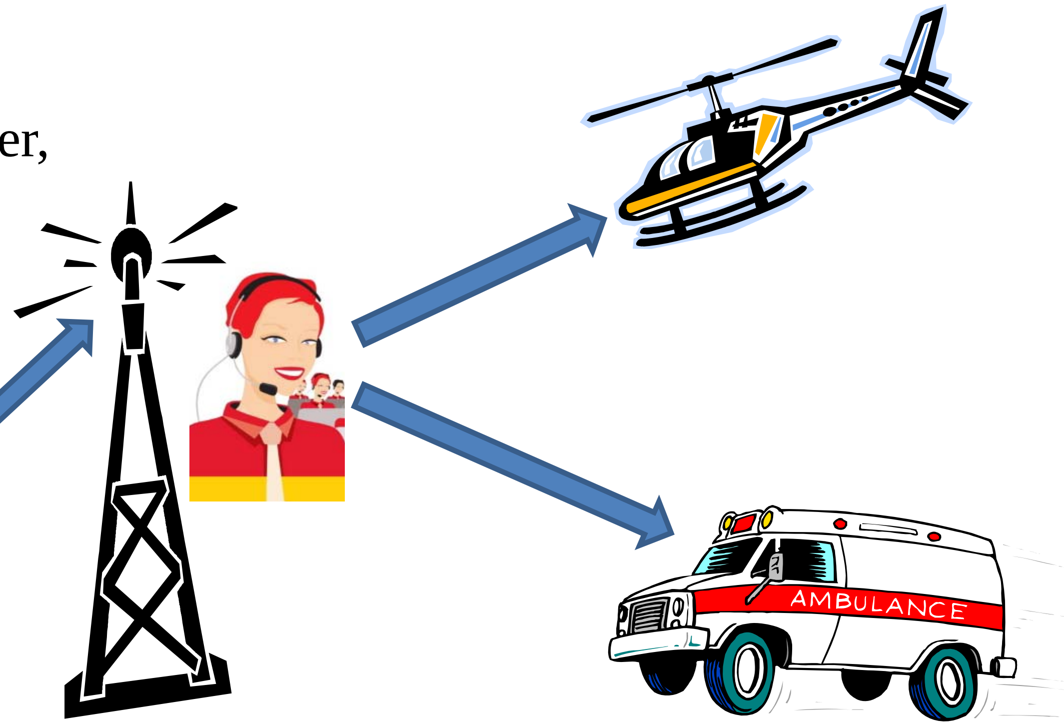


Potential benefits of AACN

- Identification of crash location **(AACN: GPS)**
- Notification of 911 PSAP **(AACN: Reduce delays)**
- Appropriate EMS and Rescue response

  (AACN: Predicting Injury Severity)
- Field Triage decision
  - Getting the **right patient** to the **right** hospital

  (AACN: Predicting Injury Severity)
- Transport Time
  - Mode of transport

  (AACN: Early Mobilization Air Transport)

Recent News Article

- **Crystal Mountain Crash Kills 1, Injures 3**
- Rollover MVC in remote mountain area
- The vehicle and occupants were not found until 12 hrs after the crash
- Three found alive were transported to Harborview, one died on arrival
- AACN could have identified this crash and location.

Time to Treatment Matters

- Head trauma is the most commonly seen trauma mechanism that has the highest mortality rate in traffic accidents.
- Mortality rate of acute traumatic subdural hematoma (ASDH) can reach 40-90%.
- Pre-surgery time: Time between accident and operation, mean was 19.6 hours, with a range between 4-54 hours.
- Conclusion: Rapid transport to hospital with neurosurgery facility was associated with better outcomes.

Zafrullah Arifin, Gunawan W - Analysis of presurgery time as a prognostic factor in traumatic acute subdural hematoma. *Journal of Neurosurgery Science-2013 -* Sep;57(3):277-80.

Destination Matters

The NEW ENGLAND JOURNAL of MEDICINE

SPECIAL ARTICLE

A National Evaluation of the Effect of Trauma-Center Care on Mortality

Ellen J. MacKenzie, Ph.D., Frederick P. Rivara, M.D., M.P.H., Gregory J. Jurkovich, M.D., Avery B. Nathens, M.D., Ph.D., Katherine P. Frey, M.P.H., Brian L. Egleston, M.P.P., David S. Salkever, Ph.D., and Daniel O. Scharfstein, Sc.D.

From the Johns Hopkins Bloomberg School of Public Health, Center for Injury Research and Policy, Baltimore (E.J.M., K.P.F., B.L.E., D.S.S., D.O.S.); and the University of Washington School of Medicine, Harborview Injury Prevention and Research Center, Seattle (F.P.R., G.J.J., A.B.N.). Address reprint requests to Dr. MacKenzie at Johns Hopkins Bloomberg School of Public Health, 624 N. Broadway, Rm. 554, Baltimore, MD 21205-1996, or at emackenz@jhsph.edu.

ABSTRACT

BACKGROUND

Hospitals have difficulty justifying the expense of maintaining trauma centers without strong evidence of their effectiveness. To address this gap, we examined differences in mortality between level 1 trauma centers and hospitals without a trauma center.

METHODS

Mortality outcomes were compared among patients treated in 18 hospitals with a level 1 trauma center and 51 hospitals without a trauma center (non–trauma centers) located in 14 states. Patients 18 to 84 years old with a moderate-to-severe injury were eligible. Complete data were obtained for 1104 patients who died in the

If you are severely injured, care at a Level I trauma center lowers the risk of death by 25%.

McKenzie, Rivara, Jurkovich…

NEJM, 2006

NHTSA AACN Activities

Outline

1. Overview
2. NHTSA and NHTSA/CDC AACN Work
3. EDR Rule and Analysis
4. Injury Prediction Algorithms
5. AACN Scorecard/Next Steps

Background
NHTSA/CDC AACN Work


CDC

MMWR

Morbidity and Mortality Weekly Report

www.cdc.gov/mmwr

Recommendations and Reports — January 23, 2009 / Vol. 58 / No. RR-1

Guidelines for Field Triage of Injured Patients

Recommendations of the National Expert Panel on Field Triage

INSIDE: Continuing Education Examination

DEPARTMENT OF HEALTH AND HUMAN SERVICES

CENTERS FOR DISEASE CONTROL AND PREVENTION

Guidelines utilized in creating AACN algorithms

CDC Field Triage Decision Scheme

STEP 1

- GCS ≤ 13
- SBP ≤ 90
- RR < 10 or > 29

Yes → Highest Level Trauma Center

No →

STEP 2

- Penetrating injuries
- Chest wall deformity
- ≥ 2 long-bone fractures
- Mangled extremity
- Proximal amputation
- Pelvic fracture
- Open/depressed skull fracture
- paralysis

Yes → Highest Level Trauma Center

No →

STEP 3

High-risk auto crash

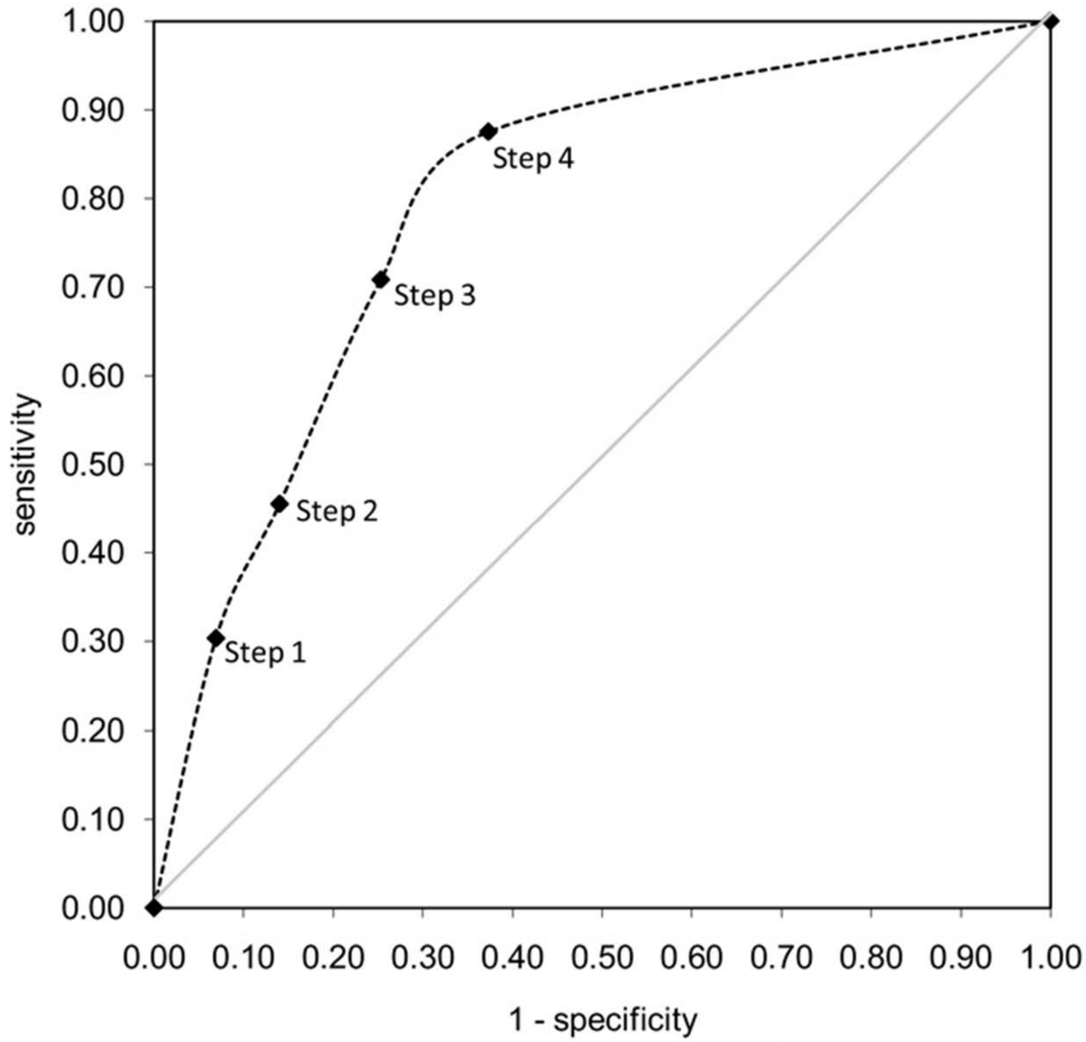
- Intrusion > 12” at occupant site
- Intrusion > 18” at any site
- Occupant ejection
- Death in same vehicle
- Vehicle telemetry data consistent with high risk of injury

Yes → Trauma Center

How does the current triage algorithm perform in real life?

- Multicenter review of EMS data from 7 regions in the Western US
- 122,345 injured patients transported by EMS over a 3 year period, 34.5% met at least one trauma triage criteria, 5.8% had an ISS>=16
- Overall sensitivity 85.8%, specificity 68.7%
- Approximately 1,000 patients were undertriaged and they tended to be older, 47% falls, 30% MVCs

Newgard et al, JACS, 2011



Algorithms examining the triage steps have been shown that each step adds to sensitivity

Summary of Prior Work

- Models were created to meet the 20% probability of ISS >15 and with good sensitivity and specificity at both Step 0 and Step 3
- The models developed by the UW have the advantage of not requiring contact with the vehicle to determine patient characteristics and utilize the electronic data recorder variables only.
- With all models NPV was high thus minimizing risk of undertriage.

Ayoung-Chee P, Mack CD, Kaufman R, Bulger EM. Predicting Severe Injury using vehicle Telemetry Data. *J Trauma 74 (1): 190-194, 2012*

NHTSA AACN Activities

Outline

1. Overview
2. NHTSA and NHTSA/CDC AACN Work
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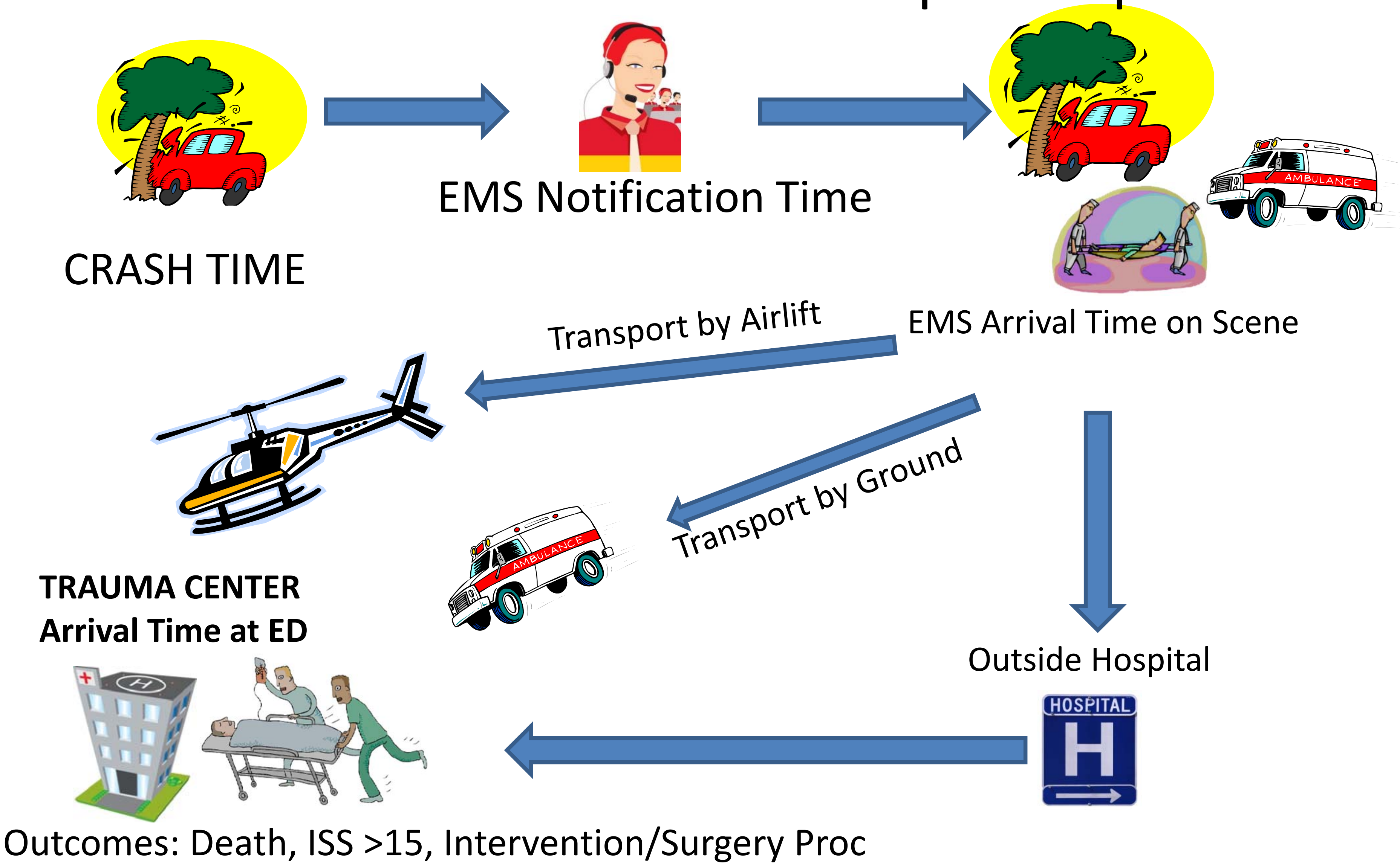
5. AACN Scorecard/Next Steps

AACN score card

– Would AACN have benefited those who died?

- What are the injury trends observed in the transport of fatalities.
- Would there be a benefit from an earlier intervention, early notification?
- Evaluate the treatment and transport of fatalities to a trauma center
- Examine the modes of transport (Fire, BLS, ALS, rotor craft, etc.) and evaluate the notification times; would it have been beneficial if gotten to the scene sooner?
- Present detailed case studies of pre-hospital fatalities and severe injury cases that would have benefited from earlier intervention

Overview of notification and transport of patients



Evaluation Steps

Part I – Highlight CIREN case studies where crash times and notification times are significant that resulted in death/severe injury or poor injury outcomes

Part II – Evaluate CIREN fatal crashes for mode of transport, times to the trauma center and cause of death.

Part III – Evaluate FARS data for prehospital times and contributing factors for prolonged times, rural vs urban

Part IV – Evaluate NASS data for all fatalities and serious injuries and assess notification times and out-of-hospital time segments. Identify factors contributing to prolonged times and determine impact of prolonged times on the risk of mortality

CIREN Case Studies with Delayed Notification

Benefit for Crash Notification Systems– CIREN case study

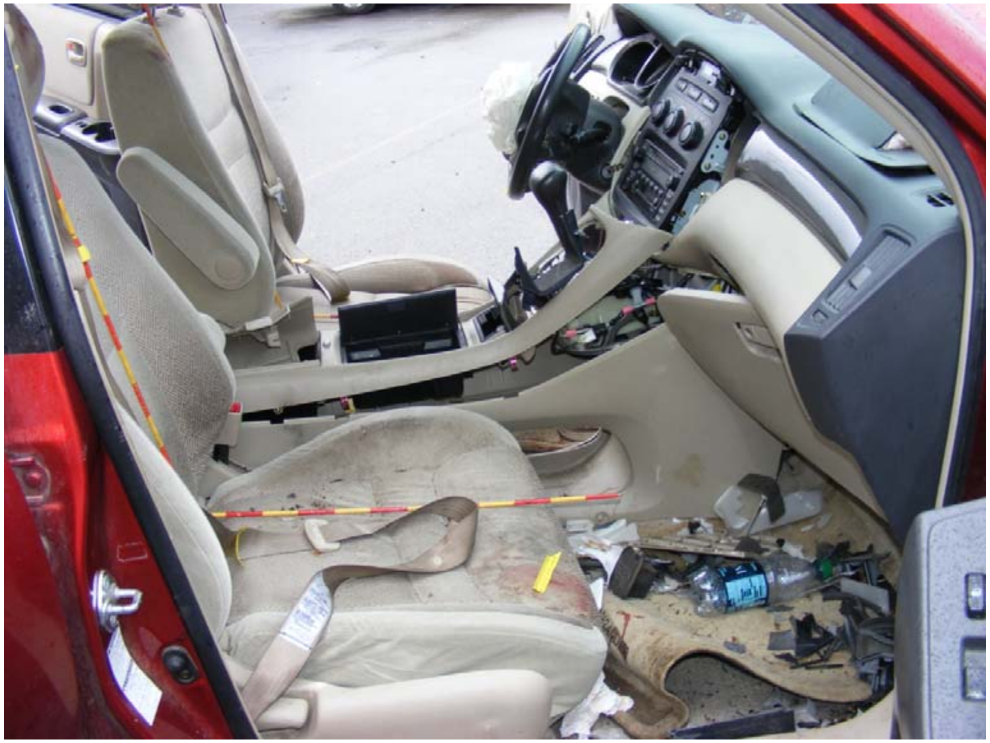
An elderly couple struck a tree late evening and rotated into ditch out of site

- Couple not found until next morning and passenger had died and driver was critically injured

-Injuries appeared survivable if EMS response was initiated

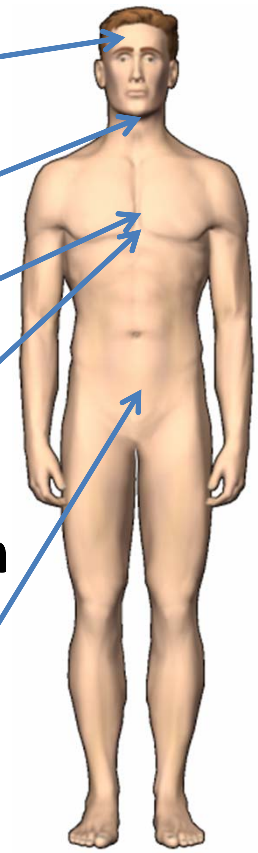
Occupant

- Front Right Passenger
- Male
- 66
- 5’9”, 205lbs (BMI-30.4)
- Shirt, jacket, jeans
- Slight reclined
- Found dead on scene



Injury Assessment

- **140695.3/SAH Sup parietal lobe, sm 2"x1"**
- **650232.2/C4 Ant surface linear horizontal nondisplaced fx**
- **441432.4/Laceration mid and lower lobes**
- **442201.4/Hemothorax with approx – (3L fluid, autopsy)**
- **854500.2/Knee ragged lac with palpable comminuted patella fx**
- **856151.2/Ant symphysis pubis fx**



Benefit from AACN notification and some treatment? – Yes.

-Over 3 liters of blood found in his chest, and lung injuries would most likely have been treatable.

-Other injuries, not life threatening

Benefit for Crash Notification System and GPS locations – CIREN case study

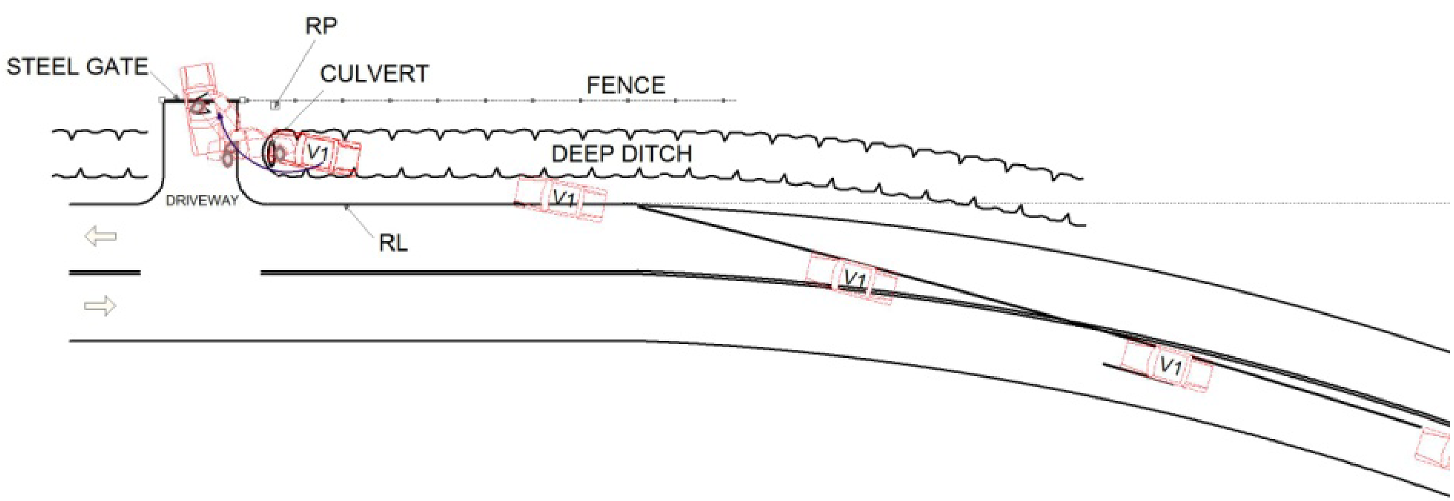
-Driver found after 8 days, departed roadway down into roadside ravine

-Survived with critical injuries after very long treatment at the trauma center

-Would have benefited greatly from AACN

CIREN Case Study

- Frontal Impact
- Objects struck: Ditch/Culvert
- A driver, front right passenger and second row passenger, all lost consciousness and were severely injured
- Crash time ~2am, resident discovered vehicle parked in the driveway the next morning (~6am), then called 911
- Case Occupant: 17 year old male, Second row right side passenger

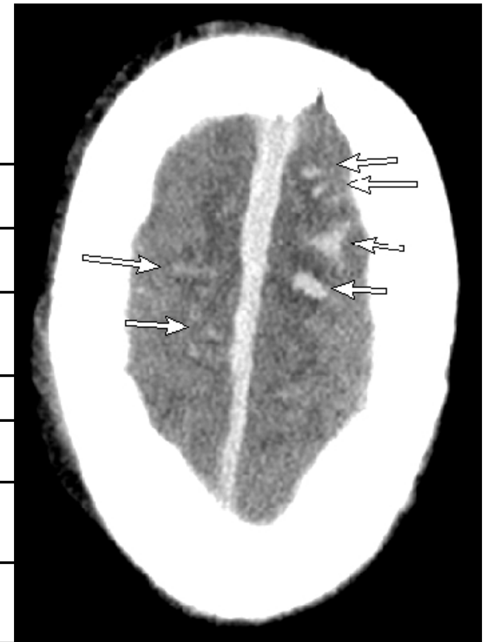


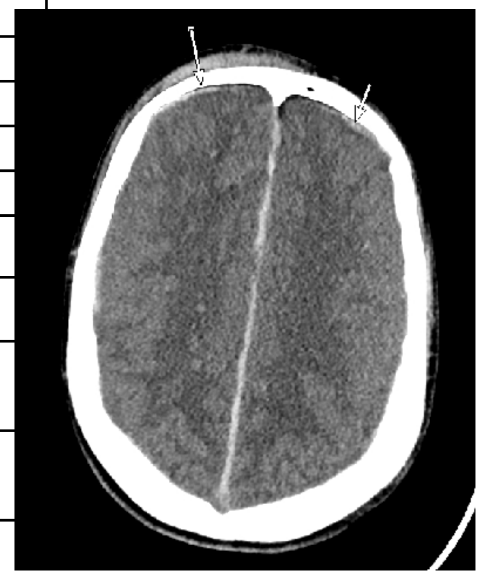
Impact

- PDOF = 20 (Event #1)
- CDC – 01FDEW05
- Delta V
  - Total: 38 mph / 61 kmph
  - Longitudinal: -35 mph /-57 kmph
  - Lateral: -13 mph /-21 kmph
  - CDR Longitudinal Velocity Change = -64.38 mph
- Manual lap/shoulder belt (no seat belt pretentioner)
- Airbag status = No air bag deployments

Injuries

AISCODE	Aspects	Description
140628.4	Bilat	Extensive DAI Bilat (ICH) (coma>6hrs)
140654.4	Bilat	Bilat parafalcine SDH & frontal
251221.2	R	R orbital floor fx through infraorbital foramen
251000.1	R	R nasal bone fxs
210402.1	R	Periorbital contusion R Eyelid
752271.2	L	comminuted fracture of the left mid radial diaphysis
752253.2	L	nondisplaced fracture of the mid left ulnar diaphysis
450201.1	R lat	1st rib fx
442202.2	R	Small pneumothorax
442202.2	L	Small pneumothorax
410202.1	R	Abrasion Front Right Chest
650220.2	R	C7 TP fx
540822.2	I	Serosal tear of descending colon.
541424.3	I	small bowel two 1cm peforations
510402.1	Inferior Right Front	Muscle contusion right abdominal wall.
510202.1	Inferior Right Front	Abdominal abrasions





Hospital Course

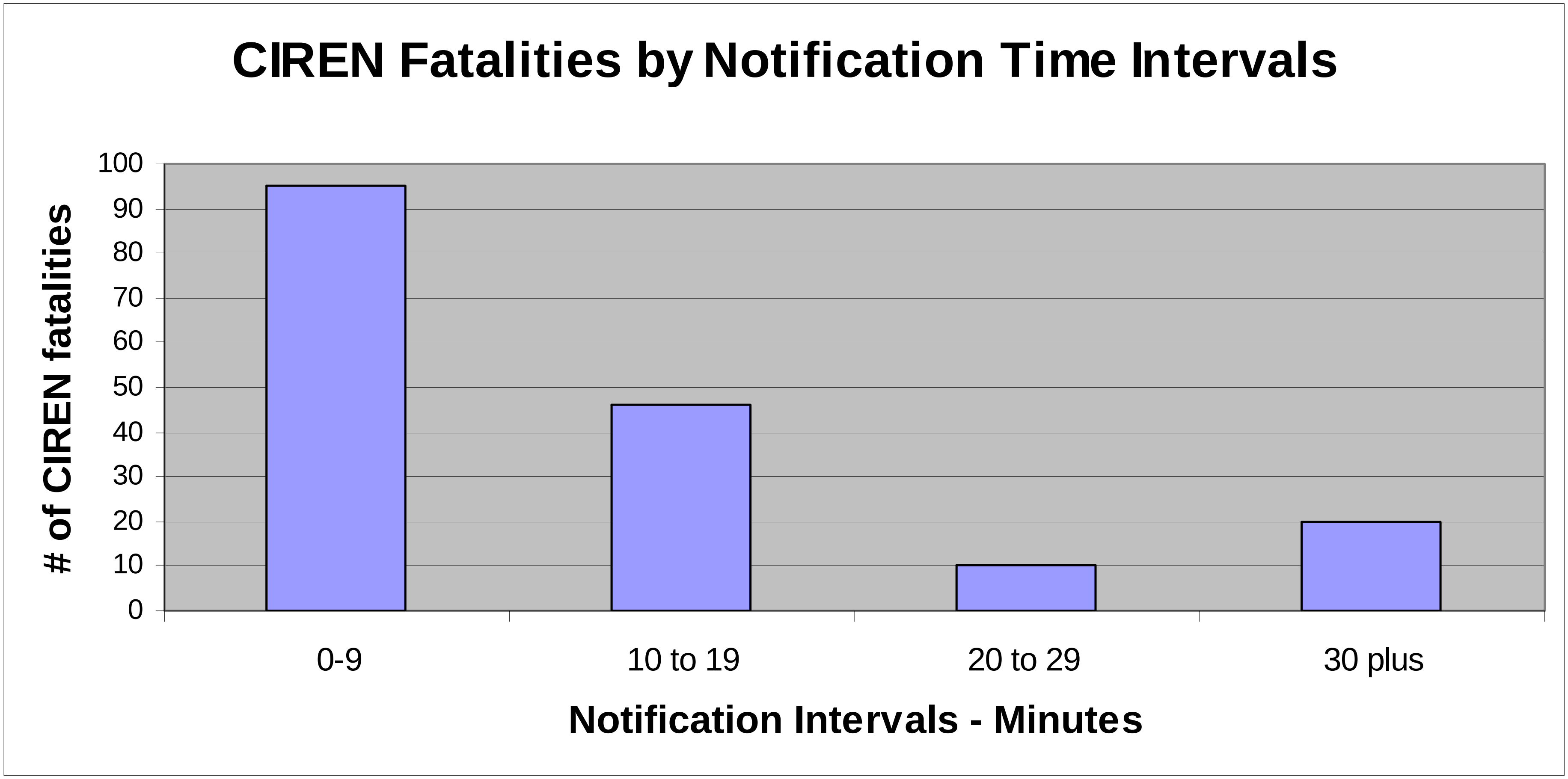
- Admit condition: Critical
- Admit vitals: BP 156/81; P 119; RR 14(vented); GCS 3T
- TBI – with prolonged coma
- Timing since crash to major intervention: 15hrs 12 min
  - Complications: Pneumonia, bacteremia, C-diff infection
- Total ICU days: 26
- Total vent days: 21

CIREN Fatalities Review

CIREN Fatalities Review

- Evaluated all fatal crashes in CIREN with complete EMS times (1996-2012, N=171)
- Assess notification intervals: (0-9, 10-19, 21-30, 30+ minutes)
- Examined major cause of death and injuries
- Examined mode of transport and those taken to outside hospital prior to transfer to trauma center
- Determine if some invasive procedure was attempted on arrival to trauma center
- All fatality cases involved threshold of ISS>15

CIREN Fatalities by Notification Times N=171



CIREN Fatalities (Notification time: 0-9 minutes)

- 95 total CIREN fatalities
- Mean ISS= 43
- Over half (52%) were transported to emergency dept
- Location of Death
  - 28 dead on scene (29%) – Mean Delta V = 55mph (35% missing)
  - 18 died in EMS vehicle (19%)
  - 7 died in Operating room
  - 1 died in Radiology
  - 28 died in ICU (29%)
  - 5 died on floor/after hospitalization
  - 1 died at outside hospital
  - 7 unknown

CIREN Fatalities (Notification time: 0-9 minutes)

- Major Cause of Death Injury
  - 48% Thoracic trauma
  - 35% Traumatic brain injuries
  - 10% Spinal injury
  - 6% Abdominal injury

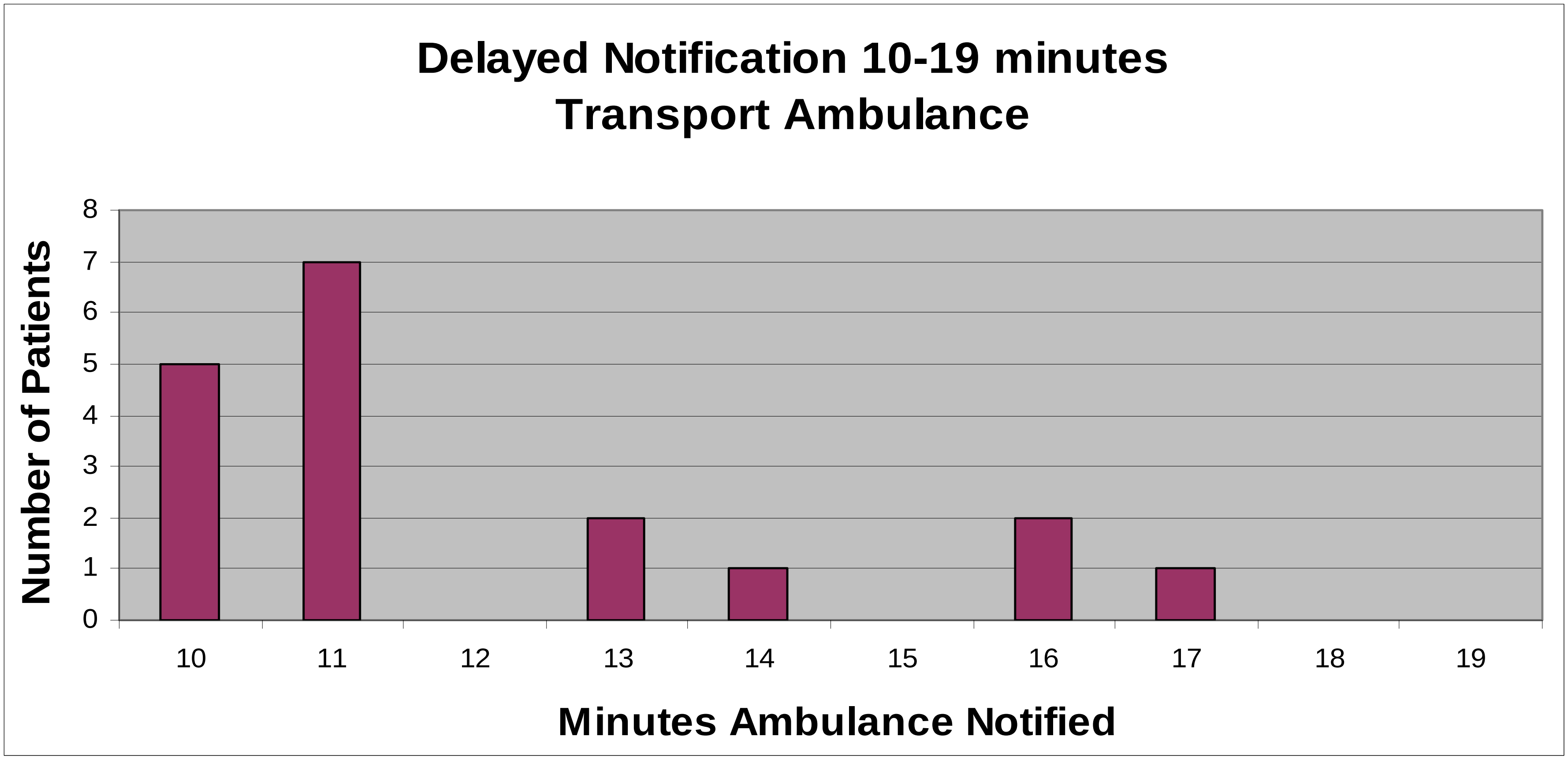
CIREN Fatalities (Notification time: 10-19 minutes)

- 46 total CIREN fatalities
- Mean Age: 49 years old
- Mean ISS= 42
- 36 (76%) were transported to medical facilities
- Location of Death
  - 10 dead on scene (22%) – Mean Delta V, 39 mph
  - 7 died in emergency dept.
  - 2 died in operating room
  - 22 died in ICU (48%)
  - 1 died on floor/after hospitalization
  - 1 died an outside hospital

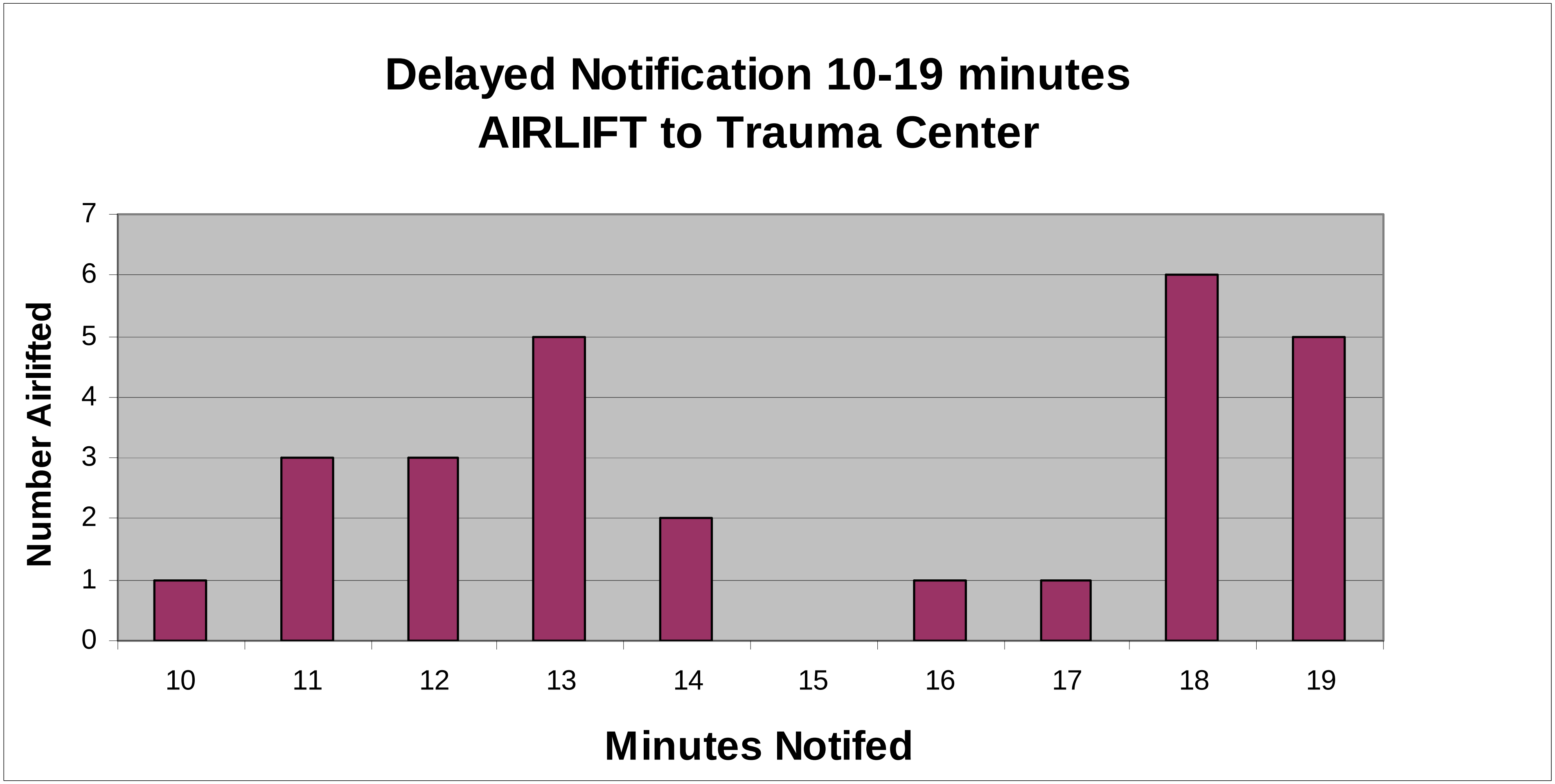
CIREN Fatalities (Notification time: 10-19 minutes)

- Two cases involved death at outside hospital
- 52% had an invasive procedure conducted in first 24 hours at trauma center
  - 26% had procedure conducted in 1-3 hours after admit time
- Cause of Death Injuries
  - 53% Thoracic trauma
  - 38% Traumatic brain injuries
  - 3% Spinal injury
  - 6% Abdominal injury

CIREN Fatalities (Notification time 10-19 minutes) Ground/Ambulance notified in minutes



CIREN Fatalities (Notification time 10-19 minutes) Airlift Notified in minutes



CIREN Fatalities (Notification time: 20-29 minutes)

- 10 total CIREN fatalities
- Mean age = 49 years old
- Mean ISS= 53
- 8 (80%) were transported to medical facilities
- Transport Mode
  - 2 dead on scene
  - 4 airlifted to trauma center
  - 1 taken to outside hospital, airlifted 2 hours later
  - 1 taken to outside hospital, airlifted 6 hours later
  - 2 taken by ambulance, died in emergency dept. (ED)

CIREN Fatalities (Notification time: 20-29 minutes)

- Major Cause of Death of Injury
  - 2 traumatic brain injury (AIS 5)
  - 3 thoracic trauma (AIS 4-5)
  - 3 spinal injury (AIS 6 injuries)
  - 2 died from complications

CIREN Fatalities (Notification time: 30 + minutes)

- 20 total CIREN fatalities
- Mean age = 55 years old
- Mean ISS= 41
- 15 (75%) were transported to medical facilities
- Transport Mode – Location of Death
  - 5 (25%) dead on scene, (cause of death 3 thorax AIS 5, 2 spinal injuries AIS 6)
  - 2 died in ED, invasive procedures immediately in ED
  - 10 died in ICU, - 6 of these were transferred from outside hospital (with 2-4 delayed hours to trauma center)
  - 2 died on floor after hospitalized
  - 1 died at outside hospital

CIREN Fatalities (Notification time: 30+ minutes)

- Major Cause of Death Injury
  - 50% thoracic trauma
  - 31 % traumatic brain injury (AIS 4-6)
  - 13% spinal injury
  - less than 1% abdominal

Summary of CIREN Delayed Notification Intervals for Fatalities

-Mean ISS remained relatively constant among notification time intervals (43, 42, 53, 41)

-Further delay in notification was associated with more transfers to outside hospitals prior to transport to the trauma center

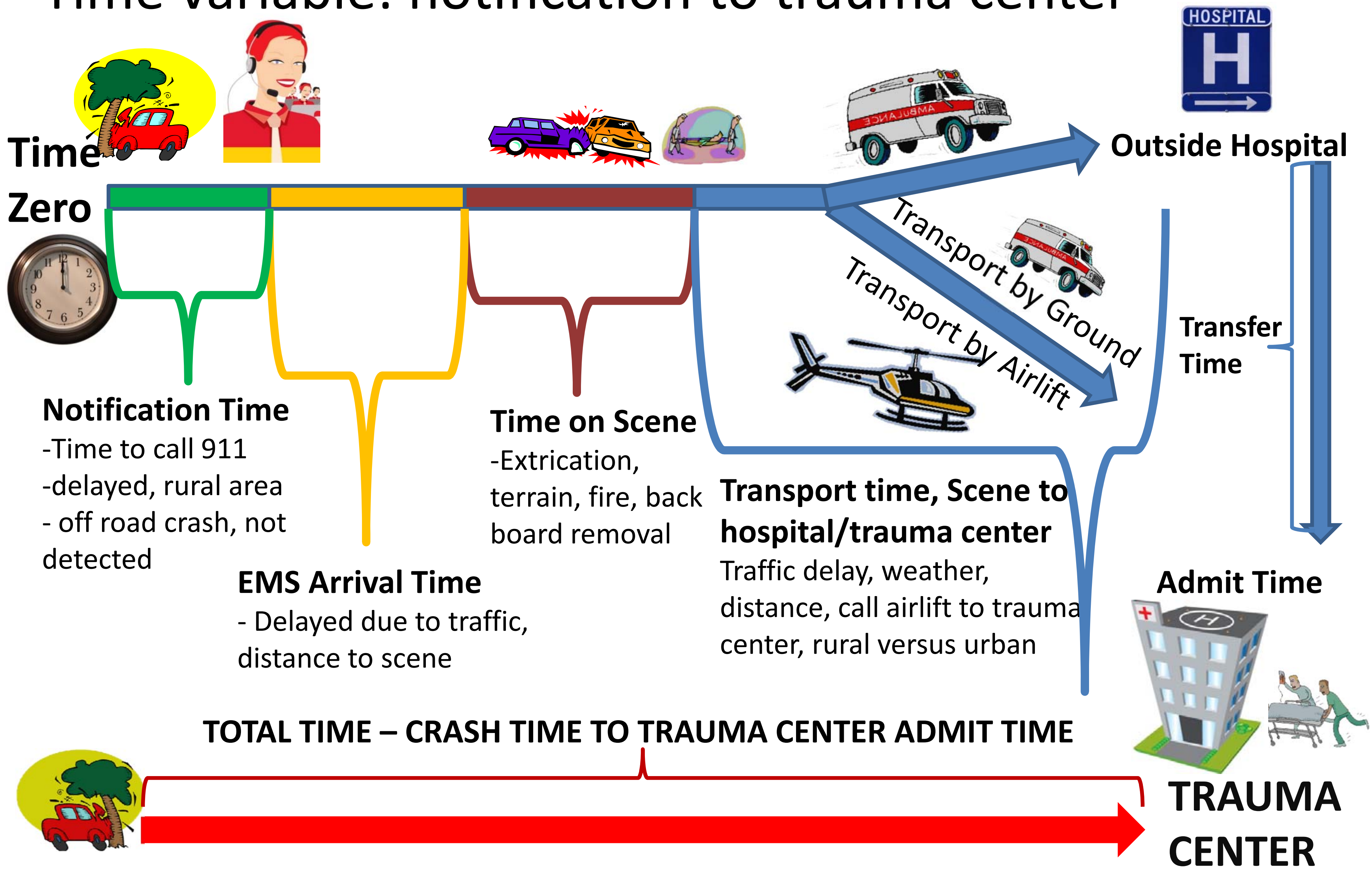
- 26% of all fatalities were dead on scene,

  -mean Delta V - 0-9min./55mph, versus 10-19min./39mph

- 62% of those dead on scene had a notification time less than 9 minutes

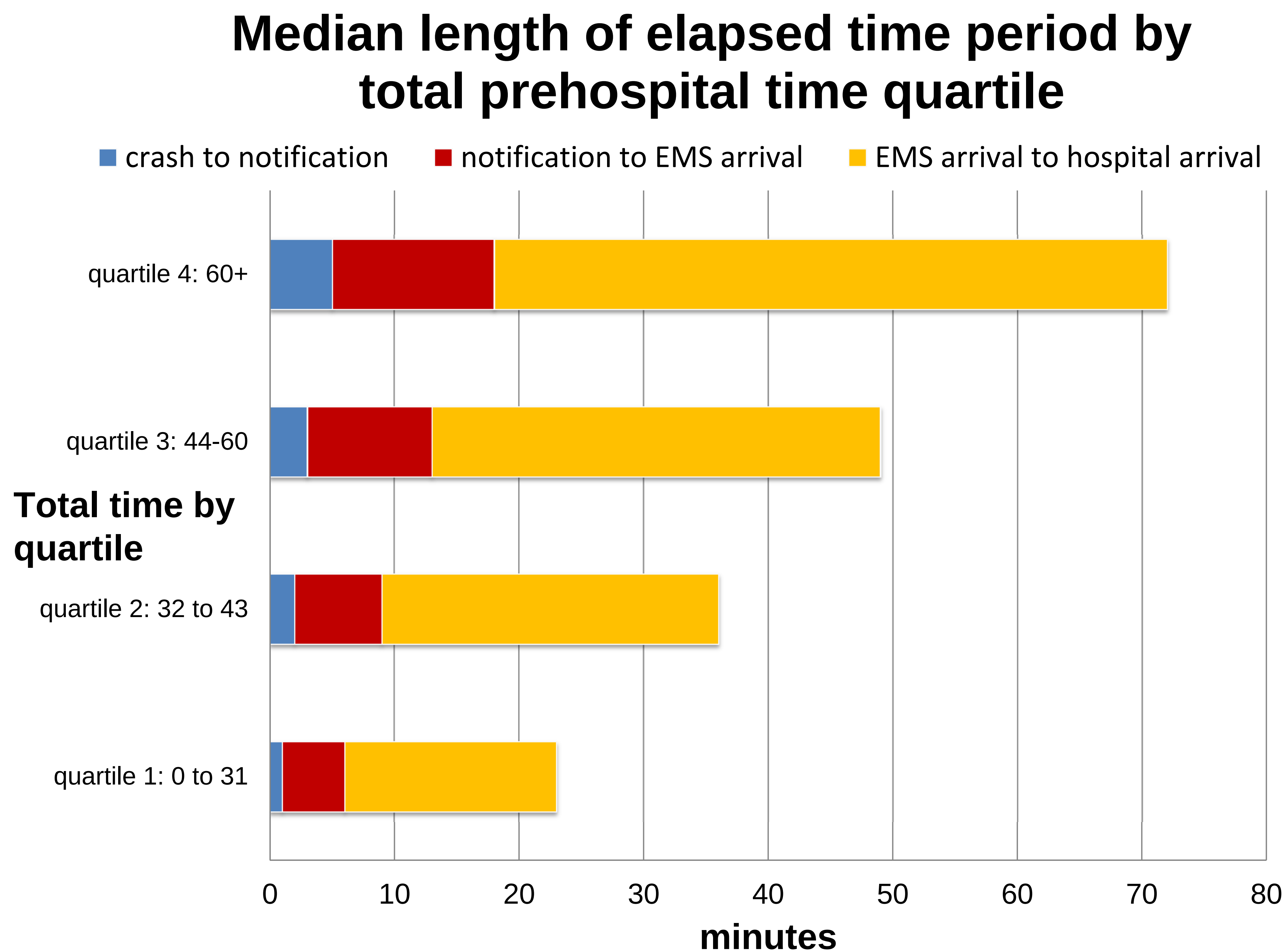
-Approximately half had a major cause of death injury to the thorax, followed by traumatic brain injury at almost a third. (overall, 75% Head/Chest)

Time variable: notification to trauma center

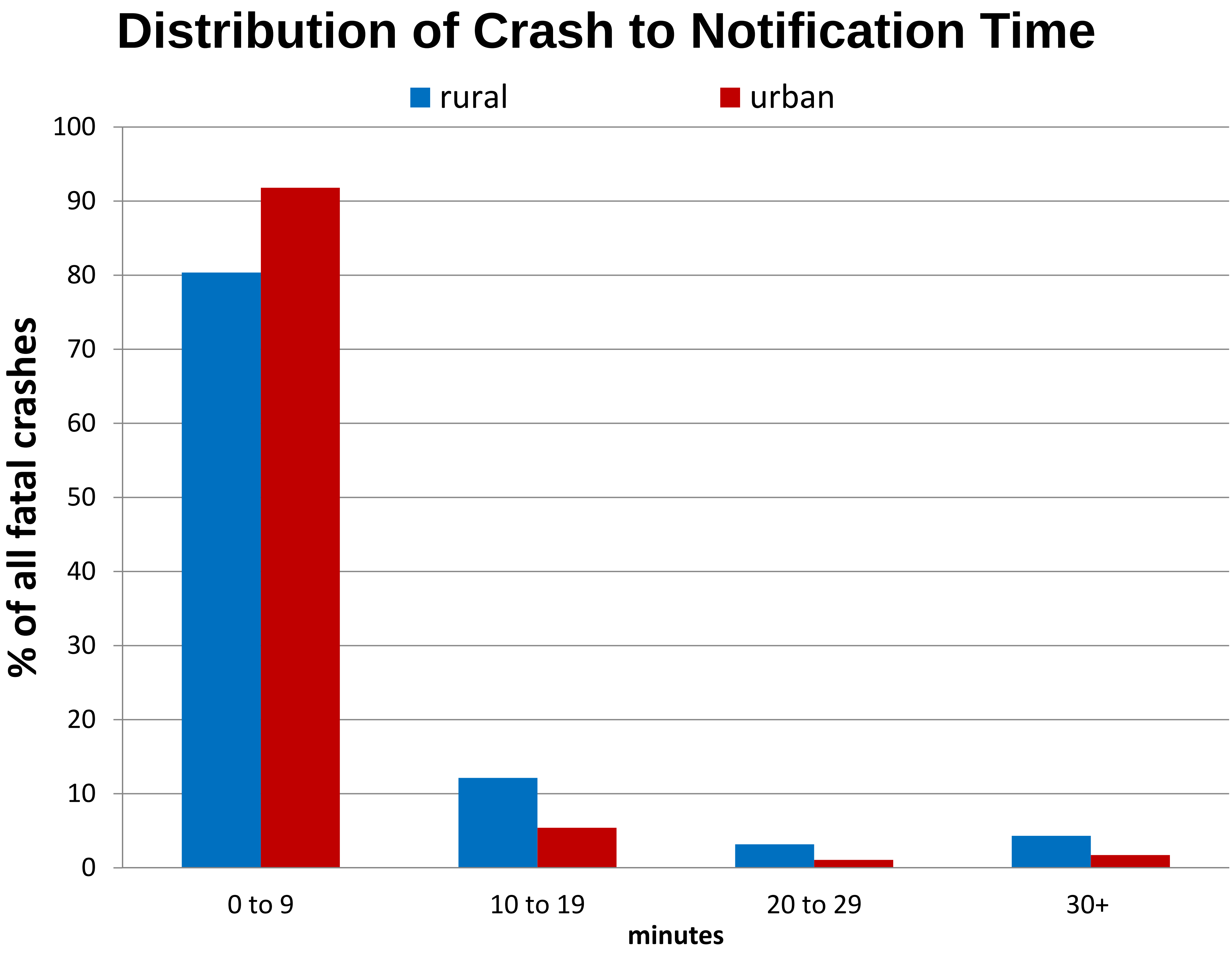


Fatality Analysis Reporting System (FARS)

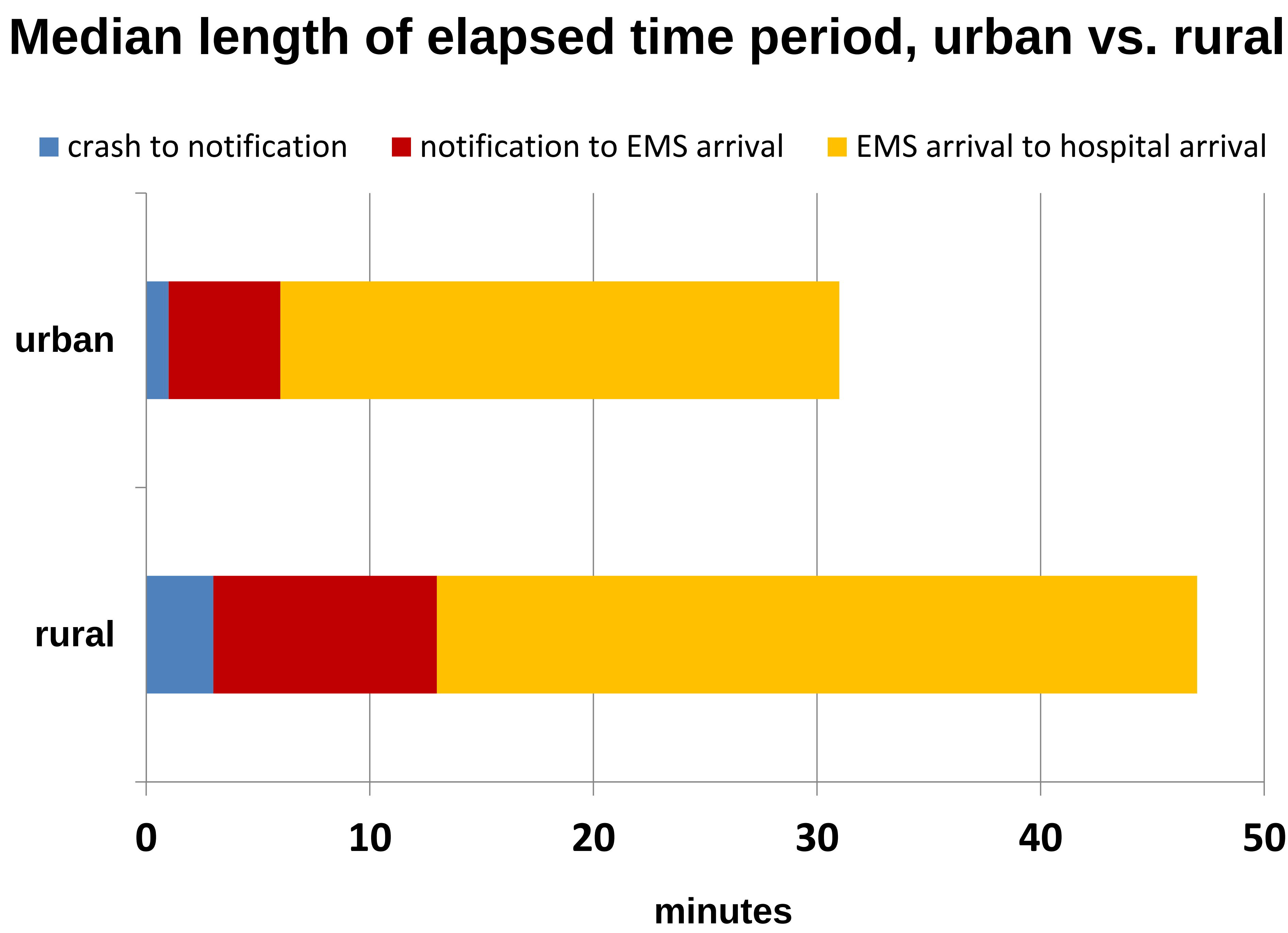
- All US fatal crashes involving a passenger vehicle, 2000 to 2011
- Passenger vehicle occupants and drivers only included in analysis
- Detailed time analysis confined to single passenger crashes due to level of detail for time data collection

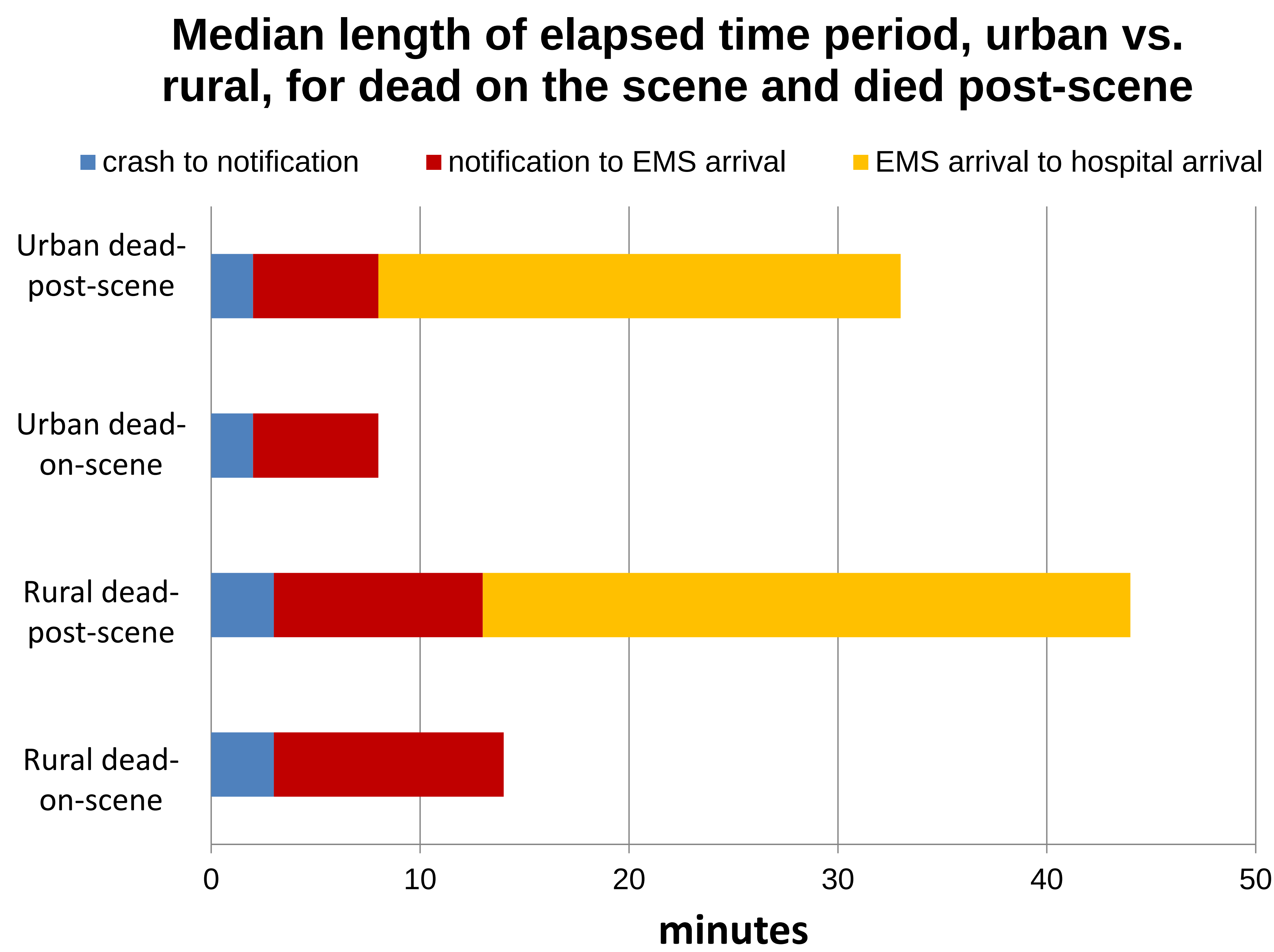


Median length of elapsed time period by total prehospital time quartile
crash to notification
notification to EMS arrival
EMS arrival to hospital arrival
quartile 4: 60+
quartile 3: 44-60
Total time by quartile
quartile 2: 32 to 43
quartile 1: 0 to 31
0
10
20
30
40
50
60
70
80
minutes



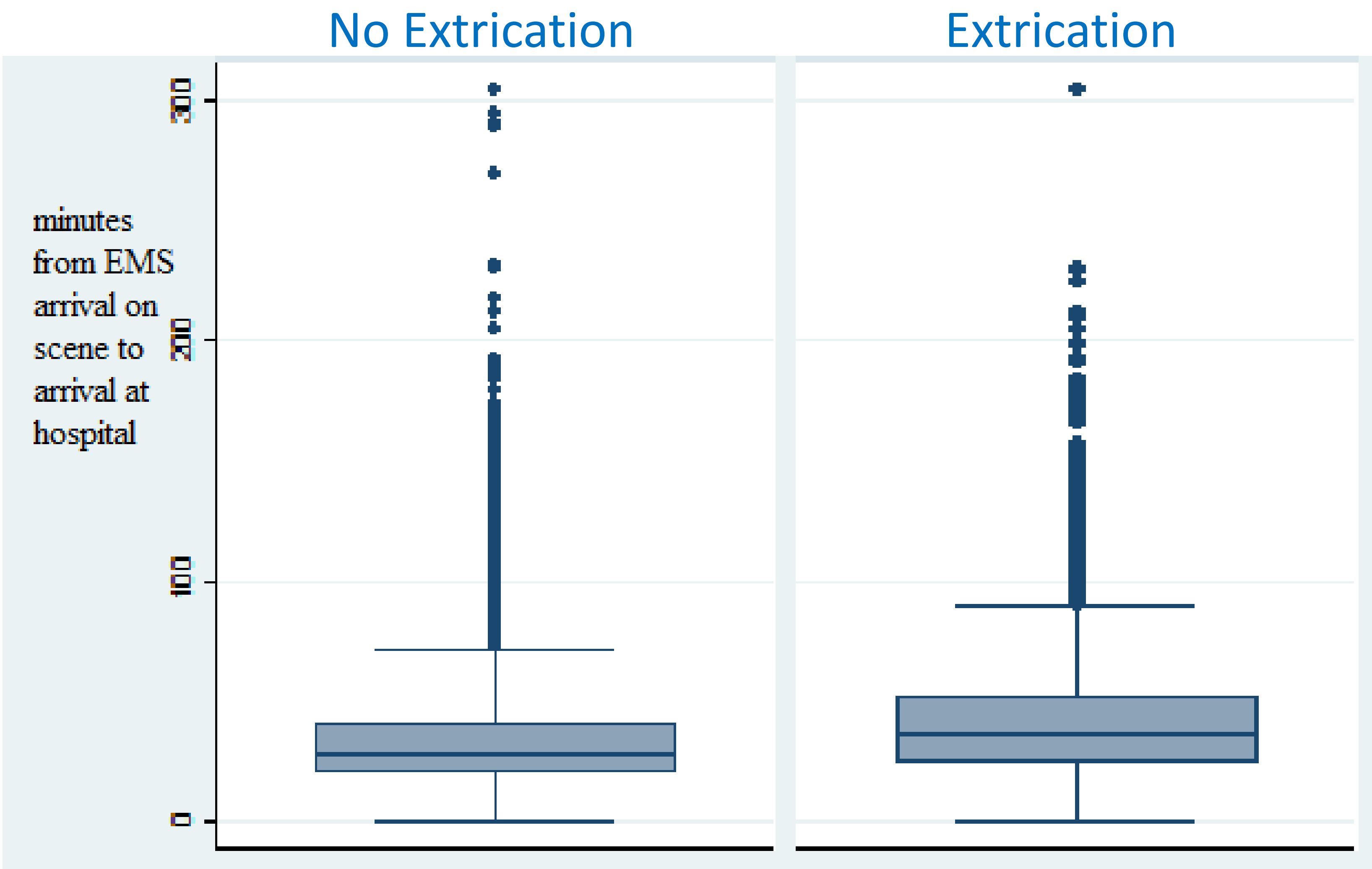
Distribution of Crash to Notification Time
rural
urban
% of all fatal crashes
100
90
80
70
60
50
40
30
20
10
0
0 to 9
10 to 19
20 to 29
30+
minutes


Median length of elapsed time period, urban vs. rural
crash to notification
notification to EMS arrival
EMS arrival to hospital arrival
urban
rural
0
10
20
30
40
50
minutes



Median length of elapsed time period, urban vs. rural, for dead on the scene and died post-scene
crash to notification
notification to EMS arrival
EMS arrival to hospital arrival
Urban dead-post-scene
Urban dead-on-scene
Rural dead-post-scene
Rural dead-on-scene
0
10
20
30
40
50
minutes

Length of time between EMS arrival on scene to arrival at hospital, by extrication



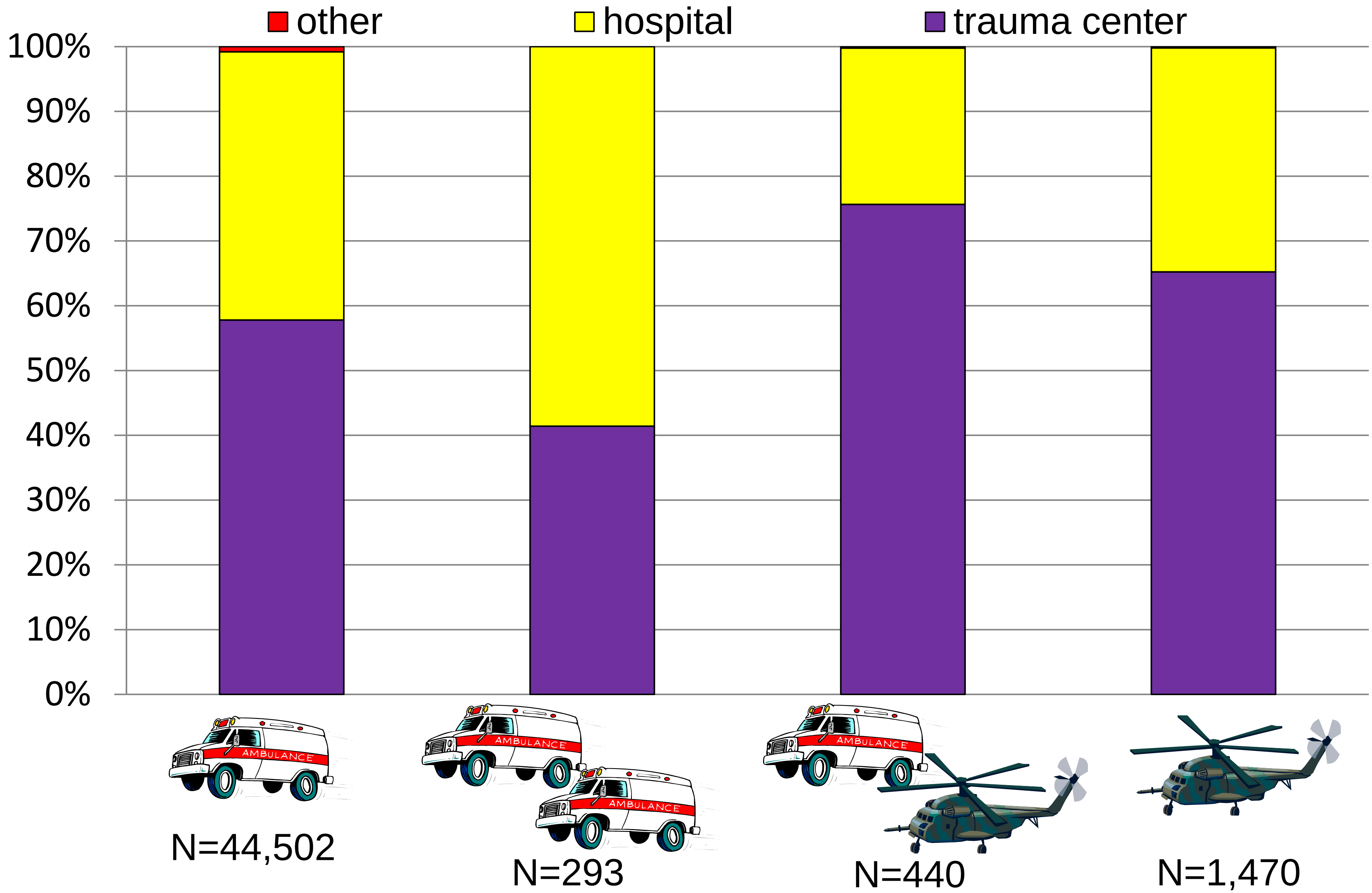
FARS Summary
Notification Time and Death

- Of all passenger vehicle occupants involved in a fatal crash, 23% were dead-on-scene, and 1% died in transit.
- Of all fatal crashes, 57% are on rural roads and 43% are on urban roads.
- Rural crashes would benefit from AACN with earlier arrival and treatment
- Time on scene and transport to medical facility dominated total time (crash to ED)
- Extrication increased time on scene

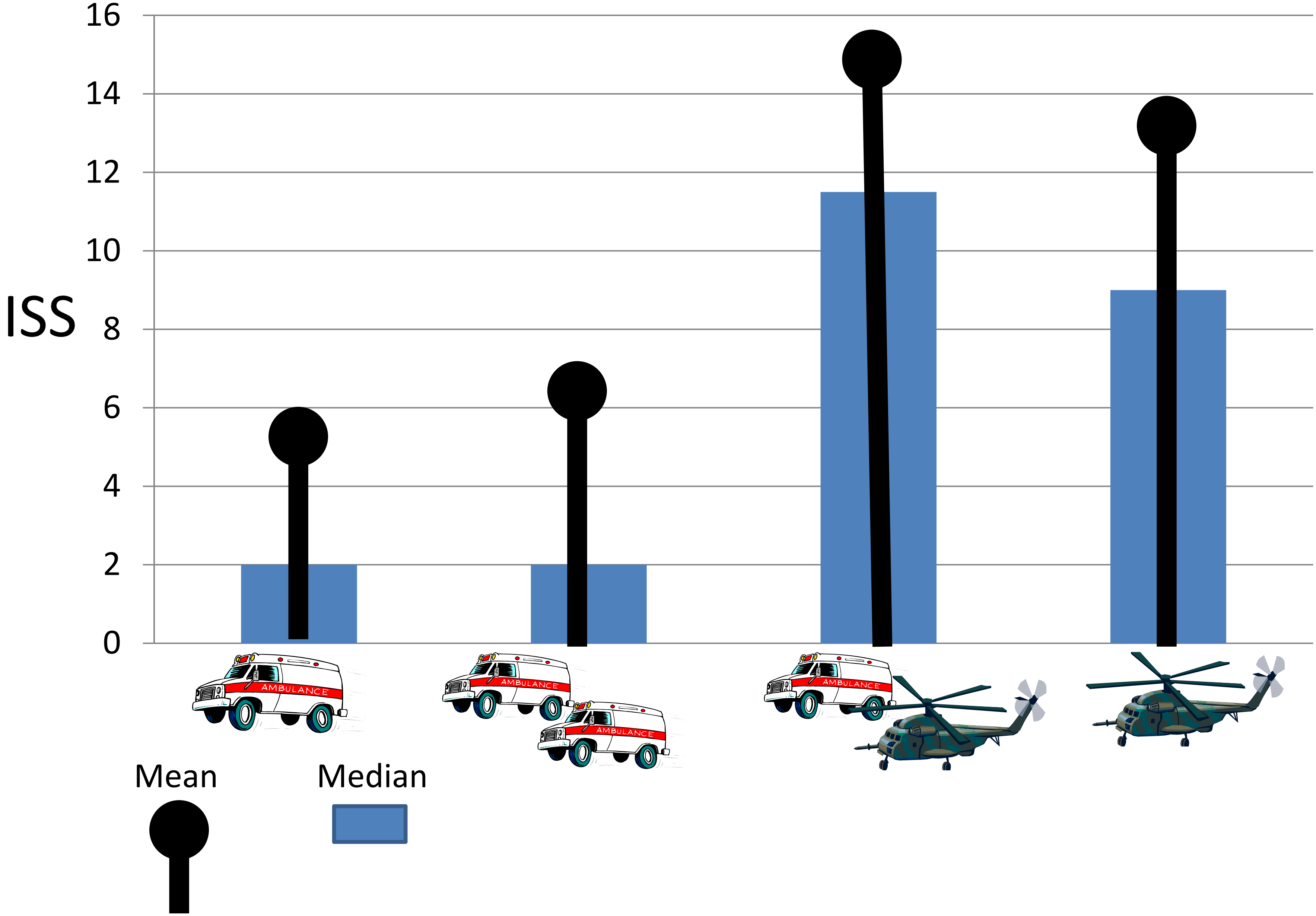
National Automotive Sampling System/ Crashworthiness Data System

- NASS/CDS represents a probability sample survey of police-reported motor vehicle crashes
- All US fatal crashes involving a passenger vehicle, 2000 to 2011
- Passenger vehicle occupants and drivers only included in analysis
- Complete case analysis based on time data availability thus not nationally representative, no weights used.
- Descriptive statistics used to investigate patterns of time periods
- Logistic regression used to investigate the odds of fatal injury based on time periods adjusting for covariates.

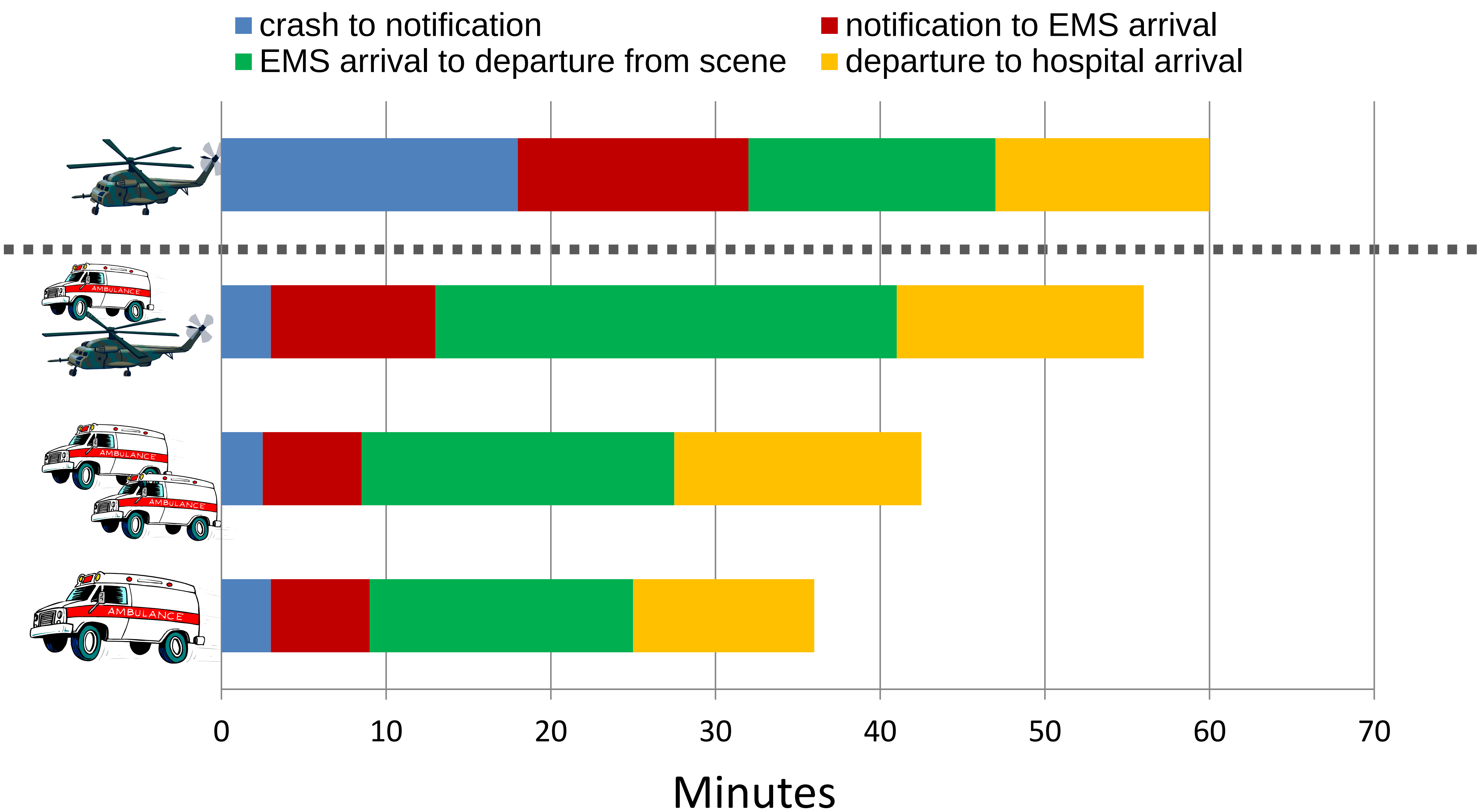
Mean of transport and destination



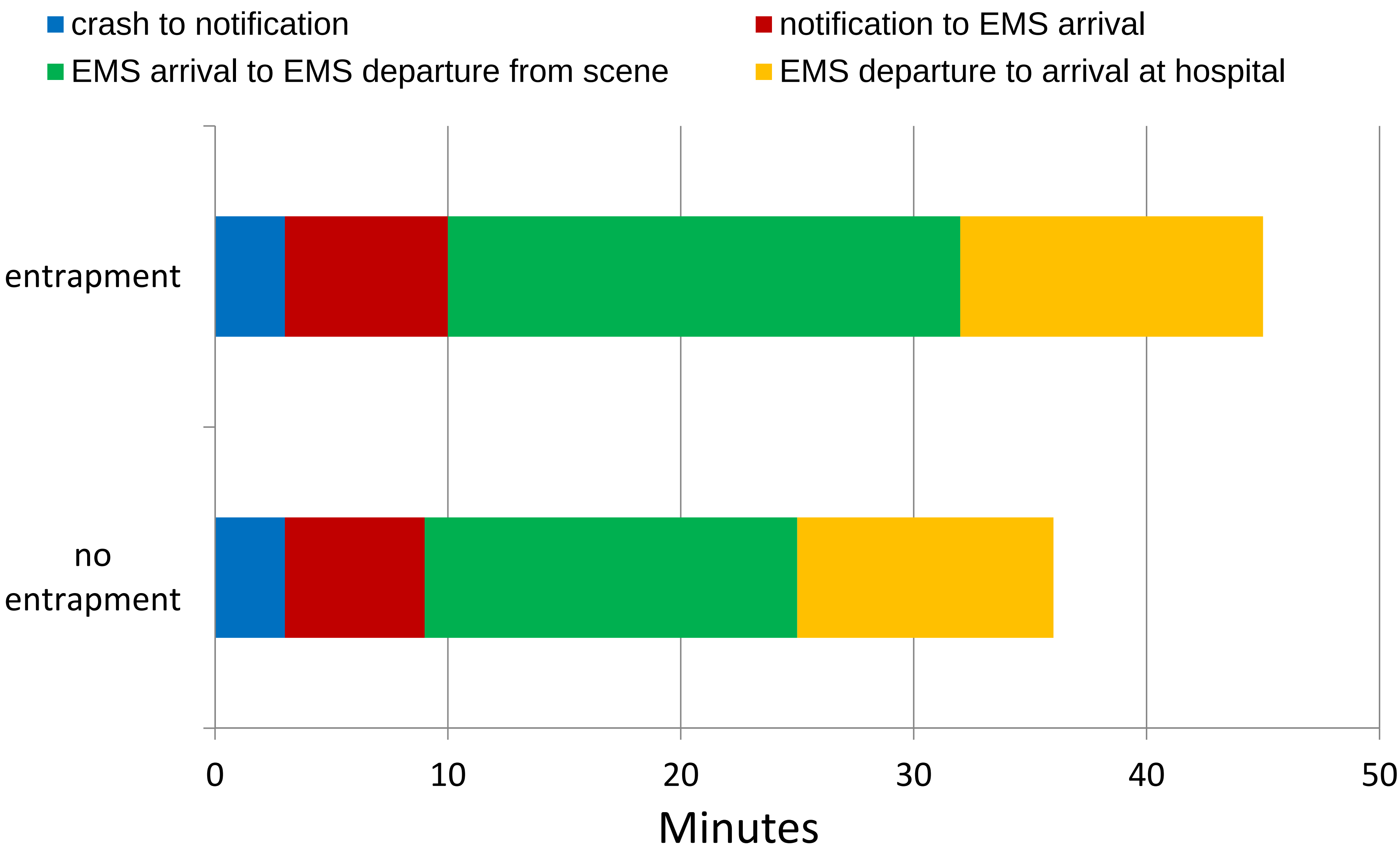
Injury Severity Score (ISS) and means of transport



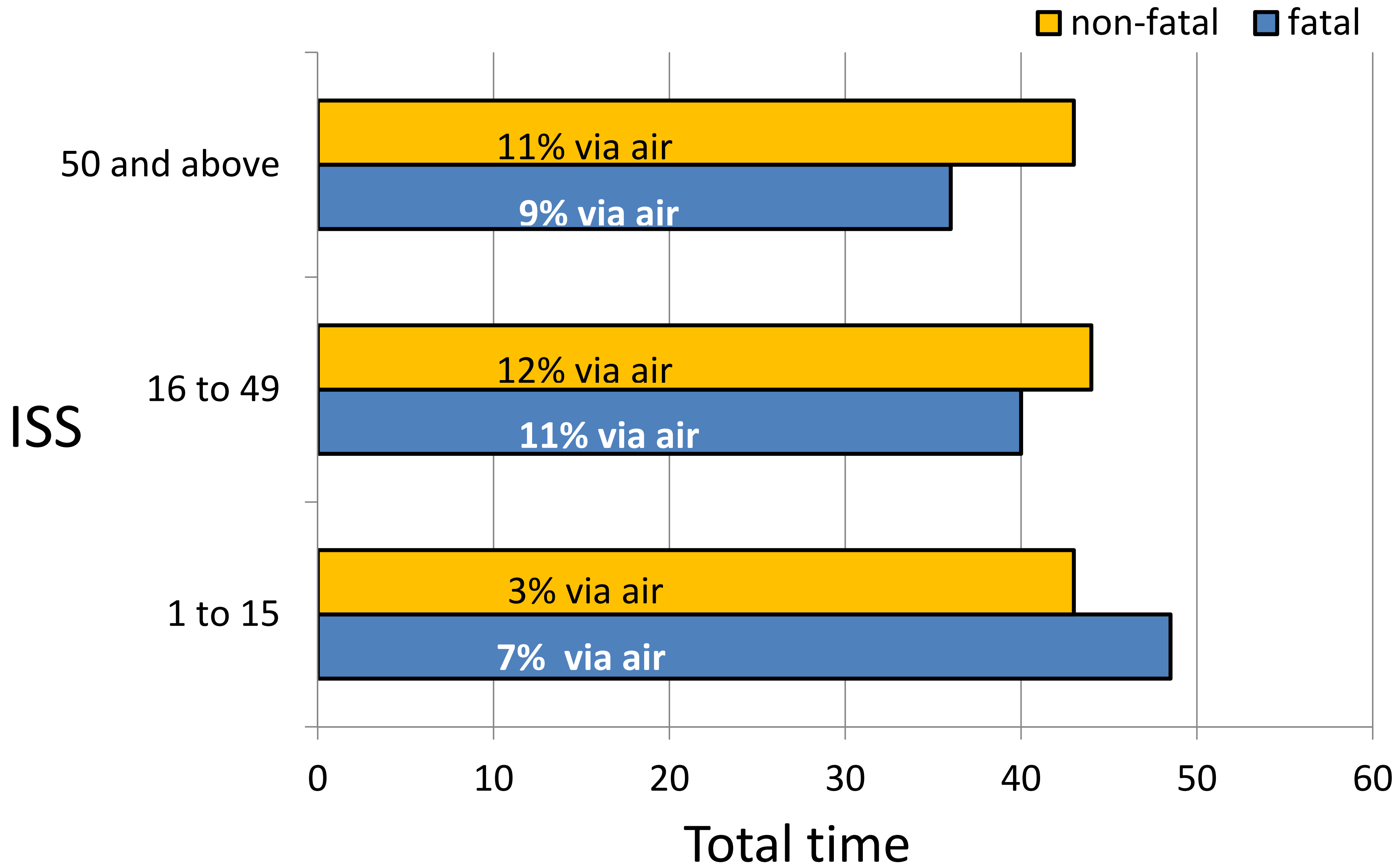
Median time elapse by transportation mode



Among those transported by one ambulance, median time elapse by entrapment



ISS categories and survival, by total time



Odds of Fatal Injury: Unadjusted Analysis

- In univariate analysis, a one minute increase in total elapsed time is associated with 1.001 times the odds of fatal injury (p-value = 0.024, 95% CI 1.000, 1.002)

Odds of Fatal Injury: Unadjusted Analysis

- In a multivariate, unadjusted analysis by time increment:

multivariate analysis	OR	p-value	95% CI	
crash to notification	1.000	0.59	0.998,	1.002
notification to EMS arrival	1.001	0.77	0.989,	1.015
EMS arrival to departure from scene	**1.027**	**<0.001**	**1.021,**	**1.032**
departure to hospital arrival	0.994	0.01	0.990,	0.999

Multivariate Analysis

- Created dummy variable based on time periods with reference 0 to 9 minutes
  - Comparison intervals were:
    - 10 to 19 minutes
    - 20 to 29 minutes
    - 30 min. to 1 hour
    - One hour and above
- Adjusted for ISS, Age, and delta V (DV total)

Odds of fatal injury by dummy time period

	OR	P-value	95% CI	
crash to notification				
10 to 19 min	0.96	0.83	0.63	1.45
20 to 29 min	0.75	0.52	0.30	1.83
30 to 59 min	0.58	0.37	0.17	1.91
1 hour +	**5.61**	**<0.001**	**2.23**	**14.12**
notification to EMS arrival				
10 to 19 min	0.88	0.51	0.60	1.29
20 to 29 min	0.58	0.36	0.19	1.83
30 to 59 min	0.63	0.55	0.14	2.87
1 hour +		perfect prediction of fatality		
EMS arrival to departure from scene				
10 to 19 min	**0.57**	**0.01**	**0.38**	**0.84**
20 to 29 min	**0.48**	**<0.001**	**0.30**	**0.75**
30 to 59 min	0.90	0.72	0.51	1.58
1 hour +	**15.77**	**<0.001**	**6.25**	**39.77**
departure to hospital arrival				
10 to 19 min	0.92	0.63	0.66	1.28
20 to 29 min	0.91	0.72	0.56	1.49
30 to 59 min	0.96	0.91	0.43	2.11
1 hour +		perfect prediction of fatality		

Odds of fatal injury

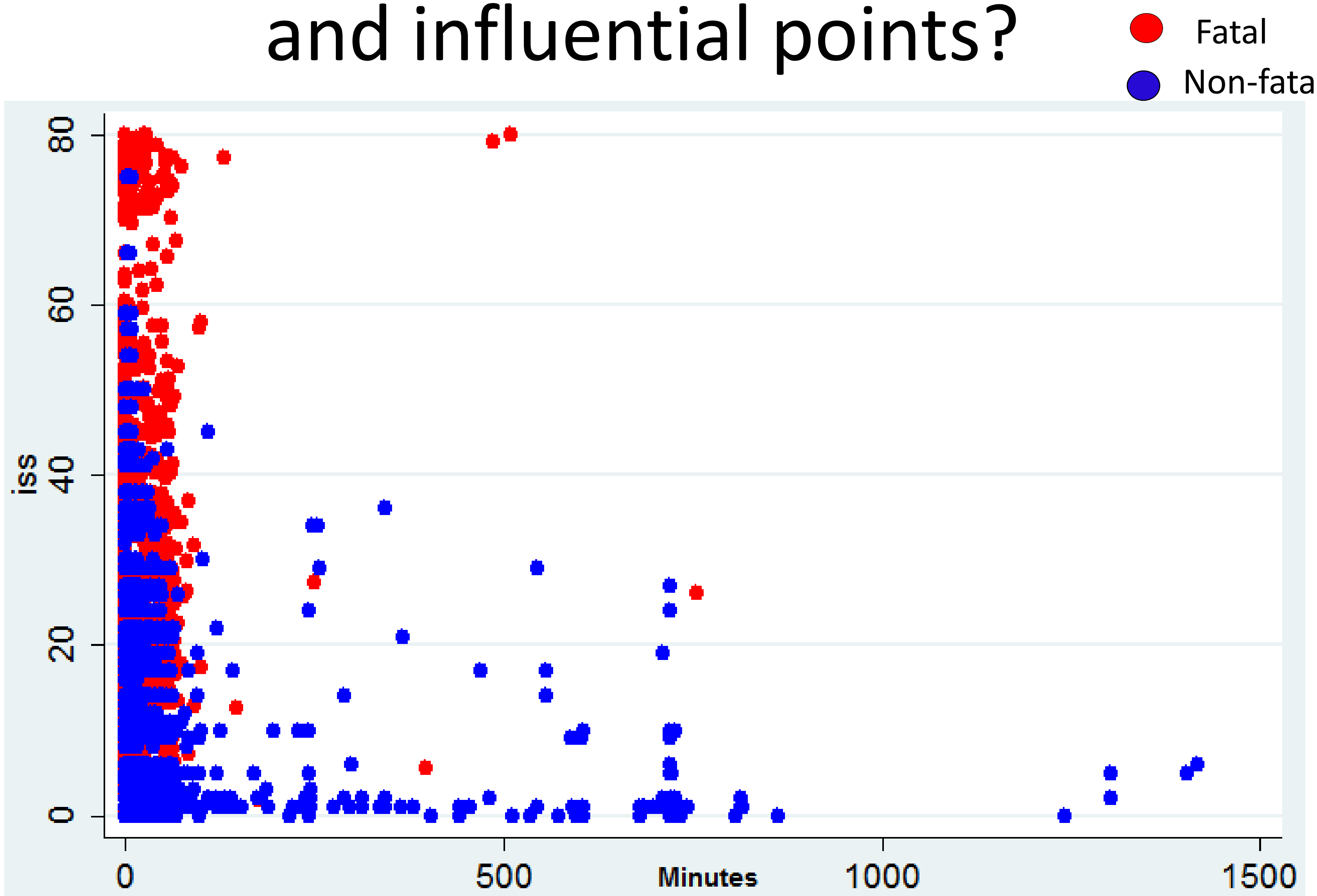
- When adjusted for age, ISS, and delta V, all time periods become non-significant, with the exception of arrival-on-scene-to-departure-to-medical-center time (OR 1.02 per minute, p-value <0.001).

- ISS, age and delta V are all significantly associated with odds of fatality
- No interaction between crash to notification time and ISS

Odds of fatal injury by transportation mode

- Adjusted for ISS, age, delta V and time periods, transportation type is not significantly associated with odds of fatal injury.
  - Air vs. ground only: OR 0.76 (p-value = 0.32)
  - Ground then air vs. ground only: 0.88 (p-value = 0.76)
  - No evidence of confounding or effect modification within time periods based on transportation mode

Crash to notification time vs. ISS: outliers and influential points?



Odds of fatal injury: influential points

- Delta beta analysis suggests there may be influential outliers for crash to notification times in the extreme time elapses.

- Results do not change considerably when crash-to-notification times are truncated at 12 hours.
- Results do change when crash-to-notification times are truncated at 6 hours.
  - OR: 1.009, p-value = 0.009

Odds of fatal injury: time cut-off

- A spline model adjusted for ISS, age, delta V, and EMS mode of transportation using robust standard errors shows a significant increase in odds of death per minute increase in time beginning at crash to notification time 30 minutes and above (OR = 1.13 per minute, p-value < 0.001).
- For example, a five minute delay (after the first 30 minutes) is associated with a 88% increase in the odds of death

Odds of fatal injury: what if?

Utilizing a recycled predictions approach:

- The current mean predicted probability of death is 0.043
- If everyone had **5 minutes between EMS arrival on scene and departure to medical facilities**, the mean predicted probability of death would be 0.035
- If everyone had **60 minutes between EMS arrival on scene and departure to medical facilities**, the mean predicted probability of death would be 0.074

NASS/CDS summary

- Different transportation modes are associated with different lengths time in response to arrival on scene, arrival on scene to departure, and departure from scene to arrival at hospital
- Entrapment is a key determinant of time on scene
- Crash to notification time does not appear to be associated with survival unless longer than 30 min
- Prolonged length of time on scene is highly associated with mortality

Limitations of NASS analysis

- Complete case analysis only (~75% of individuals were missing one or more time segments)
- Unable to conduct multiple imputations and utilize weights (not nationally representative)
- Each time elapse limited to 24 hours
  - Very small and very large time periods existed
- Limited information on transportation/final destination after initial hospital (e.g. on transfer from hospital to trauma center)

Benefit for AACN

Predicting Need for Extrication using EDR-derived variables

- FARS data showed a shift in longer on scene delays when extrication was required
- Advanced notice for need of heavy equipment response could reduce the on-scene time
- PSAPs protocol for all crashes is to assess first the need for heavy equipment, fire, vehicle on tires, etc. Then assess injury severity.

AACN predicting need for Extrication

- EDR data obtained from NHTSA and merged with NASS data set (2002-2010)
- Summary variables created from EDR files
- Sample randomly divided into a prediction and validation set
- All variables tested using step forward logistic regression to determine optimal models to predict ISS >15 or entrapment
- 40% files missing delta v and speed, usable n=742

EDR derived variables

- airbag deployment
- driver belt status
- passenger belt status
- time for driver pretensioner activation
- time for passenger pretensioner activation
- driver seat track position
- passenger airbag suppression switch position
- maximum pre-crash delta V (within 600 ms of impact)
- maximum pre-crash vehicle speed (over 5 seconds before impact)
- pre-crash vehicle speed 1 second before impact

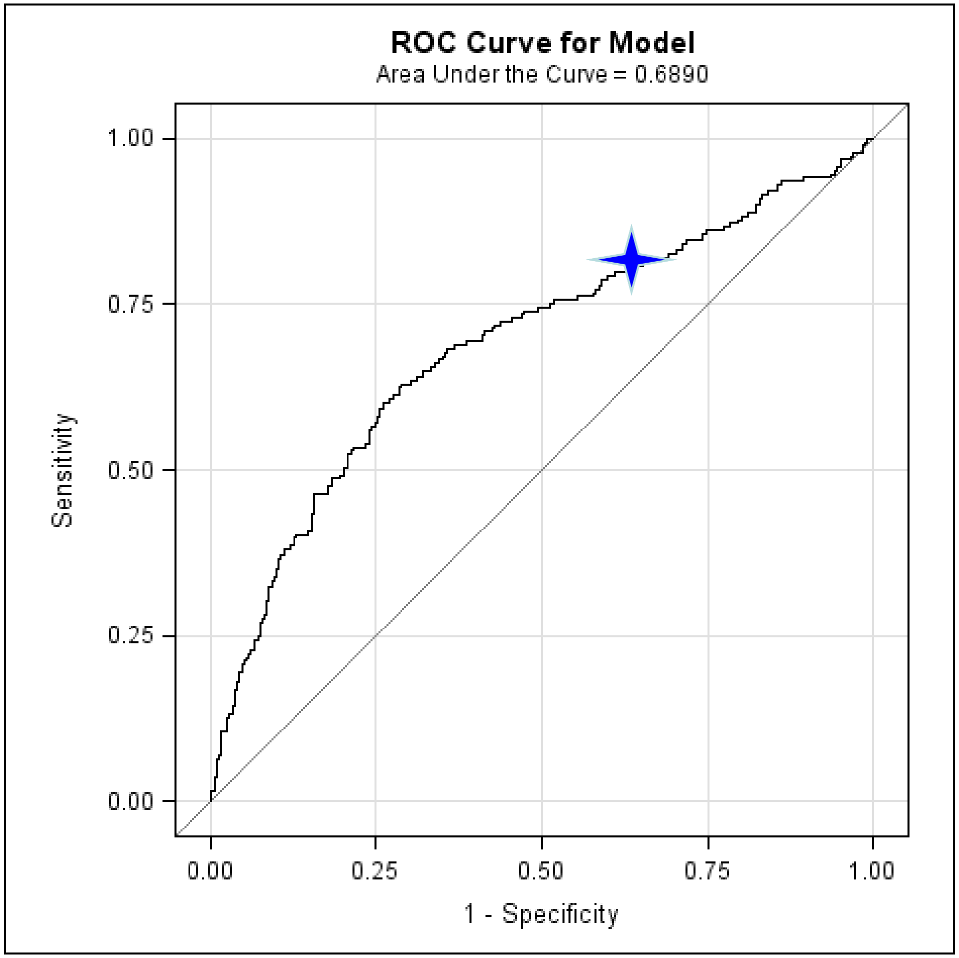
Note delta v also assessed as a polynomial variable

- maximum pre-crash engine speed (rpm) (over 5 seconds before impact)
- pre-crash engine speed 1 second before impact
- maximum pre-crash throttle percentage (over 5 seconds before impact)
- pre-crash throttle percentage 1 second before impact
- maximum pre-crash vehicle speed (over 5 seconds before impact)
- pre-crash vehicle speed 1 second before impact
- brake switch circuit on (over 5 seconds before impact)
- brake switch circuit on 1 second before impact
- time for first stage air bag deployment (ms)
- time for second stage airbag deployment
- time for first + second stage airbag deployment

Prediction of Entrapment

Variable	Odds Ratio	OR 95% C.I.	p-value
Max DV	0.890	(0.820, 0.965)	0.0050
Max DV squared	1.005	(1.002, 1.008)	0.0005
Max DV cubed	1.000	(1.000, 1.000)	0.0013
Max speed	1.017	(1.009, 1.026)	< 0.0001
RPM 1 second prior	1.000	(1.000, 1.000)	0.0119

Prediction of Entrapment




Reflects 20% Predicted probability threshold

AACN, Benefit for Extrication Predication

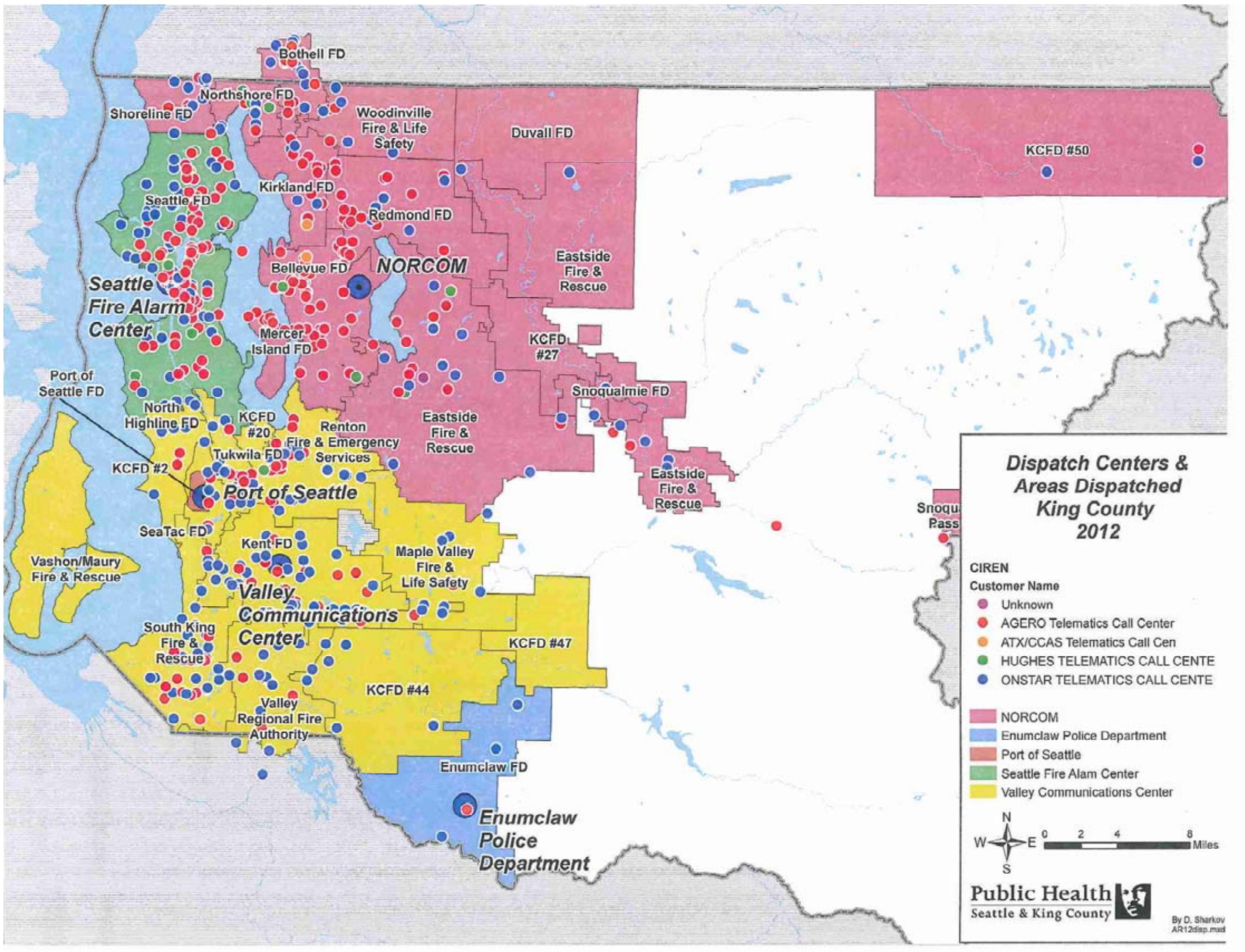
- EDR data alone can generate useful models to predict injury severity and potential need for extrication
- Development of a scale to predict these outcomes may be more useful to facilitate decisions at PSAP (Step 0) and by EMS providers (Step 3)

Benefit of AACN and GPS

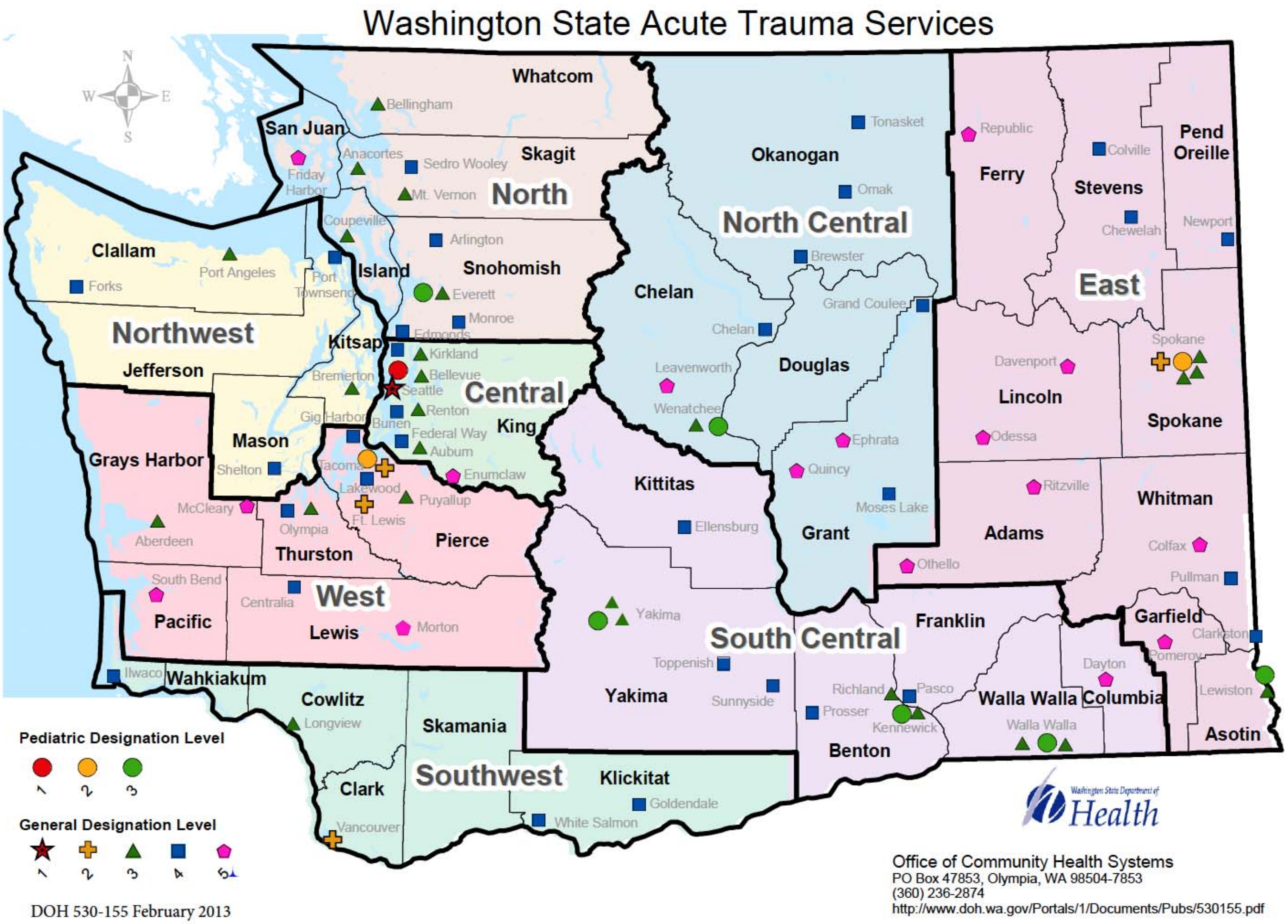
- The travel times of EMS arrival and time in transport to trauma center were both a large portion of the total time in FARS, NASS and CIREN.
- Utilization of GPS with AACN could pre-determine, airlift versus ground transport.

- Trauma system regional or State level evaluations could be useful to establish protocols for transport to Level one trauma centers, especially in rural regions.

King County, WA -GPS mapping of all AACN calls to PSAPs (~700 calls in 2012)

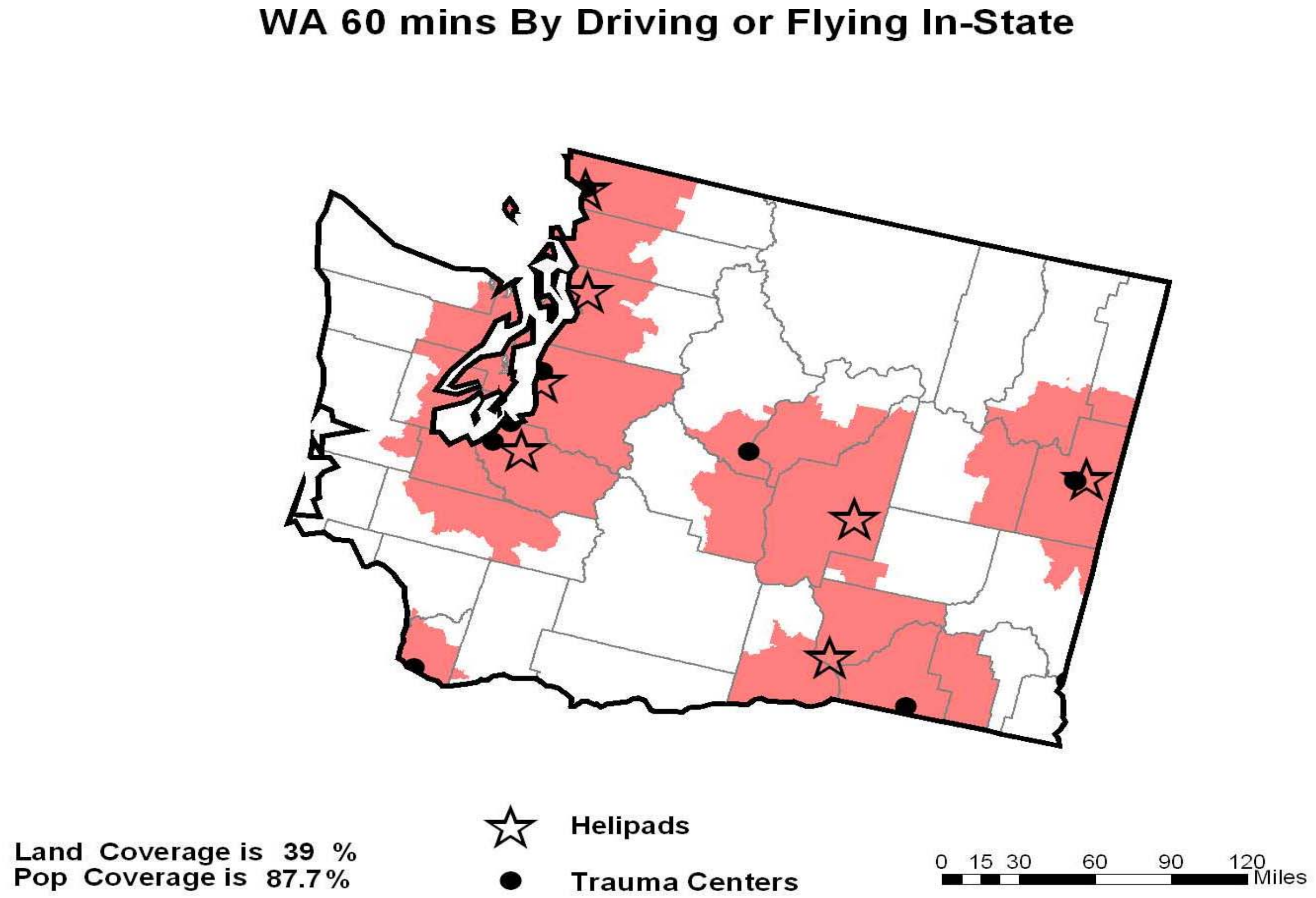


WA state trauma system



WASHINGTON STATE

- 88% OF THE POPULATION COVERED BUT ONLY 39% OF THE LAND MASS



Research on Rural crashes

Sampalis JS Denis R Fréchette P Brown R Fleiszer D Mulder D **Direct transport to tertiary trauma centers versus transfer from lower level facilities: impact on mortality and morbidity among patients with major trauma.**

– Transportation of severely injured patients from the scene directly to Level I trauma centers is associated with a reduction in mortality and morbidity.

J Trauma. 1997 Aug;43(2):288-95; discussion 295-6.

Research on Rural crashes

- **The Effect of Organized Systems of Trauma Care on Motor Vehicle Crash Mortality**

  Avery B. Nathens, MD, PhD; Gregory J. Jurkovich, MD; Peter Cummings, MD, MPH; Frederick P. Rivara, MD, MPH; Ronald V. Maier, MD *JAMA.* 2000;283(15):1990-1994. doi:10.1001/jama.283.15.1990.

Indicated that "implementation of an organized system of trauma care reduces crash mortality…development of trauma triage protocols, interhospital transfer agreements, organization of trauma centers, and ongoing quality assurance.

"MVCs frequently occur at sites remote from definitive medical intervention and thus challenge prehospital transportation, triage, and interhospital transfer mechanisms"

Benefits of AACN -Final Summary

- CIREN review:
  - Several case examples of long delays to crash notification
  - Thoracic trauma and TBI were primary cause of death
- FARS review
  - Single vehicle fatalities had a median time of 19 minutes for notification.
  - Almost half of US fatalities occurred in rural regions (benefit: GPS, need for extrication)
  - Rural crashes markedly longer times in all intervals
- NASS review
  - Increased total prehospital time associated with mortality
  - Greatest impact from reducing scene time (extrication)
  - Notification times > 30 min associated with increased odds of mortality
  - Delays in Air notification associated with prolonged times
  - A 5 minute delay in crash notification time beyond 30 min associated with 88% increased odds of mortality

Thank you