

EMS Response to Multiple Casualty Incidents

A DESCRIPTION OF THE EMS RESPONSES TO MULTIPLE CASUALTY INCIDENTS IN MINNESOTA, 2014 - 2016

EMS Response to Multiple Casualty Incidents

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Introduction

This report attempts to characterize and count the frequency of multiple casualty incidents (MCIs) in Minnesota from 2014 – 2016 as reported by emergency medical services (EMS) personnel to the Minnesota State Ambulance Reporting System (MNSTAR). This is the first report of its kind to be prepared using the MNSTAR data exclusively. The data may be used to inform planning activities around EMS resources.

There were 2,440 patients involved in 674 unique MCIs. This represents an incident rate of 14.8 persons per 100,000 population that were involved in an MCI each year in Minnesota. Most, 61%, occurred in an urbanized setting and 80% occurred on a street or highway.

The prehospital personnel's primary impression of patients most frequently reported was traumatic injury, 72%; and at least one critically injured patient was encountered in 12.5% of MCI events.

Case Inclusion

EMS transports reported to MNSTAR in this report met all of the following criteria to be considered an MCI:

- The EMS response was to a scene in Minnesota;
- Three or more patients required transport to a hospital destination by EMS;
- Two or more ambulances transported patients;
- Each MCI had a unique scene location and incident date and time; and
- The incident date was from January 1, 2014 to December 31, 2016.

This report did not use the EMS-reported variable for response to a mass casualty event because it was a poorly populated data element in the data set and because of variability among EMS personnel as to when an incident satisfied MNSTAR's definition of an MCI.¹ Instead, the more specific and objective definition was adopted for this analysis.

¹ MNSTAR definition of MCI: An event that overwhelms existing EMS resources

MCI Characteristics

Table 1. MCI Characteristics

Characteristic	Number of Patients
Incidents	674
Patients	2,440
EMS Agencies Responding	137
Hospital Destinations	103

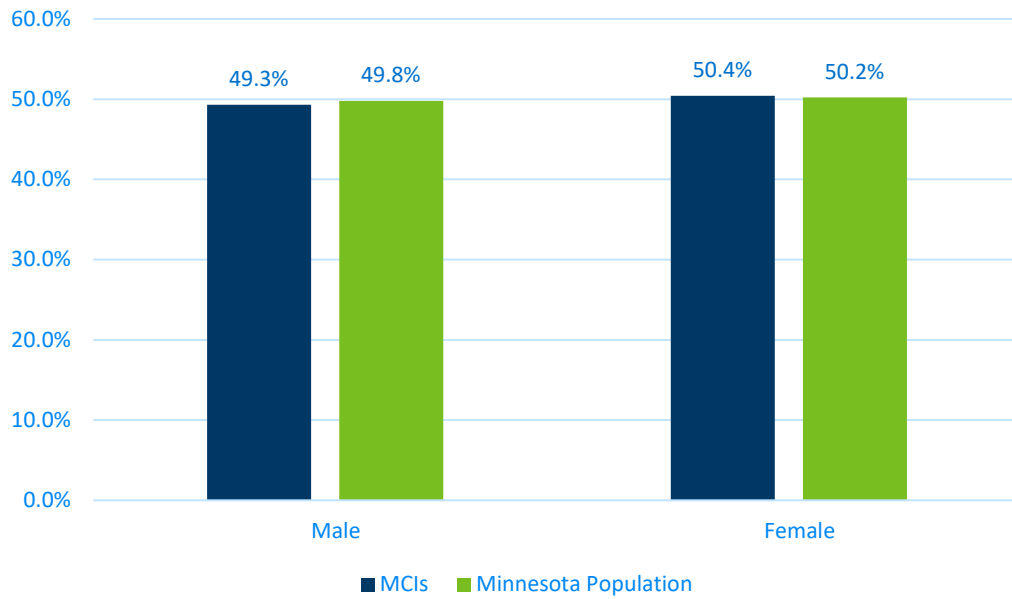
Many of the state's ambulance services (137 out of 256) transported patients associated with an MCI. A large number of hospitals received patients from those incidents.

Table 2. MCI Incident Characteristics

Characteristic	Mean	Range
Patients per incidents	3.6	3 – 13
EMS agencies per incident	1.1	1 – 3
Hospitals per incident	1.3	1 – 3
Trips per ambulance	1.0	1 – 2
Ambulances per incident	2.3	2 – 7

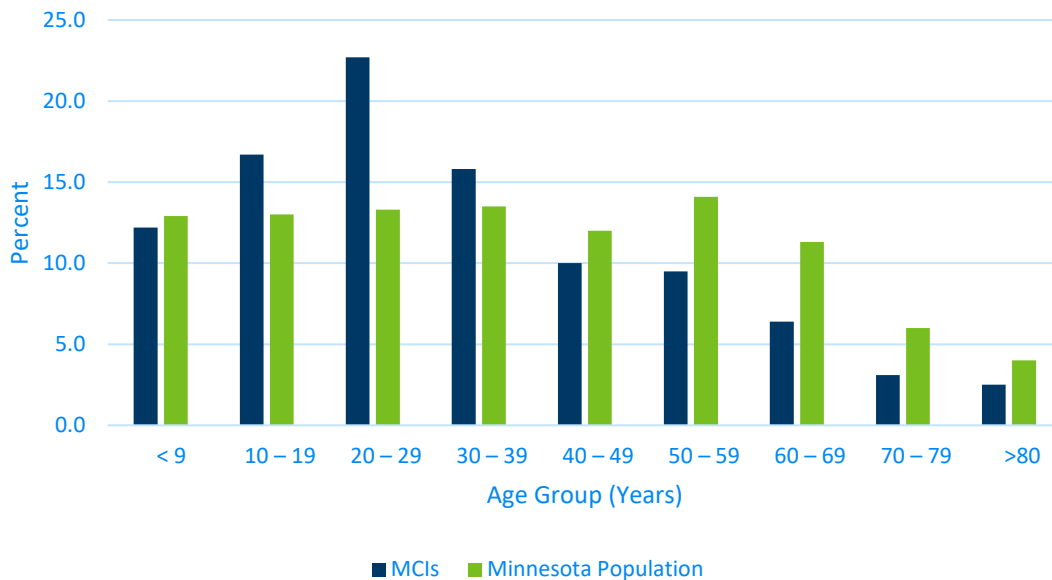
- Some ambulances made multiple trips to the hospital destination for the same MCI, possibly indicating a stressed EMS system.
- Multiple hospital destinations may suggest an MCI with injuries requiring different levels of care or stress on hospital resources.
- Most MCIs required multiple ambulances.
- Often, multiple EMS agencies responded to the same MCI.
- Some ambulances transported multiple patients at the same time.

Gender



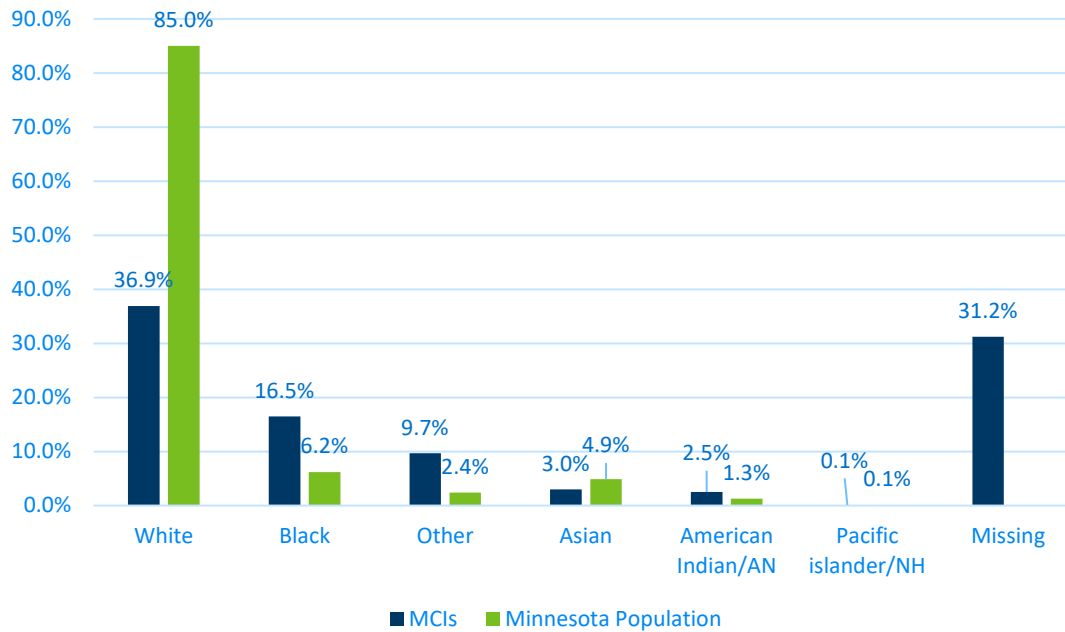
No significant gender variation was observed when compared to the general population. However, a variation was expected. Since most MCIs involved a traumatic injury and males tend to be over-represented in injury data, males were also expected to be over-represented in this data; but they were not.

Age



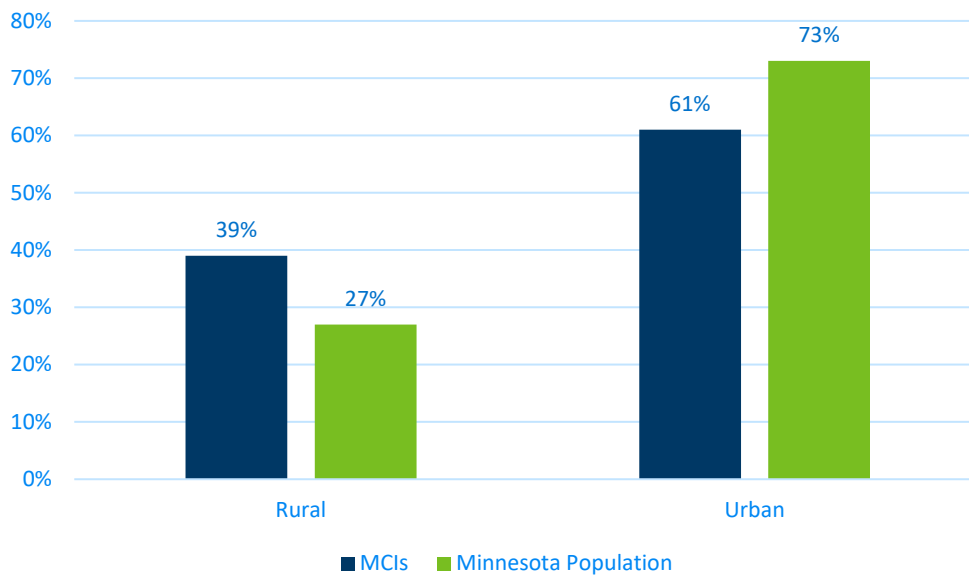
The younger age groups—10 – 19 years, 20 – 29 years and 30 – 39 years were over-represented in MCIs compared to the Minnesota population while ages over 40 years were under-represented.

Race



- The Black and American Indian/Alaska Native race groups were over-represented in MCIs compared to the Minnesota population while the White population was under-represented.
- Over 30% of EMS agencies did not report the patient’s race.

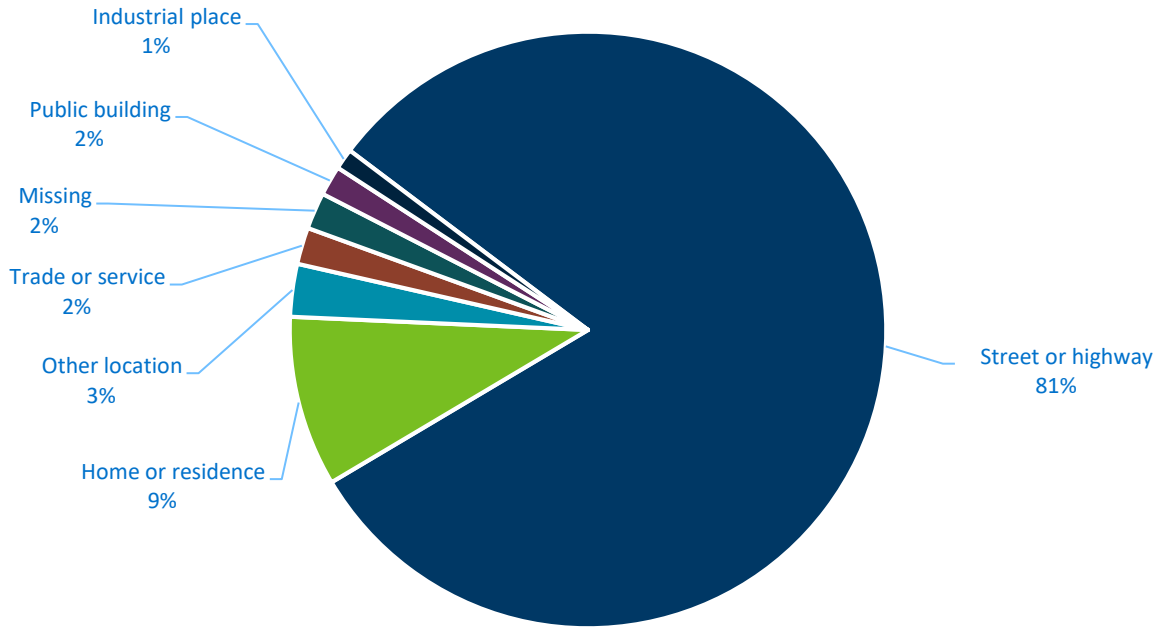
Urbanicity



United States Census Bureau definition of urbanized area

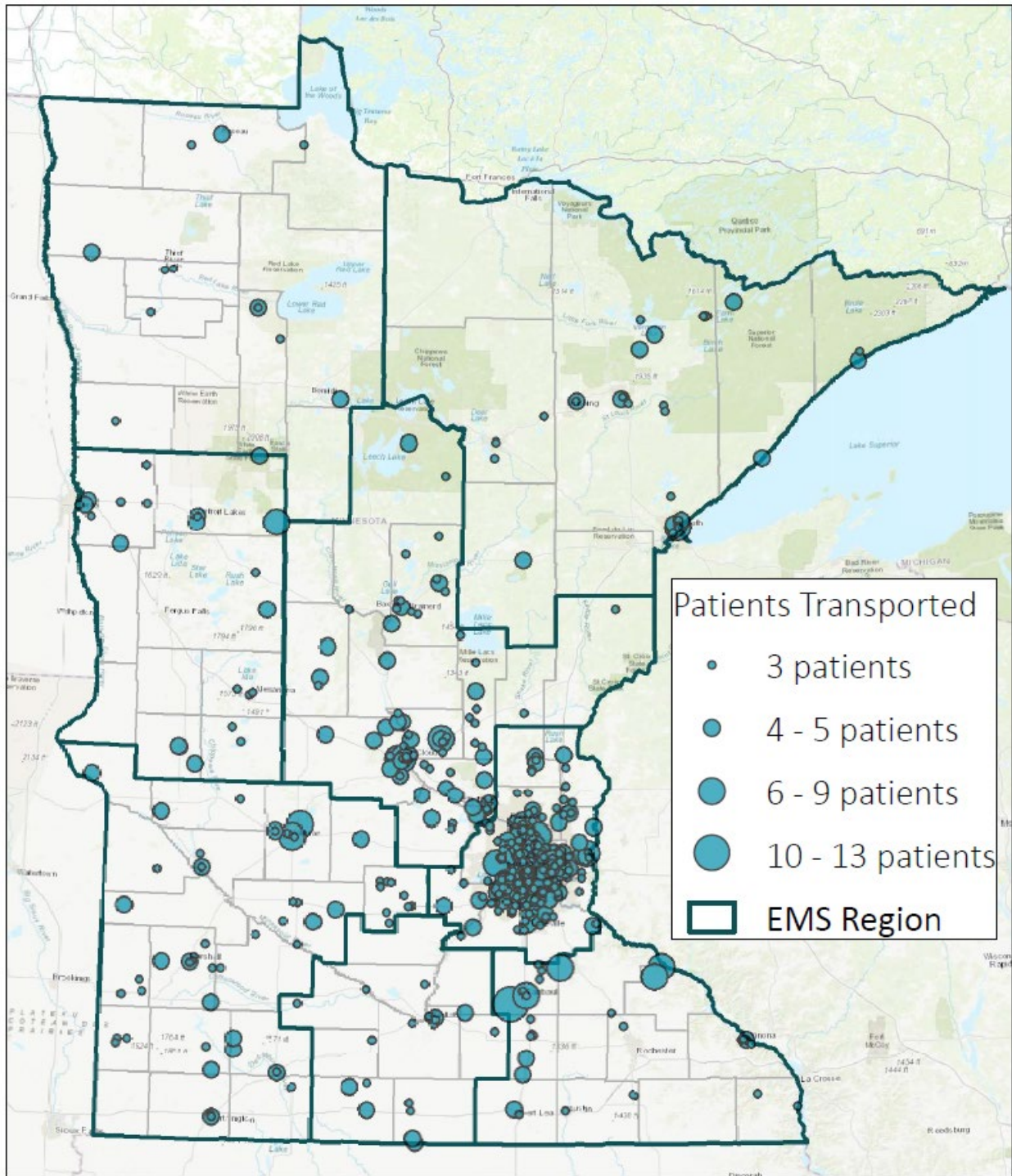
While most MCIs occur in the urban areas, MCIs are over-represented in the rural areas when compared with the population in those areas.

Location (Top Seven)



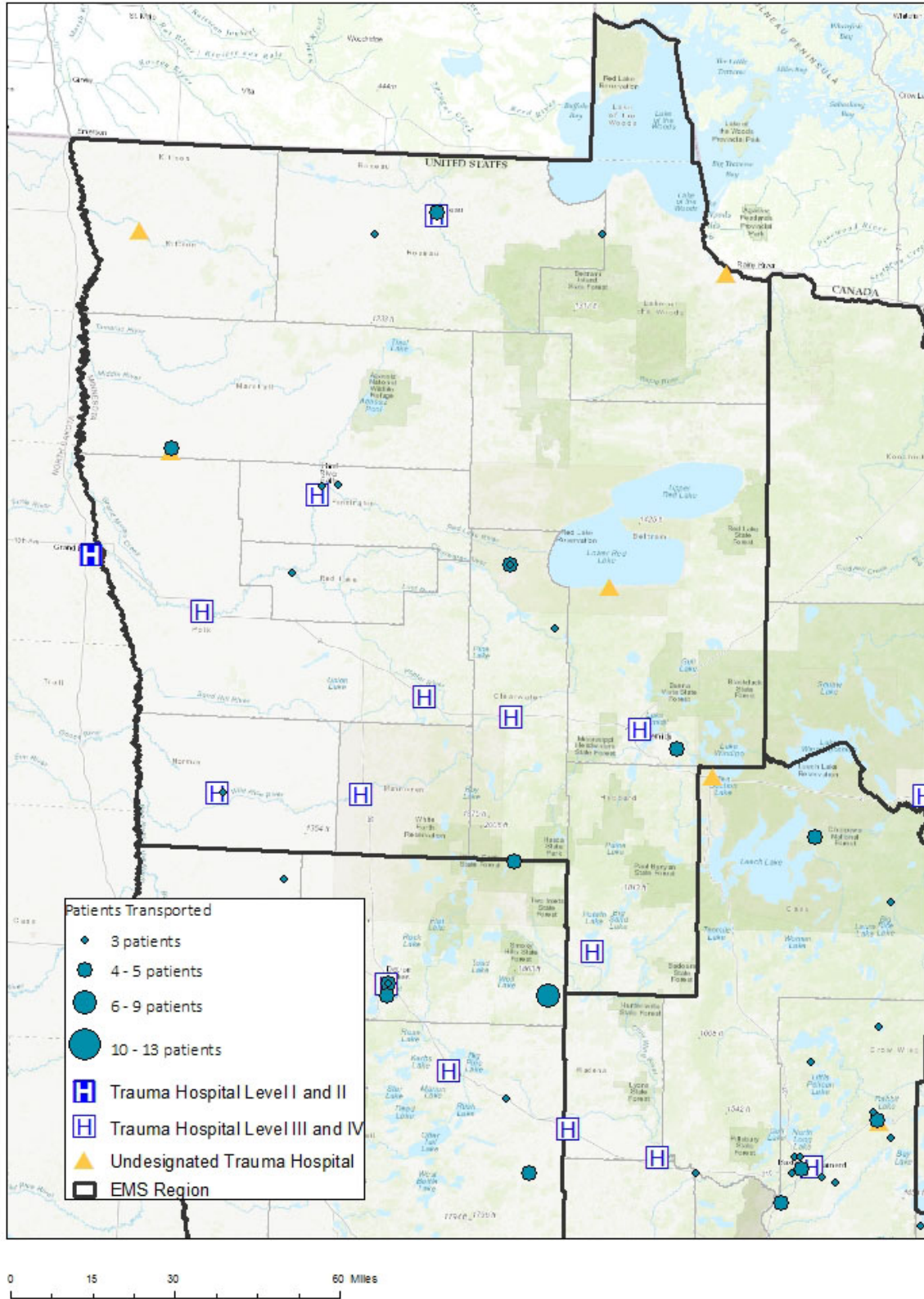
A street or highway was the most frequently reported incident location.

Maps of MCI Locations and Numbers of Patients Transported



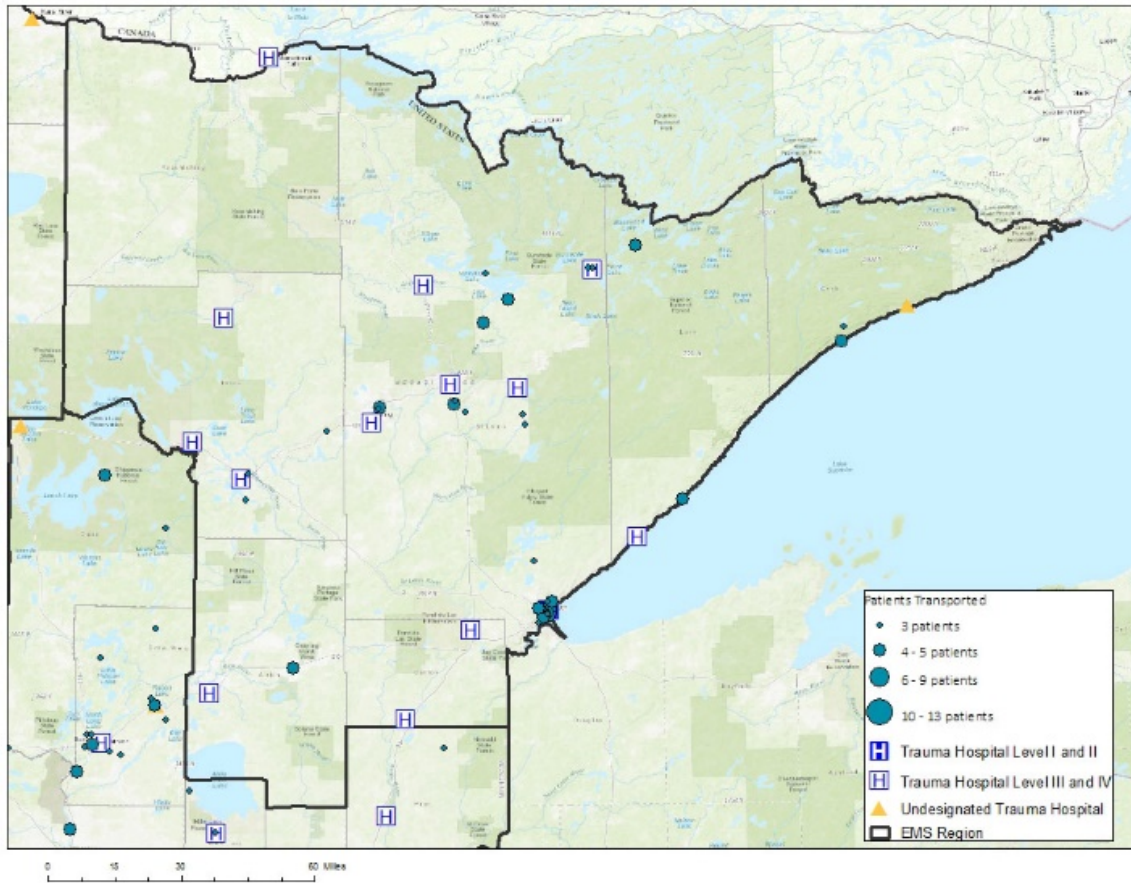
Regional Maps

NORTHWEST



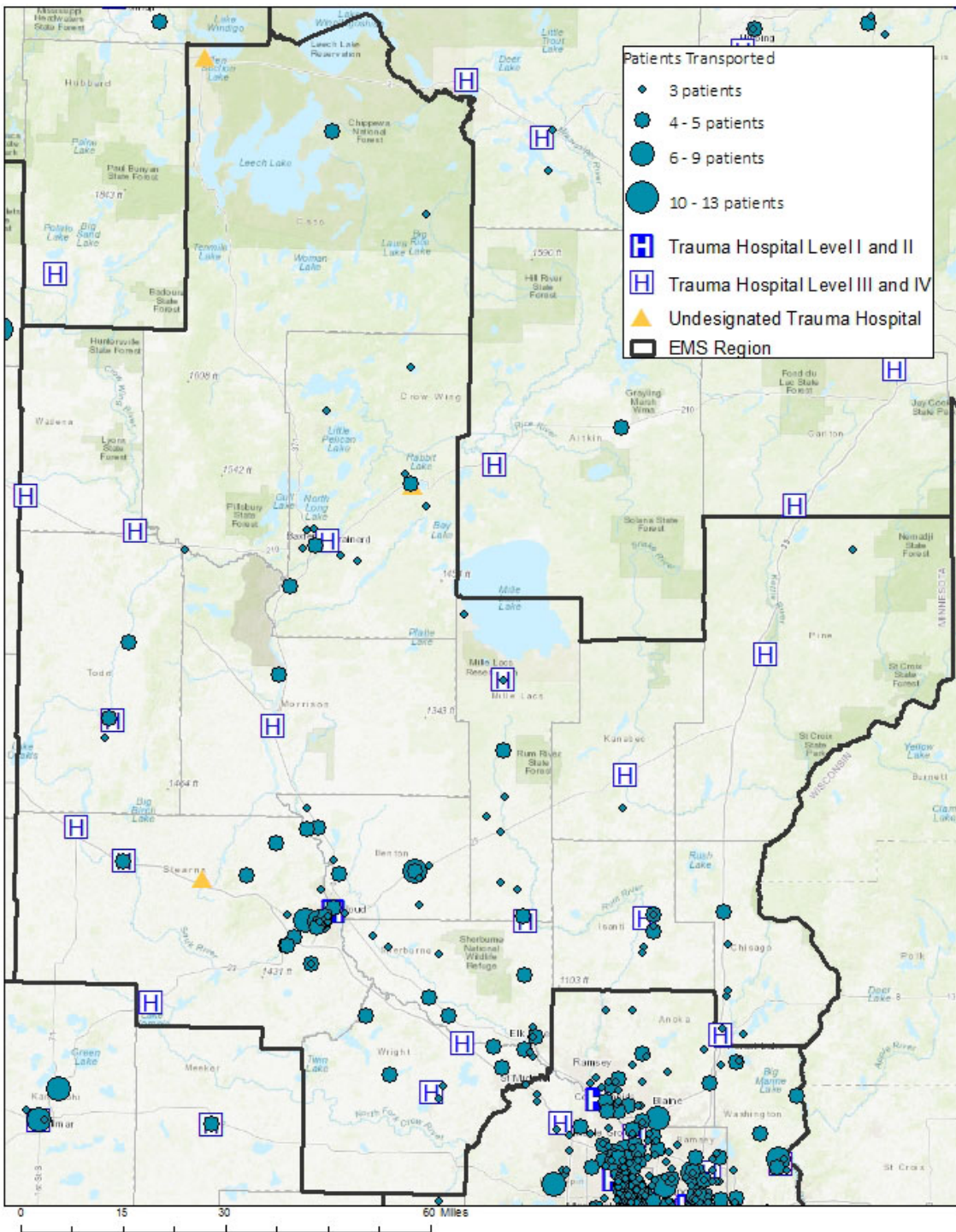
EMS RESPONSE TO MULTIPLE CASUALTY INCIDENTS

NORTHEAST



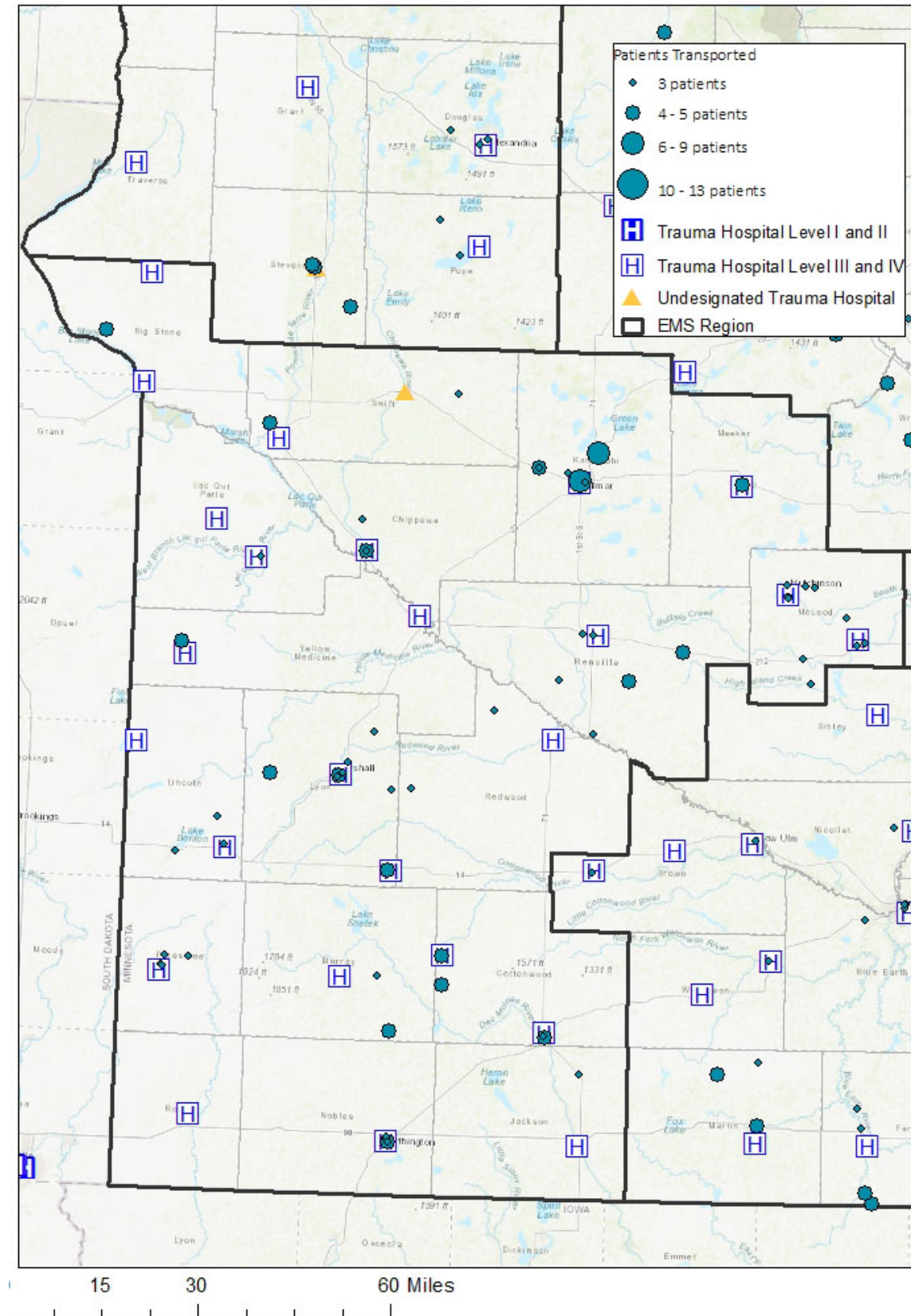
EMS RESPONSE TO MULTIPLE CASUALTY INCIDENTS

CENTRAL



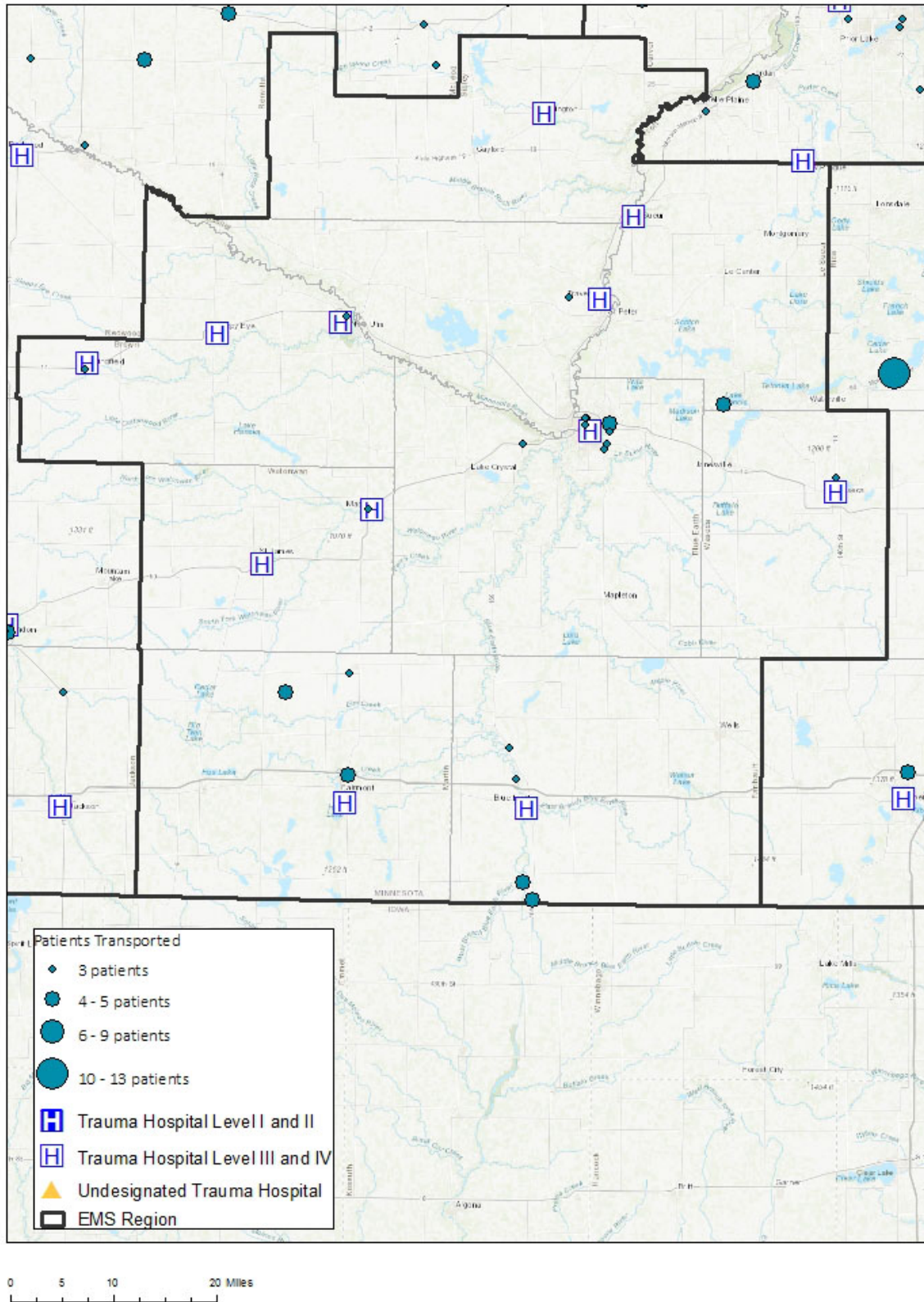
EMS RESPONSE TO MULTIPLE CASUALTY INCIDENTS

SOUTHWEST



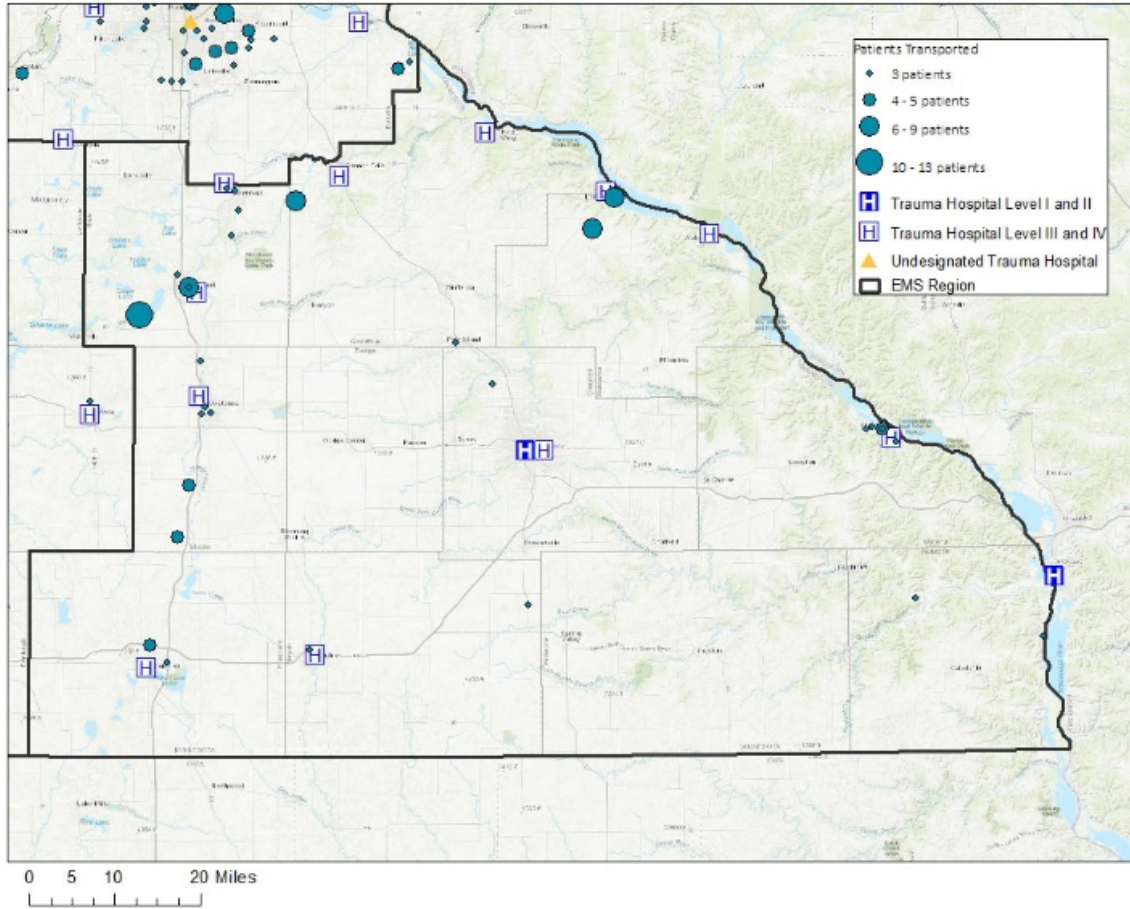
EMS RESPONSE TO MULTIPLE CASUALTY INCIDENTS

SOUTH CENTRAL

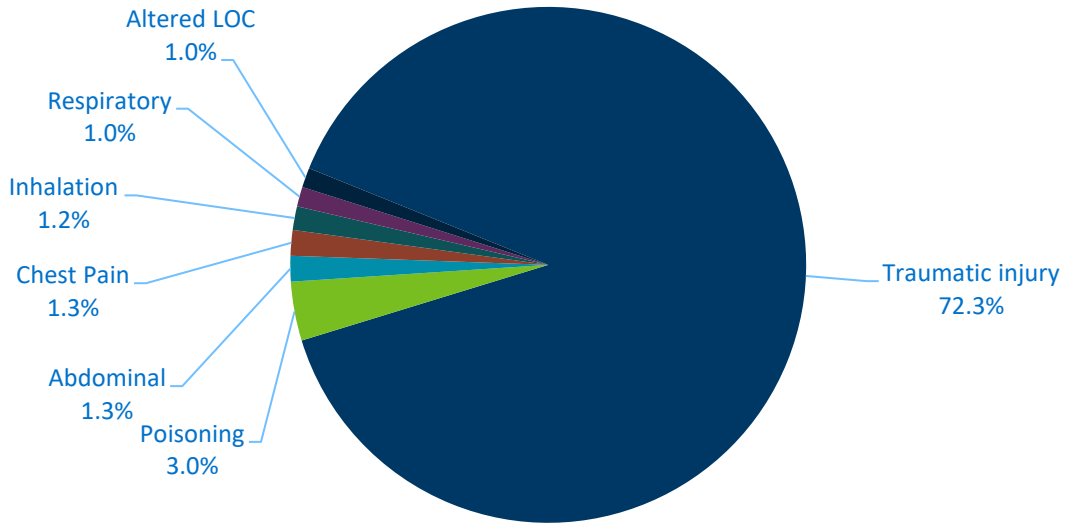


EMS RESPONSE TO MULTIPLE CASUALTY INCIDENTS

SOUTHEAST



Providers' Primary Impression (Top Seven)

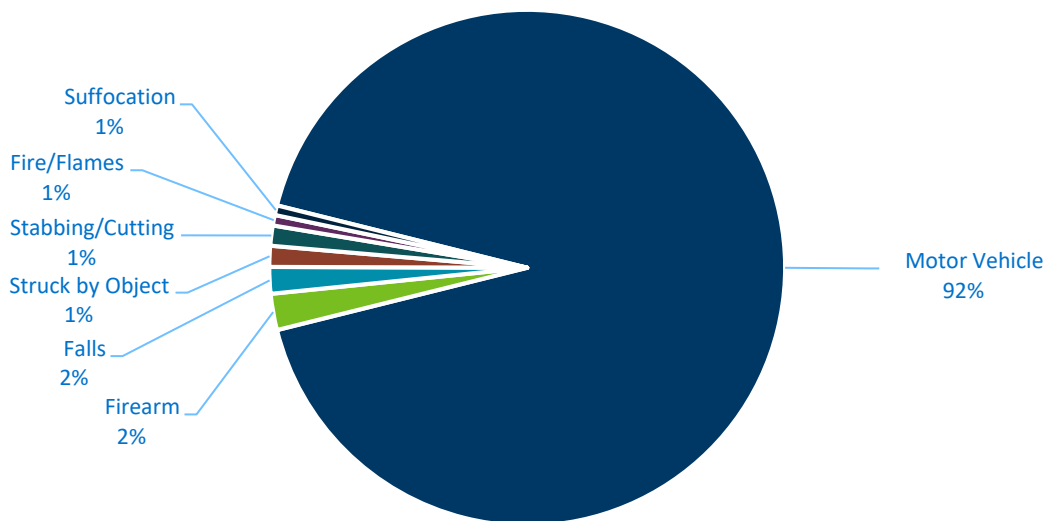


Traumatic injury was by far the predominant Primary Impression indicated by EMS personnel.

Note: One large urban EMS agency did not document any provider impressions in their data, leading to a large number of missing records for this variable.

Altered LOC = Altered level of consciousness

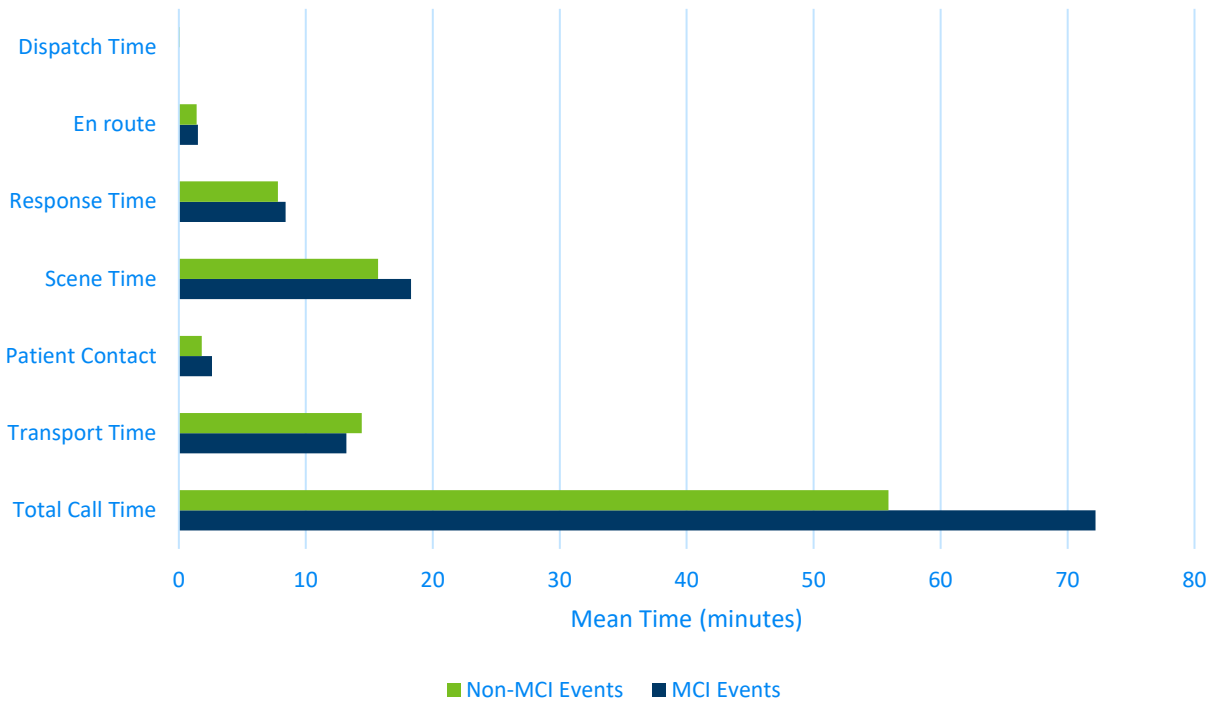
Mechanism of Injury (Top Seven)



Motor vehicle causes accounted for the vast majority of all mechanisms of injury.

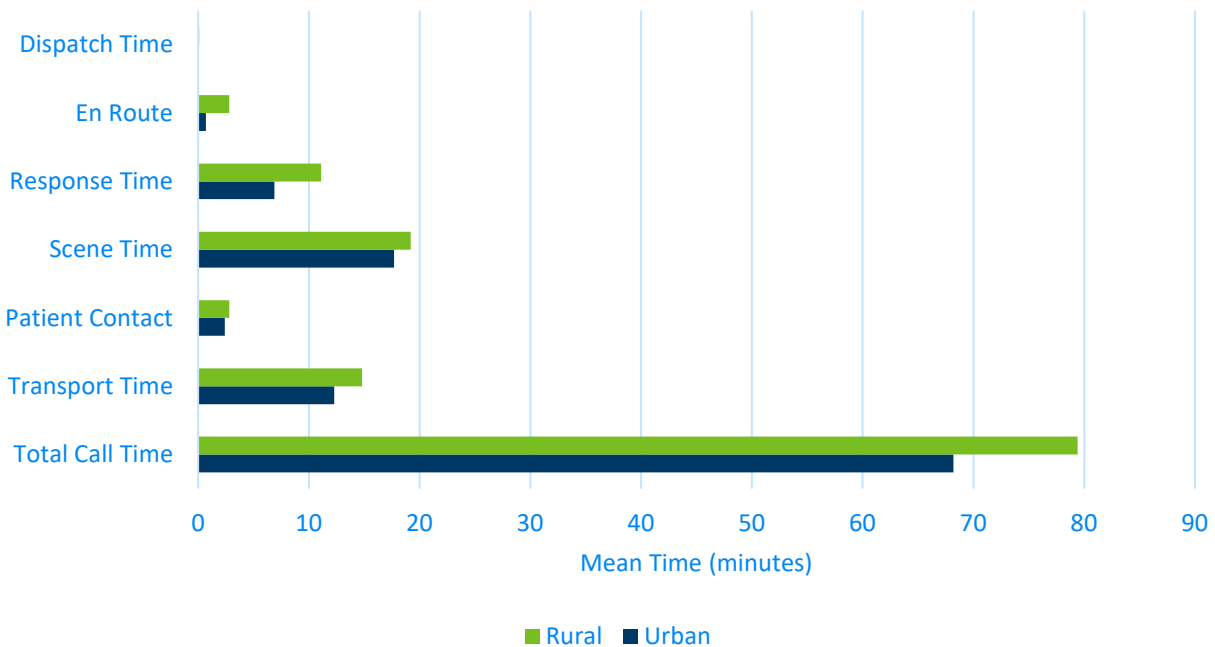
Time Performance

MCI Incidents vs. Non-MCI Incidents



Slower time performance was reported for MCIs compared to non-MCIs in all time intervals except transport time.

Urban vs. Rural MCI Incidents



- When comparing time performance for MCI events, all times were longer for rural EMS agencies than urban agencies.
- Generally, urban EMS agencies reported similar time performance for both MCI and non-MCI incidents, but rural agencies reported more disparity in time performance between MCI and non-MCI incidents.

Note: Time intervals that were negative or exceeded three hours were excluded from this analysis, except that the Total Call Time could exceed three hours.

Definitions:

Dispatch time = unit notified by dispatch date/time – Public Safety Answering Point (PSAP) call date/time

En route time = unit notified by dispatch date/time – unit en route date/time

Response time = unit notified by dispatch date/time – unit arrived on scene date/time

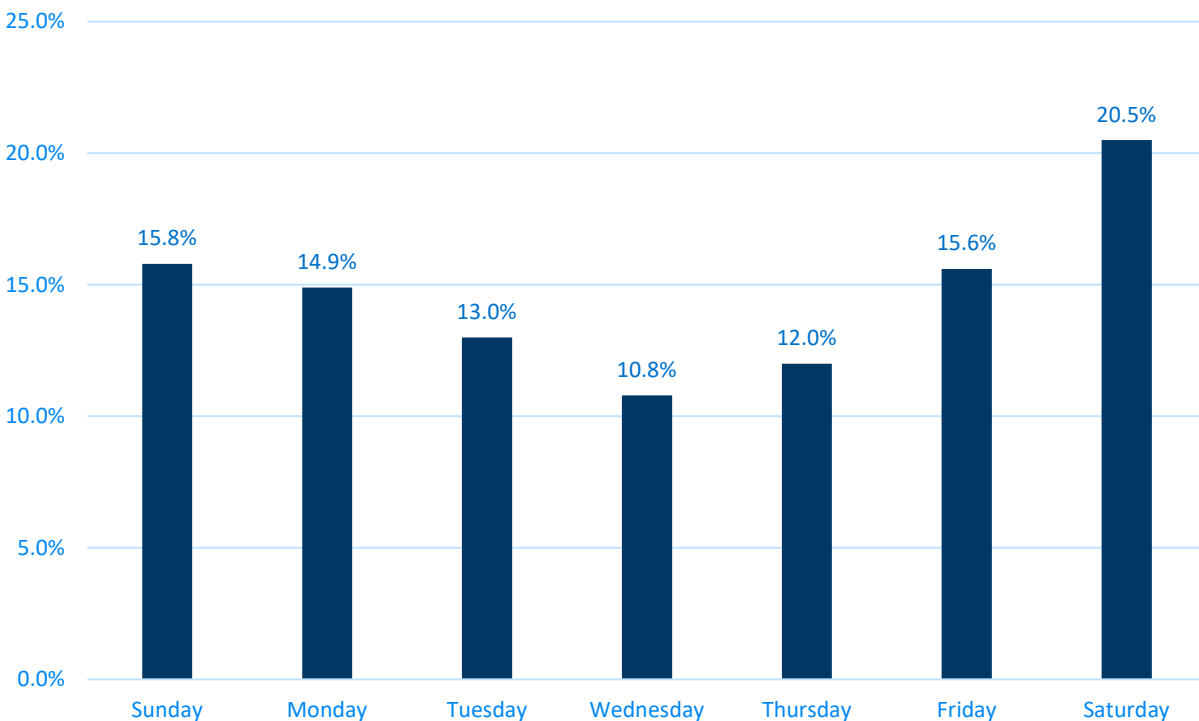
Patient contact = unit arrived on scene date/time – arrived at patient date/time

Scene time = unit arrived on scene date/time – unit left scene date/time

Transport time = unit left scene date/time – patient arrived at destination date/time

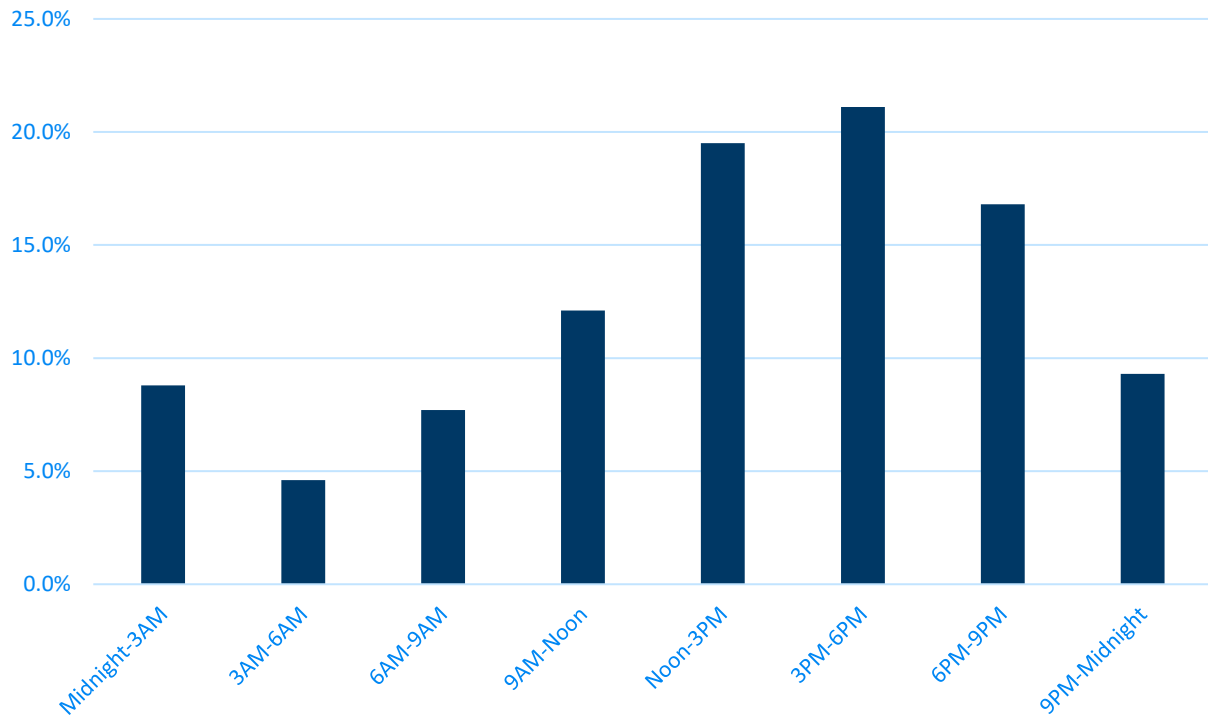
Total call time = unit back in service date/time – unit notified by dispatch date/time

Day of Week



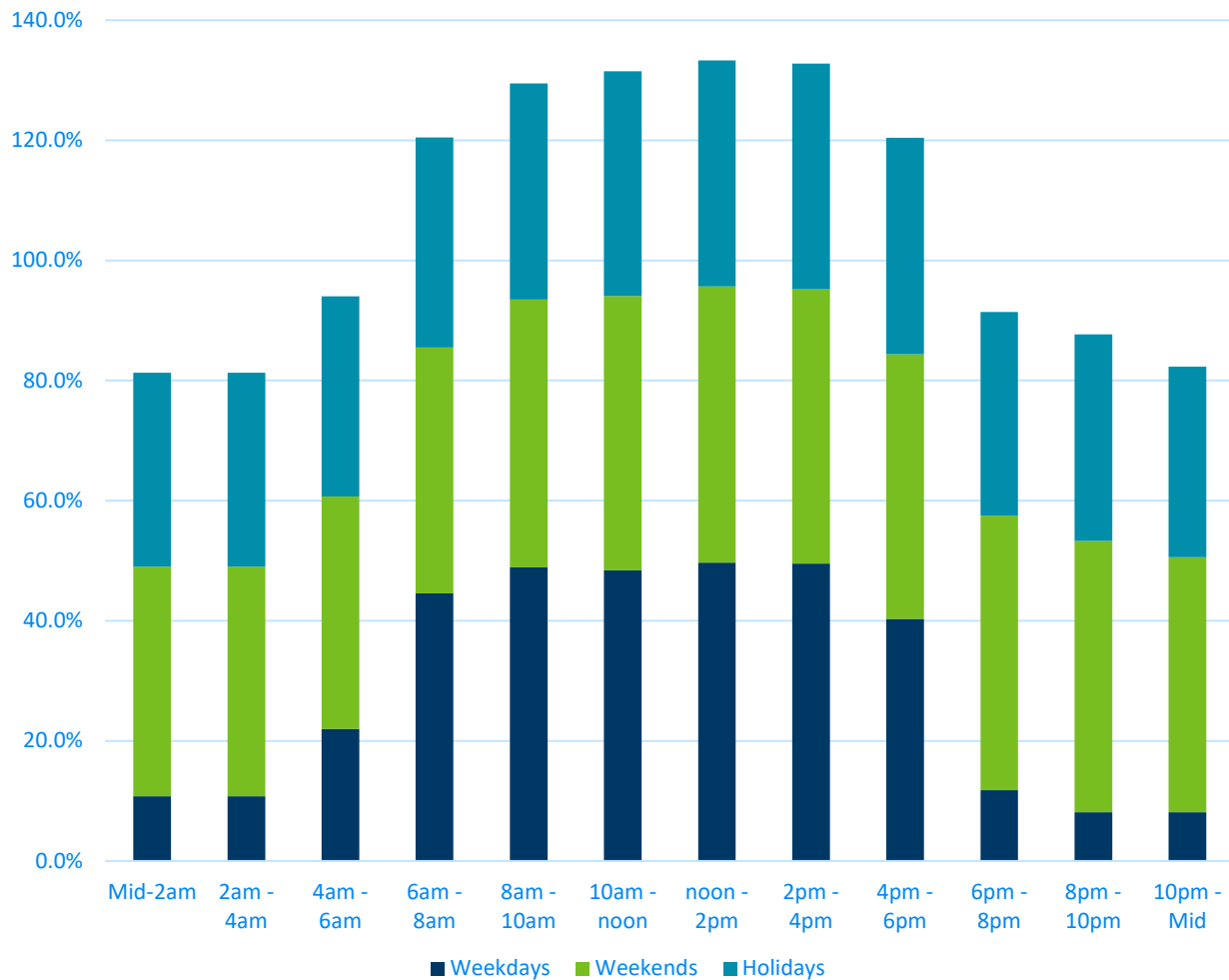
Friday through Sunday represented the days of the week when more patients were involved in an MCI.

Time of Day



Mid-afternoon through evening represented the time intervals most frequently associated with MCIs.

Rural EMS Staffing Difficulty



2016 Rural EMS Sustainability Survey

According to the 2016 Rural EMS Sustainability Survey, rural EMS agencies reported difficulty staffing their crews between 6:00 a.m. and 6:00 p.m., many hours of which overlap with the time intervals associated with the highest numbers of MCIs.

Conclusions

- Most EMS agencies were involved with an MCI (54%)
- Most Minnesota hospitals were involved with an MCI (~75%)
- 95% of the incidents involved three or fewer ambulances
- Ages 10 – 39 were over-represented in MCIs
- Black and American Indian/Alaskan Native races were over-represented in MCIs
- The vast majority of MCIs involved traumatic injuries
- EMS time performance was generally longer in MCIs
- EMS time performance was longer in rural areas
- Occurrence times of MCIs overlap with times of day associated with staffing difficulties

Appendix A: Tables

Table 3: Number of Ambulances

Ambulances Transporting	Number of Patients	Percent
Two Ambulances	1801	73.8
Three Ambulances	522	21.4
Four Ambulances	64	2.6
Five Ambulances	32	1.3
Seven Ambulances	21	0.9

Table 4: Urbanicity

Urbanicity	Number of Patients	Percent
Rural	923	38.7
Urban	1,517	61.3

Table 5: Incident Location

Location	Number of Patients	Percent
Street or highway	1,960	80.3
Home or residence	223	9.1
Other location	69	2.5
Trade or service	48	2.0
Missing	48	2.0
Public building	39	1.6
Industrial place	27	1.1
Place of recreation or sport	14	0.6
Lake, river, ocean	13	0.5
Residential institution	4	0.2
Farm	3	0.1
Mine or quarry	1	0.0

Table 6: Gender

Gender	MCIs		Minnesota Population	
	Number of Patients	Percent	Number	Percent
Male	1,203	49.3	2,747,630	49.8
Female	1,229	50.4	2,772,322	50.2
Missing	8	0.3		

Table 7: Age

Age Range	MCIs		Minnesota Population	
	Number of Patients	Percent	Number	Percent
≤ 9 years	295	12.1	711,963	12.9
10 – 19 years	453	18.6	716,938	13.0
20 – 29 years	550	22.5	732,327	13.3
30 – 39 years	359	14.7	742,952	13.5
40 – 49 years	244	10.0	663,636	12.0
50 – 59 years	231	9.5	776,873	14.1
60 – 69 years	156	6.4	624,159	11.3
70 – 79 years	75	3.1	330,643	6.0
>80 years	60	2.5	220,461	4.0
Missing	17	0.7		

Table 8: Race

Race	MCIs		Minnesota Population	
	Number of Patients	Percent	Number	Percent
American Indian/AN	60	2.5	73,970	1.3
Asian	73	3.0	272,180	4.9
Black	403	16.5	344,322	6.2
Pacific islander/NH	4	0.1	3,761	0.1
White	901	36.9	4,691,265	85.0
Other	237	9.7	134,464	2.4
Missing	762	31.2		

Table 9: Providers' Primary Impression

EMS Personnel's Primary Impression	Number of Patients	Percent
Traumatic Injury	1,765	72.3
Poisoning/drug ingestion	74	3.0
Abdominal pain/problems	32	1.3
Chest pain/discomfort	31	1.3
Respiratory distress	25	1.0
Inhalation injury (toxic gas)	29	1.2
Altered level of consciousness	24	1.0
Behavioral psychiatric disorder	16	0.7
Syncope or fainting	14	0.6
Hyperthermia	7	0.3
Cardiac arrest	7	0.3
Hypothermia	6	0.2
Shock	6	0.2
Smoke inhalation	7	0.3
Seizure	2	0.1
Allergic reaction	3	0.1
Diabetic hypoglycemia	2	0.1
Obvious death	1	0.0
Missing	389	15.9

Table 10. Mechanism of Injury

Mechanism of Injury	Number of Patients	Percent
Motor vehicle traffic crash	1,260	51.6
Motorcycle	414	17.0
Motor vehicle non-traffic crash	153	6.3
Firearm assault	45	1.8
Falls	33	1.4
Struck by object	26	1.1
Stabbing or cutting accident	14	0.6
Fire and flames	13	0.5
Mechanical suffocation	12	0.5
Stabbing or cutting assault	11	0.5
Chemical poisoning	9	0.4
Pedestrian traffic crash	9	0.4
Water transport crash	6	0.2
Electrocution (non-lightening)	6	0.2
Aircraft related crash	5	0.2
Drug poisoning	5	0.2
Machinery accidents	5	0.2
Smoke inhalation	5	0.2
Other	10	0.4
Missing	399	16.4

Table 11: Time Performance

Table 11a: MCI vs. Non-MCI

Time Intervals	MCI Events (n=1,491)	Non-MCI Events (n=466,657)	Comparison	
	Time in Minutes Mean (range)	Time in Minutes Mean (range)	Statistically Significant	Description
Dispatch time	0.0 (0.0 – 7.4)	0.1 (0.0 – 227.3)	Yes	MCI shorter
En route time	1.5 (0.0 – 178.0)	1.4 (0.0 – 215.0)	Yes	MCI longer
Response time	8.4 (0.0 – 184.0)	7.8 (0.0 – 230.0)	Yes	MCI longer
Patient contact	2.6 (0.0 – 137.0)	1.8 (0.0 – 240.0)	Yes	MCI longer
Scene time	18.3 (0.0 – 174.0)	15.7 (0.0 – 240.0)	Yes	MCI longer
Transport time	13.2 (0.0 – 126.0)	14.4 (0.0 – 240.0)	Yes	MCI shorter
Total call time	72.2 (7.0 – 216.0)	55.9 (0.0 – 240.0)	Yes	MCI longer

Table 11b: Urban vs. Rural MCIs

Time Intervals	Urban (n=1,517)	Rural (n=923)	Comparison	
	Time in Minutes Mean (range)	Time in Minutes Mean (range)	Statistically Significant	Description
Dispatch time	0.0 (0.0 – 7.4)	0.1 (0.0 – 7.0)	Yes	Rural longer
En route time	0.7 (0.0 – 28.8)	2.8 (0.0 – 178.0)	Yes	Rural longer
Response time	6.9 (0.0 – 78.0)	11.1 (0.0 – 184.0)	Yes	Rural longer
Patient contact	2.4 (0.0 – 61.3)	2.8 (0.0 – 137.0)	Yes	Rural longer
Scene time	17.7 (0.0 – 86.4)	19.2 (0.0 – 174.0)	No	Rural longer
Transport time	12.3 (0.0 – 78.3)	14.8 (0.0 – 126.0)	Yes	Rural longer
Total call time	68.2 (7.0 – 157.3)	79.4 (11.0 – 216.0)	Yes	Rural longer

Definitions:

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En route time = unit notified by dispatch date/time – unit en route date/time

Response time = unit notified by dispatch date/time – unit arrived on scene date/time

Patient contact = unit arrived on scene date/time – arrived at patient date/time

Scene time = unit arrived on scene date/time – unit left scene date/time

Transport time = unit left scene date/time – patient arrived at destination date/time

Total call time = unit back in service date/time – unit notified by dispatch date/time

Table 12: Day of Week

Day of the Week	Number of Patients
Sunday	398
Monday	311
Tuesday	328
Wednesday	272
Thursday	302
Friday	395
Saturday	518

Table 13: Time of Day

Time of Day	Number
0000 - 0300	222
0300 - 0600	117
0600 - 0900	194
0900 - 1200	306
1200 - 1500	493
1500 - 1800	533
1800 - 2100	425
2100 - 0000	234