ARIZONA DEPARTMENT OF HEALTH SERVICES

BUREAU OF EMERGENCY MEDICAL SERVICES AND TRAUMA SYSTEM

STATE LEVEL TRAUMA MEASURES

UNDER/OVER TRIAGE

ARIZONA STATE TRAUMA REGISTRY 2013

HOSPITAL DISCHARGE DATABASE 2013

Prepared by:

Vatsal Chikani, MPH

Rogelio Martinez, MPH

Data and Quality Assurance Section

Report No. 14-3-L1

Purpose:

The purpose of this report is to provide Arizona's hospitals with the levels of overtriage and undertriage for trauma patients. Additionally, this report provides insight to the fundamental purpose of a trauma system; to provide the right care to the right person in the right amount of time.

Background:

Following the State Trauma Advisory Board (STAB) meeting on May 29, 2014 a workgroup was tasked with the development of defining overtriage and undertriage. Traumatic injury in Arizona has been defined by the following inclusion criteria: http://www.azdhs.gov/bems/documents/data/ASTR/astr-trauma-patient-inclusion2013.pdf

The following report describes the level of overtriage and undertriage in Arizona as defined by the workgroup.

Methods:

The Arizona State Trauma Registry 2013 (ASTR) and the Hospital Discharge Database 2013 were queried to find cases with an "Emergency Department (ED) or Hospital Arrival Date" of January 1, 2013, to December 31, 2013.

Undertriage:

Undertriage includes patients with an ISS > 15 who were not taken to a Level I or III trauma center. An important classification schema that was utilized in undertriage was the Injury Severity Score. (ISS). An ISS represents the severity injuries sustained by a patient. Injuries with an ISS < 15 are minor to moderate. An ISS is calculated through the use of the ninth revision of the International Classification of Diseases.

Overtriage:

An overtriage includes patients that presented to a Level I Trauma Center and did NOT:

- Die or become admitted to the hospital for more than 48 hours,
- Become admitted to the Intensive Care Unit (ICU), or
- Become admitted to the Operating Room (OR).

The formula for calculating overtriage was:

$$\text{Overtriage} = \frac{\text{Patients meeting the over triage definition}}{\text{Total number of patients at Level I or III trauma centers}}$$

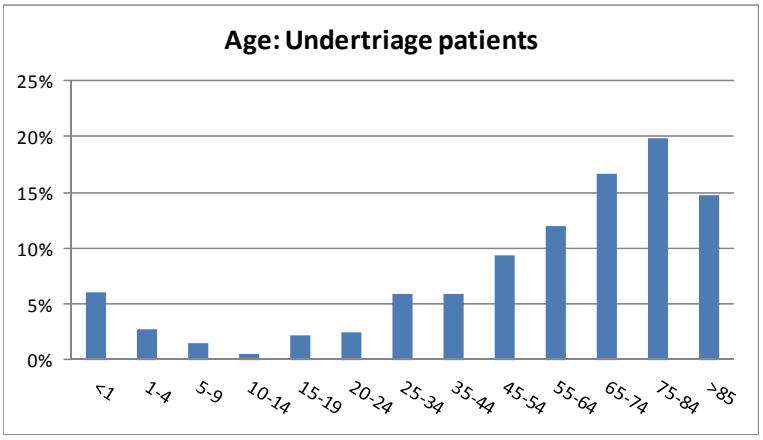
Patients who did not have a trauma team activation and met the overtriage criteria were excluded from the classification.

UNDERTRIAGE

Table 1: Demographics for patients who met the undertriage definition (n=617)

	N	%
Total patients that were undertriaged	608	100%
Age		
<1	37	6.08%
1-4	17	2.79%
5-9	9	1.48%
10-14	3	0.49%
15-19	13	2.13%
20-24	15	2.46%
25-34	36	5.92%
35-44	36	5.92%
45-54	57	9.37%
55-64	73	12.00%
65-74	101	16.61%
75-84	121	19.90%
>85	90	14.80%
Gender		
Female	243	39.96%
Male	365	60.03%
Race		
American Indian or Alaskan Native	24	3.94%
Asian, Pacific Islander	14	2.30%
Black or African American	14	2.30%
Hispanic	98	16.11%
White Non-Hispanic	453	74.50%
Native Hawaiian	1	0.16%
Refused	4	0.65%

Figure 1: Age demographics for patients who were undertriaged (n=608)



Trauma centers have dedicated staff trained to care for severely injured patients. For a functioning trauma system to occur, severely injured patients must receive treatment at designated trauma centers. In addition to providing the highest quality care for their communities, trauma centers depend on consistent volumes to refine their processes and ensure optimal outcomes.

Undertriage occurs when a severely injured patient fails to get the necessary care they require. In this retrospective analysis, a patient was undertriaged when they had an Injury Severity Score (ISS) greater than 15 and were not immediately transferred to a Level I or III trauma center.

Table 2: Triage for an ISS > 15 by trauma designation level (n=4,586)

	N	%
Total patients with ISS > 15	**4,586**	**100%**
Level I or Level III (Appropriate triage)	**3,978**	**86.74%**
Level IV (Undertriage)	**78**	**1.70%**
Non-designated (Undertriage)	**530**	**11.55%**
Total Undertriage	**608**	**13.25%**

An acceptable range of undertriage has been set by the American College of Surgeons at 1-5%. High levels of undertriage are detrimental to the survivability of patients.

Designation levels support a systemic approach to providing the appropriate level of care for trauma patients. Level IV trauma centers are typically found in rural communities and have requirements of maintaining performance improvement processes, injury prevention plans, and appropriate transfer protocols with higher level trauma centers. For further information on requirements for Level IV trauma centers please visit:

http://www.azdhs.gov/bems/documents/trauma/LevelIVTraumaCenterCriteria.pdf

Level IV trauma centers are not required to handle all the components of care for severely injured patients. The Arizona Guidelines for Field Triage of Injured Patients provides additional support for determining the appropriate level of care for patients, whether that is Level I, III, or IV. Hospitals not designated as a trauma center should continue to receive education on the importance of recognizing a patient requiring a higher level of care.

Figure 2: Triage for an ISS > 15 by trauma designation level (n=4,586)

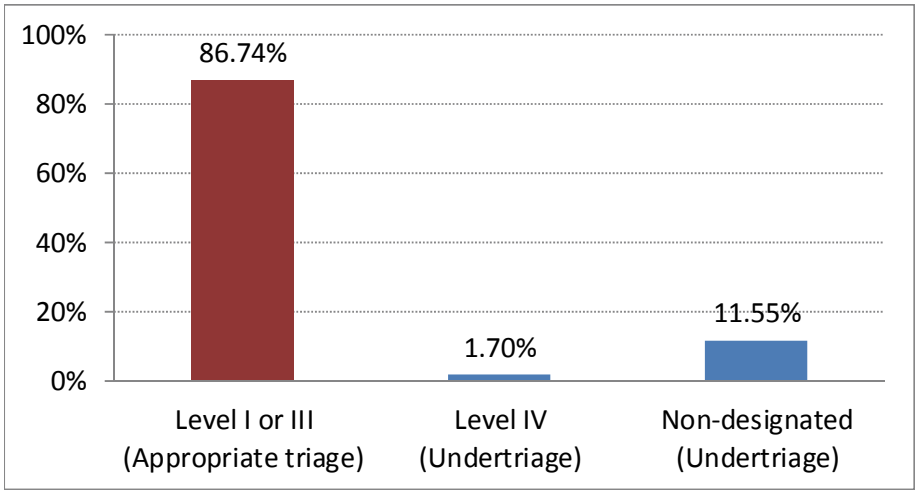
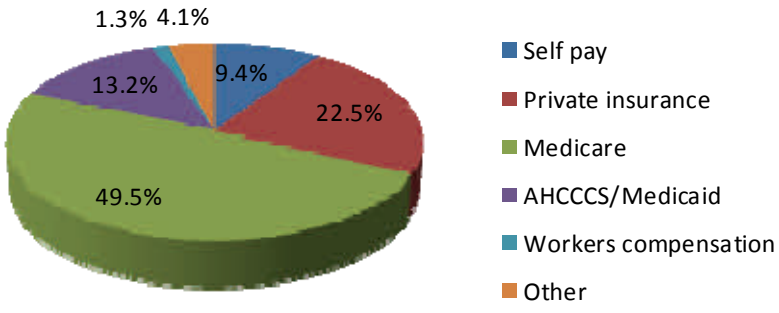


Table 3: Discharge status by trauma designation level (n=4,586)

	Level I or III (Appropriate triage)		Level IV (Undertriage)		Non-designated (Undertriage)	
	N	%	N	%	N	%
Home	2,259	56.78%	32	41.02%	244	46.03%
Transferred to acute care after admission	43	1.08%	2	2.56%	17	3.20%
Skilled nursing/Assisted living/Long Term/Rehab facility	1,157	29.08%	25	32.05%	194	36.60%
Expired	437	10.98%	16	20.51%	49	9.24%
Hospice	77	1.93%	3	3.84%	26	4.90%
Discharged with planned readmission	5	0.12%	0	0	0	0

Discharge mortality for patients at Level I or III trauma centers (10.98%), Level IV trauma centers (20.51%), and non-designated (9.24%) differ (hospice + expired). More information is necessary to determine reasons for this trend (do not resuscitate forms, missed diagnosis, dead on arrival). Rehabilitation for patients differed following treatment; Level I or III trauma centers reported 29%, Level IV reported 32%, and non designated hospitals reported 37%. Further information is needed to determine the impact of designation on difference in mortality and the need for rehabilitation.

Figure 3: Payer source for undertriaged patients (n=608)

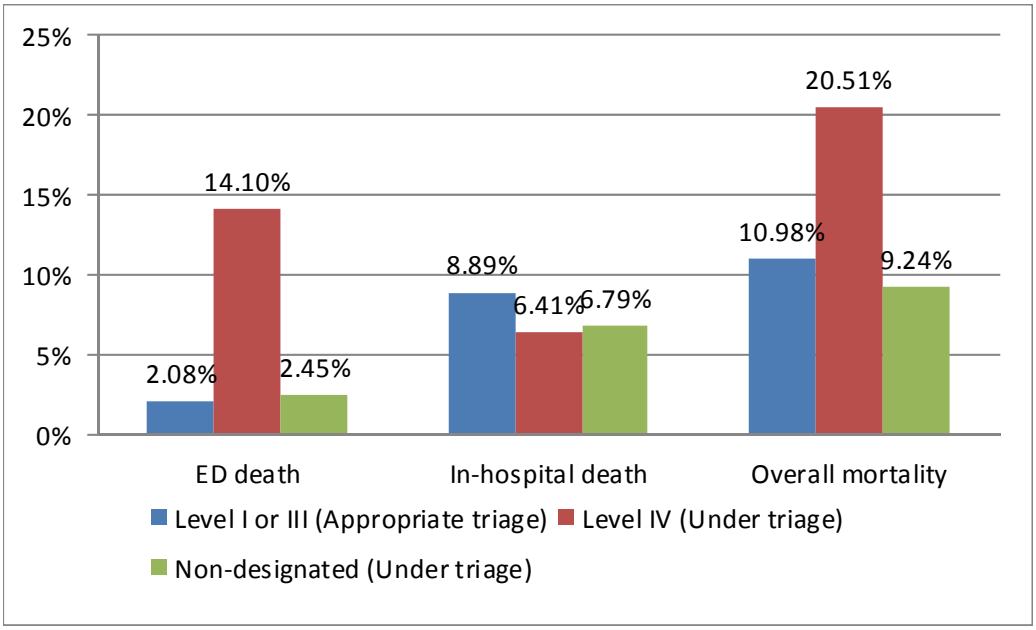


AHCCCS=Arizona Health Care Cost Containment System

Of the 608 undertriaged patients, Medicare was the primary payer in half of cases. Patients over the age of 65 made up 50% of the undertriaged population.

Private insurance was the second most charged payer (23%), followed by the Arizona Health Care Cost Containment System (AHCCCS) (13%).

Figure 4: Location of death for undertriaged patients (n=4,586)



Most deaths at Level IV trauma centers occurred in the Emergency Department (ED) (14.10%). When hospice discharges are excluded, mortality is highest in Level IV trauma centers and non-designated facilities.

Table 4: Location of death for undertriaged patients (n=4,586)

Mortality	Level I or III (Appropriate triage)		Level IV (Under triage)		Non-designated (Under triage)		Total Under-triage	
	N	%	N	%	N	%	N	%
Triaged patients	3,978		78		530		608	
ED death	83	2.08%	11	14.10%	13	2.45%	24	3.94%
In-hospital-death	354	8.89%	5	6.41%	36	6.79%	41	6.74%
Overall mortality	437	10.98%	16	20.51%	49	9.24%	65	10.69%
Survived	3,541	89.01%	62	79.48%	481	90.75%	543	89.30%

Most deaths at Level IV trauma centers occurred in the Emergency Department (ED) (12%). In-hospital deaths are highest in Level I trauma centers and non-designated facilities. This is expected as Level I trauma centers treat the most severely patients and non-designated facilities may not have the resources available and/or processes in place to deal with injury patients.

Systemic case studies should be considered for Level IV ED deaths.

Table 5: Undertriage by county of residence (n=4,586)

	Undertriaged patients	Patients with an ISS >15	Percent undertriaged
Total	608	4,586	13.26%
Unknown county	7	75	9.33%
Apache County	8	81	9.88%
Cochise County	6	78	7.69%
Coconino County	3	126	2.38%
Gila County	3	57	5.26%
Graham County	1	35	2.86%
La Paz County	1	13	7.69%
Maricopa County	288	2,462	11.70%
Mohave County	32	40	80.00%
Navajo County	14	149	9.40%
Pima County	105	648	16.20%
Pinal County	33	242	13.64%
Santa Cruz County	2	15	13.33%
Yavapai County	43	173	24.86%
Yuma County	25	106	23.58%
Out of state county	37	278	13.31%

All Arizona counties experienced higher than recommended level of undertriage except for Coconino.

The American College of Surgeons recommends a threshold of 5% for undertriage for individual facilities.

Table 6: Type of injury for undertriaged patients (n=608)

	N	%
Total	608	100.00%
Type 1 Traumatic Brain Injury (TBI)	422	69.40%
Torso	108	17.76%
Vertebral Column Injury	18	2.96%
Lower Extremity	14	2.30%
Other Head, Face, Neck	14	2.30%
Spinal Cord Injury	13	2.13%
Upper Extremity	9	1.48%
Type 2 TBI	5	0.82%
Type 3 TBI	4	0.65%
System Wide & Late Effects	1	0.16%

Over two-thirds of undertriaged patients suffered Traumatic Brain Injury (TBI). Facilities should determine the type of patients that they can treat and transfer those that will receive more appropriate care at a trauma center.

Table 7: Mechanism of injury for undertriaged patients (n=608)

	N	%
Total	608	100.00%
Falls	307	50.49%
Motor vehicle traffic	84	13.81%
Struck by/against	48	7.89%
Transport, other	43	7.07%
Unspecified	40	6.57%
Other specified	21	3.45%
Adverse effect of medicine/drugs	21	3.45%
Pedal cyclist, other	15	2.46%
Not elsewhere classifiable	13	2.13%
Firearm	8	1.31%
Natural/environmental	2	0.32%
Overexertion	2	0.32%
Cut/pierce	2	0.32%
Machinery	1	0.16%
Pedestrian, other	1	0.16%

Half of undertriaged patients were injured by falls. Additional education on falls can be found at http://www.azdhs.gov/bems/graphs/index.php?pg=infographics or by visiting Arizona Healthy Aging.

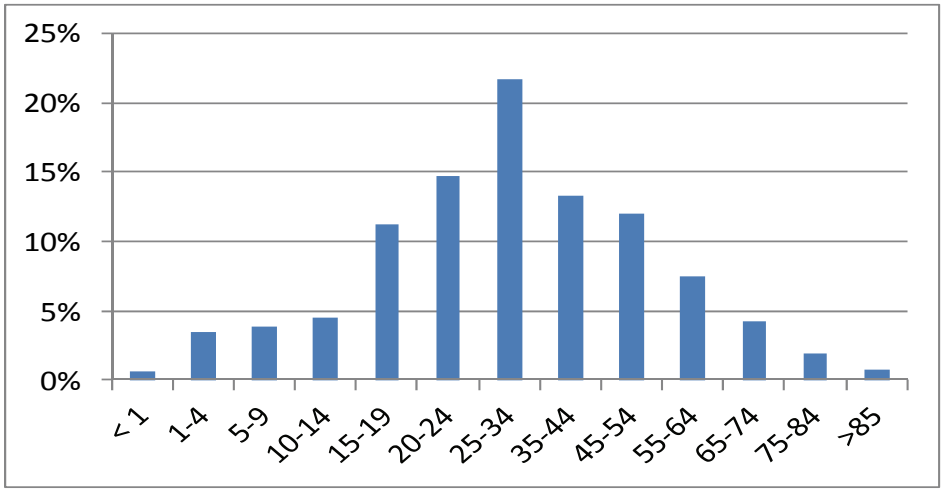
Case study examples can be further analyzed to find out why hospitals are failing to transfer fall patients to the appropriate level of care.

OVERTRIAGE

Table 8: Demographics for patients who met the definition of overtriage (n=8,598)

	N	%
Total patients that were overtriaged	8,598	100%
Age		
<1	59	0.68%
1-4	297	3.45%
5-9	334	3.88%
10-14	394	4.58%
15-19	964	11.21%
20-24	1,270	14.77%
25-34	1,864	21.67%
35-44	1,146	13.32%
45-54	1,032	12%
55-64	639	7.43%
65-74	367	4.26%
75-84	161	1.87%
>85	71	0.82%
Gender		
Female	3,195	37.15%
Male	5,403	62.84%
Race		
American Indian or Alaska Native	834	9.69%
Asian Pacific Islander	109	1.26%
Black or African American	495	5.75%
Hispanic	2,466	28.68%
White	4,461	51.88%
Other	195	2.26%
Missing or Not Documented	38	0.44%

Figure 5: Age demographics for patients who were overtriaged (n=8,598)



Arizona defines an overtriage to include patients that presented to a Level I Trauma Center and did NOT:

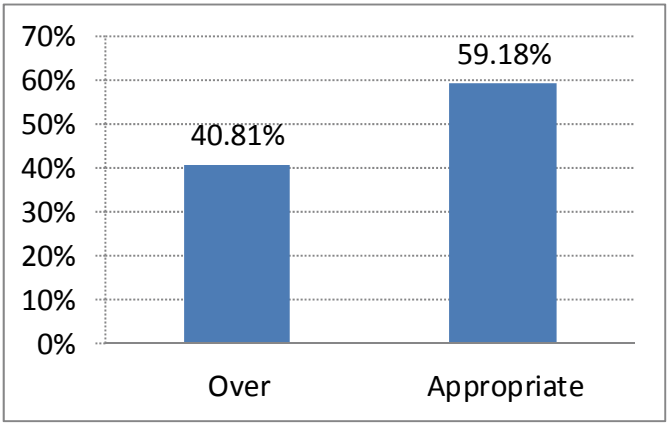
- Die or become admitted to the hospital for more than 48 hours,
- Become admitted to the Intensive Care Unit (ICU), or
- Become admitted to the Operating Room (OR).

Unnecessary overtriage may be costly to the system and contribute to resource depletion. To guard against this, many trauma centers have tiered levels of activation and actively review the amount of overtriage that occurs in their facility.

Table 9: Overtriage in Arizona (n=8,598)

Overtriage	N	%
Total patients at Level I or III trauma centers	**21,068**	**100%**
Over	**8,598**	**40.81%**
Appropriate	**12,470**	**59.18%**

Figure 6: Overtriage in Arizona (n=8,598)



Of the 21,068 patients that presented to a Level I or III trauma center, 41% were overtriaged. Further research and expertise from the trauma community is required to understand acceptable ranges for the Arizona system. An appropriate level of overtriage has been set by the American College of Surgeons at 25-50% in a facility. This threshold is much higher than the undertriage as it is less of a threat to a patient's survivability.

Figure 7: Payer source for overtriaged patients (n=8,598)

The majority of payments were charged to private insurance (32%), AHCCCS (27%), and to individuals with no insurance (23%). The total charges for over triaged patients was $189.4 million dollars for 2013. The charges to the respective payers was: Private insurance-$61 million, AHCCCS-$51 million, and Self pay-$43 million.

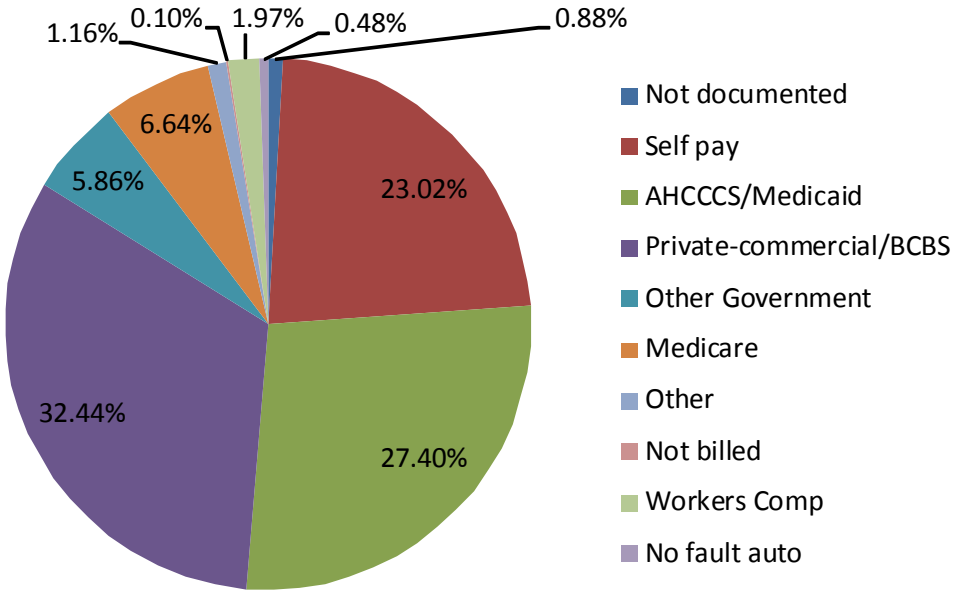


Table 10: Patient charges when overtriaged (n=8,598)

	Total charges	*25th percentile*	*Median charges*	*75th percentile*
Total charges	**$189,446,323**	**$13,727**	**$21,040**	**$28,727**

The median cost for an overtriaged patient was $21,040.

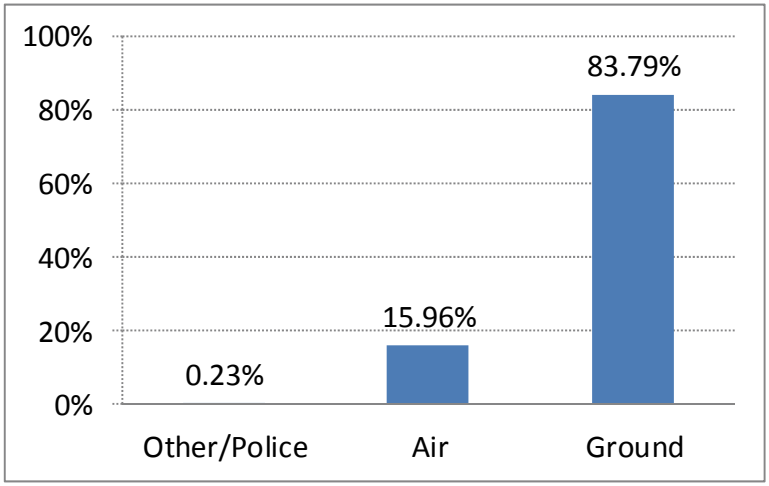
Table 11: Discharge status for overtriaged patients (n=8,598)

Discharge status	N	%
Home	8,442	98.18%
Home health	6	0.06%
Left against medical advice	81	0.94%
LTC/SNF/Other Rehab	31	0.36%
Transfer to acute care	38	0.44%

LTF=Long Term Care; SNF=Skilled Nursing Facility

Most patients were discharged home (98%). Less than 1% of patients were discharged to receive additional services such as long term care or acute care.

Figure 8: Mode of transport for overtriaged patients (n=8,598)



Of the 8,598 patients who were over triaged, the majority came by ground ambulance (84%). Only 20 patients arrived by police. Air ambulance transports should be reserved for the most severely injured patients. The occurrence of overtriaged patients being transported by air should be reduced.

Table 12: Type of injury for overtriaged patients (n=8,598)

	N	%
Total	8,598	100%
Other Head, Face, Neck	1,986	23.09%
Type 2 TBI	1,681	19.55%
Torso	1,221	14.2%
Upper Extremity	1,106	12.86%
Lower Extremity	854	9.93%
Vertebral Column Injury	665	7.73%
Missing / Not Documented	513	5.96%
Other & Unspecified	343	3.98%
Type 1 TBI	166	1.93%
Type 3 TBI	41	0.47%
Spinal Cord Injury	12	0.13%
System Wide & Late Effects	10	0.11%

Case study reviews might be beneficial to fully understanding the care patients received with significant injuries (Type 1 or 2 TBI, spinal cord injury) and find out reasons why they were discharged home within 48 hours without receiving intensive hospital services.

Table 13: Mechanism of injury for overtriaged patients (n=8,598)

	N	%
Total	8,598	100%
Motor vehicle traffic	4,845	56.35%
Falls	1,129	13.13%
Struck by/against	759	8.82%
Transport, other	567	6.59%
Cut/pierce	444	5.16%
Firearm	242	2.81%
Pedal cyclist, other	227	2.64%
Other specified	112	1.30%
Unspecified	64	0.74%
Fire/burn	44	0.51%
Natural/environmental	43	0.50%
Pedestrian, other	42	0.48%
Not classifiable	41	0.47%
Suffocation	15	0.17%
Machinery	14	0.16%
Drowning	9	0.10%
Missing	1	0.01%

The top two mechanisms of injury in overtriage differed from that seen in undertriage. Whereas, undertriage typically occurred with fall patients, overtriage occurred with motor vehicle traffic injuries.

It is possible that patients met the trauma triage criteria for mechanism under the Arizona guidelines, but additional protections such as advances in motor vehicle engineering have reduced significant injury. Additional research is required to fully understand this issue.

The counties with higher than recommended level of overtriage were Pima, Greenlee, and Santa Cruz. The American College of Surgeons recommends a threshold of 50% for overtriage for individual facilities (55%).

Additional research may help understand the impact of population growth, mechanisms, and additional hospitals integrating with the trauma system.

Table 14: County of injury for overtriaged patients (n=8,598)

	Over triaged patients	Total patients	Percent overtriaged
Total	8,598	21,068	40.81%
Unknown	41	182	22.53%
Apache	63	291	21.65%
Cochise	154	380	40.53%
Coconino	383	869	44.07%
Gila	172	449	38.31%
Graham	47	105	44.76%
Greenlee	18	32	56.25%
La Paz	26	101	25.74%
Maricopa	4,731	12340	38.34%
Mohave	5	24	20.83%
Navajo	156	539	28.94%
Other	46	186	24.73%
Pima	1,961	3407	57.56%
Pinal	481	1175	40.94%
Santa Cruz	76	148	51.35%
Yavapai	213	649	32.82%
Yuma	25	191	13.09%

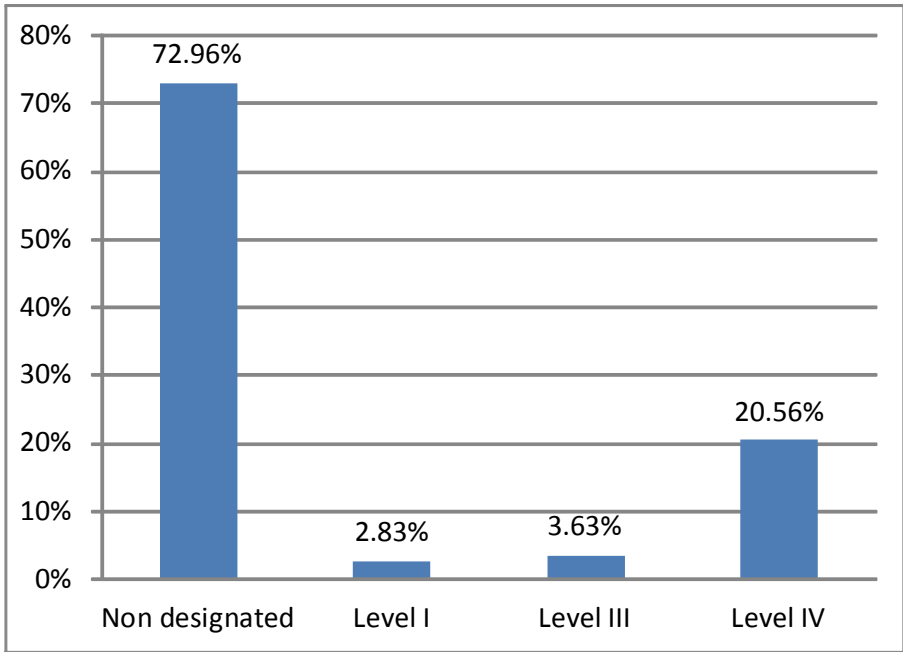
Table 15: Primary and secondary overtriage (n=8,598)

	N	%
Total	**8,598**	**100%**
Primary (from the scene by EMS)	**7,470**	**86.88%**
Secondary (Interfacility transfers)	**1,128**	**13.11%**

Overtriage in the system was mostly attributed to the primary level (87%). Primary overtriage is attributed to field triage and occurs when a patient is transported from directly to a Level I or III trauma center. During their treatment the patient gets discharged within 48 hours with no intensive procedures.

Secondary overtriage occurs when the patient gets transported to a facility which then sends them to a Level I trauma center. Patients that underwent secondary overtriage experienced a delay in their definitive care and inefficiency in the system.

Figure 9: Secondary overtriage (n=1,128)



Of the 1,128 patients who were secondarily overtriaged, 73% occurred at non designated facilities.

Further information is needed to understand the reasons for this occurrence among all levels of care.