# State of Ohio
# State Board of Emergency Medical Services
## Trauma Committee

## Geriatric Trauma Task Force

Report and Recommendations

Approved by the State Board of EMS
December 19, 2007

## EXECUTIVE SUMMARY

The Trauma Committee is required to review the statewide trauma triage criteria on a periodic basis and make recommendations to the EMS Board. During the most recent review of the triage criteria, it was recommended that the geriatric population be considered as a distinct population in regards to trauma triage.

Several reasons suggest that specific geriatric criteria are logical. This includes the differing spectrum of injury pattern in geriatric patients (e.g., greater number of falls) higher mortality and morbidity from similar injuries when compared to younger adults, physiologic changes in the elderly and greater number of co-morbidities.

Data collected in the Ohio Trauma Registry was examined to determine a specific age at which a trauma patient should be considered a geriatric patient, and to determine criteria that could be used to triage elderly trauma victims to trauma centers.

Examination of the data revealed significant increases in mortality at age 72, regardless of the severity of the injuries the patient suffered. Because of this finding, age 70 (an easier number to remember for those doing the triage) was selected as the cut-off point for geriatrics and was used to determine age-specific triage criteria.

Review of the current scientific literature suggested several possible criteria to examine. Additionally, current physiologic-based triage criteria (blood pressure and Glasgow Coma Score) were reviewed to determine if geriatric patients had different thresholds for transport to a trauma center.

The methodology used was to compare the outcomes for patients with the hypothetical indicators in the adult (16-69 years old) and geriatric (70-105 years old) populations. All results were statistically validated for significance.

The findings lead to the following recommendations to the EMS Board:

- Trauma patients 70 years of age or older should be defined as geriatric trauma.

Geriatric trauma patients should be triaged for evaluation in a trauma center for:

- Glasgow Coma Score < 15 with suspected traumatic brain injury
- Systolic blood pressure < 100 mmHg
- Falls with evidence of traumatic brain injury (even from standing position)
- Pedestrian struck by motor vehicle
- Known or suspected proximal long bone fracture sustained in a motor vehicle crash
- Multiple body regions injured

Geriatric trauma patients should be given special consideration for evaluation at a trauma center if they have diabetes, cardiac disease, pulmonary disease (COPD), clotting disorder (including anticoagulants), immunosuppressive disorder or require dialysis.

## INTRODUCTION

As part of their legislatively defined responsibility, the Trauma Committee is required to review the statewide trauma triage criteria on a periodic basis and make recommendations to the EMS Board. During the most recent review of the triage criteria, it was recommended that the geriatric population be considered as a distinct population *vis a vis* trauma triage.

Several reasons suggest that specific geriatric criteria are logical. This includes the differing spectrum of injury pattern in geriatric patients (e.g., greater number of falls) higher mortality and morbidity from similar injuries when compared to younger adults, physiologic changes in the elderly and greater number of co-morbidities.

The purpose of the Geriatric Trauma Task Force was to suggest age-specific criteria that could be used to triage elderly trauma victims to trauma centers.

## DEFINITION

Our first task was to define the geriatric patient. Our review of the literature did not reveal a consistent definition of the elderly. Those articles that did use a specific definition did not appear to have any scientific rationale for the age cut-off used.

The Task Force elected to determine if the Ohio Trauma Registry contained information that could be used to define the geriatric patient. A search was conducted evaluating age versus mortality. All patients in the Registry were included and those with injury severity scores (ISS) from 1-9, 10-14, 15-25 and 26-75 were evaluated. The results demonstrated that there was a sharp increase in mortality at age 72 with all analyses except ISS 26-75, which showed the increase at age 70. After initial discussion at the Trauma Committee, our proposal is to define the geriatric trauma patient as ***any patient greater than or equal to age 70.***

Chart 1

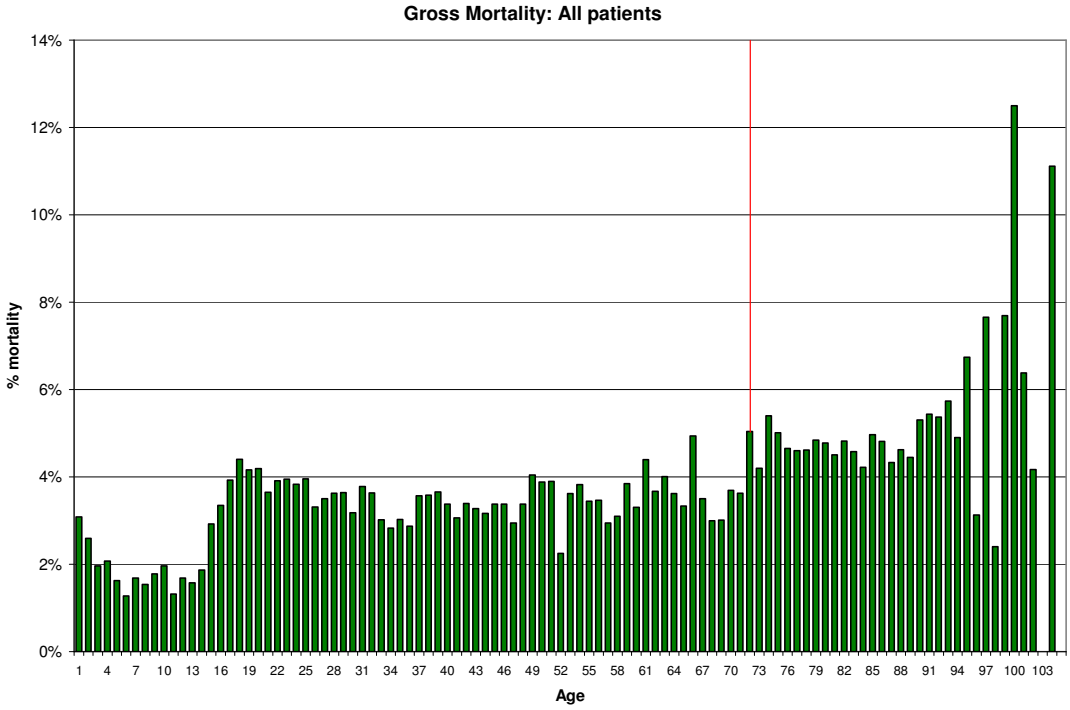


Table 1

| Age | Deaths | Total Pop | % fatal | Uncorrected Chi-Squares | OR | CI | RR | CI |
|---|---|---|---|---|---|---|---|---|
| 55 | 2874 | 66250 | 4.338 | 158.23 | 1.38 | 1.31,1.45 | 1.36 | 1.30,1.43 |
| 65 | 2359 | 51806 | 4.554 | 184.71 | 1.43 | 1.36,1.50 | 1.41 | 1.34,1.48 |
| 66 | 2315 | 50487 | 4.585 | 190.43 | 1.44 | 1.36,1.52 | 1.42 | 1.35,1.49 |
| 67 | 2250 | 49170 | 4.576 | 180.06 | 1.43 | 1.35,1.50 | 1.41 | 1.34,1.48 |
| 68 | 2203 | 47829 | 4.606 | 184.36 | 1.44 | 1.36,1.51 | 1.42 | 1.35,1.49 |
| 69 | 2160 | 46393 | 4.656 | 195.12 | 1.45 | 1.38,1.53 | 1.43 | 1.36,1.51 |
| 70 | 2114 | 44865 | 4.712 | 207.16 | 1.47 | 1.40,1.55 | 1.45 | 1.38,1.53 |
| 71 | 2058 | 43349 | 4.748 | 210.97 | 1.48 | 1.40,1.56 | 1.46 | 1.39,1.54 |
| **72** | **2000** | **41748** | **4.791** | **216.38** | **1.49** | **1.42,1.58** | **1.47** | **1.40,1.55** |
| 73 | 1914 | 40041 | 4.780 | 201.34 | 1.48 | 1.40,1.56 | 1.46 | 1.38,1.54 |
| 74 | 1836 | 38184 | 4.808 | 198.75 | 1.48 | 1.40,1.57 | 1.46 | 1.39,1.54 |
| 75 | 1734 | 36294 | 4.778 | 176.98 | 1.46 | 1.38,1.55 | 1.44 | 1.36,1.52 |

## LITERATURE SEARCH

The next step was to determine if there was work in other states or regions that has addressed the issue of geriatric trauma triage (see Appendix D). The first conclusion was that there has been little to no work defining specific geriatric triage criteria. Several studies have evaluated risk factors for geriatric trauma patients. These have tended to use mortality as an outcome measure; few studies have evaluated outcome measures such as hospital complications, functional outcome and return to normal activity.

The literature suggested several potential triage criteria which were presented to the Trauma Committee. These included:

Fall associated with head, chest, abdominal or spinal injury

Injury qualifiers including prolonged extrication, significant vehicle damage, patient ejected and pedestrian struck

Injury to more than a single body region

Injury to a single body region and at least one disease co-morbidity

It was also suggested that we consider looking at the traditional triage measures such as Glasgow Coma Scale (GCS) and systolic blood pressure (BP) as they relate to age. These analyses are included in the pages below.

## EVALUATION OF INDICATORS OF MORBIDITY

The initial intent of the Task Force was to consider not only the effect of age on mortality but on other measures of trauma care as well. Several measures were considered including complication rate, total length of stay, ICU admission, ICU length of stay and need for operative intervention. Unfortunately, these measures present a confusing picture of geriatric versus adult trauma care. This data remains confusing even when one removes patient deaths from the analysis. An example is provided in Table 2:

Table 2

| | **Single body region** | | | **Multiple body regions** | |
|---|---|---|---|---|---|
| | **Adult** | **Geriatric** | | **Adult** | **Geriatric** |
| **Live** | 57232 | 32429 | | 38909 | 11101 |
| **Die** | 1527 | 1327 | | 2592 | 1021 |
| **Total** | 58759 | 33756 | | 41501 | 12122 |
| **Gross Mortality** | 2.60% | 3.93% | | 6.25% | 8.42% |
| | | | | | |
| **# admitted to ICU** | 8024 | 3374 | | 15010 | 2954 |
| **% admitted to ICU** | 13.66% | 10.00% | | 36.17% | 24.37% |
| **Avg ICU LOS** | 3.9 | 4.8 | | 6.4 | 6.3 |
| **LOS StdDev** | 5.75 | 8.52 | | 9.44 | 3.71 |

As you can see, this seems to suggest that even when deaths were removed from the analysis, there is a higher mortality for elderly patients with either single or multiple body region injuries, their ICU length of stay is longer and those with multiple body region injuries who survive have an equivalent ICU length of stay. This trend was verified in other analyses (see Appendix A and B).

One possible explanation is a selection bias that was discovered with regards to geriatric trauma. Our analysis showed that 91.2% of adult trauma deaths occur at trauma centers (TC) whereas only 81.5% of geriatric trauma deaths occur in trauma centers. In fact, 15.9% of geriatric trauma deaths occur on regular floors in non-trauma hospitals (NTC) (see table 3)

Table 3

| | **Adult** | **Elderly** |
|---|---|---|
| Total patients | 16284 | 6964 |
| Total deaths | 704 | 384 |
| Died in TC | 642 | 313 |
| Died in NTC - ED | 48 | 10 |
| Died in NTC - admitted | 14 | 61 |
| % died in NTC non-ICU | 1.99% | 15.89% |
| % died in TC | 91.19% | 81.51% |

One other factor must be considered when comparing gross mortality between adult and geriatric trauma victims. One study suggested that there is a significant increase in mortality within the first 60 days of hospital discharge for geriatric patients (Mullins et al: Adequacy of hospital discharge status as a measure of outcome among injured patients. *JAMA* 279:1727, 1998). Therefore, the differences presented in our analysis probably represent conservative estimates of the difference between adult and geriatric populations.

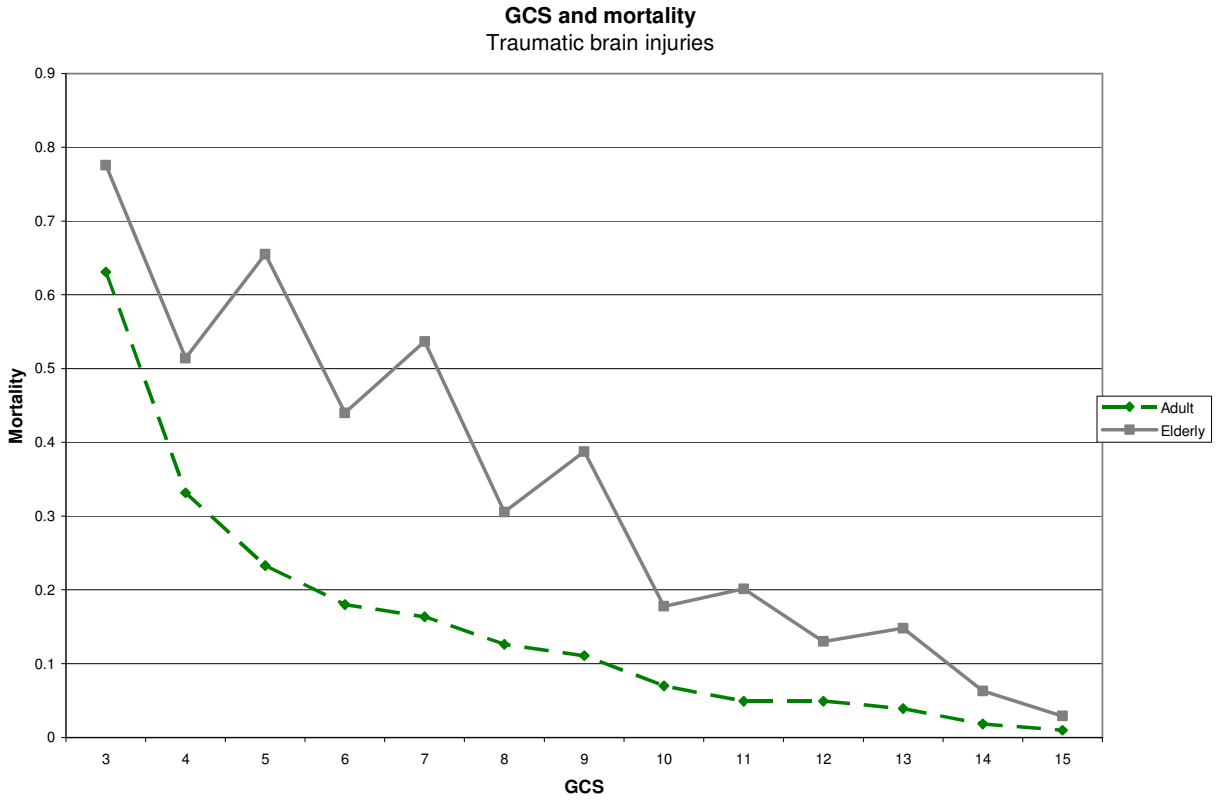
## SPECIFIC TRIAGE RECOMMENDATIONS

### Geriatrics and GCS

An analysis was conducted comparing GCS and mortality for patients with traumatic brain injury (TBI) aged 16 through 69 to those aged 70 to 105. The results are found below:

The chart below demonstrates that any geriatric trauma patient with a TBI who has a GCS < 15 is at the same mortality risk as an adult trauma victim with a TBI who has a GCS ≤ 10. Therefore, ***for patients aged 70 or greater, we recommend evaluation in a trauma center if the GCS is less than 15 with a suspected traumatic brain injury***.

Chart 2




Our statistical analysis of this trend included defining the odds ratio of mortality including the definition of 95% confidence limits with Chi-Square analysis and p value determinations. The results of this analysis are included in Table 4, comparing our data for patients > age 70 to other adults with a GCS of 13

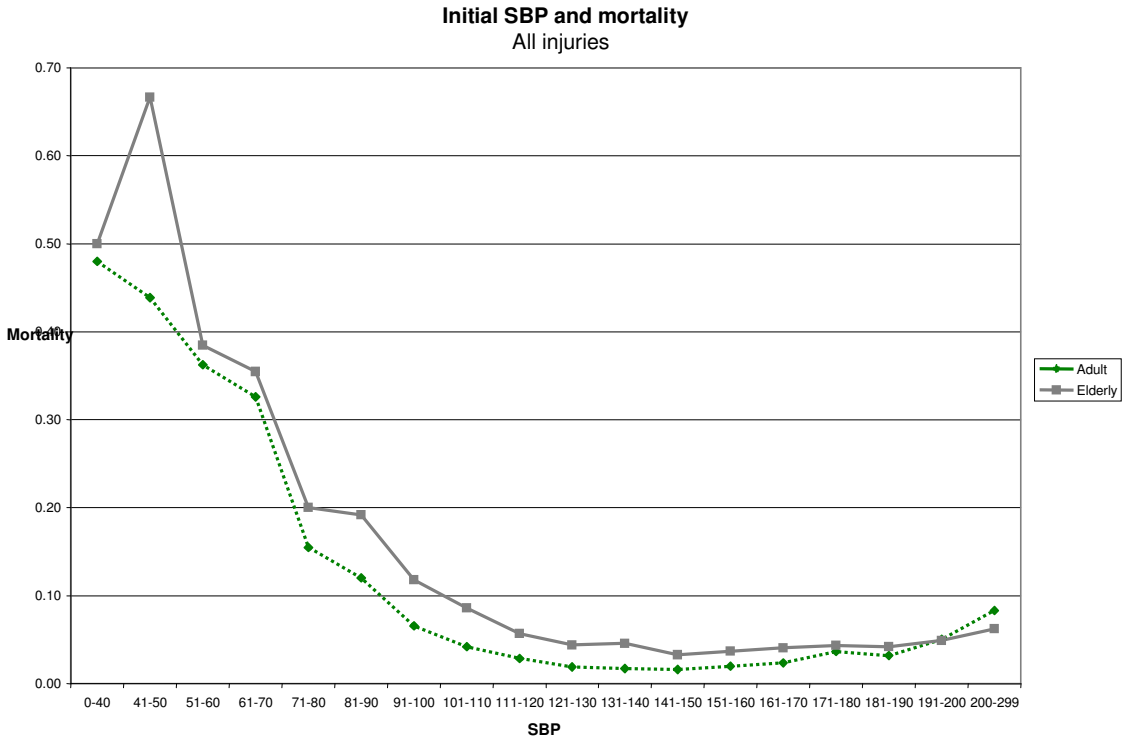
Table 4

| | Geriatric GCS = 15 | Geriatric GCS =14 | Geriatric GCS = 13 |
|---|---|---|---|
| Adult GCS = 13 | 0.74 (0.55 – 1.01)<br>$\chi^2 = 3.89$<br>(p = 0.049) | 1.65 (1.14 – 2.40)<br>$\chi^2 = 7.70$<br>(p = 0.006) | 4.26 (2.76 – 6.58)<br>$\chi^2 = 53.90$<br>(p < 0.0001) |

## Geriatrics and Systolic BP

The current triage rules for adults stipulate that patients with a systolic BP (SBP) of less than 90 mmHg should be evaluated in a trauma center. We also know that as we age, our blood vessels become less elastic and there is a progressive rise in our baseline systolic pressure. An analysis was conducted to evaluate the effect of age and first recorded BP on mortality. The graphic is presented below:

Chart 3




This data suggest that the mortality for geriatric patients with a systolic BP ≤ 100 mmHg is equal to that of younger adults with a systolic BP ≤ 90 mmHg. Therefore, ***for patients aged 70 or greater, we recommend evaluation in a trauma center if the systolic BP is less than 100 mmHg***.

Our statistical analysis of this trend included defining the odds ratio of mortality including the definition of 95% confidence limits with p value determinations. Statistically significant results are noted by an asterisk (*). The results are included below, comparing our data for patients > age 70 to other adults with a systolic BP of 81-90.

Table 5

| | Geriatric SBP 81-90 mmHg | Geriatric SBP 91-100 mmHg | Geriatric SBP 101-110 mmHg |
|---|---|---|---|
| Adult SBP 81-90 mmHg | 1.74* (1.25 – 2.42) | 0.98 (0.73 – 1.32) | 0.69* (0.53 – 0.90) |

**Geriatrics and Falls**

Unlike other adult trauma patients, falls are responsible for a large percentage of geriatric trauma care. We examined the data to determine if mortality for these patients is impacted if the fall is complicated by traumatic brain injury (TBI), spinal cord injury (SCI) or injury to the chest or abdomen. The analysis is shown below:

Table 6

| | **Adult** | **Elderly** |
|---|---|---|
| number of admitted trauma patients | 94320 | 43622 |
| | | |
| number of falls (all) | 32361 | 39080 |
| number falls (all) w/TBI | 6418 | 7071 |
| percentage falls (all) w/TBI | 19.83% | 18.09% |
| deaths from falls (all) with TBI | 385 | 841 |
| mortality of falls (all) with TBI | 6.00% | 11.89% |
| **OR = 2.12 (1.88 – 2.39) p < 0.0001** | | |
| | | |
| number falls (all) w/chest injury | 3279 | 3885 |
| percentage falls (all) w/chest injury | 10.13% | 9.94% |
| deaths from falls (all) with chest injury | 137 | 211 |
| mortality of falls (all) with chest injury | 4.18% | 5.43% |
| **OR = 1.22 (0.99 – 1.52) p = 0.0556** | | |
| | | |
| number falls (all) w/abdomen/pelvis injury | 2685 | 5378 |
| percentage falls (all) w/abdomen/pelvis injury | 8.30% | 13.76% |
| deaths from falls (all) with abdomen/pelvis injury | 31 | 133 |
| mortality of falls (all) with abdomen/pelvis injury | 1.15% | 2.47% |
| **OR = 0.98 (0.73 – 1.31) p = 0.865** | | |
| | | |
| number falls (all) w/SCI | 732 | 303 |
| percentage falls (all) w/SCI | 2.26% | 0.78% |
| deaths from falls (all) with SCI | 36 | 61 |
| mortality of falls (all) with SCI | 4.92% | 20.13% |
| **OR = 4.36 (2.80 – 6.81) p <0.0001** | | |

Interestingly, even if one considers only patients injured as the result of a same level fall (tripping, slipping, stumbling), those with a TBI have a significantly greater mortality:

Table 7

| | **Adult** | **Elderly** |
|---|---|---|
| number of falls (same level) | 8918 | 14004 |
| number falls (same level) w/TBI | 1139 | 1895 |
| percentage falls (same level) w/TBI | 12.77% | 13.53% |
| deaths from falls (same level) with TBI | 80 | 224 |
| mortality of falls (same level) with TBI | 7.02% | 11.82% |
| **OR = 2.23 (1.84 – 2.70) p < 0.0001** | | |

The risk of death for patients with chest or abdominal injuries was not significantly higher for geriatric patients, and signs of SCI are already a triage indicator for all patients regardless of age. Therefore, ***for patients aged 70 or greater, we recommend evaluation in a trauma center if there is evidence of a fall of any height complicated by a traumatic brain injury.***

**Geriatrics, Injury Mechanisms and Injury Qualifiers, including prolonged extrication, significant vehicle damage, patient ejected and pedestrian struck**
The current Ohio Trauma Registry is limited in its ability to reliably capture the injury qualifiers for trauma patients. One mechanism of injury that was reviewed was pedestrians struck by vehicles. An analysis was conducted to assess the impact of age on mortality for pedestrian accidents. The data is included below:

Table 8

| **Pedestrians Struck** | | |
|---|---|---|
| | **All** | |
| | **Adult** | **Elderly** |
| n= | 2455 | 415 |
| Deaths | 183 | 69 |
| Mortality | 7.45% | 16.63% |

These data show a significant difference in mortality for geriatric patients when compared to all other injured adults. Therefore, ***for patients aged 70 or greater, we recommend evaluation in a trauma center if the patient was a pedestrian struck by a motor vehicle.***

The odds ratio of increased mortality for elderly pedestrians struck by a motor vehicle 2.39 with a 95% confidence interval of 1.77 to 3.21 ($p < 0.0001$).

## Geriatrics and Multiple Body Region Injuries

Some literature has suggested that elderly patients with more than single body region injuries are at significantly greater risk of death. An analysis was conducted to evaluate whether this could be validated using the data in the State Trauma Registry. Body regions, determined by using the Barrell injury diagnosis matrix, were traumatic brain injuries, head/face/neck, chest, abdomen/pelvis, spine, and extremities. Information on the Barrell injury diagnosis matrix can be found in Appendix C. The results of our analyses are presented below:

Table 9

| | **Single body region** | | | **Multiple body regions** | |
|---|---|---|---|---|---|
| | **Adult** | **Geriatric** | | **Adult** | **Geriatric** |
| **Live** | 57232 | 32429 | | 38909 | 11101 |
| **Die** | 1527 | 1327 | | 2592 | 1021 |
| **Total** | 58759 | 33756 | | 41501 | 12122 |
| **Mortality** | 2.60% | 3.93% | | 6.25% | 8.42% |

| | **Dead** | **Alive** | **% Mortality** | **OR (95% CI)** |
|---|---|---|---|---|
| **Geriatric** | 157 | 1804 | 8.01 (6.81-9.21) | 1.29 (1.06-1.52)* |
| **Adult** | 368 | 5461 | 6.31 (5.69-6.93) | P=0.0097 |

There is a significant increase in mortality when a geriatric patient suffers injuries to multiple body regions. Therefore, ***for patients aged 70 or greater, we recommend evaluation in a trauma center if there are multiple body regions injured***.

## Geriatrics and Co-Morbidities

The medical literature is conflicting on the impact of co-morbidities on mortality for geriatric patients. Some of the co-morbidities that can be identified in the Ohio Trauma Registry are cardiac disease, pulmonary disease, diabetes (Type I or II), dialysis, immunosuppressive disease and clotting disorders (including anticoagulant use [Coumadin]). The analysis is presented on the next page:

Table 10

| Co-morbid condition (any) | Adult | Geriatric |
|---|---|---|
| n= | 34837 | 29951 |
| deaths | 1116 | 1449 |
| mortality | 3.20% | 4.84% |
| **OR = 1.59 (1.41 – 1.79) p < 0.0001** | | |

| Diabetes (types I & II) | Adult | Geriatric |
|---|---|---|
| n= | 7208 | 7962 |
| deaths | 209 | 368 |
| mortality | 2.90% | 4.62% |
| **OR = 1.62 (1.37 – 1.91) p < 0.0001** | | |

| Coronary artery disease | Adult | Geriatric |
|---|---|---|
| n= | 3388 | 9032 |
| deaths | 123 | 473 |
| mortality | 3.63% | 5.24% |
| **OR = 1.43 (1.18 – 1.73) p = 0.00015** | | |

| Pulmonary disease | Adult | Geriatric |
|---|---|---|
| n= | 5837 | 4820 |
| deaths | 126 | 271 |
| mortality | 2.16% | 5.62% |
| **OR = 2.60 (2.11 – 3.20) p < 0.0001** | | |

| Clotting disorder | Adult | Geriatric |
|---|---|---|
| n= | 680 | 1646 |
| deaths | 36 | 148 |
| mortality | 5.29% | 8.99% |
| **OR = 1.99 (1.41 – 2.82) p = 0.000036** | | |

| Immunosuppression | Adult | Geriatric |
|---|---|---|
| n= | 527 | 215 |
| deaths | 44 | 31 |
| mortality | 8.35% | 14.42% |
| **OR = 1.88 (1.15 – 3.06) p = 0.0069** | | |

| Cardiac disease (all) | Adult | Geriatric |
|---|---|---|
| n= | 5961 | 14759 |
| deaths | 268 | 849 |
| mortality | 4.50% | 5.75% |
| **OR = 1.30 (1.12 – 1.50) p = 0.00029** | | |

| Dialysis | Adult | Geriatric |
|---|---|---|
| n= | 460 | 527 |
| deaths | 31 | 60 |
| mortality | 6.74% | 11.39% |
| **OR = 1.78 (1.11 – 2.87) p = 0.0118** | | |

While geriatric trauma patients with any co-morbid condition had a significantly higher risk of death than their adult counterparts, the list of conditions collected by the Ohio Trauma Registry is limited to 30 specific disorders. It was felt that this could not be accurately translated into practice. Geriatric patients with diabetes, cardiac disease, COPD, immunosuppressive disorders, clotting disorders (including anticoagulant therapy) or require dialysis, appear to have a significant increase in mortality but regression analysis shows that these are not independent predictors of mortality. Therefore, ***for patients aged 70 or greater, we recommend if the patient has diabetes, cardiac disease, COPD, clotting disorder (including warfarin (Coumadin)), immunosuppressive disorder or requires dialysis that special consideration for evaluation in a trauma center be given.***

**Geriatrics and Proximal Long Bone Fractures**

One additional criterion has been suggested in discussions with the state of Florida. Their conclusions suggest that elderly patients with a single proximal long bone fracture (femur or humerus) resulting from a motor vehicle crash (MVC) have a much higher mortality and morbidity than adults.

In Ohio, the odds ratio of increased mortality for elderly MVC victims who have proximal long bone fractures is 2.41 with a 95% confidence interval of 1.81 to 3.21 ($p < 0.0001$).

Therefore, ***for patients aged 70 or greater, we recommend evaluation in a trauma center if the patient was injured in a motor vehicle crash and has a suspected or confirmed proximal long bone fracture (femur or humerus).***

## Conclusion

We recommend that trauma patients $\geq$ 70 years should be defined as geriatric trauma. They should be triaged for evaluation in a trauma center for:

- GCS < 15 with suspected traumatic brain injury
- Systolic BP < 100 mmHg
- Falls with evidence of traumatic brain injury (even from standing position)
- Pedestrian struck by motor vehicle
- Known or suspected proximal long bone fracture sustained in a motor vehicle crash
- Multiple body regions injured

We also recommend that geriatric trauma patients be given special consideration for evaluation at a trauma center if they have diabetes, cardiac disease, pulmonary disease (COPD), clotting disorder (including anticoagulants), immunosuppressive disorder or require dialysis.

Finally, we recommend that the current reference to special consideration for triage to a trauma center for patients over the age of 55 be removed.

**Appendix A.** Adult and geriatric pedestrian struck – mortality and other outcomes

| Pedestrians Struck | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | All | | | ISS 1-15 | | | ISS 16-24 | | | ISS =>25 | |
| | Adult | Elderly | | Adult | Elderly | | Adult | Elderly | | Adult | Elderly |
| n= | 2455 | 415 | | 919 | 129 | | 219 | 35 | | 237 | 52 |
| Deaths | 183 | 69 | | 7 | 4 | | 17 | 2 | | 76 | 28 |
| Mortality | 7.45% | 16.63% | | 0.76% | 3.10% | | 7.76% | 5.71% | | 32.07% | 53.85% |
| | | | | | | | | | | | |
| # w/ICU | 662 | 108 | | 147 | 31 | | 90 | 15 | | 118 | 17 |
| % w/ICU | 26.97% | 26.02% | | 16.00% | 24.03% | | 41.10% | 42.86% | | 49.79% | 32.69% |
| Avg ICU LOS | 6.88 | 6.63 | | 3.52 | 4.19 | | 7.67 | 6.6 | | 12.69 | 13.12 |
| ICU LOS StdDev | 8.86 | 7.55 | | 4.75 | 5.5 | | 8.66 | 6.38 | | 11.27 | 11.9 |
| | | | | | | | | | | | |
| # w/OR | 843 | 114 | | 311 | 43 | | 88 | 11 | | 84 | 12 |
| % w/OR | 34.34% | 27.47% | | 33.84% | 33.33% | | 40.18% | 31.43% | | 35.44% | 23.08% |

# w/ICU – Number of patients admitted to the intensive care unit
% w/ICU – Percentage of patients admitted to the intensive care unit
Avg ICU LOS – Average intensive care unit length of stay
ICU LOS StdDev – ICU length of stay standard deviation
# w/OR – Number of patients with at least one trip to the operating room
% w/OR – Percentage of patients with at least one trip to the operating room

NOTE: The intensive care unit (ICU) and operating room (OR) data exclude deaths. Also, not all facilities submit Injury Severity Scores (ISS) to the Ohio Trauma Registry, therefore the "All" column population will be higher than the sum of the populations of the three ISS columns.

**Appendix B.** Adult and geriatric falls (all falls, discharged alive) – mortality and other outcomes

| | Adult | Elderly |
|---|---|---|
| Number of admitted trauma patients | 94320 | 43622 |
| | | |
| Number of falls | 31803 | 37559 |
| # admitted to ICU | 3904 | 3456 |
| % admitted to ICU | 12.28% | 9.20% |
| Avg ICU LOS | 4.75 | 4.53 |
| LOS StdDev | 6.34 | 8.16 |
| # with OR visit | 11423 | 8744 |
| % with OR visit | 35.92% | 23.28% |
| | | |
| Number falls w/ traumatic brain injury | 6037 | 6238 |
| # admitted to ICU | 3639 | 2529 |
| % admitted to ICU | 60.28% | 40.54% |
| Avg ICU LOS | 6.14 | 5.02 |
| LOS StdDev | 7.66 | 5.95 |
| # with OR visit | 1338 | 834 |
| % with OR visit | 22.16% | 13.37% |
| | | |
| Number falls w/ chest injury | 3142 | 3674 |
| # admitted to ICU | 1202 | 630 |
| % admitted to ICU | 38.26% | 17.15% |
| Avg ICU LOS | 6.91 | 5.79 |
| LOS StdDev | 8.6 | 6.23 |
| # with OR visit | 741 | 356 |
| % with OR visit | 23.58% | 9.69% |
| | | |
| Number falls w/ abdomen/pelvis injury | 2625 | 5245 |
| # admitted to ICU | 784 | 330 |
| % admitted to ICU | 29.87% | 6.29% |
| Avg ICU LOS | 5.63 | 4.92 |
| LOS StdDev | 8.06 | 6.97 |
| # with OR visit | 803 | 434 |
| % with OR visit | 30.59% | 8.27% |
| | | |
| Number falls w/ spinal cord injury | 696 | 242 |
| # admitted to ICU | 308 | 71 |
| % admitted to ICU | 44.25% | 29.34% |
| Avg ICU LOS | 7.22 | 8.31 |
| LOS StdDev | 10.06 | 7.29 |
| # with OR visit | 227 | 43 |
| % with OR visit | 32.61% | 17.77% |

# w/ICU – Number of patients admitted to the intensive care unit
% w/ICU – Percentage of patients admitted to the intensive care unit
Avg ICU LOS – Average intensive care unit length of stay
LOS StdDev – ICU length of stay standard deviation
# w/OR – Number of patients with at least one trip to the operating room
% w/OR – Percentage of patients with at least one trip to the operating room

**Appendix C.** Barrell injury diagnosis matrix

The Barrell injury diagnosis matrix (complete name: Barell Injury Diagnosis Matrix, Classification by Body Region and Nature of the Injury) standardizes data selection and reports, using a two dimensional array (matrix) that includes all *International Classification of Diseases* (ICD)-9-CM codes describing trauma. It serves as a basic tool in epidemiological and clinical analyses of injury data.

The matrix displays nature of injury in columns and body region in rows placing each ICD-9-CM code in the range from 800 to 995 in a unique cell location in the matrix. Each cell includes the codes associated with a given injury. The matrix rows and columns can easily be collapsed to get broader groupings or expanded if more specific sites are required.

The full matrix is too complex to reprint here legibly. It can be found at the website of the Centers for Disease Control and Prevention's National Center for Health Statistics website in the section on the International Collaborative Effort on Injury Statistics.

## **Appendix D.** Bibliography

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