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## Major Trauma and the Elder West Virginian: A Six Year Review at a Level I Trauma Center

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### Abstract

**Background**—Trauma was the seventh leading cause of death for persons 65 and older in West Virginia (WV) in 2010. In 2007, fatality rates for both accidental falls and motor vehicle crashes were higher in West Virginia than the nation as a whole. US Census Data from 2010 showed WV to have one of the oldest median ages in the nation (surpassed by Maine and Vermont) and currently 16% of the population of WV is over 65 years of age.

**Methods**—This is a retrospective observational study of data extracted from the John Michael Moore Trauma Center (JMMTC) trauma registry for the time period of January 1, 2009 to December 31, 2014.

**Results**—There were 3,895 patients, aged 65 years or older, treated at the Jon Michael Moore Trauma Center in Morgantown, WV during the study time period. Accidents accounted for 98.6% of the injuries. The elderly were most commonly injured in their place of residence (59.8%). The top two mechanisms of injury were falls (75.2%) and motor vehicular crashes (13.9%). Frequently, disposition from the Emergency Department was to a higher level of care: Intensive Care Unit (32.3%) and Step-down Unit (21.2%). The most common serious injuries were intracranial hemorrhage (40.0%), lower extremity fractures (38.1%), and spine fracture (26.0%). The average hospital stay was 5.6 days and the average ICU stay was 3.2 days. Hospital discharge dispositions frequently resulted in care out of the home; skilled nursing facility (22.0%), rehabilitation facility (15.5%), morgue/funeral home (6.6%), and long-term residential care facility (5.7%). The most common pre-existing medical conditions were hypertension (71.9%), diabetes mellitus (29.3%), chronic obstructive pulmonary disease (19.5%), and dementia (18.8%).

**Conclusion**—Elder West Virginians most frequently are injured in falls and motor vehicular crashes. Pre-existing medical conditions are very common. Trauma in the elderly creates a significant burden on the patient, their families, and on the health care system in West Virginia. Injury prevention interventions have the potential to diminish the impact of trauma on elder West Virginians.

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## Introduction

Summation analysis of the data reported in the WV Vital Statistics 2011 Report reveals that accidents, all causes, were the seventh leading cause of death for persons 65 and older in West Virginia (WV) in 2011. Accidental falls and motor vehicle crashes are the most common causes of injury in older West Virginians. In 2010, Census data showed WV to have the third oldest median age in the United States at 38.9 years and that elder West Virginians were 16% of the State's population. It is projected this percentage will grow to 25% by 2030.

According to the Centers for Disease Control and Prevention, one in three seniors will fall every year. The risk of falling increases with age, with some studies reporting fall rates in excess of 40% per year for persons over the age of 85. Minor injuries, such as contusions, bruises, sprains and superficial lacerations, occur about 40% of the time after a fall. More serious injuries, fractures and internal injuries, occur about 5% of the time. In addition to increased risk of falling with advancing age, the risk for more severe injury increases with age. Elderly women living in the community are more likely to fall than older men. Seniors who fall have a significantly increased risk for entering long term care facilities after their fall.

### Objectives

The purpose of this article is to review the five year experience, from 2009 to 2014, of elder West Virginians at the Jon Michael Moore Trauma Center, Morgantown, West Virginia, one of West Virginia's two Level I Trauma Centers. Trauma is the seventh leading cause of death for West Virginia seniors over the age of 65. This study will highlight the impact of major trauma on the aging population of rural West Virginia, and the health care systems that care for these patients. This study will describe the causes of serious traumatic injuries in West Virginia seniors, and the impact these injuries have on the health care systems and on the seniors themselves. Pre-hospital and hospital resources utilized by the patients are reported. Injuries and co-morbid medical conditions are identified, in addition to the hospital dispositions for the seniors. The impact of the pre-existing medical conditions on the treatment of the injuries is discussed. Injury prevention interventions for the most common mechanisms of injury are briefly reviewed. By 2020, one in four West Virginians will be over the age of 65. Much work needs to be done in prevention of trauma in the elderly. This article helps us start moving in this direction by examining what is currently known.

In 2007, fatality rates for both accidental falls and motor vehicle crashes were higher in West Virginia than the nation as a whole. The disparities in fatality rates for accidental falls and

motor vehicle crashes are likely multifactorial. Little has been reported on the characteristics of trauma in the elderly, especially in a rural population. Taylor et al. reported age as an independent risk predictor of mortality. Rogers et al. found older, rural trauma patients die more frequently than younger patients and also had worse survival than urban senior trauma victims. This review of the experience of elder West Virginians at the Jon Michael Moore Trauma Center (JMMTC) will highlight the impact of trauma on the aging population of rural WV and the health care systems that care for them. This study will describe the causes of serious traumatic injuries in WV seniors and the impact this has on the health care system and on the seniors themselves. Pre-hospital and hospital resources utilized are reported as well as hospital discharge dispositions for the seniors. Co-morbid medical conditions and injuries will be described.

## Methods

### Selection of Cases

West Virginia University (WVU) Hospital's Jon Michael Moore Trauma Center in Morgantown, West Virginia, is a Level I Adult Trauma Center that cares for more than 4,500 trauma patients annually. The JMMTC is one of only two Level I Trauma Centers in West Virginia. The patients in this study came from 41 of the 55 counties in West Virginia. Over 100 patient data elements are entered into the Trauma Registry for each patient that include demographic information, injury location, injury date and time, cause of injury, out-of-hospital assessment/treatment, emergency department (ED) admission/assessment/treatment, hospital assessment/treatment, disposition and diagnosis, and patient outcome. Data for this study were extracted from the JMMTC registry for the time period of January 1, 2009 to December 31, 2014. All patients 65 years and older were included in the study, none were excluded. Age, gender, location of injury, mechanism of injury, hospital and ICU length of stay, discharge disposition, pre-existing conditions, and injuries were extracted. Up to 13 pre-existing conditions were entered into the trauma registry for each patient. These pre-existing conditions were summed and reported as a prevalence percentage. Over 230 distinct physical injuries were coded for the patients in the data set. These individual injuries were condensed into 12 anatomic regions for simplified reporting. The project was approved by the WVU Institutional Review Board (Protocol Number 15092920). Waiver of individual consent and HIPAA waiver was granted.

## Results

There were 3,895 patients, aged 65 years or older, in the JMMTC Registry during the study period. This sample accounted for 16.9% of all patients entered in the trauma registry during this time. Women outnumbered men (57.9% vs. 42.1%) and were significantly older ( $M = 79.0$  years,  $SD = 8.5$  vs.  $76.8$ ,  $SD = 8.2$ ,  $P < 0.001$ ) than their male counterparts. The age range for women was 65 to 105 and for men 65 to 108. Accidents accounted for 98.6% of the injuries, 1.1% were assaults, and 0.3% were self-inflicted. The most common mechanisms of injury are listed in Table 1.

Ambulance was the mode of arrival for 78.6% of patients and 8.7% arrived by medical helicopter. In the ED, 42.9% had partial Trauma Team activation and 6.7% had full Trauma

Team activation. Approximately 36% of patients were evaluated primarily by the ED Staff without Trauma Team activation, and 4.9% were directly admitted from outside facilities. From the ED, 32.3% of patients were admitted to an ICU, 21.2% were admitted to a Step-down unit, 39.7% were admitted to a floor bed, and 6.6% were admitted to the operating room. The average hospital length of stay was 5.6 days (SD = 6.5), the average length of stay for patients admitted to the ICU was 3.2 days (SD = 4.2). For the study population as a whole, almost 60% of the seniors were injured in their place of residence, 53.1% in their home and 6.7% in a residential institution. Table 2 displays the hospital discharge dispositions for the data set as a whole.

Table 3 displays the location where the injuries occurred as well as the hospital discharge dispositions by 5 year age groups.

Almost all of the elderly patients had one or more pre-existing condition (90.5%), while 64.2% had two, 36.0% had three, 18.3% had four, 7.4% had five, 2.4% had six, and 0.72% had seven. The prevalence of these pre-existing conditions is listed in Table 4. Table 5 displays the frequencies of injuries experienced by this group of elder West Virginians.

## Discussion

Trauma is a significant cause of morbidity and mortality in elderly West Virginians. By 2030, 25% of West Virginians will be over the age of 65. Women significantly outnumbered men in our study and although the age ranges for men and women were similar, women were significantly older. These age and gender differences are reflective of the elderly population of WV. Almost 80% of the patients were transported to the trauma center by ambulance and almost 9% of the patients were transported by medical helicopter. Nearly 50% of the patients had trauma team activation on arrival in the Emergency Department. Over 50% of the elderly patients were admitted to the ICU or a Step-Down Unit from the ED. The high intensity of resource utilization of the elderly trauma patient will result in increased pressure on both pre-hospital and hospital resources as this population grows.

For 6.6% of the seniors in the study group, that single trauma resulted in their death during the admission. For persons over the age of 85 the mortality rate was 10%. Table 3 shows that with increasing age, the likelihood of going home at hospital discharge decreases and the likelihood of requiring a rehabilitation facility, nursing home, long term care facility or residential facility increases, except in the 100+ age group. This loss of independence, even if only temporary for those elderly discharged to a rehabilitation or skilled nursing facility, has significant implications for these individuals and their families.

Table 4 shows that pre-existing medical conditions were extremely prevalent in the study group. Nearly 20% of the seniors had four or more pre-existing conditions. The type and frequency of the pre-existing conditions is mirrored in the prevalence of these conditions in WV. These pre-existing conditions and the traumatic injuries result in complex interactions, complicating the management of the elder trauma patient. Management of diabetes becomes more complicated during the admission when patients are not at their baseline level of physical activity, not eating normally, and having stress hormonal response to their traumatic

injuries. Poor glucose control negatively impacts wound healing and predisposes patients to other complications. Hyperglycemia is associated with increased mortality in patients with intra-cranial hemorrhage. Smoking negatively impacts wound healing. For patients with COPD, especially those still smoking, rib fractures present a significant risk for respiratory compromise and pneumonia.

The frequencies of the injuries reported here are skewed toward a more severe injury pattern than reported by Whiteman and colleagues in the 2012 article on falls in older West Virginians. The 2012 study included all patients in the WV State Trauma Registry, which includes patients that were less severely injured and admitted to the State's Level II, III, and IV Trauma Centers. Additionally, the current study includes patients injured in MVC's, a higher injury mechanism of injury likely to result in more severe injuries. Over 40% of the patients had an intracranial hemorrhage and over 12% of the patients in the study were on antithrombotic therapy for pre-existing conditions. Pre-existing anti-thrombotic therapy can make intracranial hemorrhages significantly worse. Treatment of intracranial hemorrhages with platelets and prothrombin concentrates is very expensive. Until recently, no reversal agent was available for the novel oral anticoagulants/direct thrombin inhibitors. However, the Food and Drug Administration has just approved Idarucizumab, an antibody fragment that selectively binds to dabigatran. Although Idarucizumab appears to be effective in reversing the effects of dabigatran, it is not effective for the other direct thrombin inhibitors. In addition, discontinuation of the antithrombotic therapy increases the risk for stroke, myocardial infarction and other thrombotic events.

Three-quarters of the injuries in elderly West Virginians presenting to our trauma center were injured in a fall. Elements of the Centers for Medicare and Medicaid Services Medicare annual wellness visit have the potential of identifying seniors at risk for traumatic injury. Minkemeyer et al. recently reviewed several fall risk assessment tools and recommended the Timed Up and Go test as a simple and quick evaluation tool that primary care providers in West Virginia can use in their practices to identify patients at risk of falling. Implementation of injury prevention measures, however, can be challenging, especially when pre-existing medical conditions and their treatment increase the risk for traumatic injury and its severity when it occurs.

Home is the most dangerous location for elder West Virginians, almost 60% the injuries occurred at their place of residence. The percentage of elderly injured at their place of residence increased with age. Multiple studies have identified high yield interventions for preventing falls in older adults. Long-term exercise programs that include balance, gait and strength training can decrease falls. Home modifications can decrease the incidence of falls in frail seniors. Vitamin D supplementation, to achieve a level of 30-50 nanograms/milliliter, in older women can decrease falls by 40%. Psychotropic medications and polypharmacy increase the risk of falls in older adults. If high risk medications cannot be stopped, reducing the dose may be helpful in limiting falls. Primary care providers should review the medication lists at least yearly and assess the need for all medication. Management of postural hypotension and cardiac dysrhythmias also decreases the risk of falls. Use of gait stabilizing devices, especially outdoors in the winter months can reduce falls. Low intensity vibration plate therapy is helpful in improving balance and strength. All of these

interventions have been shown to have benefit in reducing falls in community dwelling seniors. Most of these interventions have not been found to be as useful in minimizing the fall risk in seniors in long residential care facilities.

Country roads may take us home in WV, however, they can prove to be a dangerous place for WV senior citizens. Motor vehicular crashes are the second most common mechanism of injury in elderly West Virginians. The percentage of elderly West Virginians in our study group injured on the streets steadily decreased with age.

## Limitations

The study is retrospective and observational. It is limited by the lack of long term follow up of the patients. The benefits of rehabilitation therapies cannot be determined with the data in the JMM Trauma Registry. Additionally, the data for this study is from only one of the two Level I trauma centers in WV and as such may not be representative of the severe trauma in the elderly for the entire State of West Virginia.

## Conclusions

Trauma admissions for elderly West Virginians at the JMMTC were common, accounting for 16.9% of the trauma registry patients. Non-intentional injury accounted for 98.6% of the injuries. The most common mechanisms of injury were falls and motor vehicular crashes. The most common location for the injuries to occur were where the elderly reside and on the highways. The most common serious injuries were intracranial hemorrhages, lower and upper extremity fractures, and spine fractures. Pre-existing medical co-morbidities were extremely common and almost two thirds of the seniors had multiple. Hypertension, diabetes mellitus, COPD, and dementia were the most common co-morbidities. Nearly 1 in 8 of the seniors was on anti-thrombotic therapy. With increasing age, the likelihood of the elderly in our study population returning home at hospital discharge steadily decreased. Overall, 6.6% of the seniors died as a result of their trauma, and over 10% of the patients over age 85 died from their major traumatic event.

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## References

1. West Virginia Vital Statistics. WV Department of Health and Human Services. 2011. <http://www.wvdhhr.org/bph/hsc/pubs/vital/2011/2011Vital.pdf>. Accessed February 3, 2016
2. Older West Virginian Health Highlights. WV Department of Health and Human Services. [http://www.wvdhhr.org/bph/hsc/Pubs/Other/Aging2011/OlderWV\\_Health\\_Highlights.pdf](http://www.wvdhhr.org/bph/hsc/Pubs/Other/Aging2011/OlderWV_Health_Highlights.pdf). Accessed February 3, 2016
3. US Census Bureau. Interim State Population Projections – Table 5. 2005. <https://www.census.gov/population/projections/data/state/projectionsagesex.html>. Accessed February 3, 2016

4. Centers for Disease Control and Prevention. Fatalities and injuries from falls among older adults--- United States, 1993--2003 and 2001--2005. *MMWR: Morbidity and mortality weekly report*. 2006; 55(45):1221-1224. [PubMed: 17108890]
5. Taylor MD, Tracy JK, Meyer W, Pasquale M, Napolitano LM. Trauma in the elderly: intensive care unit resource use and outcome. *J Trauma*. 2002; 53(3):407-14. [PubMed: 12352472]
6. Rogers FB, Osler TM, Shackford SR, et al. A population-based study of geriatric trauma in a rural state. *J Trauma*. 2001; 50(4):604-9. [PubMed: 11303153]
7. Whiteman C, Davidov D, Tadros A, D'Angelo J. Falls and dilemmas in injury prevention in older West Virginians. *WV Med J*. 2012; 108(3):14-20.
8. Food and Drug Administration. FDA approves Praxbind, the first reversal agent for the anticoagulant Pradaxa. <http://www.fda.gov/NewsEvents/Newsroom/PressAnnouncements/ucm467300.htm>. Accessed February 3, 2016
9. Minkemeyer VM, Meriweather M, Shuler F, Mehta S, Qazi ZN. Primary care fall risk assessment for elderly West Virginians. *WV Med J*. 2015; 111(6):18-23.
10. Health Quality Ontario. Prevention of falls and fall-related injuries in community-dwelling seniors: an evidence-based analysis. *Ontario Health Technology Assessment Series*. 2008; 8(2):1-78.
11. Panel on prevention of falls in older persons, American Geriatrics Society and British Geriatrics Society, Summary of the updated American Geriatrics Society/British Geriatrics Society clinical practice guideline for prevention of falls in older persons. *J Am Geriatr Soc*. 2011; 59:148-157. [PubMed: 21226685]
12. Shuler FD, Schlierf T, Wingate M. Preventing falls with vitamin D. *WV Med J*. 2014; 110(3):10-2.
13. American Geriatrics Society Workgroup on Vitamin D Supplementation for Older Adults. Recommendations abstracted from the American Geriatrics Society Consensus Statement on vitamin D for Prevention of Falls and Their Consequences. *J Am Geriatr Soc*. 2014; 62(1):147-52. doi: 10.1111/jgs.12631. [PubMed: 24350602]

**Table 1**

## Mechanism of Injury

<b>Mechanism</b>	<b>Number of patients</b>	<b>% of Total</b>
Fall	2927	75.2
Motor Vehicle Crash	542	13.9
All Terrain Vehicle Crash	61	1.6
Motorcycle Crash	54	1.4
Physical Blow	49	1.3
Automobile versus Pedestrian	39	1.0
Laceration	31	0.8
Crush	28	0.7
Lawn Tractor Crash	27	0.7
Altercation	25	0.6
Gunshot Wound	21	0.5
Farm Tractor Crash	18	0.5
17 Other Mechanisms of Injury, Each With Incidence <0.5%	80	1.8

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**Table 2**

## Destination at Hospital Discharge

<b>Discharge Destination</b>	<b>N</b>	<b>%</b>
Home <sup>*</sup>	1887	48.4
Skilled Nursing Facility	857	22.0
Rehabilitation Facility	604	15.5
Morgue/Funeral Home	258	6.6
Residential Institution	221	5.7
Intermediate Care Facility	36	0.9
Other <sup>**</sup>	32	0.8

<sup>\*</sup> Includes dispositions of “home, no assistance”, “home, with home health”, “home, rehab outpatient”

<sup>\*\*</sup> Includes “acute care hospital”, “burn center”, “jail/prison”, “long term acute care”, “other”, “psychiatric facility”, and “unable to complete treatment/AMA”.

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**Table 3**

## Injury Locations and Hospital Discharge Dispositions by Five Year Age Range

Percentage	Age Group							
	65-69	70-74	75-79	80-84	85-89	90-94	95-99	100+
Injured at Home	41.8	46.4	53.3	58.1	63.1	64.8	61.7	60.0
Injured at Residential Facility	1.5	3.1	5.0	7.4	11.0	16.8	26.7	26.7
Injured on Street	24.9	21.6	15.8	13.5	10.0	3.5	1.7	0.0
Injured at Recreation Venue	5.9	4.1	2.0	1.9	1.0	0.0	0.0	0.0
Injured at Public Building	3.0	2.1	2.6	3.1	2.4	2.9	3.3	0.0
Injured at Other Locations <sup>^</sup>	22.9	22.7	21.3	16.0	9.5	12.0	6.6	13.3
Discharge Home <sup>*</sup>	66.7	57.7	48.0	44.0	32.8	27.6	21.7	40.0
Discharge to Rehabilitation	14.3	15.3	14.8	17.0	17.1	15.2	15.0	0.0
Discharge to Residential Facility	1.7	2.6	4.5	5.9	9.3	13.0	25.0	26.0
Discharge to Skilled Nursing Facility	12.4	17.4	23.7	24.5	29.0	33.3	26.6	20.0
Dead	2.7	5.0	7.0	7.3	10.5	9.5	10.0	13.0
Discharged other <sup>**</sup>	2.2	1.9	2.0	1.3	1.4	1.3	1.6	0.0

<sup>^</sup> Includes "farm", "mine", "industry", and "other/unspecified".

<sup>\*</sup> Includes dispositions of "home, no assistance", "home, with home health", "home, outpatient rehabilitation"

<sup>\*\*</sup> Includes "acute care hospital", "burn center", "intermediate care facility", "long term acute care", "other", "psychiatric facility", and "unable to complete treatment/Against Medical Advice".

**Table 4**

## Pre-existing Conditions

<b>Pre-Existing Condition</b>	<b>Percent</b>
Hypertension	71.9
Diabetes Mellitus	29.3
Chronic Obstructive Pulmonary Disease	19.5
Dementia	18.8
History of Myocardial Infarction	16.0
Congestive Heart Failure	15.4
Anti-Thrombolytic Drug Therapy*	12.3
Current Smoker	8.9
Major Psychiatric Disorder	6.3
Advanced Directive Limiting Care	5.8
Cerebrovascular Accident	5.3
Obesity	4.9
Other Pre-existing Conditions**	3.9
Functionally Debilitated Health Status	3.0
Alcohol Use Disorder	1.9

\* Includes Aspirin, Warfarin, Glycoprotein IIb/IIIa Inhibitors, and Novel Oral Anticoagulants/Thrombin Inhibitors

\*\* Not otherwise specified

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**Table 5**

## Injury Distributions

Injury	# with the diagnosis	% with the diagnosis
Head and neck soft tissue injury <sup>*</sup>	1955	50.2
Intra-cranial hemorrhage <sup>**</sup>	1557	40.0
Lower extremity fracture	1484	38.1
Concussion <sup>†</sup>	1390	35.7
Upper extremity fracture	1119	28.7
Spine fractures	1011	26.0
Skull and facial fractures	915	23.5
Lower extremity soft tissue injuries <sup>*</sup>	893	22.9
Upper extremity soft tissue injuries <sup>*</sup>	738	18.9
Rib fracture	649	16.7
Intra-thoracic injury <sup>‡</sup>	410	10.5
Intra-abdominal injury <sup>§</sup>	177	4.5

<sup>\*</sup> Includes lacerations, contusions, abrasions, hematomas and tissue avulsions to the body area. STI excludes fracture to the body area.

<sup>\*\*</sup> Includes subdural hemorrhage, subarachnoid hemorrhage, hemorrhage, epidural hematoma and cerebral contusion

<sup>†</sup> Includes loss of consciousness and concussion

<sup>‡</sup> Includes: pneumothorax, hemothorax, myocardial contusion

<sup>§</sup> Includes: liver laceration, bowel injury, aortic injury, spleen injury, renal injury