ATV Related Trauma in the Pediatric Population

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Disclosures

None

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ATV Epidemiology & Burden

- Prevalence
  - 81,800 ATV emergency-department treated injuries in US per year
  - 26% involved patients <16yo (around 21,500)
- Estimated Annual Cost - $2 Billon
- West Virginia Specific
  - 0.55% of US population – accounts for 5.2% ATV fatalities

-- Topping, USCPSC 2020
-- Campbell et al. J Ped Surg 2010
-- US Census 2019

US Consumer Product Safety Recs

- All drivers should take an ATV safety course
- Always wear a DoT certified helmet
- Never drive ATVs on paved surfaces
- Never allow more riders than ATV designed for
- Never operate ATVs under the influence
- Never let children under 6 years of age on ATVs

-- USCPSC 2020

WV Law

- ATV Definition
- Licensure
- Street Legal Special Purpose Vehicle
  - Valid Insurance
  - Registration similar to motorcycle

-- WV Legislature - 2020
-- Miley Legal

Street Legality

- Spark Arrestor
- ≥1 Headlight
- ≥1 Tail light
- ≥1 Brake light
- License Plate Light
- ≥1 Rear Reflector
- Front and Back Turn Signals
- Brakes
- Horn
- Functional Muffler
- Bilateral Rearview Mirrors
- Windshield or Driver Eye Protection
- Illuminated Speedometer
- Tires w 2/32in of tread

Study Goals

- Identify differences in accident demographics and substance use
- Characterize both the orthopedic and non-orthopedic injuries
- Establish pre-road legal injury baseline

Methods

- Retrospective Review of pediatric ATV trauma presenting at Ruby Memorial Hospital (2005-2020)
- Statistical review of to identify trends for targeted intervention

Patient Division

- 802 patients met inclusion criteria
- Patients were divided into 3 age groups
  - 0-7 years [n=128]
  - 8-12 years [n=177]
  - 13-17 years [n=497]

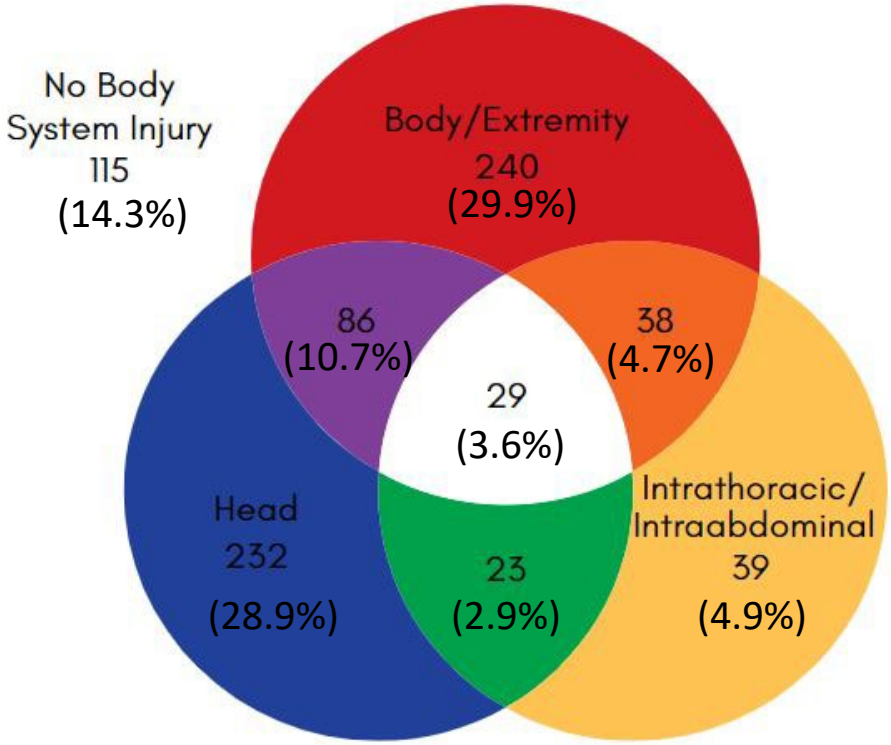
Demographics by Age (years)	0-7 (n=128)[a]	8-12 (n=177) [a]	13-17 (n=497) [a]	P[bc]
Sex				0.6063
Male	91 (71.1)	122 (68.9)	362 (72.8)	
Female	37 (28.9)	55 (31.1)	135 (27.2)	
Driver/Passenger				**<0.0001**
Driver	52 (40.6)	116 (65.5)	403 (81.1)	
Passenger	75 (59.4)	61 (34.5)	94 (18.9)	
Helmet				0.1992
Yes	38 (29.7)	69 (39.0)	164 (33.0)	
No	63 (49.2)	66 (37.3)	202 (40.6)	
Unknown	27 (21.1)	42 (23.7)	131 (26.4)	
Injury Setting				**0.0300**
Off-Road	118 (92.2)	171 (96.6)	453 (91.1)	
On-Road/Street	5 (3.9)	1 (0.6)	26 (5.2)	
Unspecified	5 (3.9)	5 (2.8)	18 (3.6)	
Race				0.3823
White	123 (96.1)	159 (89.8)	463 (93.2)	
American Indian or Alaskan Native	0 (0)	0 (0)	2 (0.4)	
Asian	0 (0)	0 (0)	1 (0.2)	
Black or African American	0 (0)	3 (1.7)	3 (0.6)	
Hispanic or Latino	0 (0)	0 (0)	1 (0.2)	
Unknown	5 (3.9)	15 (8.5)	27 (5.4)	

[a]Count and (%) within Age Group
[b]Likelihood Ratio Probability>ChiSquared
[c]Fisher's Exact when appropriate

Injury Categories by Age (years)	0-7 (n=128)[a]	8-12 (n=177) [a]	13-17 (n=497) [a]	P[bc]
Head/Face/Neck Injury	54 (42.2)	78 (44.1)	238 (47.9)	0.4221
Abdominal/Thoracic Injury	17 (13.3)	28 (15.8)	84 (16.9)	0.5959
Any Body/ Extremity Fracture	45 (35.2)	76 (42.9)	272 (54.7)	**<0.0001**
Closed Fracture	42 (32.8)	71 (40.1)	256 (51.5)	**0.0001**
Open Fracture	4 (3.1)	9 (5.1)	24 (4.8)	0.6499
Axial Fracture	2	14	99	
Lower Extremity Fracture	13	29	104	
Upper Extremity Fracture	95	135	373	
No Fractures	83 (64.8)	101 (57.1)	225 (45.3)	**<0.0001**
Single Fracture	37 (28.9)	56 (31.6)	182 (36.6)	0.1793
Multiple Fractures	8 (6.3)	20 (11.3)	90 (18.1)	**0.0005**

[a]Count and (%) within Age Group
[b]Likelihood Ratio Probability>ChiSquared
[c]Fisher's Exact when appropriate

Injury by Body System



Substance Use

- ETOH
  - Tested for in 316
  - Positive n=30
    - 9.4% of tested, 3.7% overall, 5.0% of oldest group
- UDS - Cannabinoids
  - Tested for in 233
  - Positive n=35
    - 15.0% of tested, 4.4% overall, 7.0% of oldest group

Limitations

- Retrospective study
- Limited to Ruby Memorial Hospital
- Lack long term follow up
- Expanded ATV use on roads

Next Steps

- Comparison of road injuries to post-legalization
- Collaboration review with general surgery department
- Design of targeted intervention

Conclusions

- ATV trauma presents significant cause of morbidity and mortality to pediatric population
- Helmet use has remained stagnant despite laws
- Targeted intervention strategies are much needed

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TABLE 3 Orthopedic Injury Summary	0-7 (n=128)[a]	8-12 (n=177)[a]	13-17 (n=497)[a]	Total (n=802)	P[bc]
Closed Fractures					
Scapula	2 (1.6)	4 (2.3)	9 (1.8)	15 (1.9)	0.9302
Clavicle	3 (2.3)	7 (4.0)	30 (6.0)	40 (5.0)	0.1465
Rib	2 (1.6)	9 (5.1)	28 (5.6)	39 (4.9)	0.0963
Spine	1 (0.8)	3 (1.7)	65 (13.1)	69 (8.6)	<0.0001
C-Spine	0 (0.0)	1 (0.6)	11 (2.2)	12 (1.5)	0.1227
T-Spine	0 (0.0)	1 (0.6)	20 (4.0)	21 (2.6)	0.0036
L-Spine	1 (0.8)	1 (0.6)	34 (6.8)	36 (4.5)	<0.0001
Pelvis	0 (0.0)	4 (2.3)	32 (6.4)	36 (4.5)	0.0001
Humerus	19 (14.8)	14 (7.9)	15 (3.0)	48 (6.0)	<0.0001
Forearm	7 (5.5)	23 (13.0)	60 (12.1)	90 (11.2)	0.0493
Hand (Carpal, Metacarpal, Phalanx)	1 (0.8)	0 (0.0)	17 (3.4)	18 (2.2)	0.0089
Femur	9 (7.0)	16 (9.0)	37 (7.4)	62 (7.7)	0.7585
Patella	0 (0.0)	0 (0.0)	4 (0.8)	4 (0.5)	0.4742
Tibia w/wo fibula	4 (3.1)	8 (4.5)	31 (6.2)	43 (5.4)	0.2937
Fibula (isolated)	0 (0.0)	0 (0.0)	3 (0.6)	3 (0.4)	0.7453
Ankle (Malleolus/Bimalleolar/Trimalleolar/Triplane)	0 (0.0)	2 (1.1)	12 (2.4)	14 (1.7)	0.1457
Foot (Tarsal, Metatarsal, Phalanx)	0 (0.0)	3 (1.7)	17 (3.4)	20 (2.5)	0.0487
Open Fractures					
Clavicle	0 (0.0)	0 (0.0)	1 (0.2)	1 (0.1)	1.0000
Humerus	2 (1.6)	0 (0.0)	6 (1.2)	8 (1.0)	0.2935
Forearm	1 (0.8)	2 (1.1)	5 (1.0)	8 (1.0)	1.0000
Hand (Carpal, Metacarpal, Phalanx)	0 (0.0)	1 (0.6)	3 (0.6)	4 (0.5)	1.0000
Femur	0 (0.0)	1 (0.6)	2 (0.4)	3 (0.4)	1.0000
Tibia w/wo fibula	1 (0.8)	3 (1.7)	8 (1.6)	12 (1.5)	0.8415
Ankle (Malleolus/Bimalleolar/Trimalleolar/Triplane)	0 (0.0)	2 (1.1)	3 (0.6)	5 (0.6)	0.5507
Foot (Tarsal, Metatarsal, Phalanx)	0 (0.0)	0 (0.0)	1 (0.2)	1 (0.1)	1.0000
Dislocations					
Sternoclavicular	0 (0.0)	0 (0.0)	1 (0.2)	1 (0.1)	1.0000
Acromioclavicular	0 (0.0)	0 (0.0)	2 (0.4)	2 (0.2)	1.0000
Cervical Spine	0 (0.0)	0 (0.0)	1 (0.2)	1 (0.1)	1.0000
Thoracic Spine	1 (1.6)	0 (0.0)	0 (0.0)	1 (0.1)	0.1596
Lumbar Spine	0 (0.0)	0 (0.0)	4 (0.8)	4 (0.5)	0.4742
Glenohumeral	0 (0.0)	0 (0.0)	2 (0.4)	2 (0.2)	1.0000
Elbow	1 (0.8)	0 (0.0)	6 (1.2)	7 (0.9)	0.4743
Radiocarpal	0 (0.0)	0 (0.0)	1 (0.2)	1 (0.1)	1.0000
Carpometacarpal	0 (0.0)	0 (0.0)	4 (0.8)	4 (0.5)	0.4742
Hip	0 (0.0)	1 (0.6)	3 (0.6)	4 (0.5)	1.0000
Ankle	0 (0.0)	0 (0.0)	2 (0.4)	2 (0.2)	1.0000
Tarsometatarsal	0 (0.0)	1 (0.6)	1 (0.2)	2 (0.2)	0.6163
Other					
Lower Extremity Compartment Syndrome	1 (0.8)	0 (0.0)	6 (1.2)	7 (0.9)	0.4743

TABLE 4 Orthopedic Procedures	0-7 (n=128)[a]	8-12 (n=177) [a]	13-17 (n=497) [a]	Total (n=802)	P[bc]
Joint Reduction					
Glenohumeral Reduction	0 (0.0)	0 (0.0)	2 (0.4)	2 (0.2)	1.0000
Elbow Reduction	0 (0.0)	0 (0.0)	3 (0.6)	3 (0.4)	0.7453
Hip Reduction	0 (0.0)	0 (0.0)	3 (0.6)	3 (0.4)	0.7453
Ankle Reduction	0 (0.0)	0 (0.0)	1 (0.2)	1 (0.1)	1.0000
Midfoot Reduction	0 (0.0)	0 (0.0)	2 (0.4)	2 (0.2)	1.0000
Axial Skeleton ORIF, CRIF, Fusion					
AC Joint	0 (0.0)	0 (0.0)	1 (0.2)	1 (0.1)	1.0000
Clavicle	0 (0.0)	0 (0.0)	3 (0.6)	3 (0.4)	0.7453
Pelvis	0 (0.0)	0 (0.0)	4 (0.8)	4 (0.5)	0.4742
Ex-Fix Pelvis	0 (0.0)	0 (0.0)	1 (0.2)	1 (0.1)	1.0000
Spinal Traction	1 (0.8)	0 (0.0)	4 (0.8)	5 (0.6)	0.6685
Cervical Fusion	1 (0.8)	0 (0.0)	3 (0.6)	4 (0.5)	0.6264
Thoracic Fusion	1 (0.8)	0 (0.0)	4 (0.8)	5 (0.6)	0.6685
Lumbar Fusion	0 (0.0)	0 (0.0)	5 (1.0)	5 (0.6)	0.4347
Lumbosacral Fusion	0 (0.0)	0 (0.0)	4 (0.8)	4 (0.5)	0.4742
Appendicular Skeleton ORIF, CRIF, IMN					
Humerus	16 (12.5)	9 (5.1)	4 (0.8)	29 (3.6)	<.0001
Ex-Fix Humerus	0 (0.0)	0 (0.0)	1 (0.2)	1 (0.1)	1.0000
Forearm	1 (0.8)	7 (4.0)	23 (4.6)	31 (3.9)	0.0621
Hand (Carpal, Metacarpal, Phalanx)	0 (0.0)	1 (0.6)	10 (2.0)	11 (1.4)	0.2009
Femur	7 (5.5)	16 (9.0)	39 (7.8)	62 (7.7)	0.4894
Patella	0 (0.0)	0 (0.0)	3 (0.6)	3 (0.4)	0.7453
Tibia	3 (2.3)	7 (4.0)	25 (5.0)	35 (4.4)	0.3545
Fibula	0 (0.0)	0 (0.0)	2 (0.4)	2 (0.2)	1.0000
Ankle (Malleolus/Bimalleolar/Trimalleolar/Triplane)	0 (0.0)	0 (0.0)	11 (2.2)	11 (1.4)	0.0358
Foot (Tarsal, Metatarsal, Phalanx)	0 (0.0)	1 (0.6)	6 (1.2)	7 (0.9)	0.5614
Ex-Fix Foot (Tarsal, Metatarsal, Phalanx)	0 (0.0)	0 (0.0)	1 (0.2)	1 (0.1)	1.0000
LE Fasciotomy	1 (0.8)	0 (0.0)	6 (1.2)	7 (0.9)	0.4743
Non-Operative Management					
UE Splint/Cast w/wo manipulation	9 (7.0)	16 (9.0)	43 (8.7)	68 (8.5)	0.7967
UE Brace/Sling	7 (5.5)	5 (2.8)	6 (1.2)	18 (2.2)	0.0128
LE Splint/Cast w/wo manipulation	5 (3.9)	8 (4.5)	21 (4.2)	34 (4.2)	0.9657
LE Brace	0 (0.0)	1 (0.6)	7 (1.4)	8 (1.0)	0.4544