

**Ranking the AIS body regions in  
regards to contribution to  
MVC-related mortality:  
A comparison of NASS and  
NTDB data**

**UAB CIREN Center**

# Background

- Crash occupants are assessed by max AIS score
  - Not sensitive to multi-trauma
- Current cost calculations use hierarchy based on AAAM AIS body region assignment

# Background

1: Head

2: Face

3: Neck

4: Thorax

5: Abdomen

6: Spine

7: Upper extremity

8: Lower extremity

# Background

- Designing methods to examine the mortality contribution of injuries is not new
  - Martin and Eppinger (2003 and 2005)
  - Zaloshnja (2004)
  - Eigen and Martin (2005)

# Background

- Martin and Eppinger (2003)
  - NASS-CDS 1993-2001
  - Four main injury groups
    - Head, chest, abdomen, lower extremities
  - Examined injuries noted as cause of death
    - 30% missing deaths missing cause
  - Used unweighted CDS cases

# Background

- Eigen and Martin
  - 1997-2003 NASS-CDS
  - MY 1998 and newer vehicles
  - Examined occupants with at least one AIS 2+ abdominal injury

# Background

- Each of these studies utilized data from NASS-CDS
  - 10+ year-old data
- As NASS oversamples severe collisions, results based on unweighted data may not be valid
- Use of other datasets needed to examine reliability of mortality ranks

# Background

1. What types of injuries should NHTSA strive to prevent?
2. What measurements are required of a crash dummy to ascertain whether such injuries are sustainable in a crash test?
3. How many lives may be saved under a given performance requirement to prevent such injuries?



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# Data Sources

- Crashworthiness Data System (2000-2012)
- National Trauma Data Bank (2000-2005, 2007-2010)
  - American College of Surgeons
  - Largest collection of trauma registry data in the nation
    - Over 3 million cases from nearly 1,000 trauma centers

# NTDB

- National Sample Program Research Data Set
- NTDB Research Data Set
  - Contains all records in the NTDB
  - Level I, II, III, IV, and undesignated trauma centers

# NTDB

- Limitations
  - Convenience sample
  - Not nationally representative
  - Data submitted voluntarily
  - Only includes persons admitted to a hospital

# Injury Definitions

- Body region
  - Head/Face
    - Secondary analysis excluding concussion injury
  - Neck
    - Brain stem, carotid/cerebral/vertebral arteries, cervical spine
  - Thorax
  - Abdomen/Pelvis
  - Lower extremities

# Injury Definitions

- Severity
  - AIS 2+/3+
  - Single and combination of injuries

Head	Neck	Thorax	Abdomen/ Pelvis	Lower Extremity
4	3	1	-	-
2	-	2	1	-
3	-	-	-	1

# Analysis

- Traditional mortality
- Attributable mortality risk

# Analysis

- Traditional mortality
  - Mortality risk examined for AIS 2+/3+ injuries
  - Single/Multiple injuries
  - By body region



# Traditional Mortality NASS

	AIS 2+ (uw)	AIS 2+ (w)	AIS 3+ (uw)	AIS 3+ (w)
Head/Face	22.45	9.06	43.93	27.66
w/o 16 codes	38.66	21.92	46.21	29.08
Neck	46.32	28.48	50.47	33.15
Thorax	34.52	18.56	38.40	24.15
Abdomen/Pelvis	41.43	24.44	48.16	30.75
Lower Extremity	18.76	8.84	24.41	16.44

# Traditional Mortality NTDB

	<b>AIS 2+</b>	<b>AIS 3+</b>
Head/Face	5.59	11.66
w/o 16 codes	9.10	11.12
Neck	8.15	12.11
Thorax	7.94	8.96
Abdomen/Pelvis	9.43	13.06
Lower Extremity	4.83	6.18

# Traditional Mortality Ranks

	AIS 2+		AIS 3+		Avg
	NASS	NTDB	NASS	NTDB	
Head/Face	4 (3)	4 (2)	3 (3)	3 (3)	3.50 (2.75)
Neck	1 (1)	2 (3)	1 (1)	2 (2)	1.50 (1.75)
Thorax	3 (4)	3 (4)	4 (4)	4 (4)	3.50 (4.00)
Abdomen/Pelvis	2 (2)	1 (1)	2 (2)	1 (1)	1.50 (1.50)
Lower Extremity	5 (5)	5 (5)	5 (5)	5 (5)	5.00 (5.00)

# Analysis

- Attributable mortality risk
  - Adopted from Martin and Eppinger (2003)

# Analysis

- Attributable mortality

Injury pattern	Mortality (%)
H-T-N	35
T-N	25
H-N	20
H-T	20
H	5
T	10
N	10

Body region	Attributable mortality
H	$(35-25)+(20-10)+(20-10)+5 = 35$
T	$(35-20)+(25-10)+(20-10)+10=50$
N	$(35-20)+(25-10)+(20-5)+10=55$

# Attributable Mortality NASS

	AIS 2+ (w)			AIS 3+ (w)		
	Sum	Avg	Rank	Sum	Avg	Rank
Head/Face	34.56	2.16	5	248.04	16.54	3
Neck	1026.63	64.16	1	781.09	52.07	1
Thorax	230.65	14.42	3	317.85	21.19	2
Abdomen/Pelvis	249.09	16.61	2	209.36	14.95	4
Lower Extremity	57.20	3.81	4	129.59	9.26	5

# Attributable Mortality NASS

	AIS 2+ (w)			AIS 3+ (w)		
	Sum	Avg	Rank	Sum	Avg	Rank
Head/Face w/o 16xxxx	213.64	13.35	3	285.12	19.01	3
Neck	919.67	57.48	1	758.37	50.56	1
Thorax	212.68	13.29	4	304.05	20.27	2
Abdomen/Pelvis	274.61	18.31	2	222.70	15.91	4
Lower Extremity	17.12	1.14	5	149.97	10.71	5

# Attributable Mortality NTDB

	AIS 2+			AIS 3+		
	Sum	Avg	Rank	Sum	Avg	Rank
Head/Face	127.07	7.94	3	251.83	16.79	1
Neck	140.17	8.76	1	169.22	11.28	2
Thorax	138.41	8.65	2	131.25	8.75	3
Abdomen/Pelvis	94.60	6.31	4	117.91	8.42	4
Lower Extremity	0.00	0.00	5	0.00	0.00	5



# Attributable Mortality NTDB

	AIS 2+			AIS 3+		
	Sum	Avg	Rank	Sum	Avg	Rank
Head/Face w/o 16xxxx	190.94	11.93	1	239.31	15.95	1
Neck	142.28	8.89	2	182.83	12.19	2
Thorax	139.14	8.70	3	132.95	8.86	3
Abdomen/Pelvis	95.86	6.39	4	120.16	8.58	4
Lower Extremity	0.00	0.00	5	0.00	0.00	5

# Attributable Mortality Ranks

	AIS 2+		AIS 3+		Avg
	NASS	NTDB	NASS	NTDB	
Head/Face	5 (3)	3 (1)	3 (3)	1 (1)	3.00 (2.00)
Neck	1 (1)	1 (2)	1 (1)	2 (2)	1.25 (1.50)
Thorax	3 (4)	2 (3)	2 (2)	3 (3)	2.50 (3.00)
Abdomen/Pelvis	2 (2)	4 (4)	4 (4)	4 (4)	3.50 (3.50)
Lower Extremity	4 (5)	5 (5)	5 (5)	5 (5)	4.75 (5.00)

# Ranks

	<b>Traditional Mortality Avg</b>	<b>Attributable Mortality Avg</b>
Head/Face	3.50 (2.75)	3.00 (2.00)
Neck	1.50 (1.75)	1.25 (1.50)
Thorax	3.50 (4.00)	2.50 (3.00)
Abdomen/Pelvis	1.50 (1.50)	3.50 (3.50)
Lower Extremity	5.00 (5.00)	4.75 (5.00)

# Conclusions

- Use of unweighted NASS-CDS data overestimates traditional mortality, but has minimal impact on attributable mortality
- Abdomen/pelvic injuries had the highest mortality rank for Traditional Mortality, but next-to-last for Attributable Mortality
- For both methods, neck injuries had highest mortality rank

# Conclusions

- Other than head/face injuries, rankings from NASS and NTDB data were similar
- Exclusion of concussive injuries had minimal impact overall on rankings

# References

- Martin, P.G. and Eppinger, R.H., “Ranking of NASS Injury Codes by Survivability,” 47<sup>th</sup> Annual Proceedings Association for the Advancement of Automotive Medicine, 2003.
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- Zaloshnja, E., Miller, T., Romano, E., Spicer, R., “Crash costs by body part injured, fracture involvement, and threat-to-life severity,” United States, 2000, Accident Analysis and Prevention, 2004.
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