

Pediatric Pedestrian and Cyclist Fatalities in Real World Collisions

**Michael Shkrum, Kevin McClafferty, Moheem Halari, Allison Pellar, Tanya
Charyk Stewart, Pascal Verville, Michael Pickup**

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Presentation Outline

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- Methodology
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- Limitations

Introduction

United Nations
1.35 Million

WHO Road Safety 2018
Road Traffic Injuries



Based on WHO Global Status
Report on Road Safety 2018 as of
September 8, 2021

IRTAD 2019
7% & 2.5%

Parachute Canada
Pedestrian Injuries

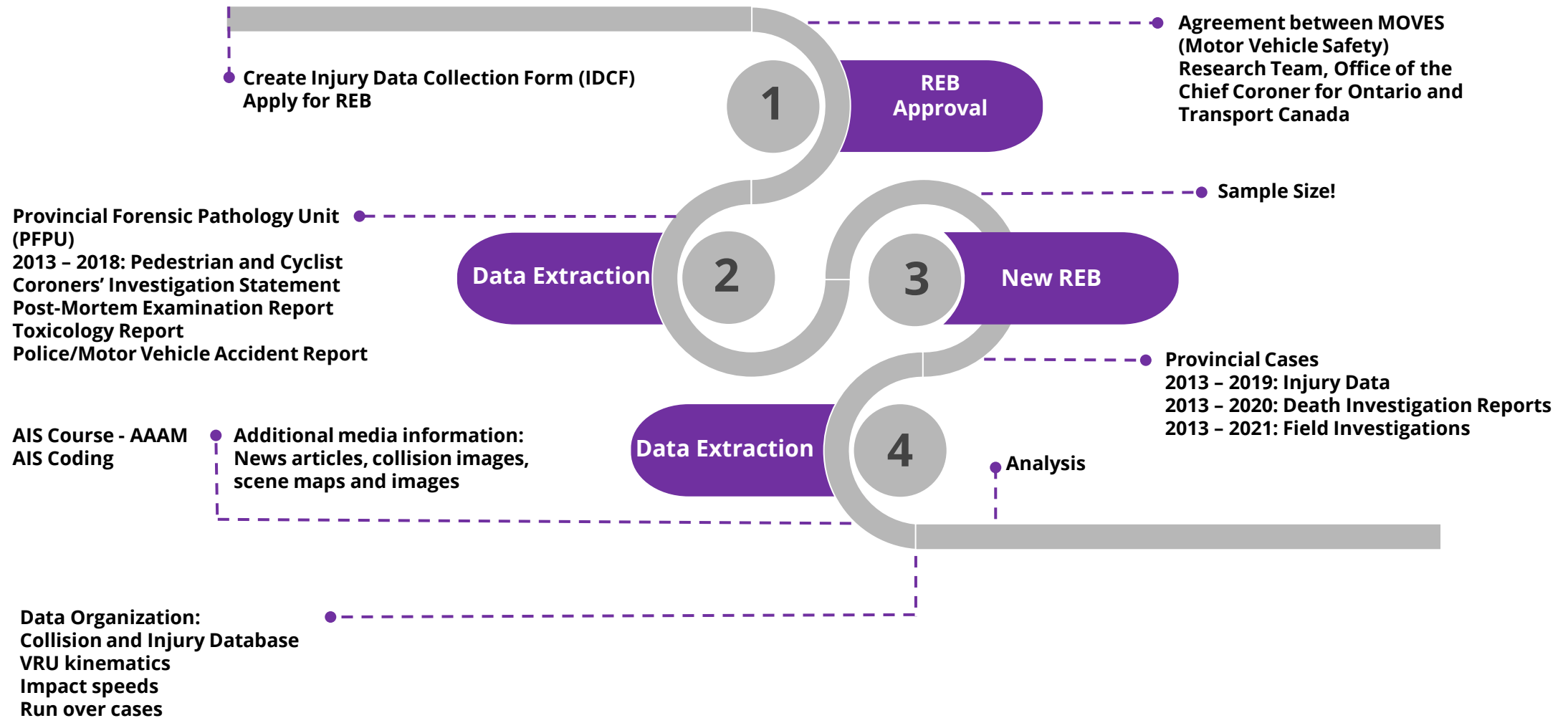
Introduction

- Collision avoidance safety feature: Pedestrian detection systems with automatic emergency braking (P-AEB)
- Comparisons are needed to assess these technologies and provide data and justification for design improvements.
- Factors such as lighting, vehicle body type, collision configuration, impact speed, VRU age and VRU pre-crash actions.

Objective

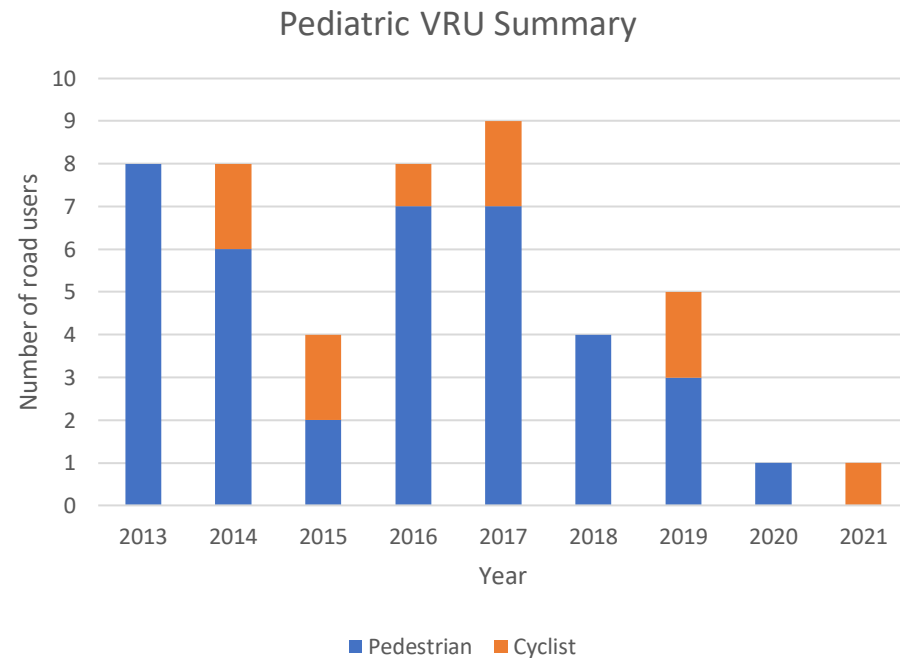
To compare real world fatal VRU crashes with the design criteria of current P-AEB systems on a cohort of fatal pediatric pedestrian and cyclist collisions in Ontario

Methodology



Results

2013 – 2021 (≤ 17 years): 48 VRUs (38 pedestrians and 10 cyclists)*



Age Group	≤ 14 years (Child)	15 - 17 years (Adolescent)
Pedestrian	27	11
Cyclist	7	3
Total	34	14

Conditions	Setting (n, %)
Area	Urban (n=34, 71%)
Weather	Clear (n=46, 96%)
Road Surface	Dry (n=44, 92%)
Lighting	Daylight (n=31, 65%)
Occurrence	Intersections (n=19, 40%)

*approximately 80% of Ontario pediatric VRU motor vehicle collision fatalities in the 2013 to 2021 period, as complete data were not available for the most recent years.

Results

	NO RUNOVER (n=21)			RUNOVER (n=27)			
	IMPACT SPEED RANGE (KM/H)			IMPACT SPEED RANGE (KM/H)			
SPEED LIMIT	31 - 50	51 - 70	71 +	0 - 30	31 - 50	51 - 70	TOTAL
SPEED LIMIT = 20 KM/H				1			1
SPEED LIMIT = 40 KM/H	1	1		4	1		7
SPEED LIMIT = 50 KM/H	1	3	1	5	2		12
SPEED LIMIT = 60 KM/H	2	5		2	1	1	11
SPEED LIMIT = 70 KM/H		1				1	2
SPEED LIMIT = 80 KM/H		2	2			1	5
SPEED LIMIT = 90 KM/H			1		1		2
N/A	1			7			8
TOTAL	5	12	4	19	5	3	48

Table 1 Impact Speed and Speed Limit Distribution for Runover and Non-Runover Collisions

Results

	NO RUNOVER		RUNOVER		
VRU KINEMATICS	CHILD	ADOLESCENT	CHILD	ADOLESCENT	TOTAL
FORWARD PROJECTION	4		19 (CY=2)	3	26
WRAP OR VAULT	5 (CY=3)	11 (CY=3)			16
REAR PROJECTION	1		3 (CY=1)		4
SIDE UNDERRIDE			2 (CY=1)		2
TOTAL	10	11	24	3	48

Table 2 VRU Kinematics in Runover and Non-Runover Collisions

Results

VEHICLE TYPE	NO RUNOVER		RUNOVER		TOTAL
	CHILD	ADOLESCENT	CHILD	ADOLESCENT	
CAR	5 (CY=3)	6 (CY=2)	3 (CY=1)	1	15
PICKUP	2		7 (CY=2)	1	10
MINIVAN	2	2 (CY=1)	2	1	7
SUV		2	5		7
HEAVY TRUCK			4 (CY=1)		4
VAN	1	1	2		4
TRANSIT BUS			1		1
TOTAL	10	11	24	3	48

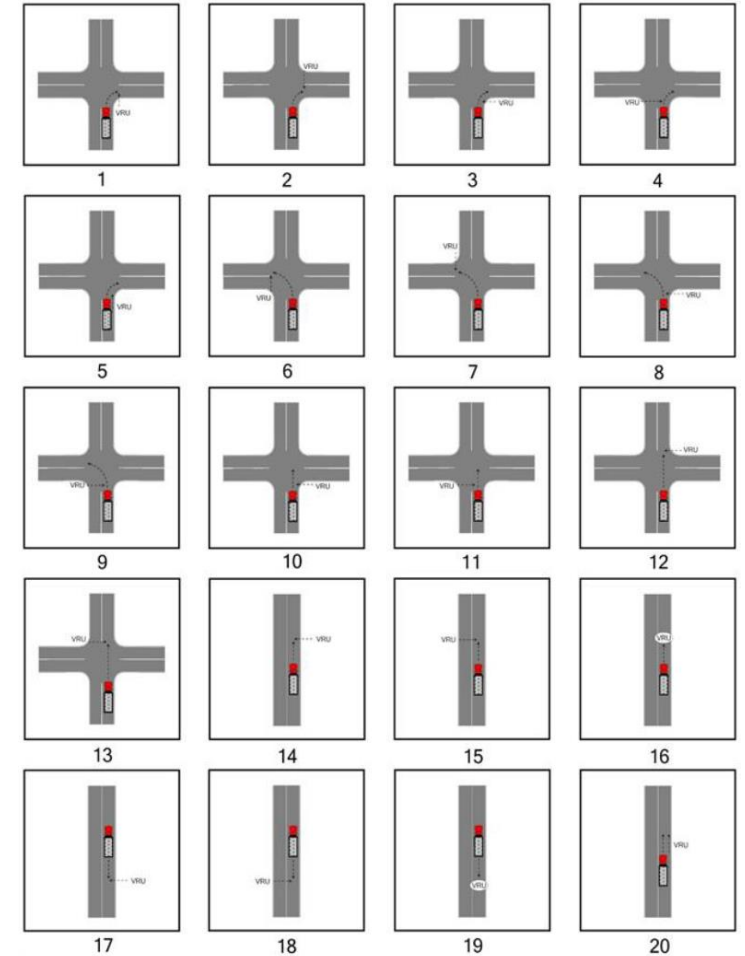
Table 4 Vehicle Type in Runover and Non-Runover Collisions

Results

VEHICLE PRE-CRASH ACTION	COLLISION CONFIGURATION	NO RUNOVER		RUNOVER		TOTAL
		CHILD	ADOLESCENT	CHILD	ADOLESCENT	
GOING AHEAD	10			1		1
GOING AHEAD	11	1	2			3
GOING AHEAD	12		1			1
GOING AHEAD	13	1				1
GOING AHEAD	14	2		4	1	7
GOING AHEAD	15	4	1	3		8
GOING AHEAD	16		1	1	2	4
GOING AHEAD	20	1	4			5
GOING AHEAD	10 or 11		1			1
LOST CONTROL	16		1			1
REVERSING	19	1				1
REVERSING	17			2		2
REVERSING	18			1		1
TURNING	3			2		2
TURNING	4			2		2
TURNING	6			3		3
TURNING	7			3		3
TURNING	9			1		1
TURNING	1 or 7			1		1
	TOTAL	10	11	24	3	48

Table 5 Collision Configuration Frequency in VRU Collisions

The most common pre-crash action was going ahead or travelling forward (n=31, 65%) which occurred in 19 of the non-runover cases (90%) and 12 of the runover cases (44%)



Results

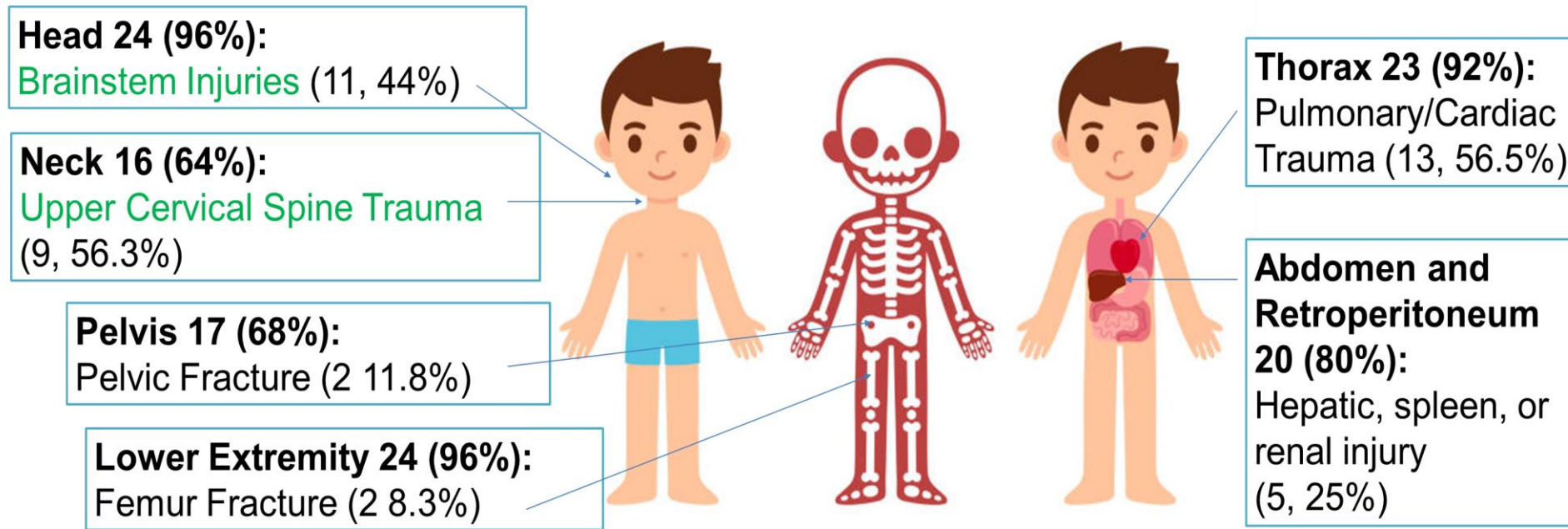
	NO RUNOVER		RUNOVER		
VRU PRE-CRASH ACTION	CHILD	ADOL	CHILD	ADOL	TOTAL
CROSSING WITH RIGHT OF WAY	2 (CY=1)		11 (CY=2)		13
CROSSING WITH NO TRAFFIC CONTROL	3	1	4	1	9
CROSSING WITHOUT RIGHT OF WAY	1 (CY=1)	4 (CY=2)			5
UPRIGHT IN PARKING AREA	1		3		4
WALKING ON ROADWAY WITH TRAFFIC		3			3
RUNNING OR RIDING ONTO ROAD	2 (CY=1)		1		3
RIDING ON ROAD WITH TRAFFIC		1 (CY=1)	1 (CY=1)		2
STANDING IN ROAD		1	1		2
SITTING IN PARKING AREA			1	1	2
SITTING ON ROAD				1	1
FELL OFF BICYCLE ONTO GROUND			1 (CY=1)		1
ON SIDEWALK OR SHOULDER		1			1
WALKING ON ROAD AGAINST TRAFFIC	1				1
RUNNING BESIDE VEHICLE			1		1
TOTAL	10	11	24	3	48

Table 6 VRU Pre-Crash Action in Runover and Non-Runover Collisions

The most common pre-crash action was crossing with the right of way (n=13, 27%) all involving children aged 14 years and under.

Results

2013 – 2018: there were 25 pediatric (0 – 14 years) pedestrian deaths in Ontario



The most frequent injury based on AIS ≥ 3 for each body region.

Vehicle Type	N, %
Pickup Truck	7 (28%)
Minivan	4 (16%)
SUV	4 (16%)
Car	3 (12%)
Van	3 (12%)
Heavy Truck	3 (12%)
Bus	1 (4%)
Total	25 (100%)

Vehicle type with frequency.

Results

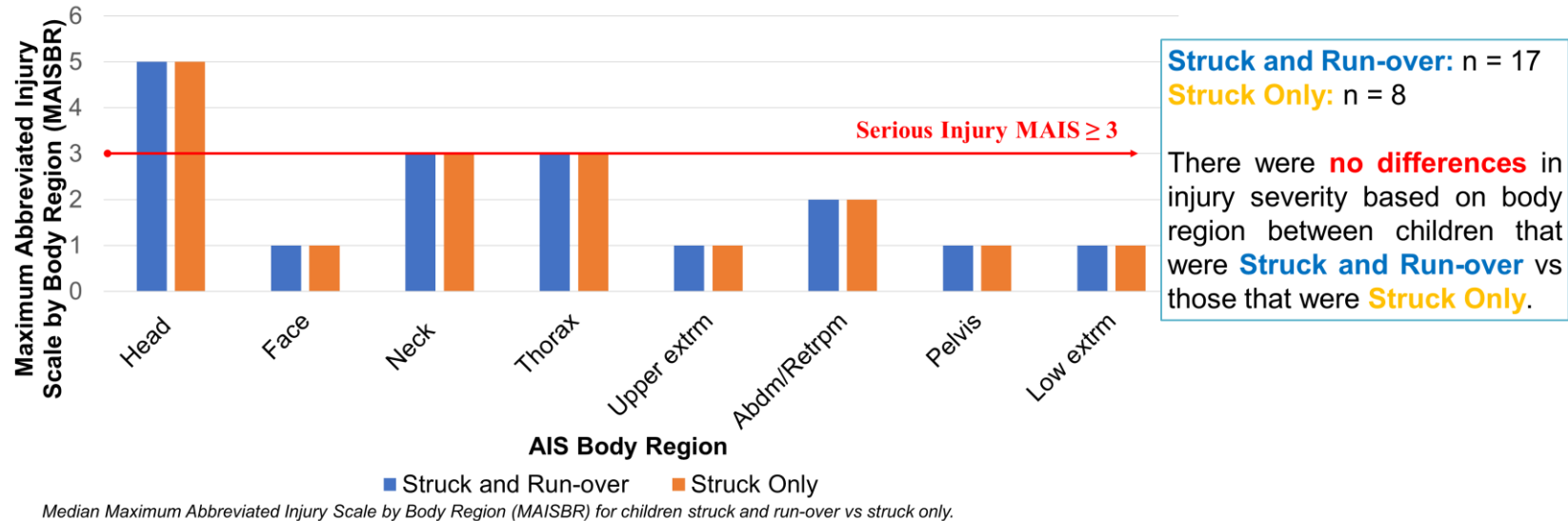
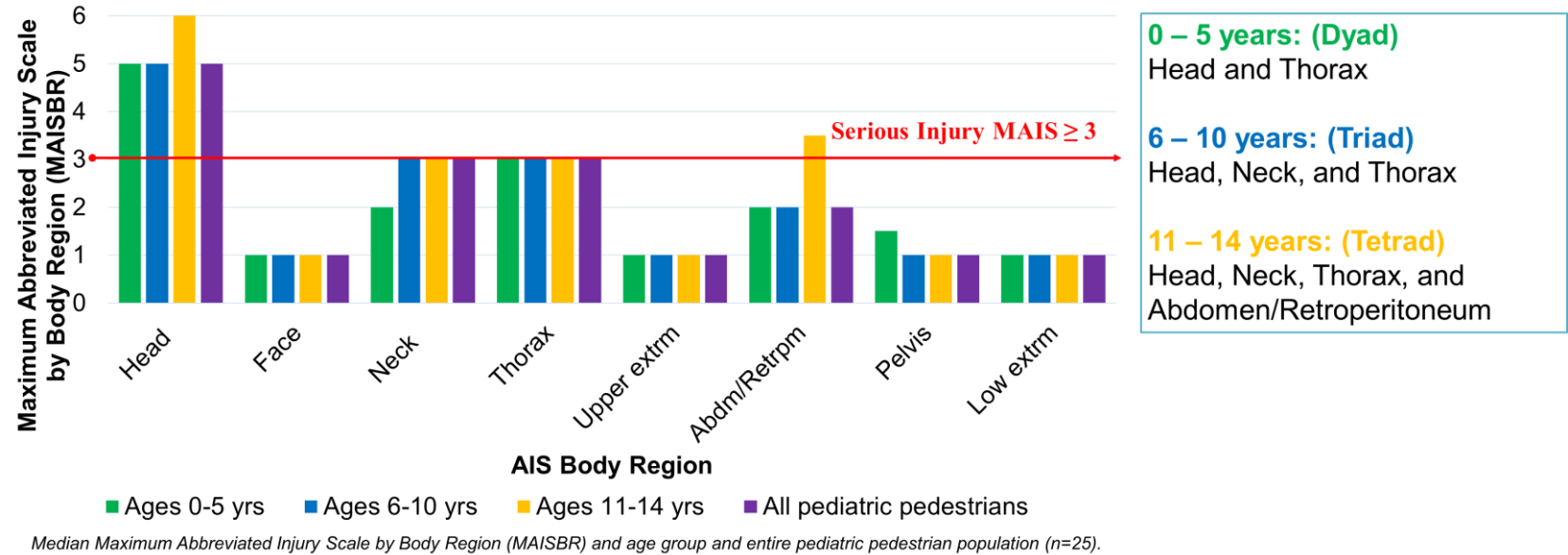
Waddell's Triad:

- 1) Fractured Femoral Shaft
- 2) Intra-thoracic or Intra-abdominal Injuries
- 3) Contralateral Head Injury

Waddell JP, Drucker WR. Occult injuries in pedestrian accidents. J Trauma. 1971;11(10):844-52.

Original Waddell's Triad:

- 1) Injury about the knee
- 2) Injury to the hip or pelvis
- 3) Craniocerebral injury



Significance

- Fatal pediatric collisions (≤ 14 years) almost always occurred in lighted conditions and typically involved low speeds and runover.
- Large vehicles played a major role in the LSVRO collisions.
- Current technology P-AEB collision avoidance systems may have been effective.
- Collisions with turning vehicles were common.

Limitations

- The mannequins used in NCAP and Euro-NCAP testing.
- The higher potential for false positive detections in turning collisions with current technology systems are of concern.
- Predicting the effectiveness of future ADAS systems is difficult as their field performance characteristics are rapidly changing.

Western University Motor Vehicle Safety Research Team:

Michael Shkrum, MD

Kevin McClafferty, BEMSc

Moheem Halari, MBBS

Allison Pellar, MEng

Tanya Charyk Stewart, MSc

Transport Canada:

Pascal Verville, BEMSc

Provincial Forensic Pathology Unit:

Michael Pickup, MD

Collaborators:

Dr. Michael Pollanen (Chief Forensic Pathologist for Ontario)

Dr. Michael Pickup (Forensic Pathologist)

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