

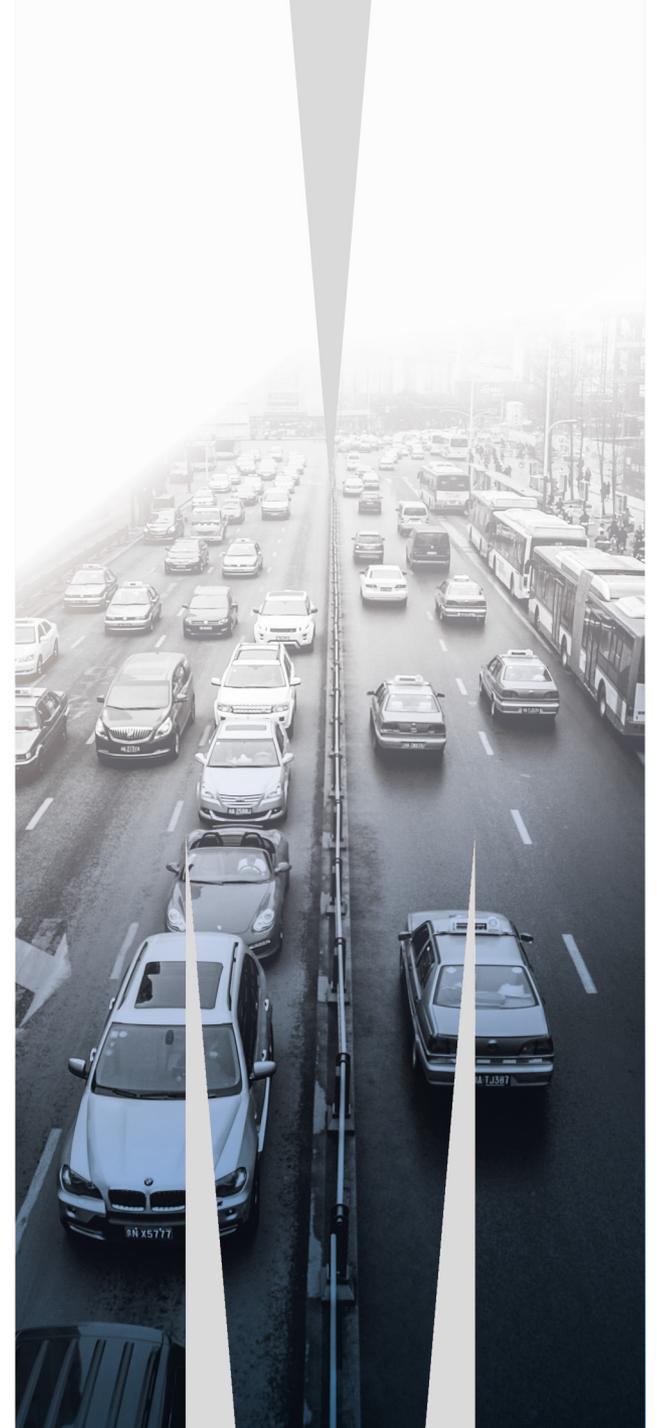
# Identifying system failures and reducing demand for post-crash care (Part 1)

Associate Professor Michael Fitzharris

ACRS Victorian Chapter, AITPM and RACV Seminar Series

Webinar

Wednesday 2<sup>nd</sup> December 2020



# ECIS Partners



MONASH  
University

ACCIDENT  
RESEARCH  
CENTRE

AlfredHealth

n<sup>+</sup>tri national trauma  
research institute



The Royal  
Melbourne Hospital

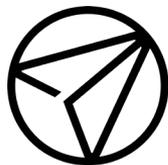
ASU SANDRA DAY O'CONNOR  
COLLEGE of LAW  
ARIZONA STATE UNIVERSITY

Loughborough  
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VirginiaTech  
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Department of Biomedical  
Engineering and Mechanics



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# Preliminary

The original presentation featured images of crashed vehicles and crash scenes to highlight system failures. This is permitted for educational purposes in workshops and similar, however due to the public availability of this presentation these have been removed.

Note: ECIS and the use of information has been approved by, and is subject to conditions of:

- The Alfred Hospital Human Research Ethics Committee (HREC)
- The Royal Melbourne Hospital HREC
- Monash University HREC

# Understanding serious injury crashes: the ECIS program

## Rationale

- Serious injury is associated with significant physical and mental health impacts for those involved and can be thought of as “the hidden toll”
- The number of road users seriously injured has increased
- In *TAC 2020*, the TAC committed to the ambition of eliminating serious injury from Victorian roads

## Objective

- The ECIS program was designed to provide the TAC insight into how crashes occur, identify factors associated with serious injury, and to identify effective and sustainable countermeasures



# ECIS Crash investigation

- Our Research Nurses obtained participation from 400 drivers (18 – 93 years, 55% male; 37% rural) or their family following admission to The Alfred or the Royal Melbourne
- “I was heading out with my boyfriend and ....”*
- Our team inspected the vehicle and the scene, obtained all possible information, and reconstructed the crash
  - Synthesised each crash to determine presence or absence of factors across the human, vehicle and road environment that contributed to crash occurrence and injury severity
  - Developed & implemented a case-by-case **Safe System Failure Analysis, based in Vision Zero**

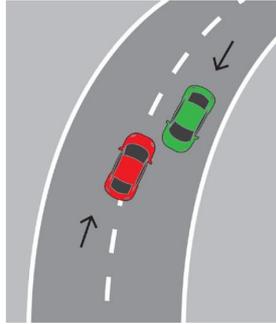
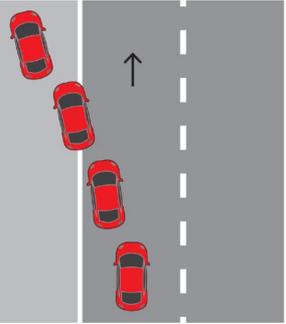


# Examining crashes based on vehicle movement drives countermeasures

## LANE DEPARTURE

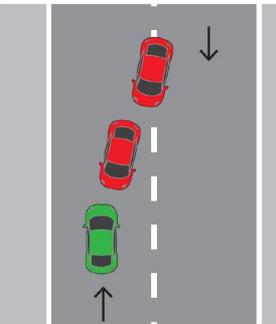
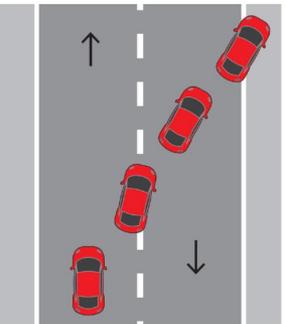
OFF-ROAD TO LEFT

HEAD-ON, ON CURVE



OFF-ROAD TO RIGHT

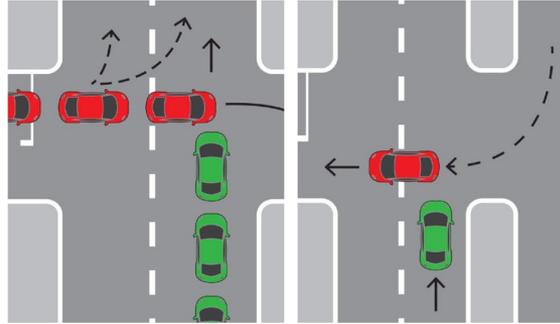
HEAD-ON, ON STRAIGHT



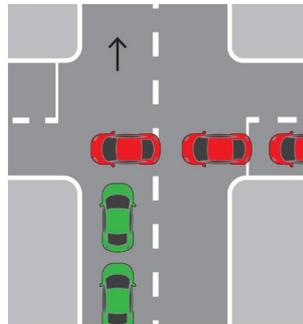
## ACROSS PATH

ENTER CARRIAGEWAY

TURN ACROSS



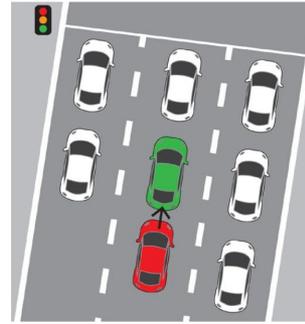
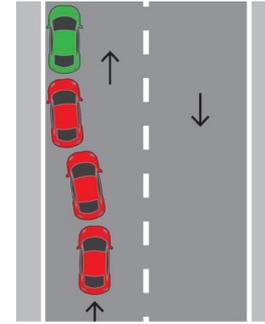
CROSS TRAFFIC



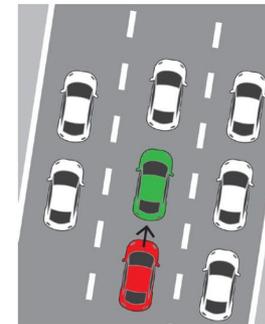
## REAR IMPACT

INTO PARKED (MIDBLOCK)

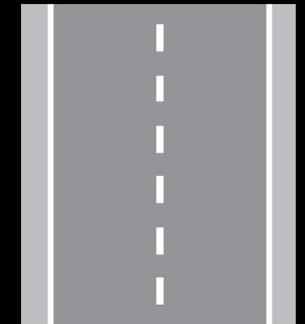
AT INTERSECTION



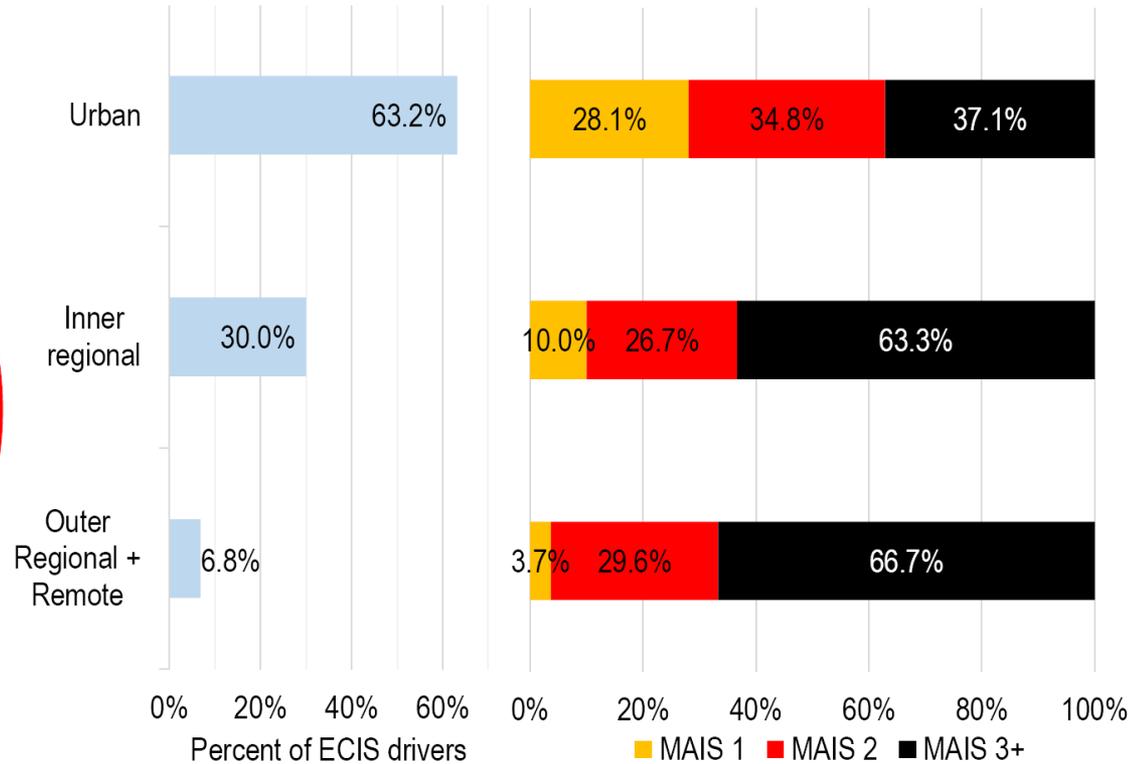
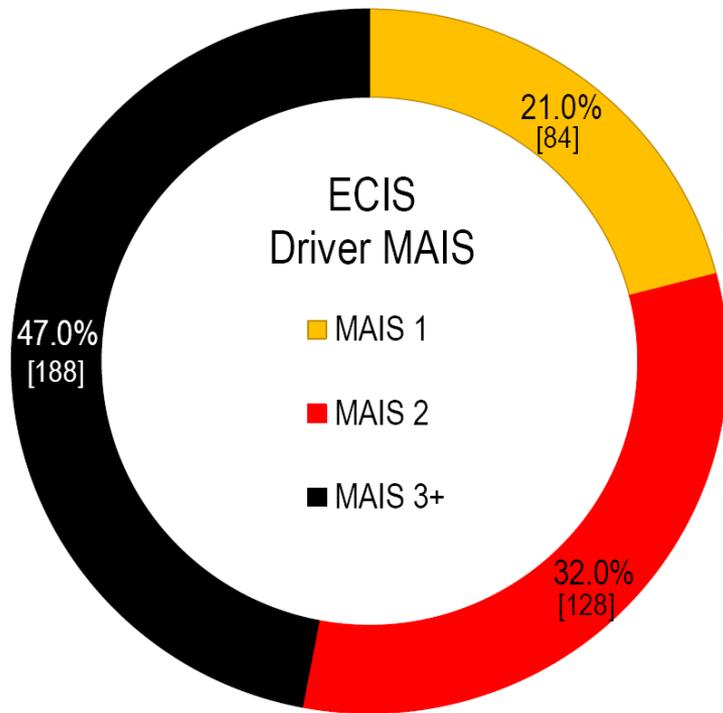
IN TRAFFIC (MIDBLOCK)



OTHER

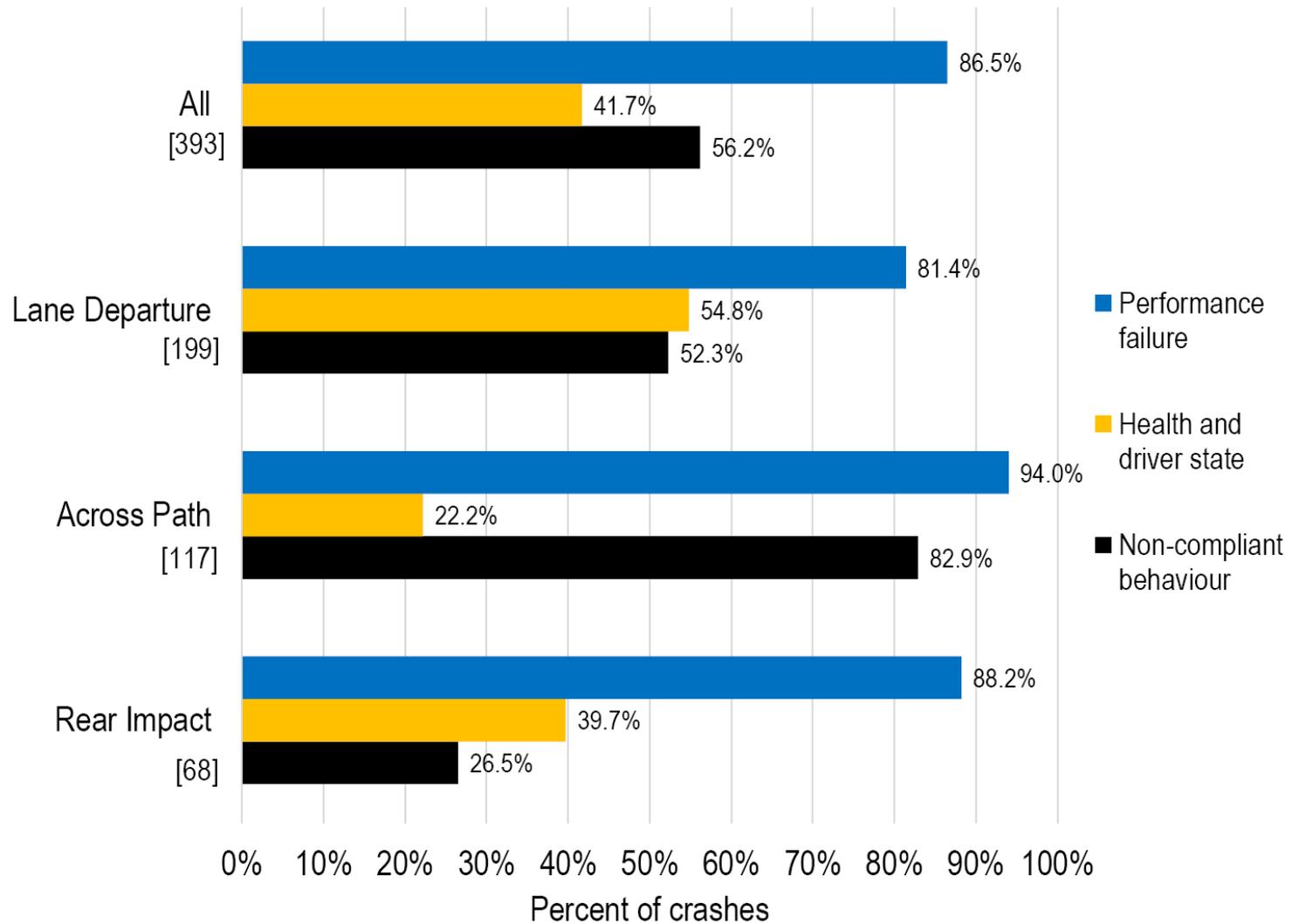


# Injury severity was high, especially in Lane Departure crashes



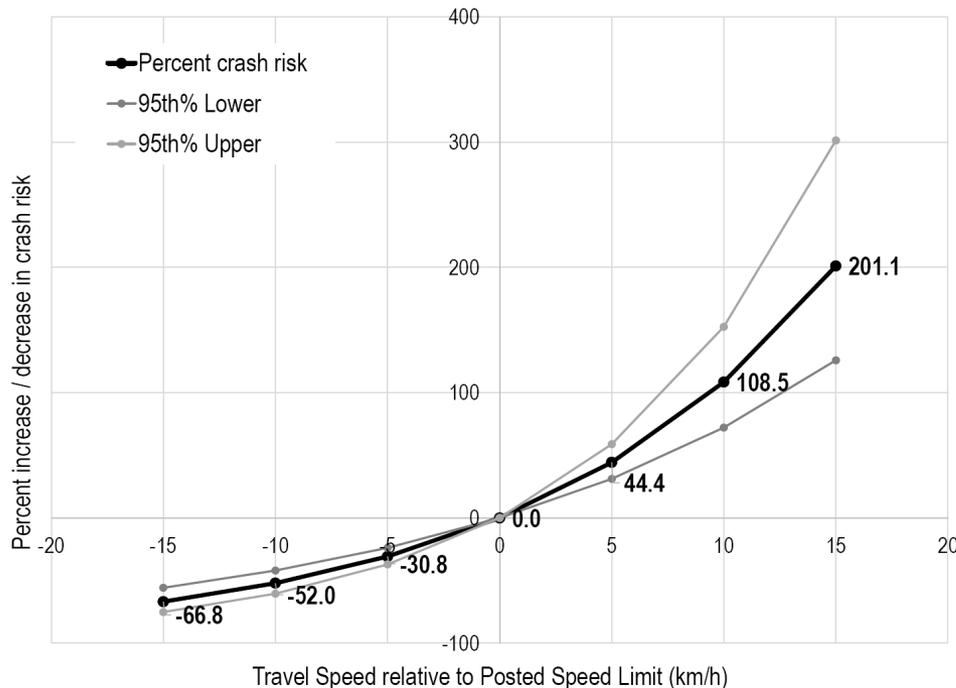
- **Lane Departure** crashes were significantly more injurious: MAIS 3+ (57.5%) + MAIS 2 (30.7%); longer LOS (10 days); rehabilitation: 47.5%
- **Across Path** crashes: MAIS 3+: 44.2%; LOS: 7 days; rehabilitation: 34.2%

# Crashes happen for many reasons, often more than one



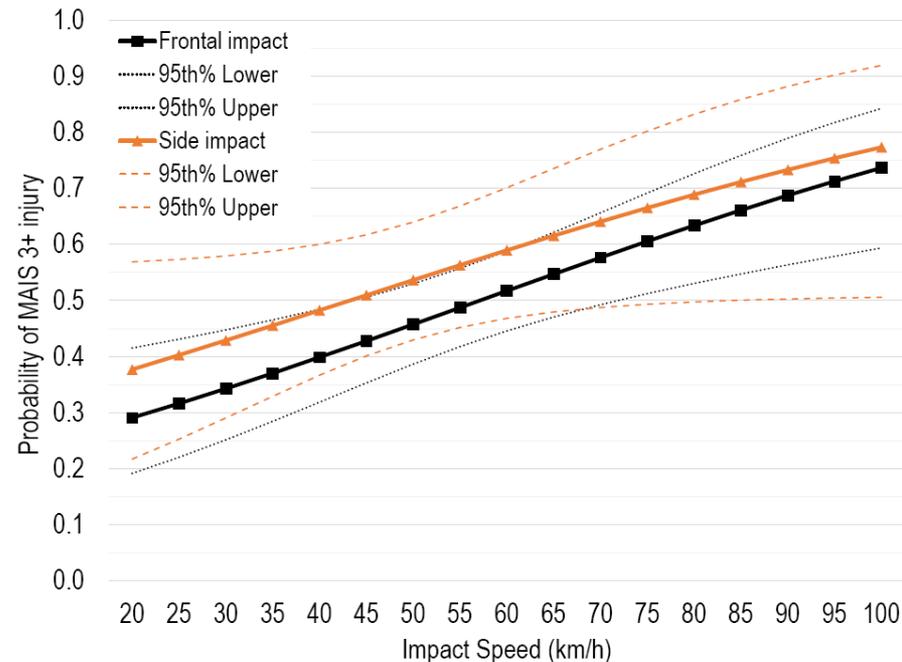
# Speed and its links to crash risk and injury severity

- Robust relationship exists between travel speed and crash risk
- Exceeding the speed limit is associated with an increased crash risk



Statistical model: Conditional logistic regression, age/sex adjusted, excludes alcohol/illicit drug  
Matched: day of week, 30-minute crash window; vehicle/movement

- Impact speed drives injury severity
- Injury severity differs by impact type
- Modified by object struck / striking
- Limited time-to-brake; 45% do not
- Exacerbated by exceeding speed limit



# Engineering safety in the vehicle and the road

## Vehicles:

- ECIS data demonstrates safety benefits of 5-star cars, with 17.2% of drivers of 2014 – 2016 MY vehicles sustaining MAIS 3+ crashes, compared to 55% for 3-star cars and less
- Vehicles have limits in how they protect occupants from serious injury, as seen in impact speed relationship. Key focus is ‘crash-packaging’ and ‘crashworthiness’
- The striking / struck object further modifies the injury severity
- **Occupants being ‘trapped’ due to vehicle crush / structural deformation – links directly to IMPACT SPEED**

## Roads:

- Road infrastructure, safety by design and matched speed limits, includes principle of liveability
- Key threats:
  - lack of physical separation to on-coming traffic or road side objects
  - scenarios where manoeuvres across path required without any measures to influence driver perception of other vehicles, to modify driver speed, or act to reconfigure the impact
- ECIS data: 58% higher risk of making an error at locations where latent risk was considered

# Vision Zero and the concepts underpinning the Safe System

- *The Vision Zero* model establishes design parameters and performance criteria to generate an **inherently safe system**, which once met results in the **elimination** of serious injury (MAIS 3+)
- Principles adopted in the *Safe System approach*
- Drivers need to be responsive, attentive and compliant with the established use rules of the system plus the road infrastructure and speed limits must align with vehicle safety performance given **predictable and foreseeable crash types**

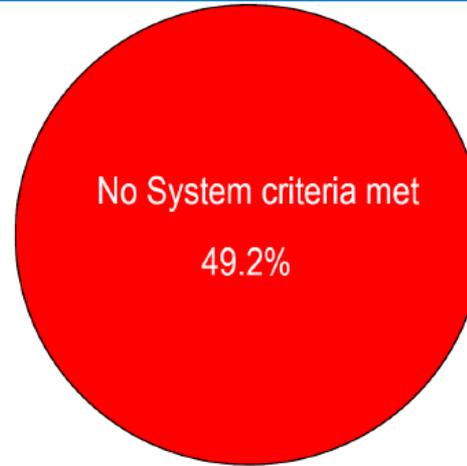
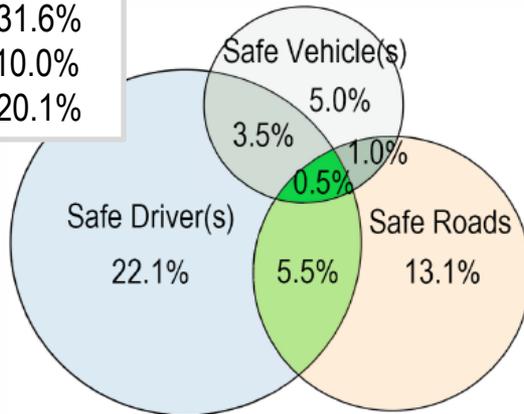
## Criteria for an inherently safe road transport system (“system boundary”)

Safe Drivers	Safe Vehicles	Safe Roads
<ul style="list-style-type: none"> <li>▪ Seat-belt worn.</li> <li>▪ Driving within the speed limit.</li> <li>▪ Not using a mobile phone (or related nomadic device).</li> <li>▪ Blood alcohol within legal limit for licence class.</li> <li>▪ No illicit drugs present.</li> </ul>	<ul style="list-style-type: none"> <li>▪ 5-star rated vehicle</li> <li>▪ ESC fitted</li> <li>▪ Frontal airbags</li> <li>▪ Side head-protecting impact airbags</li> </ul>	<p>Required to protect against serious injury:</p> <ul style="list-style-type: none"> <li>▪ Head-on               <ul style="list-style-type: none"> <li>▪ For speed limit <math>\leq 70</math> km/h, safe vehicle expected to protect</li> <li>▪ For speed limit <math>&gt; 70</math> km/h, safe vehicle plus separation required</li> </ul> </li> <li>▪ Run-off-road:               <ul style="list-style-type: none"> <li>▪ <math>\leq 50</math> km/h: safe vehicle will protect</li> <li>▪ <math>&gt;70</math> km/h = barrier</li> </ul> </li> <li>▪ Across Path (intersection):               <ul style="list-style-type: none"> <li>▪ <math>\leq 50</math> km/h: safe vehicle</li> <li>▪ <math>&gt; 50</math> km/h: safe vehicle + grade separation (forbid interaction) or roundabout</li> </ul> </li> </ul>

# System gaps and injury outcomes

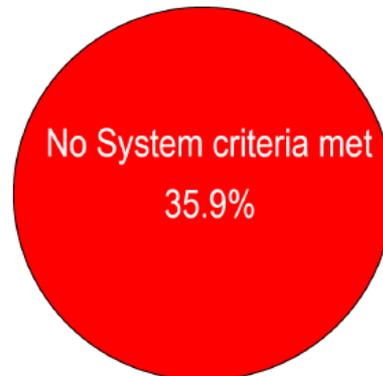
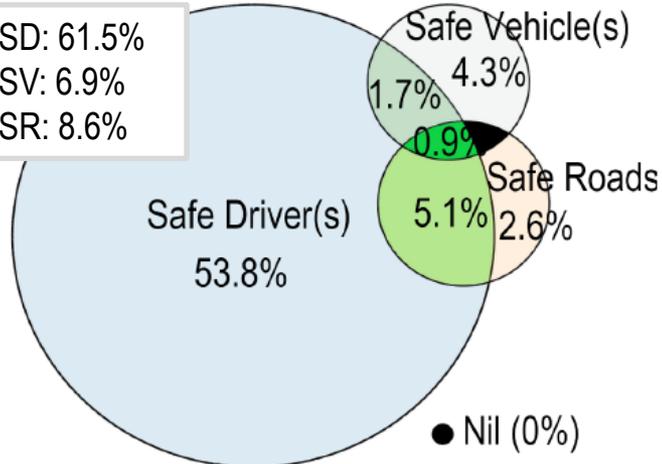
## LANE DEPARTURE CRASHES

SD: 31.6%  
SV: 10.0%  
SR: 20.1%



## ACROSS PATH CRASHES

SD: 61.5%  
SV: 6.9%  
SR: 8.6%



- Proportion of crashes where all Safe Driver, Safe Vehicle, and Safe Roads criteria were met was low
- High proportion of crashes where no system criteria were completely met**
- Failure to meet the criteria was associated with MAIS 3+ injury, a longer length of stay in hospital, the need for rehabilitation care

# Opportunities to reduce road trauma: a pressing need

- Taking a data-driven approach demonstrates how the current 'system' performs and highlights gaps in the safety performance of the road transport system
- There is a lack of 'system-level' protection for *Safe Drivers*
- Exemplar crashes demonstrate the misalignment of the engineering limits of vehicles with the road environment, pointing to a need for engineering solutions
- Demonstrates the need to improve all elements of the system **concurrently**
- Active safety systems (ADAS, C-ITS) and further improvements in 'passive safety' will play a key role, but the form and design of the road infrastructure and matched speed limits are critical, as is driver compliance
- From a trauma treatment perspective, the very high severity nature of these crashes creates challenges for EMS / first responders, which is step one on the journey to recovery

**A moment to pause and to  
pass to Dr John Crozier,  
Chair, National Trauma Committee  
Royal Australasian College of Surgeons**

For full ECIS report, please see **MUARC** website:

<https://www.monash.edu/muarc>

ECIS Report 1 Symposium material is available at the **TAC**:

<http://www.tac.vic.gov.au/road-safety/statistics/about-tac-surveys?drop=3>

