

# Potential Active Safety Benefits for Motorcyclists in the U.S.

H. Clay Gabler

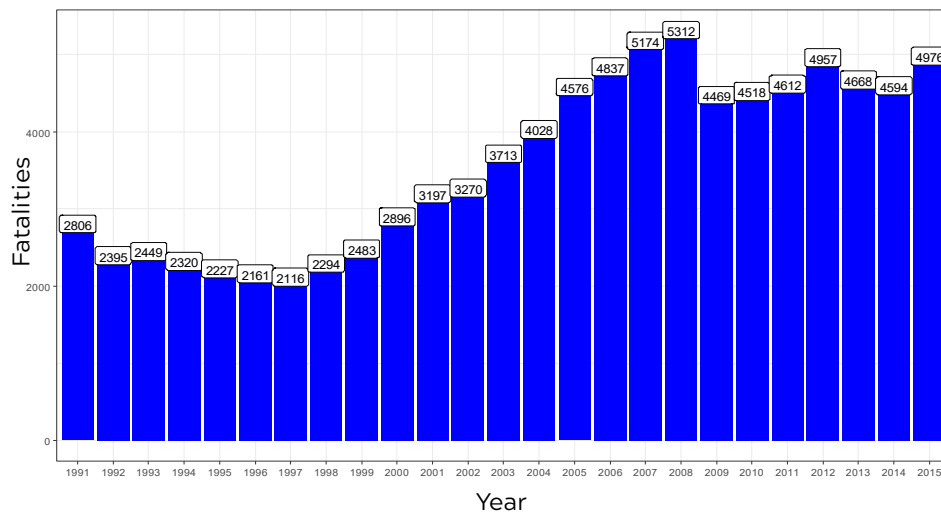
COST: "Active Safety Technologies and V2X Concepts" Meeting  
21 March 2018



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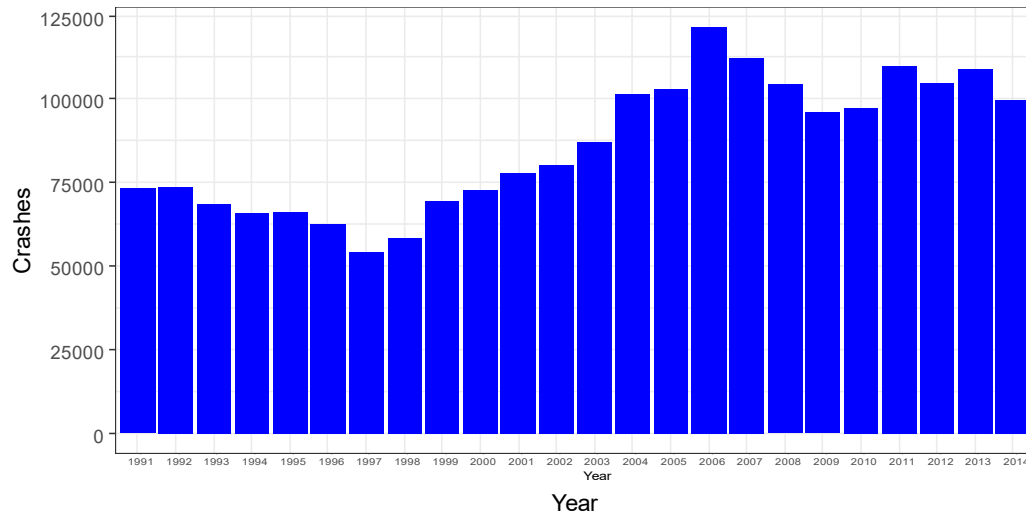


## US Motorcycle Fatalities (1991-2015)



2

## US Motorcycle Crashes (1992-2015)



3

## Helmet Use in the US

- Only 19 of 50 states have helmet laws in US
- 41% of fatally injured riders are unhelmeted
- 29% of crashes involved an unhelmeted rider

4

## Objective

To estimate the potential reduction in fatal motorcycle crashes from active safety technologies

5

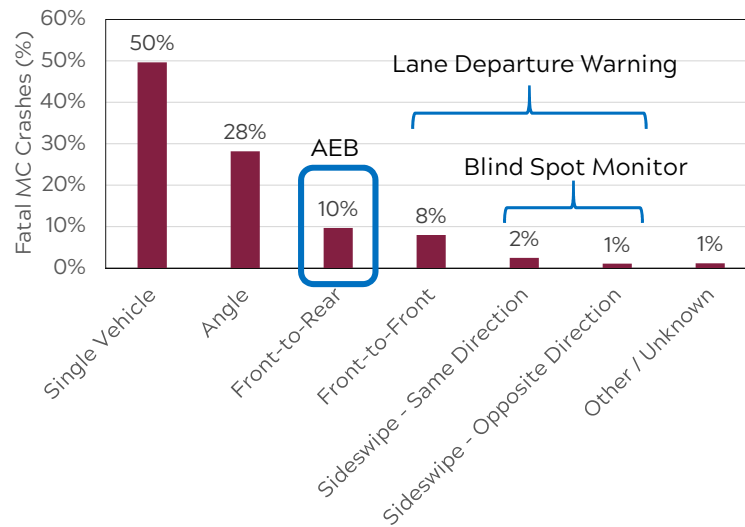
## Data Sources

Database	Severity	Number of Cases	Weighted Cases
Fatal Automotive Reporting System (FARS)	Fatalities	27,656	27,656
National Automotive Sampling System - General Estimates System (NASS-GES)	All	16,218	617,000

- 2010-2015
- Include all crashes involving motorcycles

6

## Fatal Motorcycle Crash Types (2010-2015)

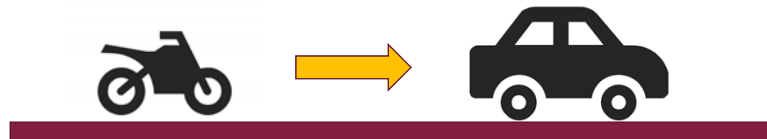


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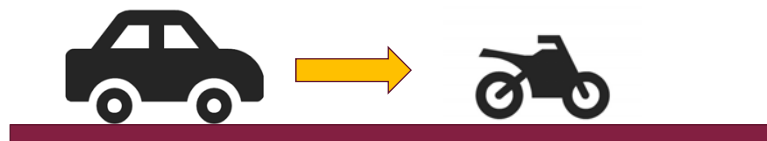
## Front-to-Rear Crashes

- AEB as a countermeasure

Scenario 1:  
MC Strikes OV

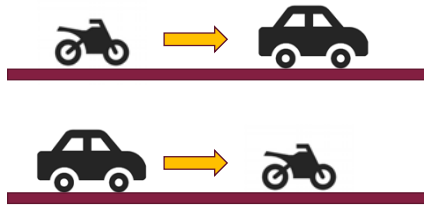


Scenario 2:  
OV Strikes MC



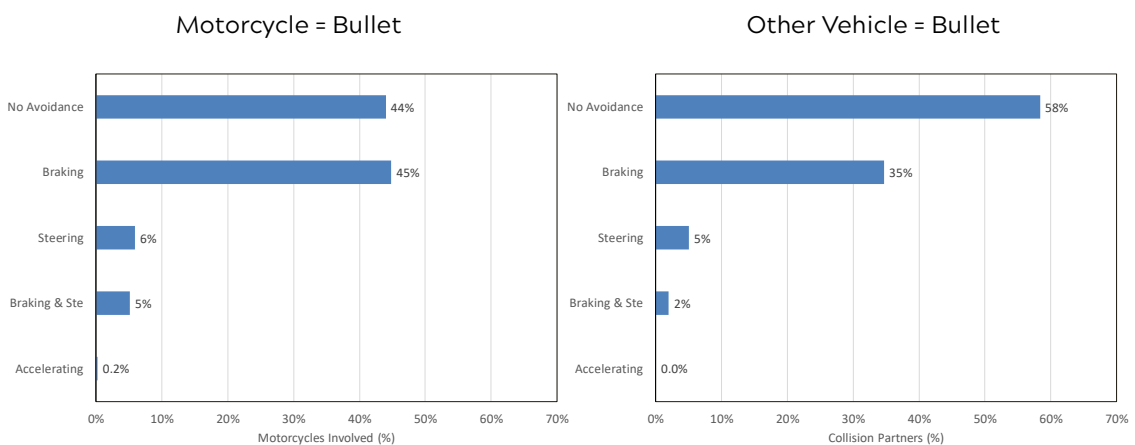
8

## Approach



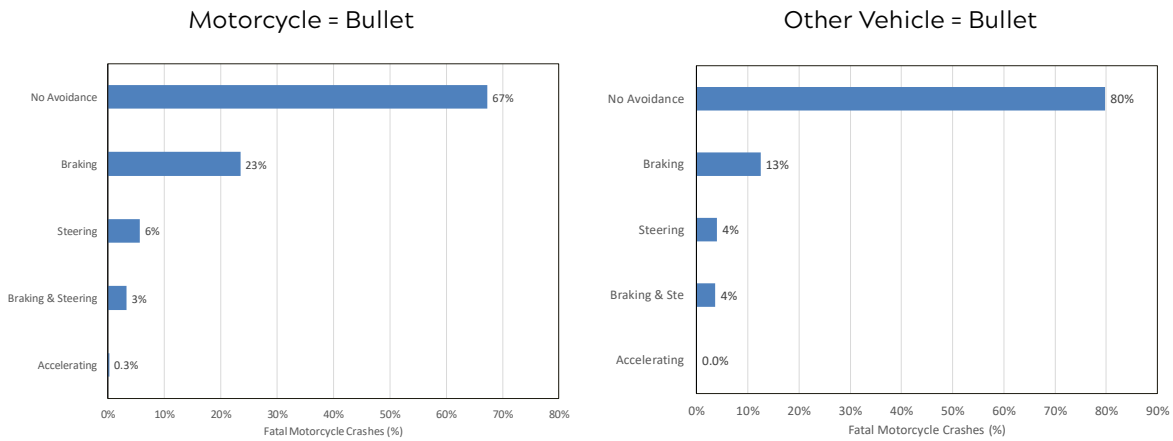
- Front-to-Rear Crashes
- Exclude Loss of Control
- Exclude Crash Avoidance
- Assess AEB limits
  - Sensors degrade in bad weather
  - Cameras limited at night
  - May deactivate with rider steering

## Bullet Vehicle Avoidance Actions: All Rear Crashes



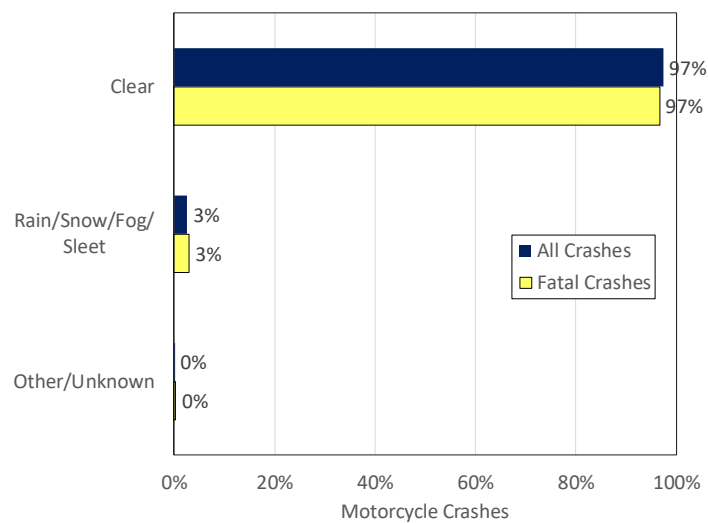
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## Bullet Avoidance Actions: Fatal Rear Crashes



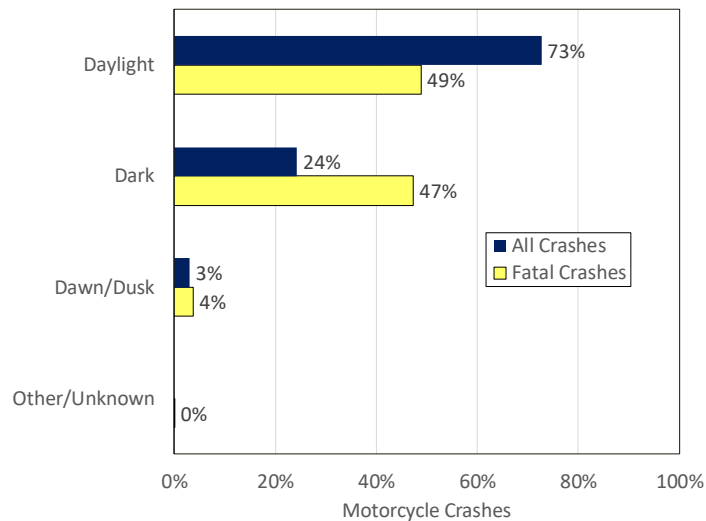
11

## Weather in Rear Crashes



12

## Lighting in Rear Crashes



13

## Potential Benefits of AEB

Max Annual Fatal Rear MC Crashes Avoided or Mitigated

Target Population	MC Bullet	Other Vehicle Bullet	Total
All Front-to-Rear	276	144	420
Exclude crashes with avoidance, e.g. steering	185	115	300
Daylight only, No Avoidance	91	56	147

14

## Potential Benefits of AEB

Max Annual Rear MC Crashes Avoided or Mitigated

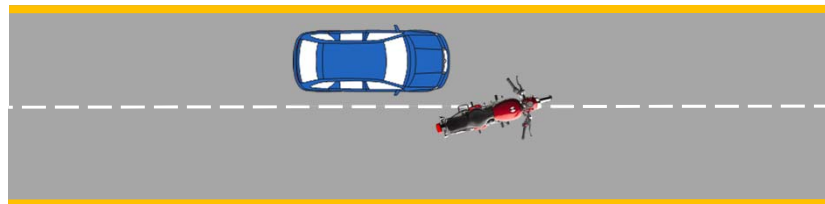
Target Population	MC Bullet	Other Vehicle Bullet	Total
All Front-to-Rear	7,300	6,600	13,900
Exclude crashes with braking or steering	3,500	3,800	7,300
Daylight only, No Avoidance	2,600	2,800	5,400

15

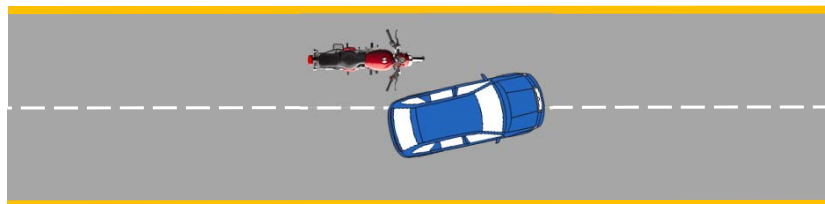
## Lane Changing / Merging Crashes

- Blind Spot Monitoring (BSM) as a countermeasure

Scenario 1:  
MC Encroaches

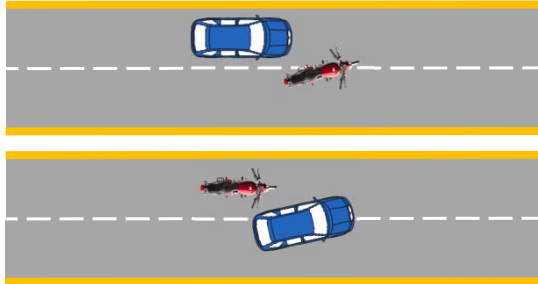


Scenario 2:  
OV Encroaches





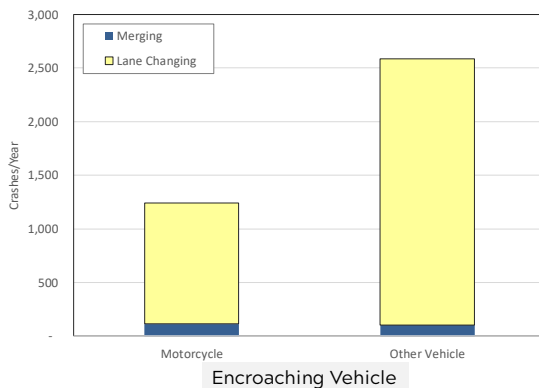
## Approach



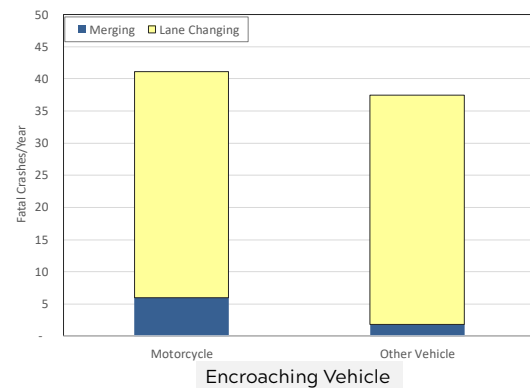
- Blind Spot Monitoring (Side View Assist)
- Include all purposeful lane changes & merges
- Exclude Loss of Control, Vehicle malfunctions, and crash avoidance
- BSM Limits
  - Inclement Weather
  - Daylight for Camera Based systems

## Lane Changing Crashes

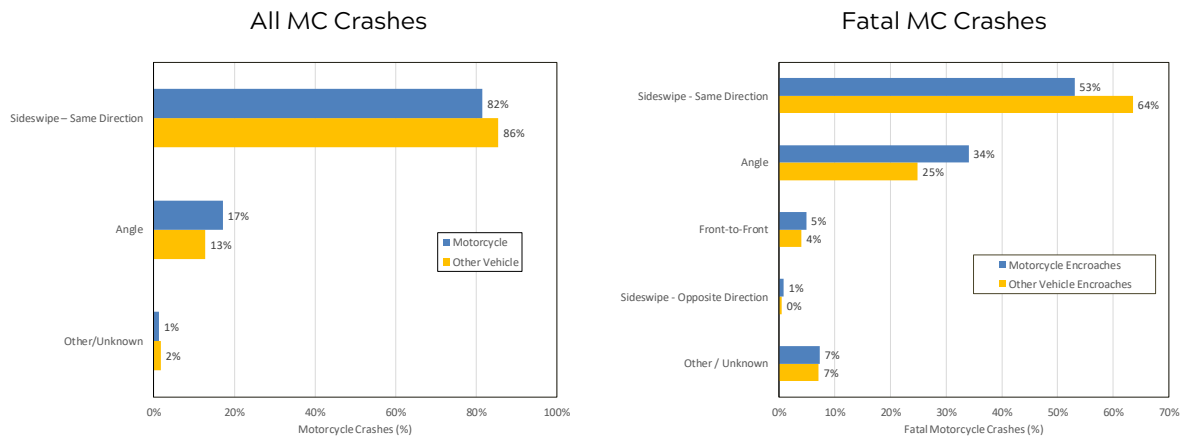
3,800 Motorcycle Crashes / Year



80 Fatal Motorcycle Crashes / year

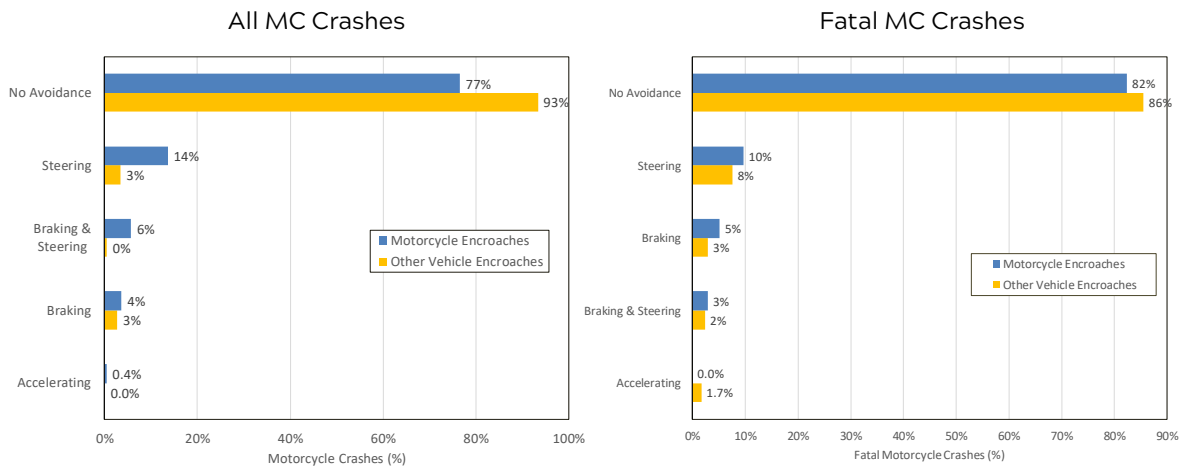


# Manner of Collision in Lane Changing Collisions



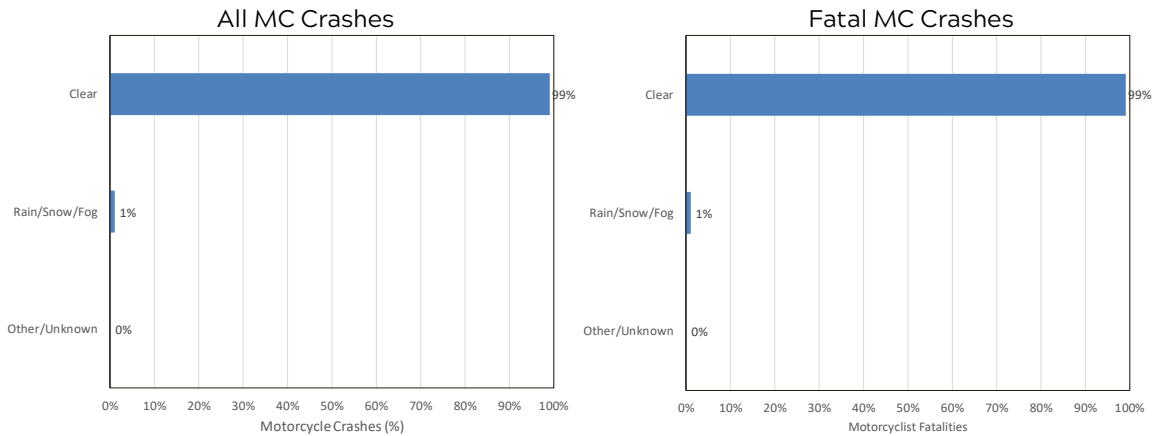
19

# Encroaching Vehicle Avoidance Actions: Lane Changing Crashes



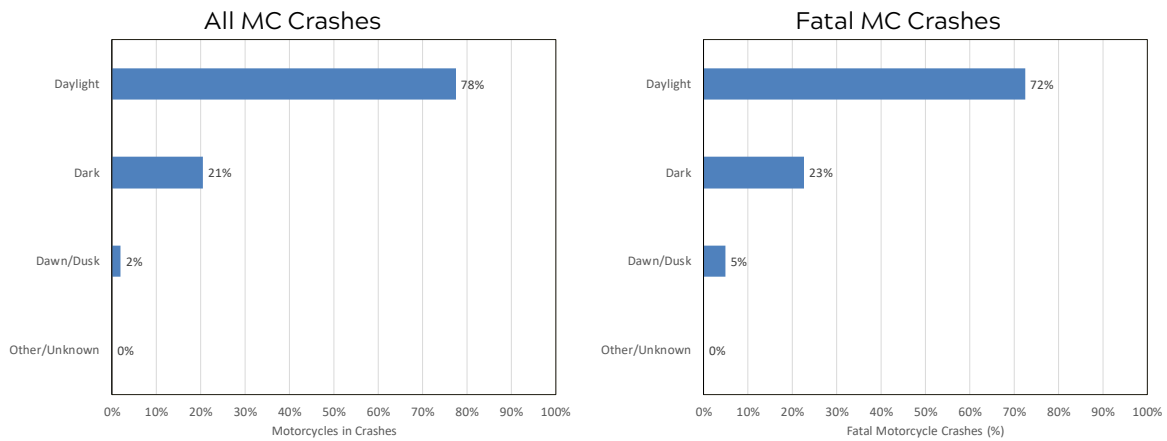
20

## Weather in Lane Changing Crashes



21

## Lighting in Lane Changing Crashes



22

## Potential Benefits of Blind Spot Monitoring

Max Annual Fatal MC Crashes Avoided or Mitigated

Target Population	MC Changes Lanes	OV Changes Lanes	Total
All Lane Changing/ Merging	41	38	79
Daylight only	30	27	57

23

## Potential Benefits of Blind Spot Monitoring

Max Annual MC Crashes Avoided or Mitigated

Target Population	MC Changes Lanes	OV Changes Lanes	Total
All Lane Changing/ Merging	1,240	2,600	3,840
Daylight only	970	2,000	2,970

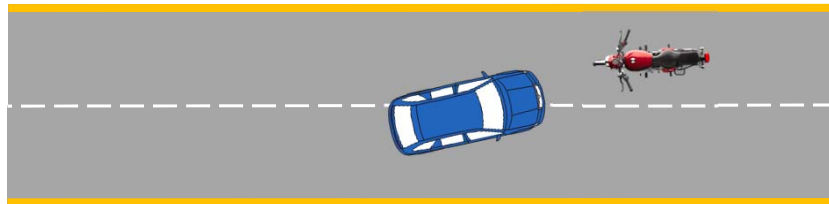
24

## Drift out of Lane

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- Lane Departure Warning (LDW) as a countermeasure
- OV only, not marketable to MCs

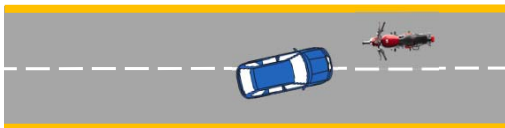
Scenario  
OV Encroaches



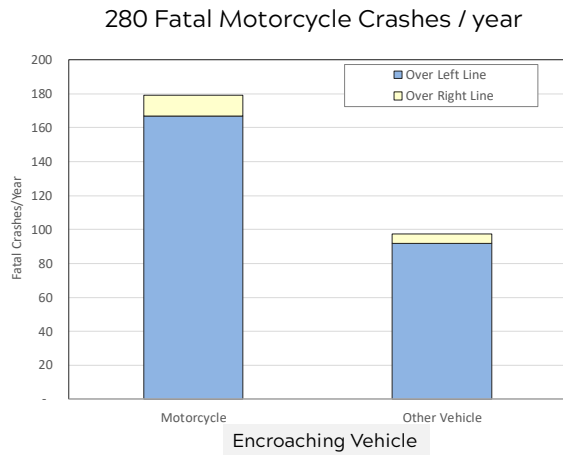
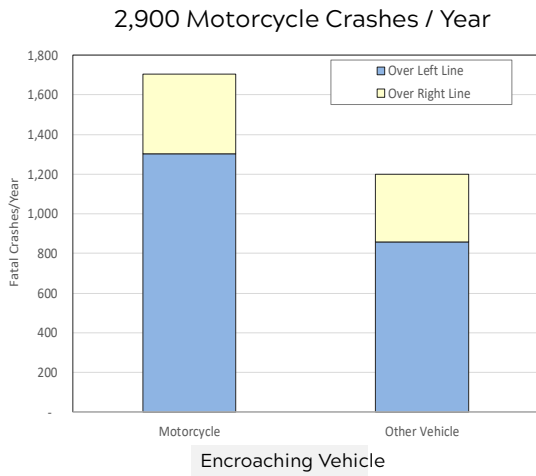
## Drift out of Lane

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- Lane Departure Warning (LDW) as a countermeasure
- All Lane Departures
- Exclude turning or lane changes
- Exclude loss of control
- Exclude vehicle malfunction

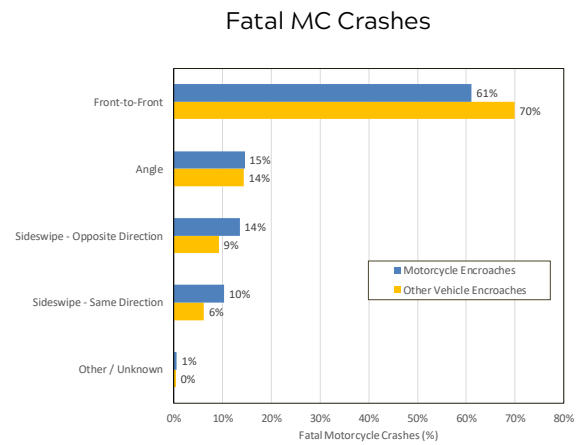
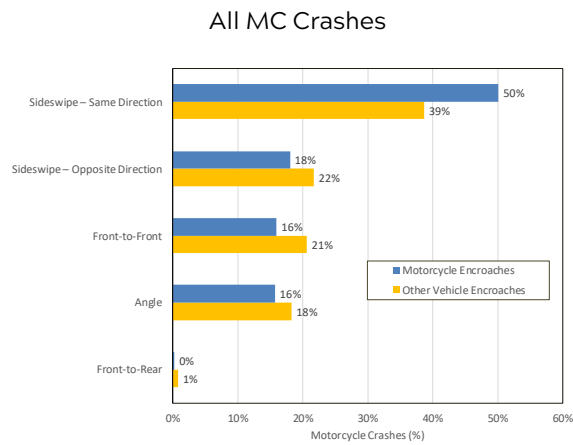


## Drift out of Lane Crashes



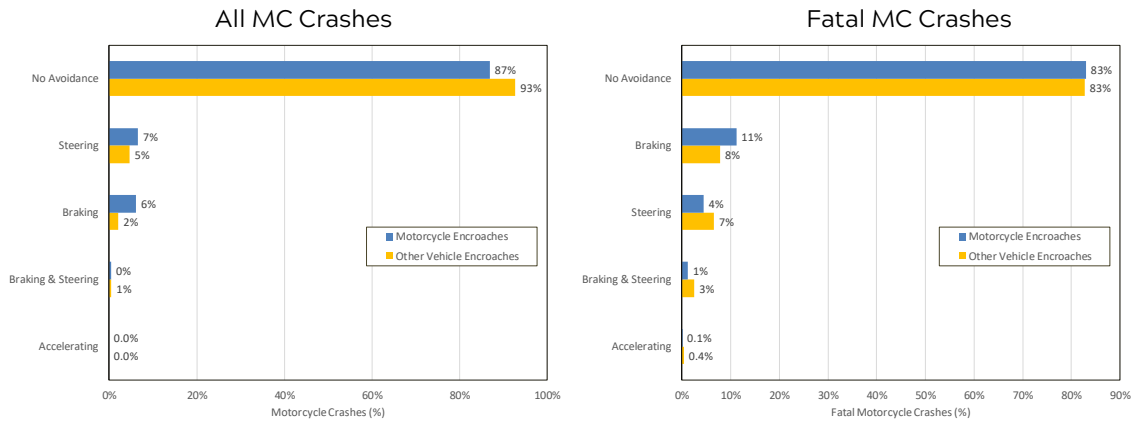
27

## Manner of Collision in Lane Departures



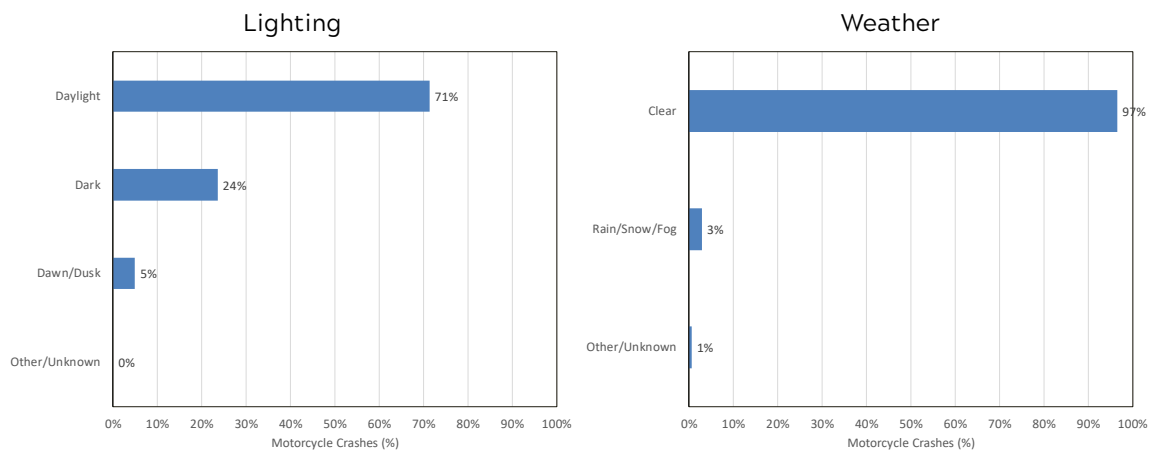
28

# Encroaching Vehicle Avoidance Actions: Lane Departure Crashes



29

# Lighting and Weather in Lane Departures



30

## Potential Benefits of Lane Departure Warning

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Max Annual Fatal MC Crashes Avoided or Mitigated

Target Population	MC Bullet	Other Vehicle Bullet	Total
All Lane Departures		98	98
Daylight only		70	70

31

## Potential Benefits of Lane Departure Warning

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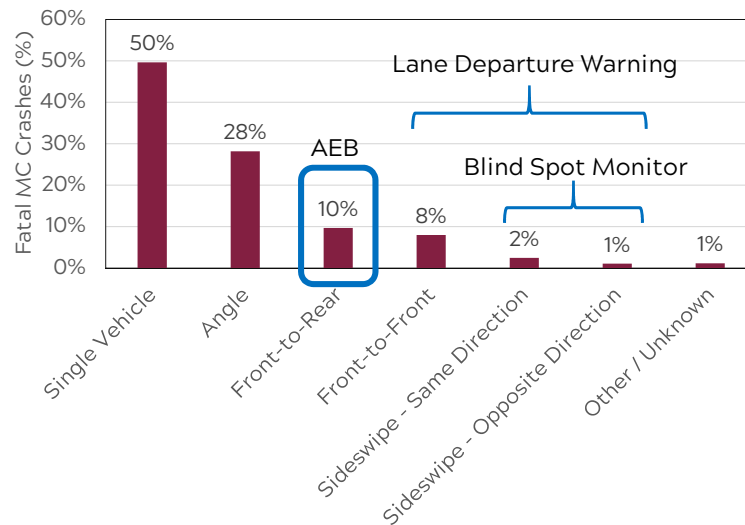
Max Annual MC Crashes Avoided or Mitigated

Target Population	MC Bullet	Other Vehicle Bullet	Total
All Lane Departures		1,200	1,200
Daylight only		850	850

32



## Fatal Motorcycle Crash Types (2010-2015)



33

## Upper Bound on Fatal Crash Reduction

Countermeasure	MC - Mounted	OV- Mounted	Total	%
Automated Emergency Braking	276	144	420	8%
Blind spot monitoring	41	38	79	2%
Lane Departure Warning		98	98	2%
<b>Total</b>	<b>317</b>	<b>280</b>	<b>597</b>	<b>12%</b>

34

## Other Active Safety Possibilities

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- Motorcycle Stability Control
- MAEB for Pedestrians & Bicyclists
- Traction Control
- Curve Speed Warning
- Connected Vehicles (V2V, V2I)

35

## Limitations

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- Upper Bound on Crash and Fatality Reduction
- Assumes 100% penetration
- Assumes ideal system
- Assumes no deactivation by riders / drivers
- ABS may further reduce crashes and injuries in other modes

36

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