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The problem of cross-over highway crashes and what can be done about them

Presented by: Neil Arason

Research Team

Neil Arason, BA, AGDM
Province of British Columbia

Shannon Erdelyi, MSc
University of British Columbia Department of Emergency Medicine

Bryan Melnyk, MA
British Columbia Ministry of Health

Herbert Chan, PhD
University of British Columbia Department of Emergency Medicine

Jeffrey R. Brubacher, MD, MSc
University of British Columbia Department of Emergency Medicine

Key literature review findings

- ❑ In the last ten years in Canada, 5,769 people were killed and tens of thousands seriously injured in head-on crashes on all types of roads.
- ❑ For undivided highways with opposite-flow traffic, safe system thinking would dictate a maximum speed not more than about 70 km/h because speeds higher than this can result in serious injury or death in the event of a cross-over crash.

Key literature review findings (continued)

- ❑ Sweden: has focused heavily on installation of centre median barriers and the implementation of “2+1” roads: a low-cost solution that involves taking wide 2-lane roads with shoulders and converting them to 3 lanes with a centre barrier added.
- ❑ In response to the continued problem of head-on crashes around the world, median barriers have increasingly been implemented on highways in Europe, Australia, New Zealand, and parts of the United States and Canada.

Study Methodology

- We used police crash reports in British Columbia between January 2004 and December 2015 to determine the count and proportion of fatal crashes that occurred on provincial highways.

- For each crash configuration we report:
 - Total number of crashes,
 - Number and percent fatal crashes, and
 - Unadjusted and adjusted odds ratios (ORs) for fatality.

Study

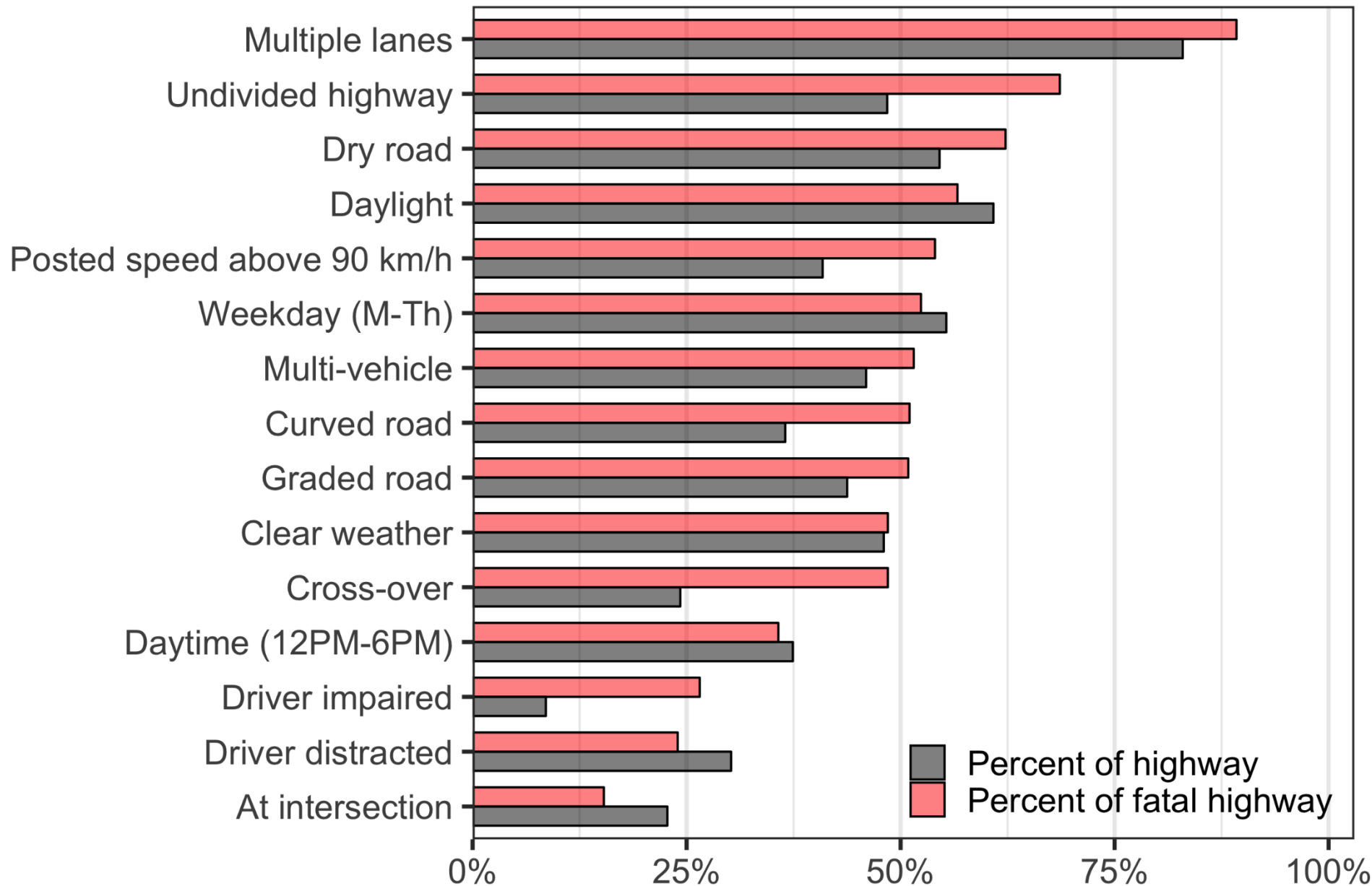
Methodology (con't)

- ❑ For each factor, we computed unadjusted ORs for fatality using logistic regression.
- ❑ We also obtained adjusted ORs for fatality using a single logistic regression model that included crash configuration and all other additional factors.

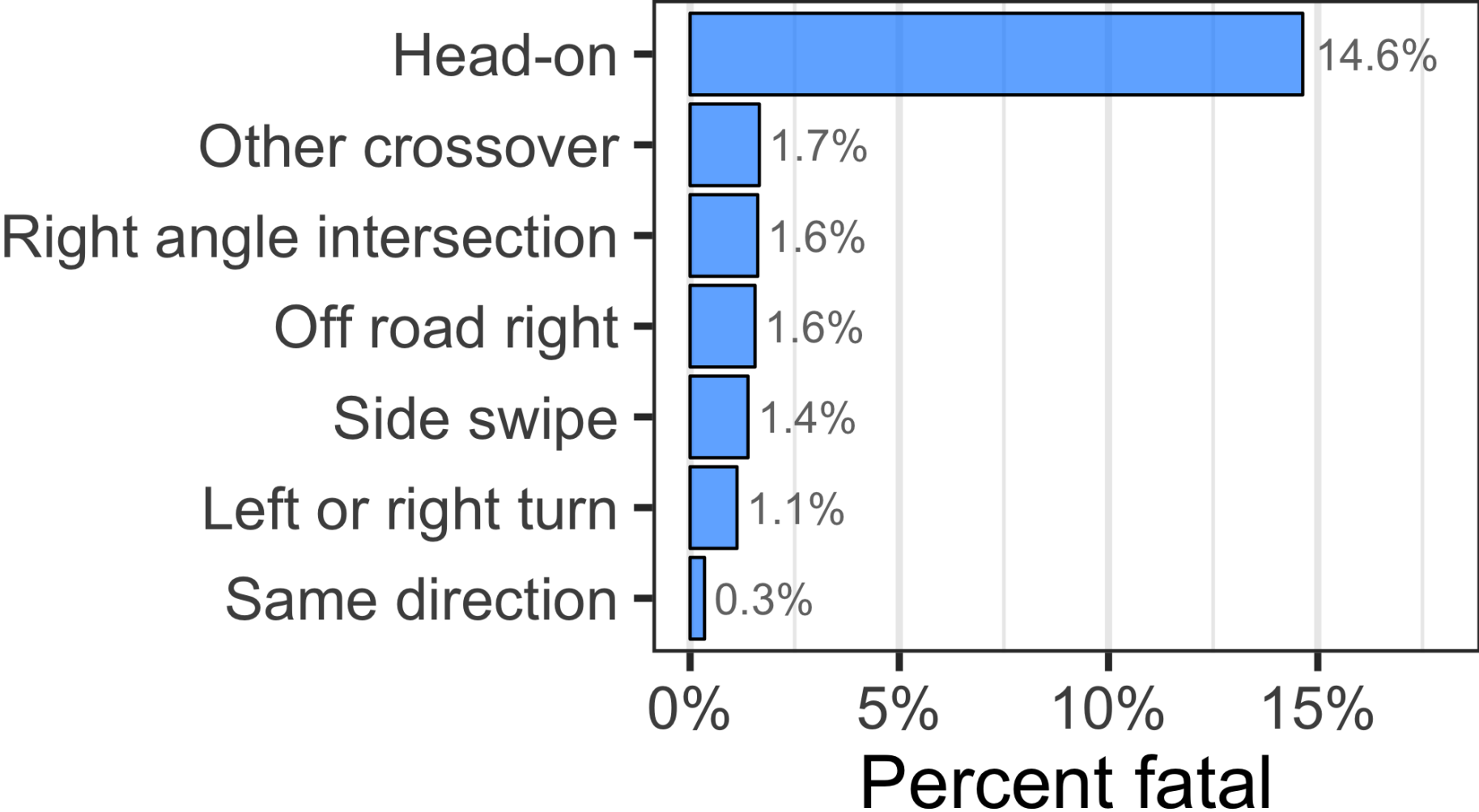
Study Methodology (con't) – literature review

- ❑ To identify crash countermeasures we searched three databases of journals of transportation engineering, injury prevention and road safety for several countries.
- ❑ A literature search was also undertaken utilizing defined search terms (cross-over crashes, preventing cross-over crashes, median barriers, cable barriers), across several databases of journals of transportation engineering, injury prevention and road safety publications.
- ❑ A total of 135 documents were screened for relevance, and of these 52 were reviewed.

Characteristics of police-reported highway crashes



Percent of all highway crashes that are fatal for each crash configuration



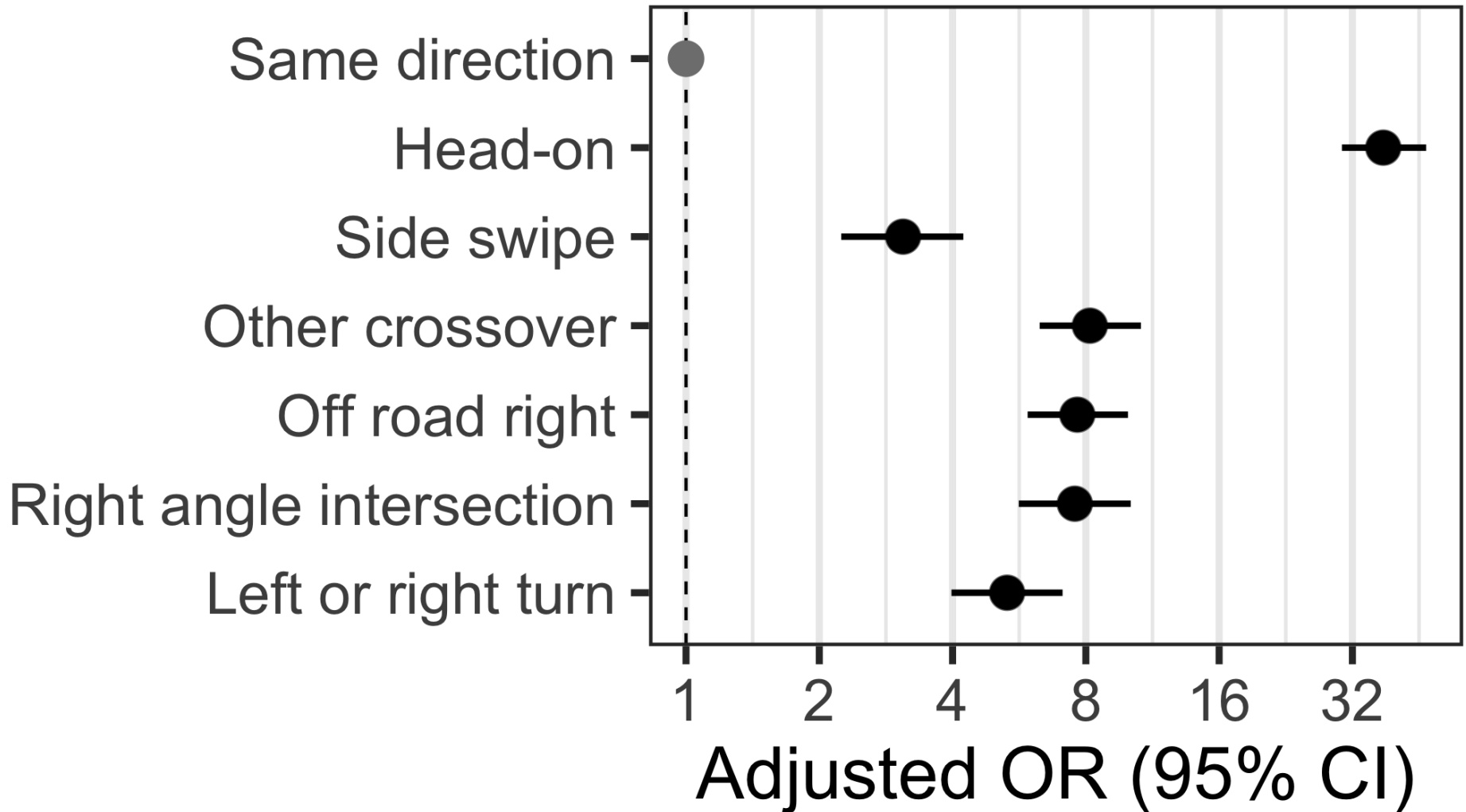
Unadjusted odds ratios for fatality in highway crashes



Other key findings: higher odds (unadjusted) of fatality for

- crashes involving two (OR=1.2) or three or more vehicles (OR=1.5),
- crashes occurring on higher speed highways (OR=1.7 for 90 km/hr or more),
- crashes occurring overnight (OR=1.4),
- crashes where police cited vehicle condition (OR=1.3) or driver impairment (OR=4.0) as a contributing factor,
- crashes occurring on highways with more than one lane (two: OR=2.6, three or more: OR=1.6),
- crashes occurring on undivided highways (OR=2.4), and
- crashes occurring on graded (OR=1.3) or curved (OR=1.8) roadways.

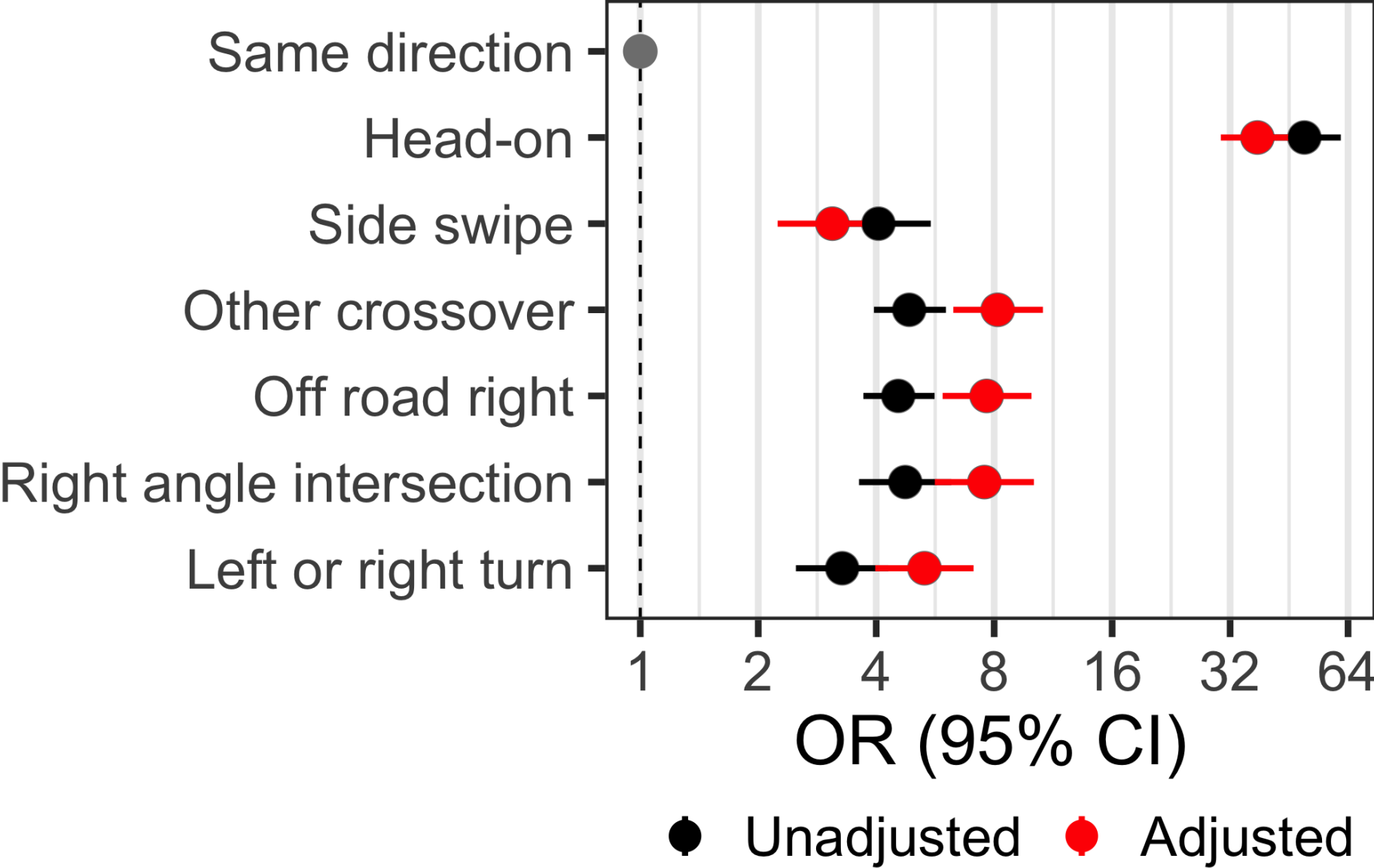
Adjusted odds ratios for fatality in highway crashes



Key findings: higher odds (adjusted) of fatality for

- ❑ two (OR=2.6) or three or more vehicles (OR=4.3).
- ❑ crashes occurring on higher speed highways (OR=1.9 for 90 km/hr or more).
- ❑ crashes where police cited vehicle condition (OR=1.2) or driver impairment (OR=3.7) as a contributing factor.

Odds ratios for fatality in highway crashes



Discussion:

- ❑ We found that the odds of fatality are almost 50 times higher in head-on collisions compared with same direction crash configurations.
- ❑ This association remains after adjusting for number of vehicles, highway speed limit, accident location, weather conditions, time of day, vehicle condition, driver factors, and road characteristics (adjusted OR for head-on collisions = 31.3).
- ❑ Although head-on collisions accounted for only 2.6% (3,463/134,646) of all highway crashes, this configuration accounted for 25.1% (507/2,016) of fatal highway crashes.

The countermeasures

Solutions to prevent head-on collisions take the form of a highway centre crash barrier for which there are generally three types:

1. Rigid (concrete) barriers,
2. Semi-rigid (steel “w”-shaped barriers), and
3. Flexible low- and high-tension (cable) barriers.







Centre barriers work!

- ❑ Ray *et al.* note that every state that studied the performance of cable median barriers, reported a reduction in fatal crashes of at least 40% and usually closer to 95%.
- ❑ In Texas, 96% of interstate system fatalities before cable barrier installation in 2003 were median crash-related. Post-implementation rates indicated virtual elimination of cross-median crash fatalities.
- ❑ The rate of cross-over crash fatalities was reduced by 100% in North Carolina, Ohio, Oregon and Utah.

Cost-benefits and financing of direct repairs

- ❑ Our lit review found centre crash barriers generate a cost-benefit return in the range of 1:2 to 1:6.6.
- ❑ In Sweden insurance companies pay for the entire direct repair cost of cable barriers to encourage more widespread use of this barrier type since road authorities are relieved of the associated repair cost burden.

Study limitations

- ❑ Our study relied on police data:
 1. Which can contain inaccurate data elements.
 2. May be incomplete as police are not required to attend all MV crashes including vehicle-pedestrian ones.
- ❑ Future studies could explore coroner data, hospital data, ambulance data or linked data sets.

Conclusions

- ❑ The odds of motor vehicle fatality are almost 50 times higher in head-on collisions compared with same direction crash configurations.
- ❑ Cross-over crashes represent almost one-quarter of all highway crashes.
- ❑ Of fatal crashes, nearly one-half are cross-over crashes, including head-on (25.1%), side-swipe (3.1%) and other cross-over crash configurations (20.2%).
- ❑ There is overwhelming evidence that centre barriers (and roadside barriers) reduce motor vehicle fatalities drastically.
- ❑ The cost-benefit return for centre barriers is between 1:2 and 1:6.6.
- ❑ We believe that centre crash barriers are one of the most effective road crash countermeasures when it comes to achieving fatality reductions.
- ❑ We recommend that every province and territory in Canada have a dedicated centre crash barrier fund in order to continually increase the number of highways that are protected by such barriers.