

Field Performance Study of **Electronic Stability Control System Effectiveness in US Fatal Crashes**

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Background

- **NHTSA ESC Study (Dang, 2006):**
Evaluated effectiveness in reducing fatal single-vehicle “run-off-road” crashes for passenger vehicles.

NHTSA Study found ESC systems effective by:

- FARS Data (fatal crashes)
35% for passenger cars
72% for light trucks
- State Data (mostly non-fatal, seven states)
46% for passenger cars
75% for light trucks

Study Objectives

- Examine field data to determine effectiveness of ESC systems in reducing fatal crashes.
- Compare fatal crash effectiveness results with those of the NHTSA ESC study.

Study Approach/Scope

- Identified vehicles with ESC systems available as standard equipment.
 - Makes, models, and series identified down to detailed trim levels.
 - Resulted in nearly **700 vehicle trim levels** (mostly 2004/2005 models) for this study.
- Matched fatal crash categories in NHTSA ESC report, then extended investigation to more vehicles and a wider range of crash conditions.

Methodology

- NHTSA Analyses:
 - “Control” group (crashes ESC would not prevent) vs.
 - “Response” group (crashes ESC would likely prevent)
 - Estimate reduction of crash involvements.

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Logistic Regression

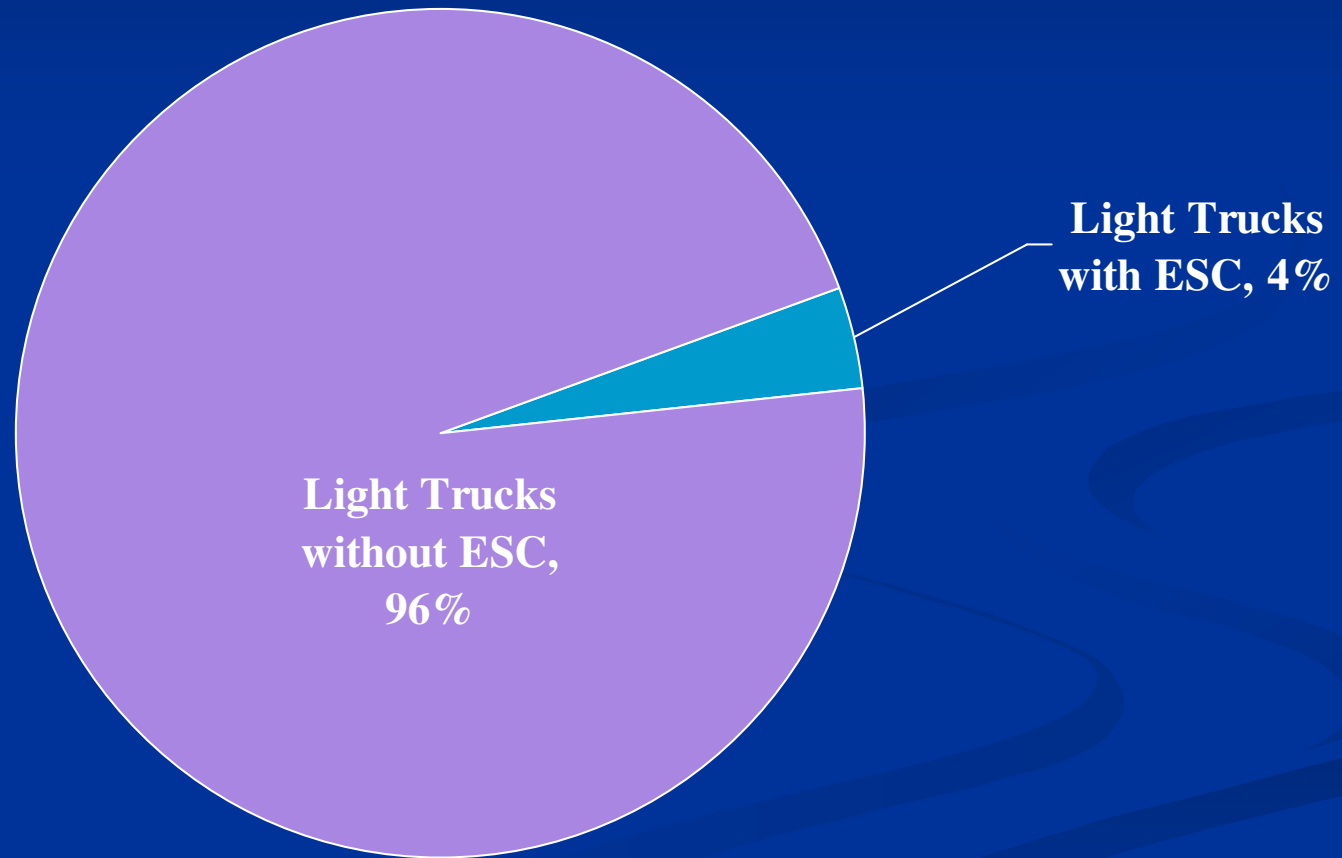
- Study examined factors *other than the presence of ESC systems* for vehicles with and without ESC to address the **relative contribution of ESC and other factors** in reducing crash-involvement rates.
 - **Factors:**
Belt use, driver age, driver gender, vehicle age, time of day, location of crash (rural/urban, freeway), driver drinking, and vehicle make/model.

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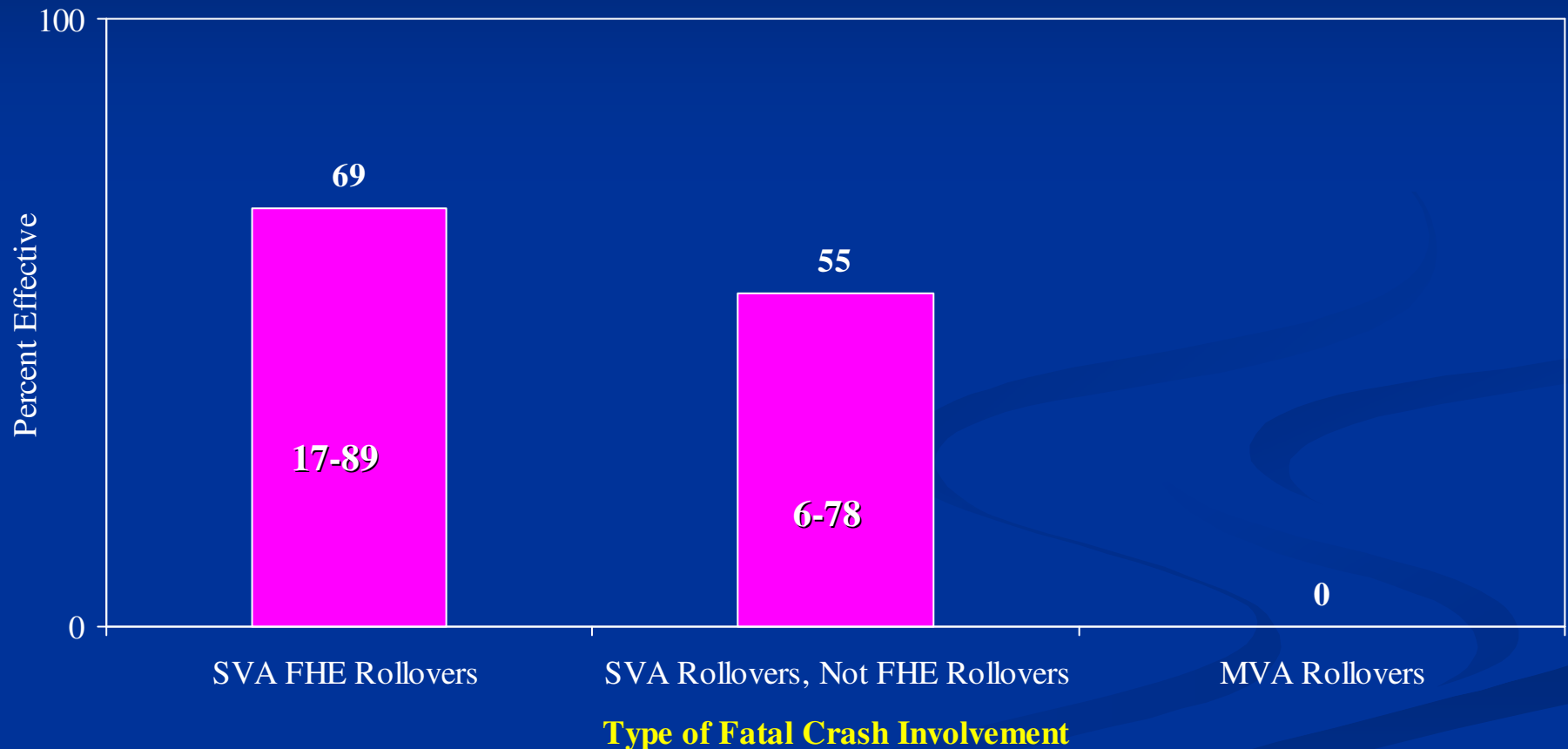
Define Additional Crash Types

- Study included additional categories:
 - Nonrollovers
 - Multiple-vehicle rollovers
 - Rollover crashes *for which rollover was not coded as the first harmful event.*

Percentage of Light Trucks with Standard ESC Registered in the U.S., All Model Years



ESC Effectiveness in Fatal Rollover Crashes Passenger Cars

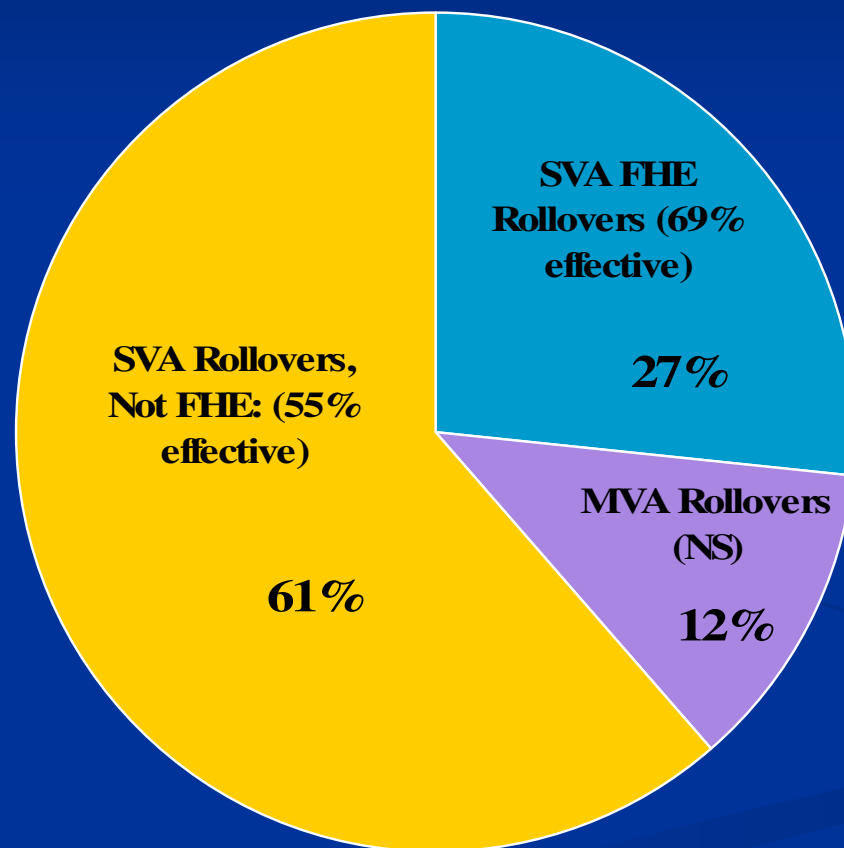


Source: FARS, 1993-2004. FHE= first harmful event.

ESC effectiveness estimates are based on logistic model, which controls for factors.

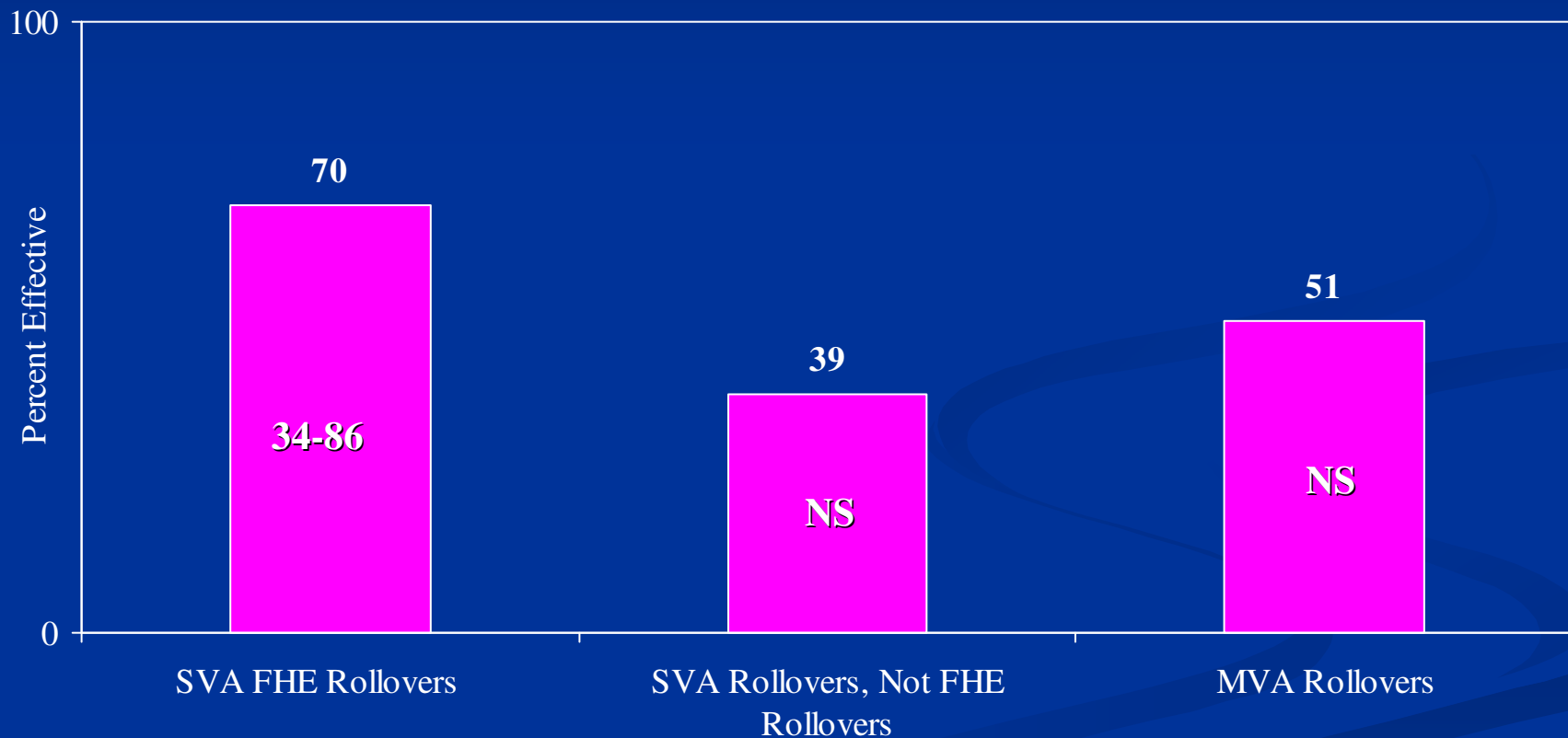
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Rollover Vehicles in Fatal Crashes: Passenger Cars, by Rollover Type



Source: FARS, 1993-2004. ESC effectiveness based on logistic model. SVA = single-vehicle accident; MVA = multiple-vehicle accident; FHE = first harmful event; and NS = Not significant

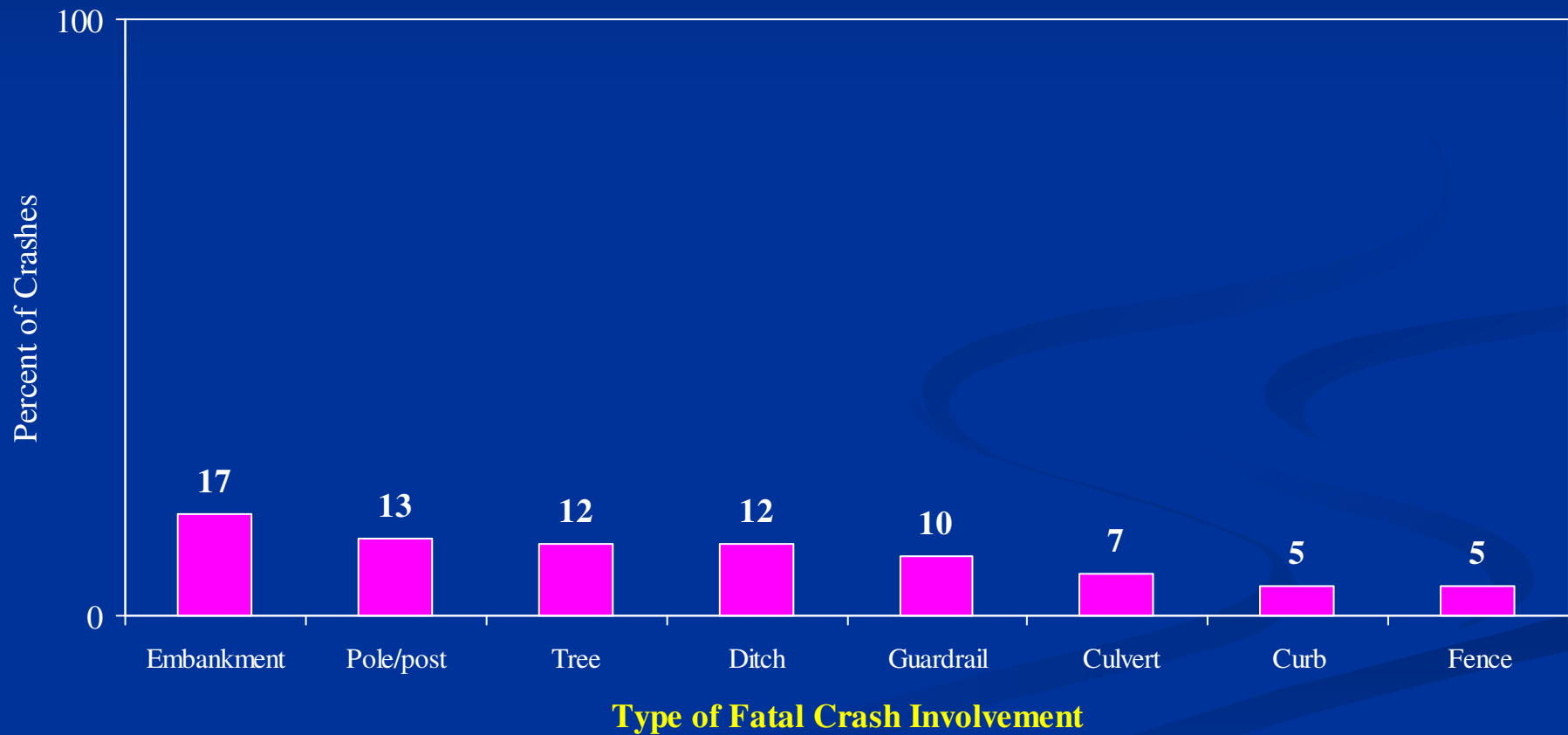
ESC Effectiveness in Fatal Rollover Crashes Light Trucks



Source: FARS, 1993-2004. ESC effectiveness estimates are based on logistic model, which controls for factors. Light trucks include pickups, SUVs, and vans up to 10,000 pounds GVWR. NS=Not statistically significant.

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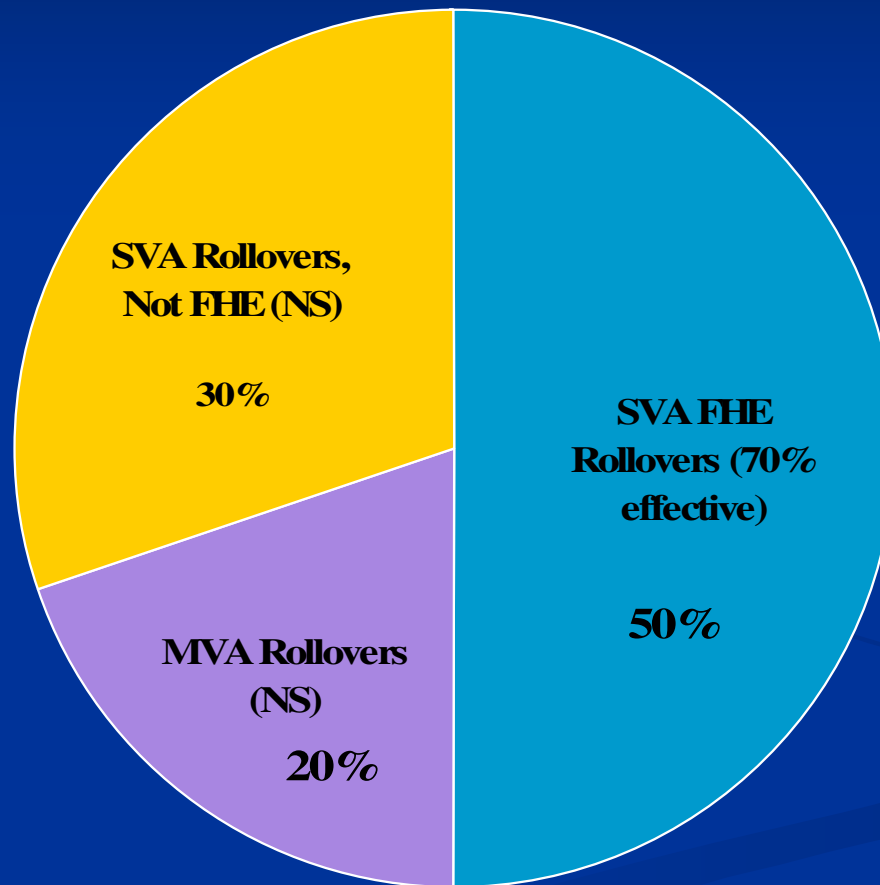
Fatal Crashes where FHE is not a Rollover Light Trucks



Source: FARS, 1993-2004.

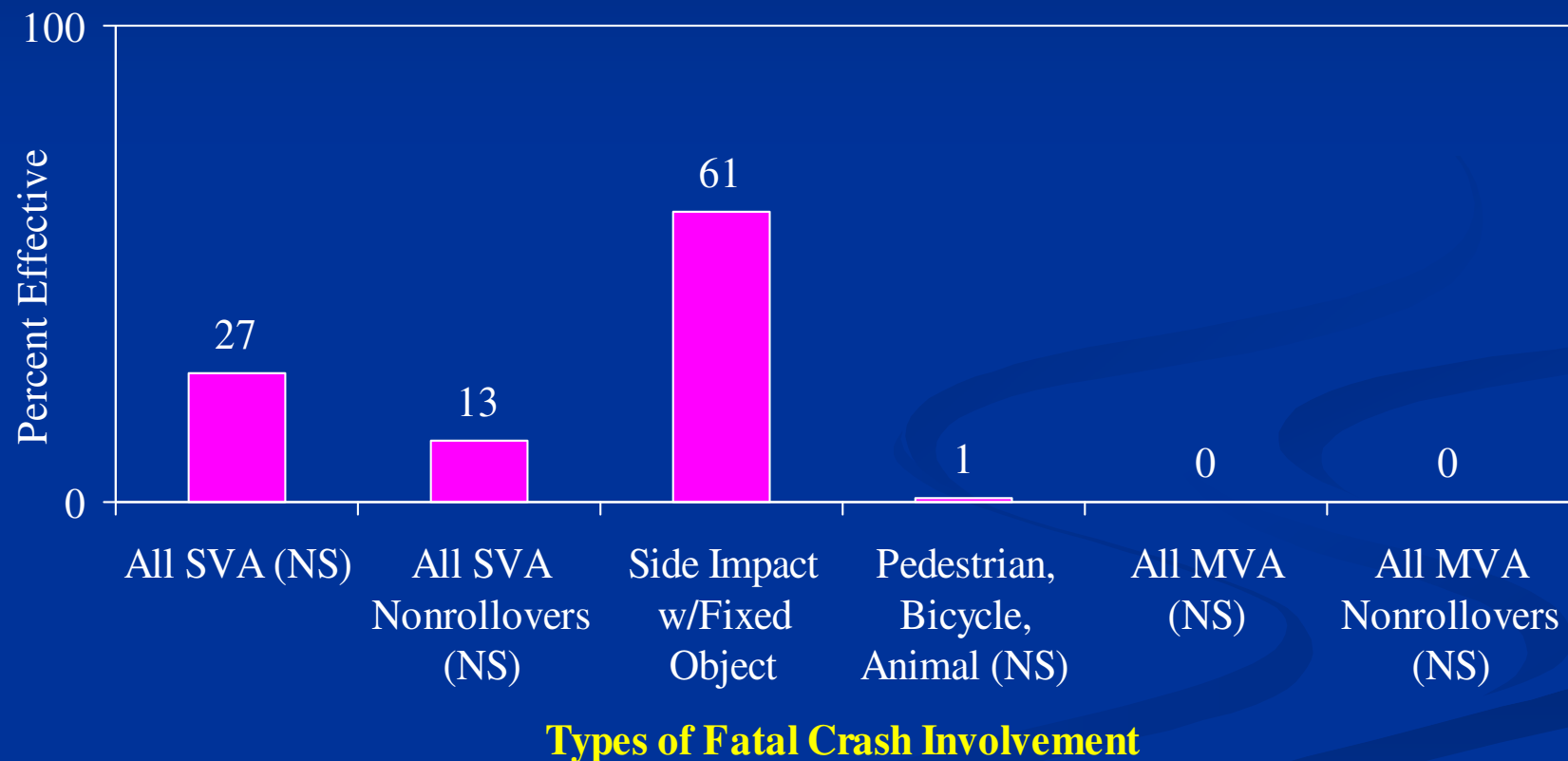
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Rollover Vehicles in Fatal Crashes: Light Trucks, by Rollover Type



Source: FARS, 1993-2004. ESC effectiveness based on logistic model. SVA = single-vehicle accident; MVA = multiple-vehicle accident; FHE = first harmful event; and NS = Not significant

ESC Effectiveness in Nonrollover/Other Fatal Crashes, Passenger Cars

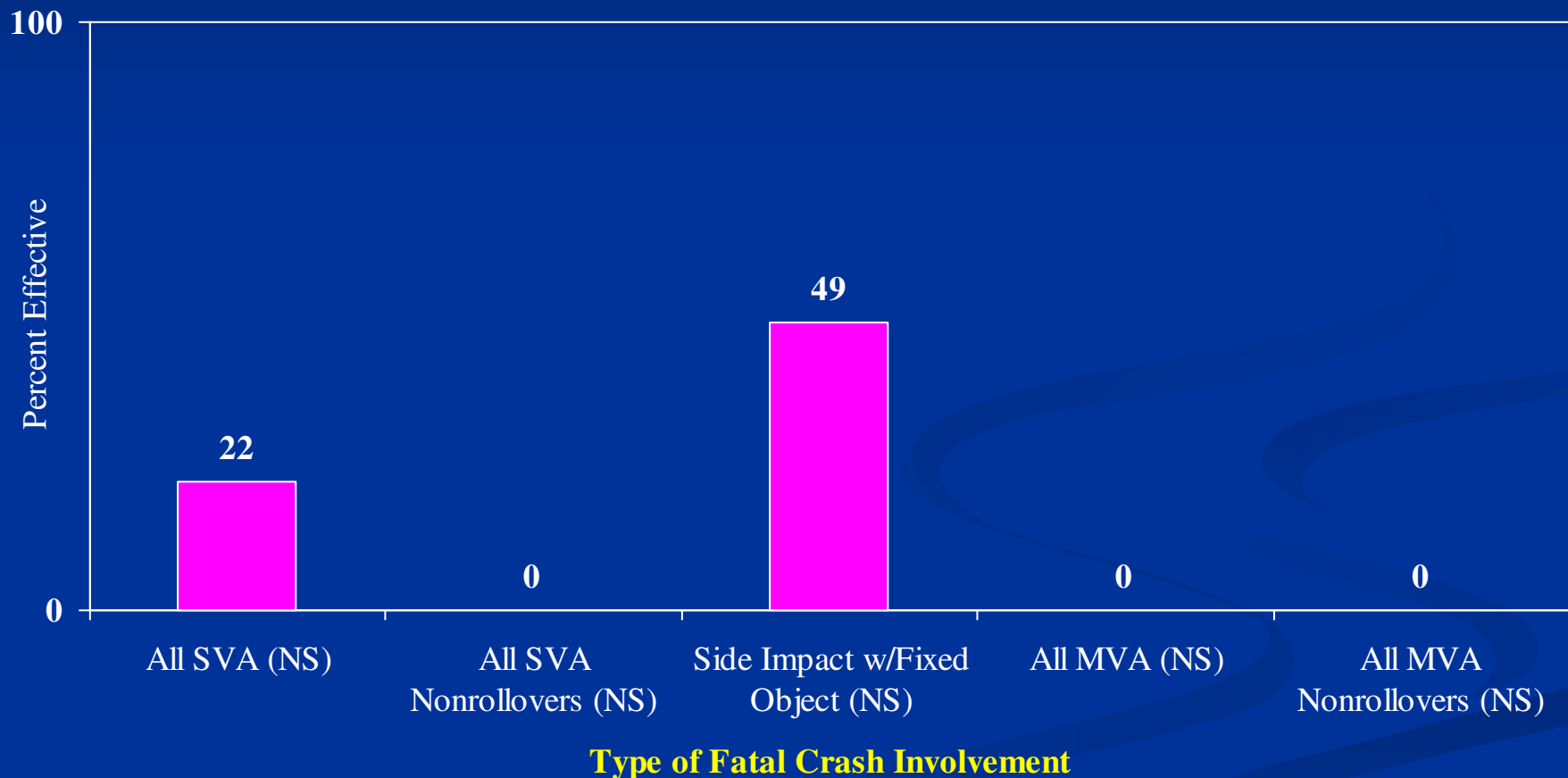


Source: FARS, 1993-2004.

Estimates are based on logistic model. NS = Not significant

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ESC Effectiveness in Nonrollover/Other Fatal Crashes, Light Trucks



Source: FARS, 1993-2004. ESC effectiveness estimates are based on logistic model, which controls for factors. Light trucks include pickups, SUVs, and vans up to 10,000 pounds GVWR. NS=not significant.

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Results Summary — ESC Effectiveness

Categories	Cars	Light Trucks
All SVA	No	No
SVA, FHE Rollovers	Yes	Yes
SVA, Not FHE Rollovers	Yes	No
Side Impact w/Fixed Object	Yes	No
Pedestrian/Bicycle/Animal	No	No
Culpable Multi-Vehicle	No	No
All MVA	No	No
MVA Rollovers	No	No

Source: FARS, 1993-2004. ESC effectiveness based on logistic model.

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Comparison with NHTSA Study

- NHTSA **relied on 2x2 contingency tables** to compare fatal crashes for vehicles with and without ESC systems.
- NHTSA **did not examine ESC system effectiveness for nonrollover crashes** separately from rollover crashes **nor consider all single-vehicle and all multiple-vehicle crashes** separately from other categories.
 - Analysis shows strong indications that ESC is much less effective for these categories than it is for rollovers;
 - These categories should be re-examined as more years of data become available.

Comparison with NHTSA Study (Cont'd)

- NHTSA logistic models had **no controls** for driver drinking, vehicle age, or most important of all, belt use.
 - When these control factors are introduced in the models, ESC system effectiveness is either **statistically insignificant or much lower than NHTSA study results show** for some crash types.
 - Field data shows that many of these rollovers are associated with a high percentage of alcohol impairment, speeding, or night time crashes.

Limitations

- ESC systems are relatively new, which limits the amount of data available for study.
- ESC systems were first introduced in high-end vehicles, which may have some effect on comparisons of vehicles with and without ESC, particularly for the earlier years.
- ESC system implementation differs by manufacturer.

Conclusions

- ESC systems are highly effective for fatal single-vehicle rollovers **in which the rollover is the first harmful event.**
- For light trucks, ESC is **not** significantly effective for single-vehicle rollovers where the first harmful events include collision with tree/pole/post/guardrail/culvert or ditch/embankment. These types of rollover crashes are primarily off-road rollover crashes.
- For both passenger cars and light trucks, ESC is **not** significantly effective in reducing fatal multiple-vehicle rollovers.

The ESC Bottomline

Good News!

- ESC systems are highly effective for certain types of crashes.

Not-so-good News

- ESC systems are NOT effective for all types of rollover or loss of control type crashes.
- Human factors/environmental factors influence crash outcome.