HOW OFTEN DO FRONT AIRBAGS FAIL TO DEPLOY IN FATAL FRONTAL CRASHES?

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ABSTRACT

Objective – Public concern has arisen about the reliability of front airbags because Fatality Analysis Reporting System (FARS) data indicate many nondeployed airbags in fatal frontal crashes. However, the accuracy of airbag deployment, the variable in question, is uncertain. This study aimed to provide more certain estimates of nondeployment incidence in fatal frontal crashes.

Methods – Fatally injured passenger vehicle drivers and right-front passengers in frontal crashes were identified in two US databases for calendar years 1998-2006 and model years 1994-2006: FARS, a census of police-reported fatal crashes on public roads, and National Automotive Sampling System/Crashworthiness Data System (NASS/CDS), a probability sample of towaway crashes. NASS/CDS contains subsets of fatal crashes in FARS and collects detailed data using crash investigators. Front airbag deployment coding for front-seat occupant fatalities was compared in FARS and NASS/CDS, and case reviews were conducted.

Results – Among FARS frontal deaths with available deployment status (N=43,169), front airbags were coded as not deployed for 18% of front occupants. In comparison, NASS/CDS (N=628) reported 9% (weighted estimate) nondeployment among front occupants killed. Among crashes common to both databases, NASS/CDS reported deployments for 45% of front occupant deaths for which FARS had coded nondeployments. Detailed case reviews of NASS/CDS crashes indicated highly accurate coding for deployment status. Based on this case review, 8% (weighted estimate) of front occupant deaths in frontal crashes appeared to involve airbag nondeployments; 1-2% of deaths represented potential system failures where deployments would have been expected. Airbag deployments appeared unwarranted in most nondeployments based on crash characteristics.

Discussion – FARS data overstate the magnitude of the problem of airbag deployment failures. There are inherent uncertainties in judgments about whether or not airbags would be expected to deploy in some crashes. Continued monitoring of airbag performance is warranted.

INTRODUCTION

Front airbags prevent deaths in frontal collisions [1-8]. Front airbags work in tandem with seat belts to restrain front-seat occupants by inflating when sensors, measuring acceleration, indicate a moderate to severe frontal impact [9].

Recent media reports raised the possibility of widespread instances of front-seat occupants dying in crashes because front airbags failed to deploy. Based on data from the US Fatality Analysis Reporting System (FARS), *The Kansas City Star* published a series of articles estimating that during 2001-2006, 1,400 deaths occurred in frontal crashes in which airbags failed to deploy [10,11]. In an internal report based on deaths included in the National Automotive Sampling System/Crashworthiness Data System (NASS/CDS), the National Highway Traffic Safety Administration (NHTSA) [12] estimated that during 2001-06, 576 people died in crashes in which front airbags did not deploy and that 360 of those who died would have benefited from front airbag protection [13].

As airbags became common in the vehicle fleet during 1988-97, some people — particularly infants in rear-facing child safety seats, unrestrained older

children, and short drivers sitting too close to deploying airbags — received airbag-induced fatal or serious injuries during low-speed crashes that otherwise would not have resulted in major injury [1,4,6,14-16]. Consequently, airbag designs were changed to reduce inflation energy and the frequency of airbag deployments in low-speed crashes [17]. These redesigns have successfully reduced airbag-induced deaths among child passengers and do not appear to have compromised protection among adults [7,17-27].

For first generation front airbags, crash test performance was certified by conducting 30 mph (48 km/h) head-on, full-frontal, rigid-barrier tests of unbelted 50th percentile male dummies. The next generation of airbags began with model year 1998, when NHTSA gave automobile manufacturers the option of certifying frontal crash performance for unbelted male dummies with 30 mph sled tests. The sled tests specified by the regulation had a longer crash pulse than rigid-barrier tests, enabling airbags to inflate with about 20-30% less energy (known as depowering) [17].

A subsequent federal rule required automakers to phase in advanced airbags with features that would tailor deployment to crash severity and occupant characteristics such as seat belt status, occupant weight, seating position, and presence of rear-facing child seat [28]. In particular, the latest generation of airbags is designed to deploy at higher crash severities for belted front occupants than for unbelted occupants. For the remainder of this paper, the latest generation of airbags will be referred to as certified-advanced airbags. Starting in model year 2003, some vehicles were equipped with certified-advanced airbags. By model year 2007, all new passenger vehicles were required to have certified-advanced airbags.

The primary objective of this study was to estimate the incidence of front airbag non-deployment in frontal crashes in which drivers or right-front passengers died. Another objective was to assess the completeness and accuracy of the information on airbag deployment in FARS, which is the leading source of data on fatal crashes in the United States.

METHODS

Data Sources

Two national US databases, maintained by NHTSA, provided information on front airbag nondeployments in fatal frontal crashes. The first was FARS, a census of fatal crashes on US public roads in which a death occurred within 30 days of the crash; documented suicides are excluded [29]. FARS data come from police crash reports, and the completeness and reliability of the data differ by variable, police agency, and individual officer. Although airbag deployment would appear to be readily verifiable by police officers at the crash scene, the accuracy of FARS coding of front airbag deployment has not been established.

The second database was NASS/CDS, a national probability sample of US police-reported towaway crashes [30]. NASS/CDS collects data for 5,000 crashes annually, including a subset of FARS fatal crashes. NASS/CDS crash investigators collect detailed data including whether airbags deployed. Quality control centers provide oversight. Using both FARS and NASS/CDS, data on airbag deployments were obtained for drivers and right-front passengers fatally injured in crashes during 1998-2006 in airbag-equipped vehicles (model years 1994-2006).

Vehicle make, model, model year, and presence of front airbags were based on decoded vehicle identification numbers (VINs) contained in the federal databases. Vindicator software from the Highway Loss Data Institute (HLDI) was used for this purpose [31].

Additional sources of data were used to ascertain whether crash-involved vehicles had first-generation, sled-certified, or a certified-advanced airbags [22]. These sources included NHTSA brochures [32], a NHTSA website [33], and the 1998-2000 National Automotive Sampling System/Crashworthiness Data System (NASS/CDS) manual [34].

Variable Definitions

Frontal collision – The study examined only front-seat occupants involved in frontal collisions, the type of crash in which front airbags are designed to provide protection. Each database had a different method of coding crash type. In FARS, frontal crashes were defined as having a principal impact of 11, 12, or 1 o'clock; if the principal impact was missing, then the initial impact clock position was used. In NASS/CDS, frontal crashes were those in which the general area of vehicle damage was coded as front for the most severe Collision Deformation Classification (crush profile).

Deployment – Nondeployment incidence in FARS and NASS/CDS was estimated after excluding occupants who were coded as having front airbags that had been disabled or removed, or missing deployment information. In NASS/CDS, occupants were eligible for study only if a crash investigator had examined the vehicle.

Airbag generation – Airbag generations were defined as first generation (model years 1994-97), sled-certified (model years 1998-2005 and reported as sled-certified), or certified-advanced (model years 2003-2006 and reported as certified-advanced).

Data Analyses

The primary outcome was front airbag nondeployment following involvement in frontal crashes as coded by FARS and NASS/CDS. Chi-square tests of proportions were used for some comparisons. Data analyses were conducted using SAS 9.1 and Microsoft Excel [35, 36].

To compare coding of airbag deployment status directly between FARS and NASS/CDS, front occupant fatalities contained in both databases were matched. Unique personal identifiers are not available from public datasets so other variables were used for matching. To be considered a valid match, FARS fatalities had to match NASS/CDS on crash year, state in which the crash occurred, seat position, crash month and first 10 digits of the VIN. Cases also were required to match at least two of the following criteria: day of week, gender, and age within one year. In a small number of matched cases, the FARS VIN either was missing or was erroneous but similar to the NASS/CDS VIN. Ultimately, 1,655 deaths of 1,700 NASS/CDS deaths were identified in FARS (97% match rate).

Weighted NASS/CDS data were used to generate national estimates, and unweighted NASS/CDS data were used for comparisons of coding. All FARS front occupant deaths during 1998-2006 for model years 1994-2006 numbered 121,514, but NASS/CDS case weights for the same categories of front occupant deaths during that period totaled 85,869. Thus, NASS/CDS underrepresents the true number of US deaths (ratio of FARS to NASS/CDS deaths = 1.415). To estimate numbers of front occupant deaths by deployment category, case weights in NASS/CDS were multiplied by 1.415 to account for NASS/CDS's underrepresentation of deaths.

Case reviews – During 1998-2006 for model years 1994-2006, a total of 628 deaths among drivers and right-front passengers were coded as frontal in NASS/CDS. All of these cases were reviewed to verify deployment status. Engineers conducted comprehensive reviews of those deaths in which NASS/CDS coded nondeployment, disabled/removed airbag, or missing deployment status. A few deaths were reclassified as belonging to a different category.

RESULTS

Incidence of Nondeploying Airbags

No differences were observed in deployments between drivers and right-front passengers so they were combined for analyses (data not shown). After excluding deaths with missing airbag deployment data, FARS reported nondeployments in 18 percent of front occupant deaths in frontal crashes during 1998-2006 (Table 1). NASS/CDS reported 9 percent nondeployment (weighted). In NASS/CDS, first-generation airbags had significantly lower nondeployments compared with sled-certified airbags (weighted 7% vs. 11%; $p < 0.001$). Statistical tests could not be performed for certified-advanced airbags because only 28 NASS/CDS deaths had these airbags.

Comparisons of Coding among Front Occupant Deaths Included in both FARS and NASS/CDS

Among the 1,655 NASS/CDS front occupant deaths successfully matched to a FARS record, FARS classified 787 deaths as occurring in frontal crashes whereas NASS/CDS classified 606 as frontal crashes (Table 2). Thirty-two percent of crashes deemed to be frontal by FARS were considered nonfrontal by NASS/CDS; differences were statistically significant ($p < 0.001$).

For the 538 deaths that were considered as occurring in frontal crashes by both databases, FARS and NASS/CDS agreed on airbag deployment status in 75% of the cases (Table 3). Deployment coding differences in NASS/CDS versus FARS were statistically significant ($p < 0.001$). In this subset of matched cases, deployment status was coded as unknown in 21% of deaths in FARS and 5% in NASS/CDS. Of the 42 deaths where FARS coded a nondeployment, NASS/CDS reported that 19 (45%) airbags actually had deployed.

The accuracy of FARS deployment coding appeared to increase over time among the matched deaths based on agreement with NASS/CDS coding, although the increase was not significant using the Breslow-Day test of homogeneity. Among nondeployments coded by FARS, percentages that NASS/CDS coded as deployed were 67% during calendar years 1998-2000 versus 42% during 2004-2006 (data not shown).

Table 1.
Coding of front airbag performance in frontal[1] crashes in which drivers or right-front passengers died by airbag generation,[2] FARS and NASS/CDS, model years 1994-2006, calendar years 1998-2006

Data source, Deployment status	First generation No.	%[4]	Sled-certified No.	%[4]	Certified-advanced No.	%[4]	All front airbags[3] No.	%[4]
FARS (Deaths)								
Deployed	14,496	84	18,548	81	1,183	78	35,320	82
Not deployed	2,858	16	4,465	19	336	22	7,849	18
Unknown	6,823		6,792		444		14,467	
Switched off/disabled	47		60		0		108	
Other	81		107		9		202	
Total	24,305		29,972		1,972		57,946	
NASS/CDS (Unweighted)								
Deployed	211	95	294	90	25	96	548	93
Not deployed	12	5	31	10	1	4	44	7
Unknown	13		12		2		27	
Switched off/disabled	5		4		0		9	
Total	241		341		28		628	
NASS/CDS (Weighted)								
Deployed	10,149	93	15,547	89	813	96	27,414	91
Not deployed	782	7	1,899	11	34	4	2,714	9
Unknown	981		736		201		1,918	
Switched off/disabled	103		245		0		348	
Total	12,015		18,427		1,048		32,394	

[1]FARS: Frontal defined as 11, 12, 1 o'clock principal impact point (or initial impact point among 335 deaths where principal was missing); NASS/CDS: Frontal defined as principal area of damage from collision deformation classification.
[2]First-generation airbags: rigid barrier test (model years 1994-97); sled-certified airbags: sled test (model years 1998-05); certified advanced airbags: certified as advanced and compliant with federal standards for occupant crash protection (model years 2003-06).
[3]Total also includes airbags that did not fall into airbag generation categories, such as those tested using rigid barriers after model year 1997.
[4]Percentages exclude missing airbag deployment data and inactivated airbags.

Table 2.
Comparison of principal impact point codes among front occupant deaths included in both FARS and NASS/CDS, model years 1994-2006, calendar years 1998-2006

	FARS Coding					
	Frontal		Not frontal		Total	
NASS/CDS Coding	No.	%	No.	%	No.	%
Frontal	538[1]	68	68	8	606	37
Not frontal	249	32	800	92	1,049	63
Total	787	100	868	100	1,655	100

[1]χ^2=651.54, 1 df; $p < 0.001$

Table 3.
Comparison of front airbag deployment coding among front occupant deaths in NASS/CDS that were matched to FARS and coded as frontal crashes by both databases, model years 1994-2006, calendar years 1998-2006

	FARS Coding											
	Deployed		Not deployed		Off/ disabled		Unknown		Nonfrontal deployment		Total	
NASS/CDS Coding	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Deployed	369[1]	98	19	45	0	–	85	74	1	–	474	88
Not deployed	5	1	13	31	1	–	11	10	1	–	31	6
Off/disabled	0	0	6	14	1	–	1	1	0	–	8	1
Unknown	3	1	4	10	0	–	18	16	0	–	25	5
Total	377	100	42	100	2	–	115	100	2	–	538	100

[1] χ^2=221.36, 12 df; $p < 0.001$

Case Reviews of NASS/CDS Front Occupant Deaths and National Estimates by Deployment Status

After reviewing case photographs and other crash investigation records for all 628 NASS/CDS front-occupant deaths coded as frontal during 1998-2006, 4 errors in deployment codes were identified: 2 airbags coded as nondeployed were switched off; 1 airbag coded as switched off was not switched off but was an instance of nondeployment; 1 airbag with unknown deployment status had been removed prior to the crash (Table 4). No deployment coding errors were observed among any front occupant deaths in which NASS/CDS indicated that front airbags had deployed. After accounting for the 4 coding errors, the weighted percentage of front occupant deaths involving an airbag nondeployment was 8 percent, and the weighted percentage with a switched off/removed airbag was 2 percent.

Of the 43 verified nondeployments, 25 were in crashes in which deployment typically would not be expected and 11 were in crashes in which deployment would have been expected based on crash severity and other characteristics (Table 4). An additional 6 deaths were classified as borderline, defined as crashes in which a deployment would not have been surprising, but was not necessarily expected. The category for 1 death could not be determined.

Of the 11 deaths where deployments would have been expected, all but 3 likely would have benefitted if front airbags had deployed (Table 5). In the borderline cases, benefits from airbag deployments were considered unlikely for 4 of the 6 deaths because of passenger compartment intrusion and other crash characteristics.

After calculating case weights from NASS/CDS for deaths with nondeployed airbags by categories of nondeployment, the case weights were multiplied by 1.415 to yield adjusted national estimates (Table 4). The resulting estimates were 449 deaths in which airbags would have been expected to deploy and another 464 deaths classified as borderline expected deployments during 1998-2006. This yielded 50-101 annual deaths, on average, in which airbags did not deploy and were potential system failures during the 9-year study period.

Reasons for nondeployment among the 17 deaths where deployments would have been expected or were classified as borderline were unclear (Table 5). One vehicle had an airbag recall issue that likely was the reason for nondeployment, whereas several vehicles had airbag recall issues that appeared unrelated to nondeployment. Repair histories could not be ascertained for airbags that had been recalled.

Several factors were responsible among the 25 vehicles in which the airbag was not expected to deploy. In 10 crashes, the most significant event was a rollover, and in many cases the occupant was ejected during the rollover. Five vehicles had frontal crashes, but these were complete underrides with large trucks in which the vehicle hood was not contacted. Four crashes were more consistent with side impacts, and in 3 of these crashes the driver was ejected through the side window. In 3 of the crashes, the fatality was caused by a foreign object striking the driver through the windshield. Finally, in 3 crashes, the vehicle had sufficiently low delta V values that an airbag would not be expected to deploy. In 2 of these crashes, the fatality was possibly due to a pre-existing medical condition.

Table 4.
Judgments regarding nondeployment, revised coding, and adjusted national estimates based on IIHS case reviews of front airbag performance in frontal crashes in which drivers or right-front passengers died, NASS/CDS, model years 1994-2006, calendar years 1998-2006

Deployment status	Original codes No.	Original codes %[2]	IIHS judgments and revised codes and case weights No.	IIHS judgments and revised codes and case weights %[2]	IIHS adjusted national estimates[1] No.	IIHS adjusted national estimates[1] %[2]
(Unweighted)						
Deaths						
Deployed	548	91	548[3]	91	–	–
Not deployed	44	7	43	7	–	–
Not expected to deploy	–	–	25	4	–	–
Expected to deploy	–	–	11	2	–	–
Borderline	–	–	6	1	–	–
Unknown	–	–	1	0	–	–
Unknown	27	–	26	–	–	–
Switched off/disabled	9	1	11	2	–	–
Total	628	100	628	100	–	–
(Weighted)						
Deployed	27,414	90	27,414	90	38,791	90
Not deployed	2,714	9	2,543	8	3,598	8
Not expected to deploy	–	–	1,890	6	2,674	6
Expected to deploy	–	–	317	1	449	1
Borderline	–	–	328	1	464	1
Unknown	–	–	8	0	11	0
Unknown	1,918	–	1,851	–	2,619	–
Switched off/disabled	348	1	586	2	829	2
Total	32,394	100	32,394	100	45,838	100

[1]NASS/CDS case weights were multiplied by 1.415 to address underrepresentation of deaths in NASS/CDS (based on ratio of FARS to NASS/CDS front occupant deaths).
[2]Percentages exclude missing data.
[3]Included 5 deaths in which vehicles had caught fire post-crash and NASS/CDS investigators judged that deployment had occurred, but extensive damage made photographs difficult to interpret by IIHS reviewers.

Among deaths with nondeployed airbags, there were 13 with first-generation airbags, 31 with sled-certified airbags, and 1 with certified-advanced airbags. Deaths with nondeployments in vehicles with sled-certified airbags were significantly less likely to be classified as expected to deploy or borderline compared with deaths in vehicles with first-generation airbags (weighted, $p < 0.001$).

DISCUSSION

FARS data suggested that front airbags failed to deploy in 18 percent of frontal crashes fatal to drivers and right-front passengers in cases where information on deployment was available. However, these were overestimates based on findings for fatal crashes included in NASS/CDS, which reported 9 percent nondeployment and 1 percent disabled/removed airbags among drivers and right-front passengers killed in crashes. Based on NASS/CDS case reviews, the percentage of nondeployments was revised downward to 8%, and 1-2% of deaths represented potential system failures where deployment would have been expected. Some of these deaths could not have been prevented by deployed airbags.

Review of all 628 NASS/CDS front occupant deaths in frontal crashes during 1998-2006 indicated a high level of accuracy in the NASS/CDS coding of airbag deployment; only 4 errors were detected in classifying deployment status. The strongest evidence of FARS overstatement of nondeployments arose from

comparison of coding among fatal crashes included in both FARS and NASS/CDS, which indicated that half of the FARS deaths coded as nondeployments were misclassified. FARS deployment coding accuracy might be improving over time; among deaths included in both NASS/CDS and FARS, the agreement of FARS and NASS deployment codes improved between 1998-2000 and 2004-06.

In a substantial number of front occupant deaths, FARS and NASS/CDS disagreed about whether the principal impact point was frontal, with NASS/CDS classifying fewer of them as frontal. Assuming that NASS/CDS codes principal impact point more accurately, one reason for FARS overestimates of airbag nondeployment in crashes considered as frontal by FARS is misclassification of nonfrontal crashes as frontal by FARS. Because front airbags are not designed to deploy in nonfrontal crashes, this likely resulted in inflated FARS percentages of nondeploying airbags in frontal crashes. Case reviews of nondeployments showed that NASS/CDS misidentified some crashes as frontal, although this would be expected to occur less often than in FARS as vehicles are inspected by crash investigators. The authors were unable to review all 1,700 deaths in NASS/CDS to determine how often impact point was miscoded by NASS/CDS. National estimates of the numbers of deaths in frontal crashes in which airbags did not deploy could either be overstated or understated depending on the true frequency of fatal frontal crashes and their deployment status.

An additional problem with FARS was the high percentage of front occupants whose airbag deployment status was unknown. Missing data may result in inaccurate estimates of nondeployment. One implication is that studies of airbag effectiveness using FARS should use airbag presence rather than airbag deployment because of missing and misclassified deployment data in FARS.

The inaccuracies in FARS may stem partly from the lack of uniformity among state police crash report forms and coding practices. Some states have airbag deployment as a separate variable on the police crash report forms; others do not. At least three states (Florida, Maryland, and Indiana) have a category known as “Safety Equipment” in which police are supposed to code airbags only if they deployed.

In NASS/CDS, nondeployments were significantly less common among first-generation airbags compared with later airbag generations. Yet nondeployments categorized as expected to deploy or borderline were significantly more common for first-generation airbags relative to sled-certified airbags. These results suggest improved deployment algorithms among sled-certified vehicles, but must be interpreted cautiously because of small numbers in NASS/CDS.

Match rates for deaths included in both FARS and NASS/CDS were high (97%) and were based on multiple variables, lessening the likelihood of inaccurate identification of fatal crashes. A limitation of the study was small numbers of deaths among occupants with certified-advanced airbags. Another limitation stems from the inherent uncertainties of researchers making judgments about whether or not an airbag would be expected to deploy in some crashes and whether airbag deployments in individual crashes would have reduced injury severity. To address this challenge, three engineers reviewed the cases.

Since the first reports of airbag-induced fatalities started appearing, regulators, automobile manufacturers, and airbag manufacturers have been engaged in an effort to prevent such fatalities and injuries while designing airbags that deploy appropriately when front occupants need their protection. Different manufacturers have reached different conclusions on the optimal algorithms for triggering airbags and how to protect out-of-position occupants from deployment-related injuries. Several of the crashes involved minor frontal impacts prior to the most severe frontal crash, and the effect of these impacts on the airbag system is unknown. Certified-advanced airbags, which can suppress deployment or vary the degree of airbag inflation, are intended to balance protection versus risk to front occupants.

CONCLUSIONS

Failures of front airbags to deploy in crashes in which drivers or right-front passengers died and in which the front airbags usually would be expected to deploy appear to be relatively uncommon and far less frequent than suggested by FARS data. NHTSA should take steps to improve the accuracy of airbag deployment coding in FARS. Findings of this study were consistent with the internal NHTSA (2008) analysis. Nonetheless, the estimated number of front occupant deaths in which front airbags were expected to deploy is of concern. Examination of airbag system components and further in-depth investigations of vehicles with nondeployments would be useful to help shed light on what is occurring and whether there are possible countermeasures. Continued monitoring of front airbag performance is warranted, particularly for the newest generation of advanced airbags that are designed to optimize front airbag deployment.

Table 5.
IIHS case reviews of 43 driver and right-front passenger frontal crash deaths with front airbags verified as not having deployed, NASS/CDS, model years 1994-06, calendar years 1998-06

Deployment classification based on case review	Possible reasons for nondeployment	Seat position	Airbag generation	Delta-V[1] mph (NASS/CDS)	Would airbag have been beneficial?	Other comments	NASS/CDS case	Vehicle make/model	Model year
Expected to deploy	Airbag recall issue	Driver	Sled-certified		Yes	- Passenger airbag deployed	2006-74-195B	Dodge Truck - Caravan Van	2000
Expected to deploy	Unknown	Driver	First generation		No	- Passenger airbag deployed, although underride crash	2000-78-19A	Chevy/GEO - Lumina 4D	1997
Expected to deploy	Unknown	Driver	Sled-certified	40	Yes		2001-12-116A	GMC Truck - S15/Sonoma Pickup	2000
Expected to deploy	Unknown	RFPass	Sled-certified	19	Yes	- Apparently unrelated airbag recall issue	2004-3-96B	Honda - Civic 2D Coupe	1998
Expected to deploy	Unknown	Driver	Sled-certified		Yes		2004-43-323B	Toyota - Tacoma PU X Cab	1998
Expected to deploy	Unknown	RFPass	Certified-advanced		Yes		2004-47-83A	Chevy/GEO Truck - Slvrdo 1500 PU E C	2003
Expected to deploy	Unknown	Driver	Sled-certified	29	Yes		2005-50-18B	Chevy/GEO-Cavalier 2D	1998
Expected to deploy	Unknown	Driver	Sled-certified		Unlikely		2006-3-121B	Honda - Accord 4D	2003
Expected to deploy	Unknown	Driver	First generation		Yes	- Apparently unrelated airbag recall issue - Passenger airbag deployed	2006-43-149A	Mazda - Protégé 4D	1995
Expected to deploy	Unknown	Driver	Sled-certified	35	Yes		2006-78-47B	Daewoo - Lanos 4D	2000
Expected to deploy	Unknown	Driver	First generation	42	No	- Incorrectly coded in NASS as vehicle not having airbag	2005-45-88B	Chevy/GEO - 10/1500 Pickup ½ T	1996
Borderline	Unknown	Driver	First generation		Possibly	- Oblique impacts	1998-45-165J	Honda - Accord 4D	1996

Deployment classification based on case review	Possible reasons for nondeployment	Seat position	Airbag generation	Delta-V[1] mph (NASS/ CDS)	Would airbag have been beneficial?	Other comments	NASS/CDS case	Vehicle make/model	Model year
Borderline	Unknown	Driver	Sled-certified		No	- Possible airbag recall issue - Driver side thorax airbag deployed	2000-76-139A	GMC Truck - Yukon 4D	2000
Borderline	Unknown	Driver	Sled-certified		No	- Vehicle rolled over	2005-73-161B	Chevy/GEO Truck - Astro EXT Van	1999
Borderline	Unknown	Driver	First generation	16	Yes		2006-43-198B	GMC Truck - Suburban ½T 4D	1996
Borderline	Unknown	Driver	First generation		Unlikely	- Vehicle rolled over	2006-45-117B	Chevy/GEO Truck - S10 Blazer 4D	1996
Borderline	Unknown	Driver	Sled-certified	18	No	- Injuries due to intrusion directly into greenhouse	2006-50-83B	Hyundai - Tiburon 2D	2000
Not expected to deploy	Complete un-derride	Driver	Sled-certified		No		2000-43-243A	Chrysler/Plymouth Truck - Voyager Van	2000
Not expected to deploy	Complete un-derride	RFPass	Sled-certified		No		2000-45-160A	Toyota - Camry 4D	1998
Not expected to deploy	Complete un-derride	Driver	First generation		No		2001-73-41B	GMC Truck - Safari EXT Van	1994
Not expected to deploy	Complete un-derride	Driver	Sled-certified		No		2002-47-39A	Mazda - 626 Sedan	1999
Not expected to deploy	Complete un-derride	Driver	First generation		No		2005-43-3B	Chevy/GEO Truck - T10 Blazer 4D	1997
Not expected to deploy	Foreign object	Driver	Sled-certified		No	- Driver killed by object striking windshield prior to crash	2002-11-39J	GMC Truck - T15 Jimmy 4D	1999
Not expected to deploy	Foreign object	Driver	Sled-certified		No	- Snowmobile struck the vehicle in the greenhouse	2003-11-18A	Subaru - Forester 4D	2001
Not expected to deploy	Foreign object	Driver	Sled-certified		No	- Fatality caused by fence post entering windshield and striking driver	2005-75-56B	Chevy/GEO - Cavalier 2D	1998

Deployment classification based on case review	Possible reasons for nondeployment	Seat position	Airbag generation	Delta-V[1] mph (NASS/ CDS)	Would airbag have been beneficial?	Other comments	NASS/CDS case	Vehicle make/model	Model year
Not expected to deploy	Low delta-V	Driver	First generation	12	No	- Reconstruction overestimates delta-V	1998-11-214B	Buick - LeSabre/ Centurion/Wildcat	1994
Not expected to deploy	Low delta-V	Driver	First generation	11	No	- Reconstruction overestimates delta-V	1998-12-40A	Chevy/GEO Truck - S10 Pickup	1995
Not expected to deploy	Low delta-V	Driver	Sled-certified	8	Unknown		2002-81-42A	Jeep - Grand Cherokee 4D	2000
Not expected to deploy	Rollover	Driver	Sled-certified		Unlikely	- Driver ejected during rollover	2000-75-22A	Lexus - LX470 4D	1999
Not expected to deploy	Rollover	Driver	First generation		No	- Driver ejected during rollover	2001-75-152B	Chevy/GEO Truck - S10 Pickup	1997
Not expected to deploy	Rollover	Driver	Sled-certified	7	No	- Driver ejected during rollover	2002-45-157A	Ford Truck - Expedition 4D	2003
Not expected to deploy	Rollover	Driver	Sled-certified	2	No		2002-72-122A	GMC Truck- Envoy 4D	2002
Not expected to deploy	Rollover	RFPass	Sled-certified		No		2004-3-102A	Chevy/GEO - Impala 4D	2001
Not expected to deploy	Rollover	Driver	Sled-certified		No		2004-45-126A	Ford Truck - Ranger Super PU	2002
Not expected to deploy	Rollover	Driver	Sled-certified	5	No	- Driver ejected during rollover	2004-73-142B	Ford Truck - Excursion 4D	2000
Not expected to deploy	Rollover	Driver	Sled-certified	11	Unlikely	- Driver partially ejected during rollover	2006-8-181B	Chevy/GEO Truck - T10 Blazer 2D	2001
Not expected to deploy	Rollover	Driver	Sled-certified	7	No	- Driver partially ejected during rollover	2006-42-149A	Kia - Sorento 4D	2004
Not expected to deploy	Rollover	RFPass	Sled-certified		No	- Right front passenger ejected during rollover	2006-47-61A	Ford Truck - Ranger Pickup	2004
Not expected to deploy	Side impact	Driver	First generation		Unlikely	- Driver ejected through window	1999-48-78B	GMC Truck - Yukon 4D	1995

Deployment classification based on case review	Possible reasons for nondeployment	Seat position	Airbag generation	Delta-V[1] mph (NASS/CDS)	Would airbag have been beneficial?	Other comments	NASS/CDS case	Vehicle make/model	Model year
Not expected to deploy	Side impact	Driver	First generation		No	- Catastrophic intrusion	2000-78-26B	Chevy/GEO Truck - 1500 PU EXT C 1/2T	1996
Not expected to deploy	Side impact	Driver	Sled-certified		Unlikely	- Driver ejected and decapitated during complicated crash	2006-48-294B	Toyota - Tacoma PU	2000
Not expected to deploy	Side impact	Driver	Sled-certified		No	- Driver ejected through driver door window	2006-50-12B	Chevy/GEO Truck - S10 Blazer 4D	2000
Unknown		Driver	Sled-certified			- Not enough vehicle information for determination	2006-9-169A	Chevy/GEO - Aveo 4D	2004

[1]Longitudinal delta-V calculated by NASS/CDS program.

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