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The Honorable David Strickland
National Highway Traffic Safety Administrator
1200 New Jersey Avenue, SE
Washington, D.C. 20590

Dear Mr. Strickland:

The National Accident Sampling System (NASS) is in crisis. It lacks adequate funding, its design is hopelessly out of date, and it provides far too few cases of sufficient severity to be useful. The fact that NASS did not provide early warning of problems with out-of-position occupants in air bag deployments and Firestone tires on Ford Explorers is a critical indictment of its limitations.

To begin the process of revitalizing NASS, we request that the agency:

1. Conduct a major analysis of how NASS can be made more useful particularly if NHTSA is unable to obtain significant budget increases.
2. Require that cooperating police agencies from which NASS cases are selected use photography to enhance the information collected on cases that are more serious than fender benders to provide a basis for case selection and additional information (such as when a vehicle cannot be found during an investigation).

NASS is currently so dysfunctional that even if some temporary diversion of funding from case investigation and disruption in data collection is necessary, it would be easily justified by resultant improvements in the system.

We have attached a white paper analyzing the problems of NASS and suggesting critical improvements that could be made even if funding increases were not made. We look forward to a bold initiative – similar to that initiated NASS in the late 1970s – to rethink and redesign NASS.

Sincerely,

Clarence M. Ditlow
Executive Director

Carl E. Nash, Ph.D.

Attachment

Redesign of the National Accident Sampling System

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Introduction

The thirty year old National Accident Sampling System (NASS) has been severely compromised by budget cuts that have: (1) reduced the system to 24 teams investigating fewer than a quarter of the cases anticipated in the original system,[1] and (2) left the system with a sampling design that has not been fundamentally reviewed or updated for decades to ensure that the sample adequately represents the national experience.[2] The system is also chronically plagued by the relatively low severity crashes with only low-level injury consequences that comprise a substantial majority of NASS cases.[3] Furthermore, NASS was not designed to collect data on accidents involving pedestrians, pedalcyclists, motorcyclists, medium trucks, heavy trucks or buses.

NASS desperately needs additional funding just to remain as now designed. The current budget is just over $12 million (about $3,000 per crash) compared with around $10 million per year in the early 1980s providing about 10,000 cases ($1,000 per case). The original design would have produced nearly 19,000 cases per year which, at current costs, would require a budget of around $60 million. The Fatal Accident Reporting System (FARS) has a budget of around $7 million to collect basic information on the 34,000 fatal crashes that have occurred annually in recent years.

The NASS sample design is out of date with case weights that are so disparate that serious analysis based on the sample design is impossible. NASS data cannot provide national estimates of anything more than the basic statistics of highway crash losses.

The system provides no information on pedestrian, bicycle, motorcycle, truck, or bus crashes. NASS has too few cases to provide any meaningful information about the performance of particular makes and models even when sisters and clones and a complete run of years of a particular platform generation is included.[4]

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[1] The original design was for 75 teams and four zone centers producing 18,600 cases per year. In 2008, NASS had 24 teams doing about 4,000 cases. NHTSA has tried to overcome these shortcomings with Special Crash Investigations, but this is a band aid approach. The NASS designers said that it will not produce a representative sample if the number of cases drops to fewer than 12,000 cases per year.

[2] A particular problem is that the weighting factors of a small minority of cases are exceptionally high so that these cases dominate the results of an analysis based on the available weighting factors. Other cases have very low weighting factor making them irrelevant in an analysis. NHTSA has offered little guidance on how to deal with these analytical difficulties.

[3] We estimate that only about one quarter of all NASS cases provide information on crashes where there is a potential for serious to fatal injury, and even fewer that actually have such injuries.

[4] Rollover cases are an exception because a much larger proportion of rollovers have serious consequences than other types of crashes. An analyst can improve the estimates by considering a number of years of data if changes in vehicles and conditions have not changed much over those years.

It is difficult to obtain sufficient data to evaluate significant changes in motor vehicles or other conditions in a timely manner. Examples include the shift in design from truck to passenger car-based SUVs, the effectiveness of changes in air bag designs, and the impact of changes in anti-lock brake design. Changes in vehicle design to reduce pedestrian injuries could not be evaluated using the current NASS system.

Need for Additional Crash Data

Efficient programs to diagnose vehicle safety problems and evaluate changes in vehicles require a minimal amount of high quality, detailed crash data. NHTSA can provide efficient vehicle regulation, consumer information, and assessment of serious vehicle safety defects *only* if it has such data. Decisions on minimum safety performance levels in regulation could be more accurate with a larger number of cases involving the relevant crash conditions. In the roof crush rulemaking (FMVSS 216), NHTSA based its decision to propose a strength-to-weight ratio of 2.5 on only 31 NASS cases.[5] Setting the regulatory requirement too low or too high can have multi-billion dollar implications for the excess number of casualties in rollovers as well as for the cost of new vehicles.

Had NASS been operating at its original design size, the agency could have spotted the problem with Firestone tires on Ford Explorers much earlier. The savings in life and limb from that discovery, even a few months earlier, would have been sufficient to cover the extra cost of NASS at its full design size.[6] Explorers were introduced in 1990 and the defective tires were on some of the earliest models. If the excessive Explorer rollovers resulting from failures of Firestone tires could have been spotted by the mid-1990s, it could have saved hundreds of lives and at least one billion dollars for Ford & Firestone.

Vehicle designers need the feedback that comes from an adequate number of detailed, statistically valid investigations of serious crashes. Several years after initiation of the NASS system, a committee of auto industry safety officials presented a report to the agency estimating that the original design would provide roughly fifty crashes involving each high volume car line sufficiently early that analysis of these crashes could positively influence the design of the next generation vehicle.

The primary focus of NHTSA should be on the crashes that are most likely to cause serious to fatal injuries both because of their devastating human impacts and because they have the greatest economic consequences. Thus, the agency's crash data collection systems must focus on crashes at a severity level likely to result in serious to fatal injury. Severe to critical head and neck injuries have the greatest economic cost, but all cases with AIS 3+ injuries should be useful to NHTSA.

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[5] It was later shown that in nearly half of these crashes, the major injuries were the result of crashes preceding a rollover that was only incidental to the crash, leaving fewer than twenty cases from which the relationship between roof crush and injury in a rollover could be evaluated.

[6] There were more than 300 fatalities in the Explorer/Firestone tire crashes which, along with the costs of injuries and property damage in these crashes, had a cost of well over a billion dollars according to NHTSA figures on the economic cost of injury. The extra cost of NASS at its original design size would be less than $50 million at current costs.

Redesign of the NASS System

One strategy for enhancing the system would be to increase the NASS budget to the point where the original design could be fulfilled. That would require a major budget increase that is unrealistic in the current budget climate. Rather, the system must be modified to increase the proportion of more serious crashes (both as measured by the severity of impacts and of consequent injuries) at more modest cost. A substantially majority of the more than 2,500 relatively minor NASS cases with minor to moderate injuries could be eliminated so that the resources can be dedicated to more serious crashes with a high probability of AIS 3+ injuries.

General Case Selection. At present, NASS researchers gather lists of cases from police agencies and run the algorithm to determine which should be investigated. Cases are characterized by: the type and model year of the vehicle, the tow status and disposition of the vehicle, and the most severe injury. Case selection depends critically on the very basic information provided in a typical police accident report (PAR). The sampling algorithm attempts to bias case selection to more serious crashes and more recent model vehicles, but this does not overcome the basic limitation of the small total number of cases that can be investigated or the highly inexact police coding of crash injuries. Researchers typically do two investigations per week. NASS would be improved by enhancing the proportion of serious crashes selected for investigation.

Vehicle Photographs and Selection. If modest additional information were collected by the police in the agencies from which cases are sampled, it should be possible to make the case selection more rigorous. In particular, if officers in these agencies were given electronic cameras with instructions on how to take up to 10 photographs of crashes that are more than fender benders – particularly of the vehicles involved – they could be used by the NASS researchers to select the most serious crashes for investigation.

Reviewing the photos and making some basic assessments would result in a minor increase in the time put into case selection; but the cost of such a change would be small, particularly in relation to the improvement that would result. The police agencies should be willing to take the photos and provide them if NHTSA supplied the equipment and gave some training in its use because it would be to their advantage to have the additional evidence in PARS. If police agencies in a particular Primary Sampling Unit (PSU) are unwilling to photograph significant crashes, NASS should either select alternative police agencies or relocate the PSU.

Reasonably good electronic cameras and printers cost as little as $50 each. If we assume that NHTSA would have to buy 10 cameras and 3 printers for each investigator to cover the police, that would cost perhaps $50,000, with a replacement cost of around $20,000 per year in subsequent years. An additional investment of $100,000 for a contract to develop a new sampling system would be necessary. The benefit/cost ratio of such expenditures would be very high.

Sample Design and Weighting Factors. Beyond these improvements, it is critical to find a way to modify the sampling system to ensure that the highest and lowest weights are within a reasonable range. Reliable analysis is impossible with differences greater than an order of magnitude. A detailed analysis of why exceptionally high or low sampling weights occur should permit a modification of the sampling algorithm to ensure that weighting factors are reasonable.

Productivity Enhancement. Other equipment that could facilitate the work of the NASS investigators are bar code readers to accurately read the VIN of a crash involved vehicle, and a GPS to facilitate finding and identifying crash locations. Prices of these items have come down substantially, and the increase in productivity they would foster would make them cost/beneficial.

A Partial Melding FARS and NASS. A simple way to enhance NASS at modest additional cost would be to add one researcher to each of the current 24 teams whose responsibility would be solely to investigate fatal crashes. The new *Fast FARS* could be used to provide a sample frame for selecting cases. Fast FARS provides direct notification of fatal crashes nationwide within one to several days of their occurrence.

The 24 new investigators could each conduct about 100 cases per year for a total of 2,400 per year, or roughly one of every 10 fatal crashes of light vehicles per year. These new researchers might have to travel outside the PSU to investigate some of their cases, but they would not have to visit police agencies to list cases. A sampling algorithm could be developed to make the selections every day or two at headquarters or at the Zone Center, with assignments being sent out to the new researchers.

The cost of this system would be higher per case than the cost of regular NASS cases because of travel costs. At $4,000 per case, the extra budget would be around $10 million per year. Of course, the full 24 investigators would not have to be added initially, the new system could be phased-in.[7]

The addition of 2,400 cases with fatal injuries would dramatically improve the quality of NASS cases for at least two reasons. First, the information available from police investigations of fatal crashes is generally more comprehensive and complete than for many less serious crashes. Second, the crashes themselves are likely to be much more interesting and useful from the standpoint of analysis and evaluation than the more minor crashes that are typical in NASS.

[7] If there is simply no possibility of increasing the NASS budget, existing researchers could be assigned to conduct some of the cases identified in Fast FARS. Since more than 2,000 NASS cases that are of little interest would be dropped under the proposed reform, there would be an opportunity to substitute a number of these fatal crashes for some of them.

Appendix A. A Suggested Selection Criteria based on Police Photographs

The local police could be instructed to take photographs of the greatest damage areas of each vehicle along longitudinal or lateral axes in order to permit a visual estimation of the Collision Deformation Classification (CDC) extent zone of the damage. They could also be asked to photograph the interior to show any deployed air bags or major intrusion. For rollovers, they could photograph roof damage: both structural failures and major scratch patterns. If there is another object involved (guard rail, tree, etc.) they could photograph that too. Finally, photographs of fire damage and extensive fuel spillage would permit selection of cases with major fires.

When a researcher lists cases at a police agency, he or she would review photographs taken by the investigating officer. The following would be the procedure:

1. If there are photographs of more than one vehicle, the vehicle with the greater amount of damage would be reviewed.
2. When reviewing the photographs, the researcher would first identify the clock position of the greatest damage on the vehicle (or identify a rollover or undercarriage as the area of primary damage).
    a. Any rollover with significant roof involvement (significant actual buckling or deformation of the roof structure, at least two broken windows, or scratch marks indicating major roof contact with the road or ground, or an indication that the vehicle rolled more than five quarter turns) would be given an A rating for vehicle damage. If there were at least two quarter rolls, it would be given a B rating.
    b. Any frontal crash (damage area 10 o'clock through 2 o'clock) that the researcher estimates has at least three CDC zones of front extent intrusion would be given an A rating for vehicle damage; more than two front extent zones would be given a B rating, and more than one front extent zone would be given a C rating.
    c. Any side crash (damage in the passenger compartment area of 7 to 11 or 1 to 5 o'clock) that is more than three CDC side extent zones would be given an A rating, more than two side extent zones would be given a B rating, and more than one extent zone a C rating
    d. Any rear crash (damage primarily behind the second seat of the passenger compartment of 4 to 8 o'clock) with more than five CDC rear or side extent zones would be given an A rating, with more than four extent zones would be given a B rating, and less than four would be given a C rating.
    e. Any crash with undercarriage damage as the principle area would be given a C rating unless the interaction caused damage that is obvious when looking at the vehicle above the rocker panels in which case it would be given a B rating.

f. Any crash that had a fatal injury or a *known* injury at the time of review of the PAR greater than AIS 2, regardless of other factors, would be given an A rating.

g. Any crash that has intrusion into the occupant compartment estimated to be more than twelve inches would be given an A rating. Any crash with such intrusion more than six inches would be given at least a B rating.

h. Any crash that involves a major fuel spill or fire would be given an A rating.

i. If the researcher finds any crash that had other factors that might give it particular interest, he or she should call the Zone Center to confer on the appropriate rating.

3. Only A rated crashes should be included in the initial selection. B rated crashes can be considered if there are too few A rated crashes to fill the sample frame, and C rated crashes can be considered if there are too few A and B rated crashes to fill the sample frame (this should be a very rare occurrence). Where there is uncertainty about selection between two or more cases, the severity of occupant injuries would become the deciding factor.

4. It might be appropriate to consider any case in which an air bag inflates to be an A case regardless of the other conditions, but this may not be sufficiently rigorous as a selection factor.

To determine whether the selection factors outlined above are reasonable, a small panel of researchers could be engaged to review a set of one to several hundred recent NASS case photographs to determine which would be selected, and whether the selected cases would provide a higher quality of NASS cases.

Addendum: Analysis of NASS Cases

As a result of new, as yet unpublished work by Ozkan, we have determined that the concept of weighting factors may be faulty for many specific analyses of NASS cases. The NASS weighting factors are based on a small number of very general descriptors of the crashes. The first weight is a function of the PSU: the part of the country (northeast, south, midwest, and west) and the degree of urbanization (central city, suburban, and other). The next level is based on the police jurisdiction (the number of PARs reported and the severity of crashes reported on the PARs). Finally, the selection is based on five factors: the model year and type of vehicle, the tow status and disposition of the vehicle, and the most severe injury in the crash.

Clearly if a different set of characteristics were the basis for selection such as the color of the vehicle or the gender of the driver, a different set of weighting factors would result. As a consequence, we believe that weighting factors must be assigned depending on the purpose of the analysis of crash data.

Ozkan is developing a technique called *indirect sampling* that can map NASS cases on to State data files using common crash descriptors to provide weighting factors that are specific to the characteristics used for the mapping. The descriptors are chosen based on the purpose of a study.

As a consequence of this insight, we now believe that NASS could even be designed as a convenience sample taken from representative areas of the country where the police accident reporting is good, the state data files are high quality, and local police and medical institutions provide good cooperation (which would include a willingness to photograph crashes that are reported). However, it should be possible to design a sampling algorithm that results, to at least some degree, in a representative sample. To make the resulting files useful, NHTSA would develop a methodology that permits analysts derive their own weighting factors based on the purposes of their analyses.

The details of how NASS could be redesigned should be worked out in a manner similar to the way the original NASS was developed. To the extent feasible, existing team's locations, teams, and zone center should be preserved if they can meet the critical criteria for the redesign. It may be that up to one year of NASS data collection will be compromised by converting to the new system. However, existing NASS data files may be made more useful by applying the new methodology to derive revised weighting factors.