

National Conference on Medical Indications for Air Bag Disconnection

Conducted by

**The Ronald Reagan Institute of Emergency Medicine
Department of Emergency Medicine**

and

The National Crash Analysis Center

**The George Washington University Medical Center
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Final Report

Executive Summary

At the request of the National Highway Traffic Safety Administration, The Ronald Reagan Institute of Emergency Medicine, with the assistance of the National Crash Analysis Center (NCAC), both of The George Washington University (GW), convened an expert panel of physicians to formulate recommendations on specific medical indications for air bag disconnection. The panel consisted of 17 physicians, each nominated by a professional society or organization. The medical societies were selected because their members were either the most likely to see air bag-related injuries or to be questioned about air bag risks by their patients. The medical conditions considered were provided by NHTSA as the most common concerns expressed by members of the public in disconnection requests to the agency. One additional condition for discussion was added by panel members.

The Reagan Institute was responsible for coordination of the conference, including methods of discussion and consensus development. This report represents a summary of the results of the conference. While the report has been reviewed by the participants, any endorsement of the recommendations by the specialty societies will be subject to the bylaws of the respective groups.

Air bags have been proven effective at saving lives in frontal crashes. Air bags have also been shown to present a risk of death or injury in certain situations. Currently, there are proposals to allow disconnection of air bags at the request of consumers. While disconnection removes the risk of injury from air bag deployment, disconnection also risks the loss of lifesaving benefits in the event of a potentially fatal crash. The panel approach was to determine those specific situations in which risks of air bag deployment might weigh heavily enough to mitigate the benefits.

The panel generated a number of general needs regarding the subject area. These needs focus on improved data collection about air bag performance, support for dissemination of conference results to physicians and the public, and improved consumer awareness about the risks of air bag deactivation.

The panel addressed a list of issues which are detailed in this report. Many of the issues relate to specific situations such as pacemakers and previous surgery. In most of these areas, the best information available indicates that the benefits of air bags clearly outweigh the risks. More general issues, such as short stature, were less clear. The available data, particularly regarding lives saved and nonlethal injuries suffered and averted is not clear enough to make specific recommendations about what specific height places an individual at risk from a deploying air bag. Proximity to the initially deploying air bag appears to be the central issue, not necessarily height. The panel recommends that the vast majority of automobile owners keep their air bags connected. The clinical experiences of the panelists and their colleagues confirm the dramatic change in injury patterns and outcomes since the advent of air bag technology. Improved research and data collection is vital to future decision-making by policymakers and consumers.

The purpose of the conference was to discuss specific medical indications for air bag disconnection and to formulate recommendations in these areas. During the course of these discussions, the panel developed a list of general recommendations related to air bag safety data and public information.

General Recommendations:

1. The benefits of air bags are well-known to physicians who care for patients who have been in crashes. These benefits should be preserved and improved. Air bags may be considered as analogous to other medical therapies, all of which have known risks and benefits. Physicians make decisions about risks and benefits of various forms of therapy every day. As larger populations are exposed to these therapies, both risks and benefits can become more apparent. For example, we have accepted thrombolysis as effective therapy for myocardial infarction, despite known serious risks. The use of air bags to lessen the risk of death and injury in frontal crashes must be considered in a similar fashion.
2. There is a paucity of population-based data on a number of the areas of interest related to air bag injury patterns. Improved injury surveillance might be able to address some of the areas of concern in a directed way. For example, emergency departments, trauma centers, and primary care providers could participate in data collection systems that could be adapted to search for persons of certain heights, pregnant women, or patients with pacemakers in order to determine true incidences of injury with adequate estimation of exposure risk. These systems could complement existing systems such as the National Automotive Sampling System (NASS) and the Fatal Analysis Reporting System (FARS).
3. There is a significant need for improved data collection on air bag safety specifically and traffic safety in general. The panel recommends improved detail about specific injuries and medical risk factors to improve current data collection systems for air bag-related injuries specifically and traffic-related injuries in general.
4. While the panel was not asked to consider specific air bag systems, the participants recognize that engineering improvements are an important component of injury control. There is a significant need for increased research on occupant sensing systems and the effects of increases in air bag deployment thresholds. Research and development on occupant sensing systems has the potential to remove many of the issues in question addressed by the panel. The panel recognizes that the issue of air bag deployment thresholds is complex. Changes in deployment thresholds have been suggested by others as a method of injury reduction. The panel recommends increases in biomechanics research in this area in order to establish a proper risk-benefit analysis.
5. Consumers should be provided with improved information about the specifications and efficacy of the air bag systems in their vehicles. Not all air bags or air bag systems are identical. Air bag system designs vary widely and continue to evolve. Recognizing that certain information is proprietary, the panel suggests that consumers be provided with more extensive information about specific air bag systems in order to make more informed decisions.
6. The panel recommends that NHTSA provide assistance to disseminate the conference information to various specialty groups. Most effective dissemination of the panel's recommendations will be to a wide range of health care providers, including the membership of the organizations represented, nurses, physician assistants, and others. The panel suggests an approach incorporating elements of the early cardiac care notification program of the National Heart, Lung, and Blood Institute. The panel feels strongly that the recommendations should be provided to practitioners as directly and simply as possible. Numerous stakeholders should also be incorporated into this cooperative education effort. These stakeholders include, but are not limited to, local, state, and federal governments, manufacturers, auto dealers, managed care organizations, and medical societies and organizations.
7. Air bag disconnection may decrease the effectiveness of certain seat belt restraints; therefore, consultation by the vehicle owner with the car manufacturer is recommended before any air bag system is disconnected. The popular press has reported to the public that newer seat belt designs may not restrain

occupants adequately in frontal crashes without the accompanying deployment of air bags. Auto manufacturers and dealers have an important role to play in educating consumers. Information regarding the increased potential for injury and death in frontal crashes after air bag disconnection should be disseminated to the public as clearly as possible by manufacturers and governments.

8. Any automobile owner who elects to have an air bag disconnected should be aware of the risk of injury to other persons who may ride in the affected seat at a later date. This concern clearly applies to both driver and passenger-side air bags.

Methods

The panel consisted of 17 physicians, each nominated by a professional society or organization. The medical societies were selected because their members were either the most likely to see air bag-related injuries or to be questioned about air bag risks by their patients. During the month prior to the conference, the Reagan Institute communicated with each panel member regarding content and any information needs for the conference. During this month, each panel member extensively reviewed the available medical and engineering literature about air bag technology and injury risk and prevention in preparation for the conference.

The opening general session consisted of a didactic presentation by the NCAC with an opportunity for discussion. This session served to update and clarify engineering and data issues and to familiarize panel members with the format of the conference. Following this general session, the panel was divided into three groups for discussion of specific issues.

Each group consisted of five or six physicians, and was assisted by a moderator and a scribe. Each group also had access to ongoing technical assistance from the NCAC, the course director, and NHTSA. Each group was assigned specific areas of discussion with some duplication among the groups on more general areas.

Each group discussed each topic area in order to address seven specific results: known data, unknown data, recommendations, level of confidence in recommendation, rationale for recommendation, specific issues affecting recommendation, and stakeholders. Each group presented their findings to the overall panel for discussion and formulation of final recommendations. The panel's final recommendations constitute the major findings of this report.

What follows is a summary of the panel's specific recommendations. For each specific condition, we list potential issues, recommendations, and discussion. Potential Issues Previously Raised are those areas in which a member of the public might have concerns or questions before receiving a medical opinion. Recommendations are those specific statements generated by the panel and intended to be communicated to the public and the medical community. Discussion includes explanatory information concerning the recommendation. It is important to emphasize that all issues were discussed in the context of risk of injury in relation to the overall lifesaving benefits of air bags.

Specific Issues:

Pacemakers:

Potential Issues Previously Raised - Air bag deployment might cause failure of a pacemaker or failure or discharge of an implantable defibrillator.

Recommendation - There is no evidence to support disconnecting airbags for occupants who have pacemakers, implantable defibrillators, or similar devices.

Discussion - Pacemakers and similar hardware are specifically designed to withstand impact. The forces associated with air bag deployment are typically distributed throughout the chest and are not directed at one specific area. The impact suffered without an air bag may in fact be more severe and more localized than that with an air bag. Clinical experience does not demonstrate any significant concern about the effects of air bag deployment on this type of hardware when properly installed. As forces to the chest in areas directly contacted by seatbelts may exceed forces from air bags, it is important the belts be placed properly and not directly over these devices.

Supplemental oxygen:

Potential Issues Previously Raised - Air bag deployment might be associated with increased risk of fire in the presence of supplemental oxygen. The equipment necessary for supplemental oxygen delivery might be associated with an increased risk of injury during air bag deployment

Recommendation - There is no evidence to support disconnecting air bags for reason of fire hazard or equipment risk for persons who require supplemental oxygen. All equipment such as tanks and regulators should be properly secured away from the air bag.

Discussion - There have been no reported fires after air bag deployment, and there is no reason to suspect that an environment enriched with only personal supplemental oxygen would create a fire hazard. While occupants frequently report the presence of “smoke“ after air bag deployment, this substance is more likely residual powder used to create smooth air bag deployment. The presence of any stray object in the front seat of a vehicle, particularly in a position between the module and the occupant, creates the potential for injury during deployment. Standard oxygen delivery devices such as canulae, tubing, and masks are soft and flexible and present a minimal hazard. Equipment such as regulators and tanks should be kept in a position away from the air bag so as not to be between the occupant and the module. Devices for securing tanks in vehicles might be an area for improvement.

Eyeglasses:

Potential Issues Previously Raised - During air bag deployment, eyeglasses might place the vehicle occupant at increased risk of eye injury specifically caused by the interaction of the air bag and the eyeglasses.

Recommendation - There is no reason to recommend disconnection of air bags for persons wearing eyeglasses.

Discussion - There are a number of anecdotal cases of eye injuries after air bag deployment, both with and without eyeglasses. Eyeglasses may, in fact, be protective during air bag deployment. There is no obvious increased risk of injuries in the presence of eyeglasses; moreover, impact with the steering column or dashboard may be more dangerous to someone wearing eyeglasses than impact with an air bag. Persons who need eyeglasses should wear them to drive and should not have air bags disconnected solely because of the eyeglasses.

Median sternotomy:

Potential Issues Previously Raised - Decreased stability of the sternum after median sternotomy might create an increased risk of intrathoracic injury due to the force of air bag deployment.

Recommendation - We recommend that persons who have undergone median sternotomy not disconnect air bags.

Discussion - Uneven pressure on the chest can harm a patient with a recent median sternotomy because the external wound may be opened. An air bag does not cause this uneven force; seatbelts or striking an object like a dashboard can cause this uneven force. Although there have been no cadaver tests in this specific area, in general the forces across the chest are less with an air bag during impact than without. The combination of air bag and seatbelt remains the best solution in a frontal crash. Most surgeons recommend that patients wait two to three weeks before driving after a median sternotomy, irrespective of the presence of an air bag.

Angina:

Potential Issues Previously Raised - An episode of angina or dysrhythmia might be precipitated by the force and sudden nature of air bag deployment in someone with ischemic heart disease.

Recommendation - We recommend not to disconnect air bags for persons with angina.

Discussion - It is known that emotional or physical triggers can cause sudden death in patients with cardiac disease. It is also known that certain blows to the chest can cause sudden death in persons with or without cardiac disease. However, there is no evidence to suggest that this phenomenon is occurring with any greater frequency in the presence of air bags. In general the force of an air bag is distributed across the chest and not localized directly over the heart. Deployment of an air bag may produce anxiety; however it occurs at the same time as a crash, another anxiety-producing event.

COPD/Emphysema/asthma:

Potential Issues Previously Raised - The byproducts of the propellant might precipitate severe bronchospasm in persons with lung disease.

Recommendation - We recommend not to disconnect air bags for patients with these chronic lung diseases.

Discussion - There is no risk of oxygen deprivation during air bag deployment because of the quick deflation of the device. There is some equivocal evidence to suggest that the chemical irritants produced may precipitate bronchospasm in persons with asthma. However, there is no evidence to suggest that this phenomenon is occurring with any greater frequency in the presence of air bags. There is no reason to suspect that persons with any type of chronic lung disease will be adversely affected by an air bag deployment sufficiently enough to justify disconnection of the device. As with other conditions, the benefits of air bags in these situations outweigh the risks.

Breast reconstruction/Mastectomy:

Potential Issues Previously Raised - Women who have undergone mastectomy and/or breast reconstruction may suffer injury to those previous surgical sites during air bag deployment.

Recommendation - We recommend not to disconnect air bags on the basis of previous breast reconstruction in its various forms or on the basis of previous mastectomy.

Discussion - As with other conditions related to chest anatomy, crash forces are distributed more evenly in the presence of an air bag than with only a seatbelt or with no restraint. The low risk of implant rupture exists with allogenic or gel-filled implants, not flap procedures. While rupture has been reported anecdotally with seatbelt use, this phenomenon has not been noted to occur due to air bags. If a rupture occurs, a repair can be done. Flap reconstruction with native tissue is no more likely to be damaged than native breast tissue. The exact forces required to rupture an implant are not known, and might be an area for future research.

Scoliosis:

Potential Issues Previously Raised - Persons with severe scoliosis may be at increased risk of injury during air bag deployment because of positioning problems.

Recommendation - If capable of being positioned properly, persons with scoliosis should keep air bags connected in their vehicles.

Discussion - This specific condition might make it impossible for a person to sit upright and away from the air bag. This very small portion of the population of persons with scoliosis might be candidates for disconnection. It must be remembered that a person sitting far forward in either the driver or passenger seat is also at increased risk of injury from other structures (steering column, dashboard) in front of them.

Previous back or neck surgery:

Potential Issues Previously Raised - Persons with previous back or neck injuries or surgery might be reinjured by a deploying air bag.

Recommendation - We recommend not to disconnect air bags in cases of persons with previous back or neck surgery.

Discussion - Air bags are known to be protective against spinal injuries overall in frontal crashes. This protective effect would be expected to include patients with previous surgery. Sites of fusion within the spinal column likely provide increased protection from injury because of increased strength. In general, most surgeons recommend that postoperative spinal patients not drive for six to twelve weeks. This recommendation should not change in the presence of an air bag.

Previous facial reconstructive surgery or facial injury:

Potential Issues Previously Raised - Persons with previous facial injuries or surgery might be reinjured by a deploying air bag.

Recommendations - We recommend not to disconnect air bags for persons with previous facial reconstructive surgery or facial injury.

Discussion - While there is concern about damage to rigid prosthetic implants from the force of an air bag, the likelihood of facial injury is higher after contact with a firm object such as a steering wheel. This risk-benefit analysis is likely to hold true for any person with previous facial surgery or injury. The effect of changing deployment thresholds and depowering bags is a potential area for investigation in this and other conditions.

Hyperacusis or tinnitus:

Potential Issues Previously Raised - The noise of a deploying air bag might exacerbate the symptoms of persons with hyperacusis or tinnitus.

Recommendations - We recommend not to disconnect air bags for persons with hyperacusis or tinnitus.

Discussion - Airbag deployment is known to create sound that approaches 170 decibels. The risk of damage to hearing is present at 140 decibels. However, the phenomenon of hearing loss has not been noted to occur due to air bags. The specific conditions of hyperacusis and tinnitus are not associated with hearing loss, and persons with these conditions would have no greater likelihood of hearing loss from air bag deployment than any other persons. Some persons with tinnitus report that noise triggers attacks of tinnitus; however, it is difficult to separate the noise of an air bag from the noise of a crash in many situations. Given the potential general risk from air bag noise, muffling the noise of deployment might be an area for future study.

Advanced age:

Potential Issues Previously Raised - Persons of advanced age might be at increased risk of injury from air bag deployment compared to their risk of injury without an air bag.

Recommendation - Advanced age by itself does not suggest the need for air bag disconnection.

Discussion - There is a large spectrum of fitness in the elderly, and physiologic age may not necessarily coincide with chronologic age. It is known that older persons are at greater general risk of injury in all types of crashes. The data suggests that air bags may be less effective in the older population although the cause of this finding is unclear. There is no evidence to suggest that advanced age by itself, in the absence of other potential risk factors examined here, warrants air bag disconnection. More study on age as an independent risk factor for injury, and in association with other factors, is needed.

Osteogenesis Imperfecta:

Potential Issues Previously Raised - The fragility of the bones of persons with osteogenesis imperfecta places them at increased risk of injury from air bag deployment.

Recommendation - The panel recommends air bags not be disconnected for persons with osteogenesis imperfecta.

Discussion - While there is little population-based data in the crash experience of this group, it is anticipated that the injury risk to these persons is higher without an air bag and proper restraint than with an air bag.

Osteoporosis/Arthritis:

Potential Concerns Previously Raised - Persons with osteoporosis and various types of arthritis may be at increased risk of injury from air bag deployment.

Recommendation - For persons with osteoporosis, arthritis, and other skeletal conditions air bags should not be disconnected unless the person cannot sit back at a safe distance from the air bag.

Discussion - Persons with specific conditions, such as ankylosing spondylitis, may have a relatively stiff spine and thus may be unable to place themselves an acceptable distance from the steering wheel while driving. Other than in this specific circumstance, persons with osteoporosis and types of arthritis are generally benefitted by the presence of an air bag. In general, the distribution of loads across bony surfaces in the presence of air bags is less than with belts alone.

Wheelchairs

Potential Concerns Previously Raised - It may be impossible to place certain wheelchairs in certain air bag-equipped vehicles. Persons in wheelchairs may be at increased risk of injury from a deploying air bag.

Recommendation - For persons in wheelchairs the decision to allow disconnection of the air bag should be handled on a case-by-case basis. Disconnection may be needed if installation of special equipment requires removal of the air bag. If wheelchair installation or steering column configuration does not necessitate air bag removal, we recommend not to disconnect air bags.

Discussion - In certain situations, the air bag must be removed from a steering column in order to install a specially-designed steering wheel for the driver. This is particularly true in a person with upper extremity weakness after a spinal cord injury. In these situations, handles are installed on smaller steering wheels in order to make steering more feasible. In the absence of circumstances requiring reconfiguration of the steering mechanism, there is no reason to suggest that those in wheelchairs are at increased risk of injury from air bag deployment. In all cases the occupant should be belted and the wheelchair secured to reduce the risk of injury.

Achondroplasia:

Potential Concerns Previously Raised - Persons with achondroplasia and other syndromes associated with short limbs may be at increased risk of air bag-related injury because of proximity to the module.

Recommendation - In persons with achondroplasia we recommend allowing disconnection of driver-side air bag only if the person is unable to sit back from the air bag.

Discussion - Persons with significantly congenitally shortened limbs may be required to sit very close to the steering wheel in order to operate a vehicle. In this situation, pedal-extendors will offer limited assistance as the arms are also affected. However, there is no reason to disconnect the passenger-side air bag for an occupant with achondroplasia.

Previous ophthalmologic surgery:

Potential Concerns Previously Raised - Persons with various types of ophthalmologic surgery may be at unreasonable risk of injury because of the fragility of their ocular structures.

Recommendation - For patients who are binocular, air bags should remain connected for overall safety and protection of eyes. For patients who are monocular with or without prior surgery the known benefits of air bags overall outweigh risks. While the monocular patient may perceive a threat to vision exceeding the benefit of airbag protection, we recommend that airbags remain connected. We understand that the data in this specific area is limited at this time.

Discussion - There is little population-based data on which to base a clear recommendation that applies to all persons in this category. There are a number of anecdotal reports of serious eye injuries after air bag deployment. Most of these reports lacked long-term followup, and most were unilateral. Corneal surgery may lead to longer postoperative globe weakness than cataract surgery because of the location and size of the incision. It is not clear in these types of postoperative conditions whether the risk of ocular injury is greater with or without an air bag. The panel recognizes that most eye injuries that occur after air bag deployment are minor and lead to full recovery. The recommendation of the panel is based on an analysis of the relative risks of injury using the best data available. The panel suggests review of eye registry data and further review of this issue in order to formulate future recommendations.

Down syndrome and Atlantoaxial instability:

Potential Concerns Previously Raised - Persons with Down syndrome and severe developmental delay may be incapable of reliably sitting back from an air bag. Persons with Down syndrome and atlantoaxial instability may be at unreasonable risk of severe neck injury during air bag deployment.

Recommendation - Disconnection of the passenger air bag is warranted if a person with this specific condition cannot reliably sit properly aligned in the front seat, such as in those with developmental delay.

Discussion - Children and adults with severe developmental delay, including some with Down syndrome, may be incapable of consistently maintaining a position away from a passenger-side air bag. If these individuals cannot ride in a back seat, air bag disconnection may be warranted.

While there is no known data on this specific situation in relation to air bags, atlantoaxial instability is present in 20% of persons with Down syndrome. This instability creates the clear risk of atlantoaxial subluxation. Persons with this condition should clearly sit properly restrained in the back seat of a vehicle. In situations in which they must sit in the front seat, air bag disconnection may be warranted because of the risk of cervical injury, particularly if these individuals have developmental delay which prevents them from consistently maintaining proper positioning.

Monitoring of infants and children:

Potential Concerns Previously Raised - Certain infants must be monitored and cannot be in the back seat when the only adult in the vehicle is the driver.

Recommendation - The panel recognizes that there are a few specific medical conditions in which infants and young children must be in the front seat for monitoring by the adult driving. In such situations, the passenger side air bag may need to be disconnected.

Discussion - Parents are frequently concerned that they will be unable to properly monitor their infants if the infants are in the back seat without an adult. The American Academy of Pediatrics has clearly recommended that infants without underlying medical conditions can safely ride alone in the back seat properly restrained in a rear-facing restraint. The data shows that in the absence of an air bag, the injury risk in the back seat is 30% less than the risk in the front seat. The panel recognizes that certain vehicles do not have back seats. In these vehicles the option of on-off switches is already available. Monitoring of certain infants may require placement of the car seat in the front passenger seat when the only adult in the vehicle is the driver. These situations may warrant air bag disconnection or an on-off option. Parents should clearly recognize that distraction while driving significantly increases the risk of a crash. Ideally, if a child needs attendance in a vehicle, someone other than the driver should be available. It is anticipated that the American Academy of Pediatrics will make recommendations regarding which specific conditions warrant close monitoring while driving.

Pregnancy:

Potential Concerns Previously Raised - The proximity of the gravid uterus to the deploying air bag creates an increased risk of fetal death.

Recommendation - Assuming proper positioning (sitting as far away as possible) and proper seat belt restraint, the benefits of air bags appear to outweigh risks in pregnant women by the limited data available. The panel recommends that air bags not be disconnected for pregnant women at this time. Further research is needed in this important area.

Discussion - The panel feels that there is no reason to recommend disconnection of passenger-side air bags in the case of pregnant women. There is a clear concern on the part of the public about the safety of the fetus in the presence of a driver-side air bag. What is clearly known is that the leading cause of fetal death is maternal death. Protection of the pregnant female with proper lap and shoulder restraint is vital. However, pregnancy places the gravid uterus closer to the steering wheel as pregnancy develops. While there is a risk of fetal death from air bag deployment, there is also a clear and well-documented risk of placental abruption and fetal death from low-velocity impact, such as contact with a steering wheel. Based on the current data, the panel recommends that the benefits of air bags outweigh the risks for pregnant women. This recommendation is made with the recommendation that further study be done on the biomechanics of injury to the gravid uterus and the fetus during crashes and air bag deployment.

Short Stature:

Potential Concerns Previously Raised - Persons of short stature cannot place themselves a safe distance from the air bag module and thus are at increased risk of injury.

Recommendation - We are not able to determine an absolute cut-off height and weight for disconnection of air bags. Given proper positioning and seat belt use, at a maximum distance from the air bag the benefits of air bags appear to outweigh the risk for patients of small stature given the current data. Further study is warranted given the potential risks and the large population involved.

Discussion - Short stature is a common area of concern for the public in regard to air bag deployment. As proximity to the air bag is the major issue, the passenger-side air bag should not be disconnected for a passenger of short stature. Beyond just short stature, weight, arm length, and leg length also play important roles in driver positioning. We know that a disproportionate number of the deaths attributed to air bag deployment have occurred in persons of short stature. However, of the 150,000 estimated air bag deployments involving persons of short stature, only 14 are known to have been fatal. In all cases, however, for both tall and short-statured individuals, close proximity to the deploying air bag was the overriding factor in the death. As with some other categories, there is somewhat limited population-based data on this specific population in order to formulate an exact risk-benefit ratio. The panel feels strongly that while the vast majority of persons of short stature benefit from the presence of an air bag, this area should be studied using improved database systems and injury surveillance.

Summary

There are a number of potential confounders that are not specifically addressed in this report. Unless otherwise specified, we refer to driver-side air bags in making specific recommendations and pointing out areas of concern. Under most circumstances, with the notable exception of infants in rear-facing infant seats, the person in the passenger position can be made safe from inadvertent injury by the use of proper restraint and placement of the seat in the most rear position. Certain vehicles with bench seats may complicate this issue and may need to be considered carefully on a case-by-case basis.

We have not addressed the issue of multiple children in a vehicle without enough acceptable seats. This is a clear concern on the part of some parents. This situation, however, does not result from any specific medical condition but is merely dependent on the number of occupants in a vehicle at a particular time. Drivers should carefully consider the risks and benefits of certain seating positions before placing occupants in a vehicle.

The combination of surveillance data and clinical experience suggests that the overall effects of the presence of air bags in the vehicle fleet have been positive. Reliable data using injury surveillance and information on crash dynamics points out that over 2500 lives have been saved by air bags. Many thousands more injuries have been averted. The clinical experiences of the panelists and their colleagues confirm the dramatic change in injury patterns and outcomes since the advent of air bag technology.

This panel of 17 physicians of diverse specialties has used the best data available combined with clinical experience in order to develop recommendations for physicians and their patients to consult when considering the option of air bag disconnection. It is clear from our analysis of the facts that the vast majority of persons, especially if properly restrained, are likely to benefit from the presence of an air bag as a supplemental restraint. Air bags are one important component of protection for front seat occupants in frontal crashes. We cannot overemphasize the importance of proper seat belt restraint for all vehicle occupants. In conclusion, we choose to emphasize several points:

- Air bags are proven effective in both saving lives and preventing injuries.
- Virtually all persons are more likely to avoid injury and death when protected by an air bag in a frontal crash.
- Persons who choose to disconnect air bags because of a specific concern should carefully consider the increased injury risk to themselves and other potential occupants after that disconnection from loss of air bag protection.
- Future owners of vehicles with disconnected air bags should be clearly notified of the disconnection.
- The panel urges increased support for crash injury surveillance, particularly for less severe injuries, improved research on tolerance of human tissue to injury, research and development of improved occupant sensing systems, and research on crash effects on pregnant women.
- Children and infants should ride in the back seat.
- **All occupants of motor vehicles should be properly restrained by seat belts.**

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