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Back-up Detection Devices: What Do We All Need to Know? Dangerous Blind Zones

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BACKGROUND

Every year, thousands of children are injured or killed when they are inadvertently backed over. It is estimated that 50 children a week are backed over (USA Today, 2006). Many times the backover occurs in a private driveway (USA Today, 2004). Ironically, the Centers for Disease Control and Prevention (CDC, 2002) reports that in more than 57.7% of all child pedestrian crash related injuries, not just backovers, the person behind the wheel was the parent of the victim. These tragedies are occurring with greater frequency because more and more people are driving larger vehicles with bigger blind zones. More than 60% of backover incidents involve a truck, van, or sports utility vehicle (SUV). Children backed over by larger vehicles are more severely injured than those children backed over by passenger cars (Pinkney, et al., 2006). The CDC reports that more than 9100 children were treated in hospital emergency rooms owing to nontraffic, noncrash incidents in a 1-year period.

BLIND ZONES

Figure 1 illustrates the length of blind zones behind several different size vehicles for an average height driver (5 feet, 8 inches) and a shorter driver (5 feet, 1 inch).

Consumers Union, nonprofit publisher of Consumer Reports Magazine, revealed findings to the public in August 2006 of the blind zones that exist behind vehicles. Blind zones behind SUV's and pick up trucks may be dangerously high. A 51-foot blind zone was reported behind the Chevrolet Avalanche pick-up truck for a short driver (5 feet, 1 inch).

EDUCATION

Education to increase widespread public awareness is paramount to prevent backover injuries and deaths. One campaign, Spot the Tot, was developed by Primary Children's Medical Center (PCMC), Safe Kids Utah, and the Utah Department of Health (UDOH) who joined forces to save children's lives in 2004. According to the Safe Kids Utah Coordinator, this innovative program was developed because of the growing number of Utah children who were being hurt

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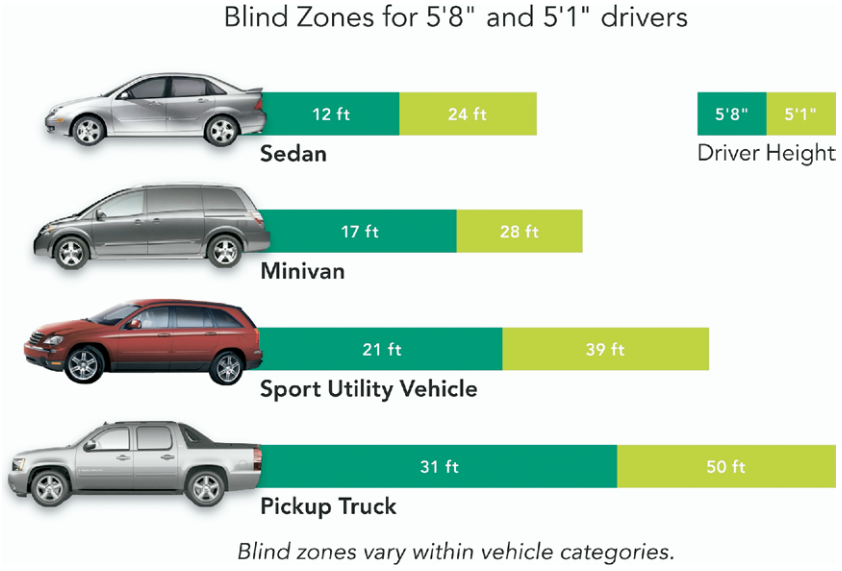
FIGURE 1. Examples of blind zones by vehicle category. Note: From The Collaborative Project of California Department of Health Services, KIDS AND CARS and the Trauma Centers of Children's Hospital & Research Center; Oakland, Children's Hospital and Health Center, San Diego; San Francisco Injury center - Department of Surgery, UCSF; Santa Clara Valley Medical Center; Stanford Medical Center; UC Davis Health System; University Medical Center; (UCSF-Fresno). Keep Your Kids Safe in and around Cars. Copyright 2006 by Author. Reprinted with permission.



and killed in driveways and parking lots. The campaign addressed an urgent need to educate families to remember to check around their vehicles for children before getting behind the wheel. Figure 2 shows a small child, a "tot," playing. This child might not be seen by a driver backing up because of the blind zone behind the vehicle.

Safe Kids Worldwide (2006) has launched the Spot the Tot educational campaign nationally to further promote Utah's mission of keeping children safe around cars. The campaign teaches parents and caregivers to take a quick walk around their vehicles before driving to make sure there are no children or other objects around the vehicle. The few second walk-around should be performed at home, on the street, and in parking lots according to Safe Kids Worldwide. Figure 3 demonstrates the walk around a vehicle, looking for children or objects.

LEGISLATION

KIDS AND CARS™ (2003) is a consumer advocacy group that tracks all non-traffic accidents and is active in trying to protect children from injury in and around cars. Janette Fennell, Founder and President of the group, worked diligently with members of Congress in 2006 to pass bipartisan legislation HR 2230 and S1948 that would have established basic safety regulations. This legislation would require the National Highway Traffic Safety Administration (NHTSA) to set a standard for rear visibility that all vehicles must meet and require autoreverse mechanisms for power windows and a brake transmission interlock device that works in all key positions. Unfortunately, in a final attempt to pass these bills in mid-December 2006, a Senate member put a hold on the bill that prevented passage. There are new commitments from the Senate Commerce, Science, and Transportation Committee staff that there will be hearings early next year and a renewed effort to work toward passage. The House and Senate sponsors seem strongly committed to enacting this legislation in 2007.

PREVENTION

Besides advising parents to visually inspect the area around their vehicle before getting in the driver's seat, maintain constant supervision of children, and vehicle design change, what else can be done to help alleviate this growing problem? There are many safety devices on the market that could help prevent these devastating tragedies. While a few of the higher end model cars come with rear-view technology, most devices are optional for an additional cost. Keep in mind that any technology is dependent on how the driver uses it. In addition, some devices can be difficult to install and require dash or windshield mounting, wiring, attaching cables, and heavy-duty hardware installation on the roof or rear bumper. Inclement weather can interfere with a driver's ability to see clearly with camera models.

BACK-UP DETECTION DEVICES: USEFULNESS AND EFFECTIVENESS

The NHTSA recently announced completion of a study on backover technology (2006) to determine how effective the systems are and how they are being used by drivers. One conclusion of the study was that camera-based systems appear to have the potential to address the risk of backover incidents. The NHTSA study revealed concerns that "camera performance can change from vehicle

FIGURE 2. Note: From Children's Primary Medical Center. Copyright pending by Intermountain Healthcare. Reprinted with permission.

to vehicle and from situation to situation. . . . Further, the ability of drivers to become accustomed to such systems and then to use them effectively when backing needs to be better understood" (p. 1).

As reported in USA Today-McLean, VA (O'Donnell & Carty, 2006), Virginia Tech Transportation Institute has done two studies for General Motors (GM) in the past 3 years of drivers using rear-view and warning technologies. They found that systems with sensors and warning beepers and those with cameras had little effect on whether participants struck unexpected obstacles. At least half the drivers still hit them.

A Canadian study (Gladzuri, 2005) investigated the potential safety benefits of vehicle backup proximity sensors in reducing the risks to small children and other pedestrians. The researchers looked at six commercially available ultrasonic proximity sensors. Actual effectiveness appeared to depend on varying vehicle and human factors. The effectiveness was limited to vehicle speed and the height of the object. The sensors would not necessarily pick up on a child who was sitting or crawling on the ground.

The back-up warning alarm that emits a "beep-beep" to warn pedestrians outside of the vehicle whenever the driver shifts into reverse gear may be the least effective of backup devices. In one study (Sapien, Roux, & Fullerton, 2003), 100% of the preschool children studied did not respond at all to the alarm with avoidance behavior.

Extra mirrors and wide-angle lenses are only effective if the driver is alert and using them. Panoramic imaging was evaluated in this study as it provided a larger field of view and better resolution than the conventional video camera. When the car moved closer to the object, the accuracy of the system increased. This sensor was believed to have an advantage over other similar products on the market today.

Consumer Reports (2004) published ratings of selected back-up systems. Following are systems and ratings of various sensor and camera models. According to the authors, the overall score is based on display quality and field of view for camera systems, and the display usefulness and sensitivity of the sensor models. Sensitivity reflects the performance of sensor systems at detecting various objects and relating relative distance to the driver. Field of view is the visible area covered by the camera systems. Display denotes the quality of the image on the monitor; for the sensor systems, the effectiveness of the audible and visible warning devices. Ease of installation is a judgment of how much skill and time is required to install a model.

Sensor Models

The Grote Obstacle Detection system 78520 for $275.00 (2005) was rated an overall score of excellent and a sensitivity score of excellent, with ease of installation as good (Consumer's Union, 2004). Grote (2005) describes its obstacle detection as a system that contains flat sensor technology, provides 150 degrees of horizontal field vision up to 7 feet, and monitors back-up zones nine times per second. It also has an automatic self-test, which indicates to the driver that the system is working when it is activated. It is mounted on the license plate bracket and does not require drilling.

Echomaster EM-PV® for $275.00 (n.d.) was also rated an overall score of excellent, with sensitivity being very good and ease of installation as fair (Consumer's Union, 2004). Echomaster (n.d.) describes

FIGURE 3. A 5-second walk could save a child's life. Note: From Safe Kids Worldwide. (2006). A five second walk could save a child's life. Retrieved November 20, 2006 from http://www.safekids.org. Copyright 2006 by Author. Reprinted with permission.

its detection pattern as having a range for 6 full feet behind the vehicle's bumper, while at the same time giving excellent peripheral coverage.

The Rostra Pro Universal Rear-Obstacle Sensing System (ROSS®) 250-1594 priced at $350.00 (2000) was rated an overall score of excellent, with sensitivity of very good and ease of installation of fair. It was the only higher-rated model not affected by inclement weather (Consumer's Union, 2004). Rostra (2000) describes this system as using microwave motion sensing technology, alerting the driver to obstacles as far away as 12 feet behind or next to the rear end of the vehicle. The ROSS® uses three bumper-mounted sensors and a LED display to indicate rear-obstacle proximity. The LED is also tied into a beeping sound source, which activates only when in reverse. The beeper is loud, but a low-tech sound volume control is included with the kit.

Camera Models

HitchCAM™ (n.d.) retails several camera models. The best ratings were for two models, both priced at $800.00. The HitchCam™ HCFC1B rated overall as excellent, field of view, excellent, and ease of installation as good (Consumer's Union, 2004). The screen size is 2.25 by 2 inches. HitchCAM™ is firmly secured with a high-quality hitch lock on the license plate frame. It requires minimum drilling. This system is less susceptible to vandalism, theft, or road hazards, as other camera systems require bolting to the bumper or roof. HitchCam™ (n.d.) promotes its model as improving the visibility of larger vehicles by exposing 4- to 5-foot vertical rearview blind zones that can extend as far as 20 feet back. It is said to work day and night and provide excellent picture quality, owing to an automatic low-light feature. The HitchCAM™ HC-001C was rated with an overall score of excellent, field of view of very good, and ease of installation of very good (Consumer's Union, 2004). The screen size is also 2.25 by 2 inches. Retailers claim that HitchCAM™'s plug-and-play design can be installed in about 20 minutes by an installation technician. Other products on the market require intricate wiring by a professional and are time-consuming because the vehicle's rearview mirror must be removed and replaced. HitchCam™ states that there is no need to remove, mount over, or exchange the vehicle's stock rearview mirror, allowing compass and temperature displays to remain visible and in use.

Audivox® RVMPKG3 (n.d.) is priced at $400.00, with an overall score of excellent, field of view of excellent, and ease of installation of poor. The LCD screen is large (3.25 by 2.5 inches) and mounts on the rear-view mirror so the driver sees both images. The display must be turned on manually. Shifting into reverse does not activate it. Installation involves drilling.

OTHER TECHNOLOGY

Safety Mirrors

With a ScopeOut® Aerodynamic mirror (Sense Technologies, Inc., 2006), drivers are able to see a much wider, unobstructed view of oncoming traffic and pedestrians, including small children through their rearview mirror. ScopeOut® states that it reduces the danger from vehicle blind zones and may be especially helpful when changing lanes or pulling out of parking spaces next to large vehicles or buildings. The product sells for under $100 and is produced in two models, one for automobiles and one for SUVs, minivans, and station wagons.

Doppler Radar System

Guardian Alert® is a Doppler Radar system with a notification display in the vehicle that will alert the driver with a 3-step audio/visual warning that an obstacle is behind the vehicle. Guardian Alert® (Sense Technologies, Inc., 2006) advertises that, unlike other less effective systems, it covers a zone from ground level to 5 feet high and from the rear of the vehicle back about 9 feet automatically, with nothing required of the driver. This is how the system works: Using a tape measure, mark

off a distance of 18 feet straight out from behind the vehicle. Ask a person to stand there. The vehicle should remain stationary while the person begins to walk toward it from behind. When the person reaches a distance of 9 feet from the vehicle, the display should indicate a flashing yellow/green light. When the person reaches a distance of 5 feet from the vehicle, the display should turn to a flashing red/green light and emit a fast audible beep. When the person is within a distance of 3 feet of the vehicle, the display will show a solid red light and the beep should become continuous, warning the driver that an object is dangerously close to the vehicle. The device is available for about $300.00.

WHAT'S NEXT?

Sally Greenberg, Senior Product Safety Counsel for Consumer's Union, says rearview cameras are extremely effective. However, Greenberg (2006) says "it's much safer to build the danger out of the products." Cameras may be the best of the technology available at the present time, but they are only a piece of the larger solution. Another piece of the solution will be for all vehicles to be manufactured with rear-detection devices and for a standard to be established for rear visibility that all vehicles must meet. That may happen if legislation HR 2230 and S1948, as discussed previously, are successful when reintroduced to the House and Senate in 2007. Since the Omnibus Transportation Bill, the Safe, Accountable, Flexible, Transportation Efficiency Act (SAFETEA-LU) was passed and the NHTSA has begun investigating methods for collecting nontraffic, noncrash data. The agency says it will also continue to study methods for reducing backovers, analyze prevention technology and provide an estimate of cost savings that would result from widespread use of backover prevention devices. The NHTSA (2006) recently announced that the agency "plans to conduct additional work to estimate the effectiveness of such systems and to develop specifications of performance for any technology that could be developed to address this risk" (p. 1). Consumer's Union is also currently evaluating newer products on the market today that have dated their 2004 study. The results of these further studies may force a change in vehicle design. New technology is always emerging, such as Complementary Metal Oxide Semiconductor (CMOS) imager chips that "directly sense depth - 3D pixel-by-pixel" and enable cameras to perceive objects more accurately than current ultrasonic sensor systems. While sophisticated sensors, such as radar and lidar, are under development, companies worldwide are scrambling to find cheaper ways to use cameras to calculate distance. This is because cameras have become so inexpensive, according to a senior analyst at ABI Research. "The other motivation for going to cameras is that different driver assistance applications could potentially share the same camera and even the specialized computer chips and software needed to calculate distance." (CC Times, 2006). Other solutions to the growing problem of backovers are environmental modification, such as circular driveways and fenced-off play areas around the home (Fenton, Scaife, Meyers, Hansen, & Firth, 2005).

CONCLUSION

Studies have shown that there is no substitute for driver alertness and education of parents and children about the potential danger created when children are behind vehicles. Parents and caregivers need to be aware of available rear-observation safety devices and the education currently available to help prevent backovers that are an increasing source of childhood trauma. During anticipatory guidance, pediatric nurse practitioners need to be vigilant about educating parents to be aware of the blind zone around a vehicle and the potential danger for a child who may not be visible to the driver. They should help parents understand the developmental level of their young child (especially a toddler). Between 1 and 3 years, children have established some degree of independence, such as walking, but do not cognitively comprehend the concept of danger. They do not distinguish boundaries of a driveway, or a street, from a yard. Young children are also impulsive and spontaneous. This developmental immaturity makes them vulnerable to a tragedy if they are out of the parent's sight, around a car, even for a second.

AUTHOR'S NOTE

Bonnie Lovette, RN, MS, PNP, is one of the primary investigators for a backover study involving most of the major trauma centers in California including San Francisco General Hospital (UCSF); Stanford University Medical Center; Children's Hospital & Research Center Oakland; University of California, Davis; University Medical Center, Fresno; Santa Clara Valley Medical Center; and Children's Hospital, San Diego. Janette Fennell of KIDS AND CARS is the consultant on the study. This study will attempt, through collection of data, to establish a "baseline" from which to measure changes in the incidence of backover injuries and deaths in successive years. The project will be the first step towards making it possible to measure any change in numbers of injuries and deaths that may result from prevention efforts, such as an educational campaign and promotion of safety devices.

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