

Tractor Risk Abatement and Control as a Coherent Strategy

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Abstract

The agricultural tractor was the principal source of fatal injury on American farms for the latter part of the 20th century, and they maintain that distinction today. Much has been learned about the toll of these fatalities and how to prevent them over the last ten years, yet public policy has generally been unsuccessful in reducing this toll. A policy conference entitled Tractor Risk Abatement and Control convened in 1997 to develop recommendations to reduce this death toll. Several stakeholders at the conference agreed on 25 action items, which if implemented would reduce the number of tractor-related deaths by more than 2,000 by the year 2015. These recommendations relate to tractor overturns, runovers, and traffic collisions as well as youth operators. This article addresses the completeness of a strategy for preventing tractor-related injuries for each of these four areas based upon an evaluation model derived from the Theory of Planned Behavior and an antecedent model. The ultimate result of this model is to influence an individual's intention to act to prevent injury. The set of recommendations was found to provide a coherent strategy. In addition, implementing the strategy at an organizational level is discussed.

Keywords. Tractors, Overturns, Runovers, Collisions.

The tractor remains the leading agent of death on farms. Despite decades of awareness of this problem and knowledge of effective solutions, the death toll continues to increase. As of 1998, a report found that 32% of agricultural deaths are tractor-related, averaging 270 occupational fatalities per year. In addition, 264,651 tractor-related restricted-workday and 10,939 tractor-related lost-time injuries occur each year (Donham et al., 1998).

This article reviews the progress made in tractor risk abatement and control (TRAC) since the report "Agriculture at Risk: A Report to the Nation" was published (Merchant et al., 1989). It also evaluates the recommendations from a TRAC policy conference that convened in 1997.

Agriculture at Risk

Based on 1986 data, the Agriculture at Risk report (Merchant et al., 1989) identified the tractor as the principal agent of fatal or disabling injury on farms, accounting for more than three-fourths of machine-related deaths. The report

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recommended a federal mandate for the installation of rollover protective structures (ROPS) on all tractors sold in the United States, including economic incentives to persons to retrofit ROPS on their tractors within five years and requiring ROPS on all tractors within 10 years. This did not occur, and assuming that half of all overturn fatalities related to old tractors that lacked a ROPS for that period (1990–2000) would have been prevented, this inaction cost about 1,095 lives (Myers and Pana–Cryan, 2000).

The Agriculture at Risk report observed that even with this epidemic of death and a public duty “to assure as far as possible every working man and woman in the nation safe and healthful working conditions,” action is lacking. The law requires each employer to provide a workplace “free from recognized hazards that are causing or likely to cause physical harm” (U.S. Congress, 1970). Nevertheless, a false perception exists that farm employers are exempt from this law, and as a result, exempt from the duty to keep their farms free of recognized hazards. The origin of this misperception is that the agricultural community believes that riders to the annual appropriations for OSHA have rendered them exempt. These riders restrict OSHA from “expending” funds to enforce OSHA standards on most farms, but they do not negate the law (Kelsey, 1994).

The Agriculture at Risk report characterized the general public as unaware and therefore unconcerned about farm safety and health. This remains a problem. Tipper Gore’s pictures at the 2000 Democratic Convention showed then Vice–President Gore riding an old tractor, which lacked a ROPS, with a child on his knee. Kenny Chesney’s video of his song “She Thinks My Tractor’s Sexy” shows him bouncing to the music on a tractor that lacks a ROPS. Rural road signs across the country warn of tractors on the road with an icon of a tractor and driver, but the tractor has no ROPS. Many advertisements on television use rural settings in which tractors lack a ROPS.

As recently as February 13, 2001, “Sesame Street” aired a segment about farm life in which a child stood next to an adult tractor driver. The young child waved at the camera from within the cab as the tractor rolled by. This indicates that society has not recognized the danger to a child of being an extra rider on a tractor, yet no responsible program would depict a child being placed in an automobile without a restraint. The romance of farm life clouds recognized hazards such as these.

The TRAC Policy Conference

In 1997, the University of Iowa recognized that little had been accomplished in abating and controlling agricultural fatalities related to the tractor. It convened a policy conference from which 25 action items were published in a report. If these recommendations are implemented, then 2,000 lives will be saved by the year 2015 (Donham et al., 1998). The recommendations were responses to four questions:

1. How do we ensure that every tractor that needs a ROPS has one?
2. What combination of public and private policies is needed to prevent tractor–related collisions on roads?
3. What combination of public and private policies is needed to prevent injuries from tractor runovers?
4. What combination of public and private policies is needed to eliminate tractor–related injuries among youth?

Evaluation Framework

A theory-oriented approach for evaluating the TRAC recommendations as a coherent strategy will help to ensure that better approaches than trial-and-error are used (Lipsey, 1993). For this article, a theoretical model serves as the framework to evaluate the coherence of the strategy. The model—the Theory of Planned Behavior (ToPB) as modified by an A ⇆ B ⇆ C behavioral model—aims to predict and understand an individual’s behavior (Cole, 2000; Petrea, 1996, 2001). The A ⇆ B ⇆ C model postulates a set of antecedent conditions in which attitudes (A) precede behavioral changes (B), which precede consequences (C). The ToPB model contains a complex of antecedent conditions to behavior, which for our purpose is to act on the four questions posed above. In the model, the immediate antecedent condition is “intention,” which is preceded by four more conditions, as shown in figure 1:

1. Attitudes are positive or negative evaluations of the behavior.
2. Social pressure is an individual’s perceptions of the pressures from others to perform the behavior.
3. Perceived control is the degree of control the individual perceives as having over the behavior.
4. Culture (one of many external variables) is portrayed in the A ⇆ B ⇆ C model as the ultimate antecedent and affects each of the three other conditions as well as intention (Cole, 2000). It has been defined as traditions, ethics, and other standards that influence the way things are accomplished with others. For this article, it represents the need for concerted action.

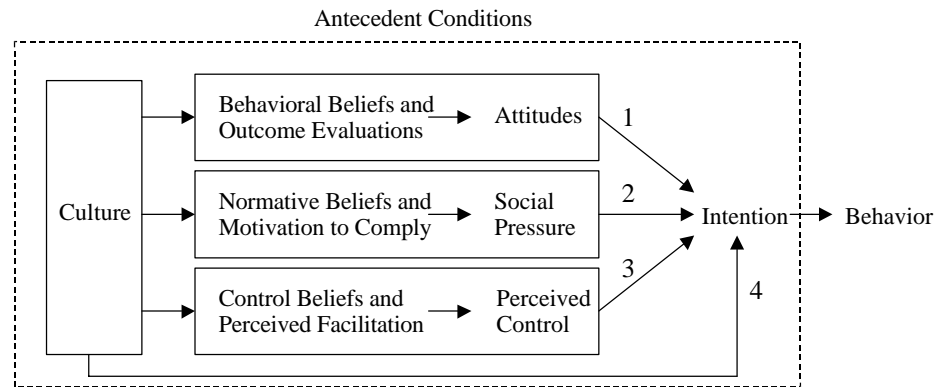


Figure 1. The theory of planned behavior (ToPB) model modified for use in this evaluation. Sources: Petrea (1996) and Cole (2000).

Analysis

The premise for this evaluation is that when actions (the 25 recommendations) are mapped against all four conditions (attitudes, social pressure, perceived control, and culture) a coherent strategy for effecting individual intentions to prevent injury is represented. The evaluation is organized by the four questions related to tractor safety (overturns, collisions, runovers, and youth operators) and their associated recommendations.

Overturns

The National Safety Council estimates that 2,191 deaths resulted from agricultural tractor overturns for the 11-year period 1985 to 1995 (NSC, 1997). These deaths account for more than one-third of all agriculture production-related fatalities in the U.S. (Murphy and Yoder, 1998). The lack of ROPS is the most serious source of preventable death related to tractors, and overturn-related deaths occur on ROPS-equipped tractors when seatbelts are not worn. The mandatory introduction of ROPS has reduced the rate of fatalities to nearly nil in other countries (Reynolds and Groves, 2000). Thus, prevention strategies include the installation of ROPS and the use of seatbelts or other restraints. The TRAC conference generated 12 recommendations related to this question. Table 1 shows that all four of the antecedent conditions are addressed when mapped against the ToPB model, indicating a coherent strategy.

Table 1. Recommendations to ensure that every tractor that needs a ROPS has one.

Recommendations	Antecedents to Intention			
	Attitudes	Social Pressure	Perceived Control	Culture
R-1. Develop an educational/social marketing program to change social norms regarding ROPS.		X		
R-2. Monitor and regularly publish tractor injuries (with teaching messages).	X			
R-3. Establish a tax rebate or subsidy program for retrofit ROPS installation.			X	
R-4. Establish a research program to design ROPS for pre-ROPS tractors and for work environments with low clearances.			X	
R-5. Define and seek ways to limit liability risks for ROPS manufacturers, dealers, and installers.			X	
R-6. Promote development of incentive programs such as certified safe farms.			X	
R-7. Require by July 1, 2003, that all tractors have ROPS if operated by persons under the age of 18 or by employees.				X
R-8. Require by July 1, 2005, that all tractors sold must be equipped with an approved ROPS.				X
R-9. Require by July 1, 2005, a recycling/removal program for tractors not appropriate to fit a ROPS.				X
R-10. Require by July 1, 2007, that all tractors operated on public roads have an approved ROPS.				X
R-11. Require by July 1, 2010, that ROPS be installed on all tractors for which approved ROPS are available.				X
R-12. Require by July 1, 2015, that all tractors be equipped with approved ROPS.				X

Attitudes

Recommendation 2 (R-2), to monitor and regularly publish tractor injuries, relates to shifting negative attitudes to positive attitudes about installing a ROPS and using a seatbelt. In one study, the most significant influences on senior farmers' safety beliefs were personal knowledge of injuries or deaths of friends and neighbors, and

personal experience (Whitman and Field, 1995). Human parables offer an opportunity for changing attitudes away from such views as, "ROPS are a waste of money." These attitudes can change when a local farmer is killed, and when the solution is widely taught to the farm population (Cole, 2000). After two years of a program that uses this approach in two Kentucky counties, 55 farmers retrofitted their tractors with ROPS. In the previous year, only four retrofits had occurred (Cole et al., 1999).

Social Pressure

R-1, to develop an educational/social marketing program to change social norms regarding ROPS, applies social pressure to encourage the installation of ROPS. As discussed earlier in this article, the general public remains unaware and therefore unconcerned about agricultural safety and health. Influential social pressure factors found in one study were parents, grandparents, family mentors, and news reports of injuries or incidents (Whitman and Field, 1995).

Perceived Control

R-3 through R-6 relate to perceived control. These recommendations are, respectively: to establish a tax rebate or subsidy program for retrofit ROPS installation; to establish a research program to design ROPS for pre-ROPS tractors and for work environments with low clearances; to define and seek ways to limit liability risks for ROPS manufacturers, dealers, and installers; and to promote the development of incentive programs such as certified safe farms.

For any prevention model to be effective in reducing deaths from overturns, two barriers need to be removed (Myers, 2000b). One is technological, and the other is economic. Related to technology, research by Ayers and Liu (2000) has yet to find a tractor for which a retrofit design is not possible. ROPS designs are needed because nearly half of the 2.7 million non-ROPS tractors lack a retrofit design. Moreover, because current designs "get in the way" of tree limbs or barn doors, farmers may remove the ROPS. Thus, solutions need to be designed for these farmers, too (Myers and Snyder, 1995).

As to the economic barrier, efforts in Virginia and Pennsylvania have demonstrated that programs for publicizing and providing rebates influence farmers to install ROPS on tractors. The Virginia Farm Bureau Insurance Services has been successful at providing rebates of \$250 each for 118 ROPS retrofits as of the summer of 2000 (Stone and Saacke, 1998; B. Stone, personal communication, June 2000). The Gunthrie Rural Health and Safety Coordinator in Bradford County, Pennsylvania, has successfully established a ROPS rebate program of up to \$500 each that resulted in 45 farmers installing ROPS. (G. R. Jelliff, personal communications, 18 September 2000 and 11 January 2001).

The certified safe farm is another incentive program, and its intent is for insurance companies to reduce premiums on farms that participate in the program and meet criteria for a safe farm (Jaspersen et al., 1999). An insurance reduction of 10% to 25% should pay for safety modifications (Thu et al., 1998). Furthermore, to encourage the decision to retrofit, five tractor manufacturers have offered ROPS and seatbelt kits for older tractors at cost to their dealers (New Holland, 1997).

R-5 addresses a barrier to manufacturers or dealers that results from a fear of liability associated with designing and mounting a ROPS on older tractors. Indeed, in 1957, the University of California halted the distribution to farmers of drawings for

constructing ROPS because of the fear of liability (Skromme, 1986). Although liability is a factor in business behavior, no study has been identified that indicates the effectiveness of this particular action.

Culture

R-7 through R-12 relate to cultural variables for requiring ROPS on tractors for particular applications and by particular dates. Staged over a 12-year period, these recommendations, respectively, are to require: that all tractors have ROPS if operated by persons under the age of 18 or by employees, that all tractors sold must be equipped with an approved ROPS, the establishment of a recycling and removal program for tractors not appropriate to fit a ROPS, that all tractors operated on public roads have an approved ROPS, that ROPS be installed on all tractors for which approved ROPS are available, and that all tractors be equipped with approved ROPS. Although not generally enforced in the U.S., R-7 is fulfilled in part since a regulation requires a ROPS on any tractor operated by an employee.

The Victorian WorkCover Authority, in the state of Victoria, Australia, provides a model for accomplishing this set of recommendations. The authority launched a program that included a combination of regulations, rebates, and publicity. Moreover, it was administered by the Victorian Farmers Federation, and all farmers and farm machinery dealers were satisfied with the scheme. During the 1997-1998 period, the scheme reduced the number of unprotected tractors by 70%, from 17,420 to 5,290, in the state of Victoria (Day and Rechnitzer, 1999).

Collisions on Roads

The second question relates to roadway collisions. About 15,000 farm vehicles per year are involved in highway incidents (Abend and Hallman, 1996). A study for the years 1988-1993 counted 444 farm-vehicle occupants killed, and an additional 238 occupants of other vehicles or pedestrians killed in incidents with farm equipment on the highways (Gerberich et al., 1996). In addition to the use of a seatbelt in the presence of a ROPS (see R-10 in table 1), prevention strategies include better marking and lighting of farm equipment and safe driving training. The TRAC conference recommended six actions (R13-R18) related to the second question, as shown in table 2. The recommendations relate to two different populations: tractor operators, and automobile drivers on public roads.

Attitudes

R-15, to include a question on driver's license exams regarding traffic safety relative to interacting with farm machinery on roads, and R-16, to develop an educational program for the driving public about driving safety on roads where farm machinery is being operated, both aim to raise automobile drivers' awareness of the hazards related to slow-moving vehicles. Through education, drivers' attitudes regarding farm vehicles on roads should shift from ignorance to consideration.

The National Institute for Farm Safety resolved that the Secretary of Transportation should launch a "Sharing the Road" campaign that would: include safety issues regarding the operation of motor vehicles in the presence of farm machinery, include rural roadway safety on state driver's license exams, and provide safety information about agricultural equipment for driver training. Moreover, discussion at a conference in Kansas City revealed that North Carolina farmers have identified safety on the roads as a major concern (Myers, 2000a).

Table 2. Recommendations for policies to prevent tractor-related collisions on roads (continued from table 1).

Recommendations	Antecedents to intention			Culture ^[a]
	Attitudes	Social pressure	Perceived control	
R-13. Promote improving the visibility to automobile drivers of farm vehicles on the roads.		X		
R-14. Prohibit by the year 2005 the driving of tractors on the roads without a valid driver's license.	X			
R-15. Include a question on driver's license exams regarding traffic safety relative to interacting with farm machinery on the roads.			X	
R-16. Develop an educational program for the driving public about driving safety on roads where farm machinery is being operated.			X	
R-17. Utilize an incentive program to ensure that tractor operators have knowledge of safe tractor operation and that tractors have safe marking and lighting.			X	
R-18. Implement by July 1, 2005, uniform model codes for tractor lighting and marking.			X	

^[a] Recommendation 10 from table 1 also contributes to the culture antecedent for this strategy.

Social Pressure

R-13, to promote improving the visibility to automobile drivers of farm vehicles on the roads, targets increasing social pressure as a way to effect laws. Such an effort has been tried in Illinois to legislate the FARM (Few Accidents with Reflective Material) program, but the social pressure needs to be broadened to allay liability fears of farm equipment dealers (Aherin, 2001).

Perceived Control

R-17 provides for incentives to ensure proper lighting and marking of farm equipment on roadways. As discussed above, these incentives need to overcome concerns regarding liability consistent with R-5 since dealers' concern about liability restricted the implementation of a law to improve marking and lighting in Illinois (Aherin, 2001).

Culture

As a cultural variable, R-14, to prohibit by the year 2005 the driving of tractors on the roads without a valid driver's license, aims to ensure that tractor drivers understand the operation of the tractor and the rules of the road. R-18, to implement uniform model codes for tractor lighting and marking, may require national standards since the 50 state codes for lighting and marking of slow-moving vehicles vary widely (Glascok et al., 1995).

Runovers

As to the third question, 50% of runover-related fatalities involve operator or extra-rider falls, and 27% are non-highway pedestrian runovers (Pratt and Hard, 1998). In Indiana, the principle risk factor related to runovers of youth was allowing them as extra riders on tractors or combines (Freeman et al., 1998). Prevention strategies include wearing a seatbelt in the presence of a ROPS, either no extra riders or the use of instructional seats, and no bypass starting. As shown in table 3, recommendations R-19 through R-22 relate to this question.

Table 3. Recommendations for policies needed to prevent injuries from tractor runovers (continued from table 2).

Recommendations	Antecedents to intention			
	Attitudes	Social pressure	Perceived control ^[a]	Culture ^[b]
R-19. Develop a social marketing program to promote a social norm discouraging extra riders on tractors.		X		
R-20. Develop an educational/social marketing program about injuries from tractor runovers.		X		
R-21. Promote sale and installation of safety devices that prevent bypass-start injuries.	X			
R-22. Promote the manufacture, sale, and installation of extra-rider seats for new and used tractors.	X			

^[a] Recommendation 6 from table 1 contributes to the perceived control antecedent for this strategy.

^[b] Recommendation 23 from table 4 contributes to the cultural antecedent for this strategy.

Attitudes

R-21 and R-22 relate to attitudes. R-21 aims “to promote sale and installation of safety devices that prevent bypass-start injuries,” and manufacturers’ have mounted programs to bring this hazard to the attention of the farmer. R-22, to promote the manufacture, sale, and installation of extra-rider seats for new and used tractors, aims at changing attitudes toward designing the tractor seating system to safely accommodate extra riders.

Social Pressure

R-19, to develop a social marketing program to promote a social norm discouraging extra riders on tractors, and R-20, to develop an educational and social marketing program about injuries from tractor runovers, both relate to social pressure. Whereas R-19 is specific and aims to discourage extra riders on tractors, R-20 recommends social marketing for building a public will to solve the tractor runover problem.

Perceived Control

Although R-6, to promote the development of incentive programs such as certified safe farms, deals with ROPS, it recommends a broad program that could also be adapted to address the runover problem, and thus add to the perceived control by the farm operator through insurance savings.

Culture

A cultural variable is not included in the set of recommendations for runovers. However, R-23, to require youths to have formal tractor operator training, could apply to preventing runovers (e.g., by wearing seatbelts).

Injuries Among Youth

From 1992 to 1995, 41% of 155 deaths reported among agricultural workers aged 19 years or younger occurred while the individuals were working on their family farms (Derstine, 1996). Young agricultural workers have three times the risk of death that private sector workers have, and tractors are their leading cause of death (Hard et al., 1999). In a study in Indiana and Wisconsin, half of the fatalities of children and adolescents involved tractors. The leading causes were runovers, overturns, and entanglements (Sheldon and Field, 1995). The principal prevention strategy is parental awareness of age-appropriate tractor operation. As shown in table 4, the TRAC conference recommended three actions related to the fourth question.

Table 4. Recommendations for policies to eliminate tractor-related injuries among youth (continued from table 3).

Recommendations	Antecedents to intention			
	Attitudes	Social pressure	Perceived control	Culture ^[a]
R-23. Require youths to have formal tractor operator training.				X
R-24. Promote the social norm that parents closely supervise all youth working under their direction and management.		X		
R-25. Develop, promote, and disseminate guidelines for parents regarding developmentally appropriate tasks in tractor operation.	X			

^[a] Recommendation 7 from table 1 also contributes to the cultural antecedent for this strategy.

Attitudes

R-25 aims to develop, promote, and disseminate guidelines for parents regarding developmentally appropriate tasks in tractor operation. These guidelines are used to influence parental attitudes for their children's safety while they are performing work with the farm tractor. The NIOSH National Childhood Prevention Initiative at the National Children's Center for Rural and Agricultural Health and Safety in Wisconsin is developing these guidelines (Castillo et al., 1998).

Social Pressure

R-24, to promote the social norm that parents closely supervise all youth working under their direction and management, relates to social pressure. Farm Safety 4 Just Kids is one of the most active groups that encourage parents to closely supervise youth activity on the farm (Pellett, 1999). As an example, they have mounted campaigns to reduce the practice of allowing children as extra riders on tractors.

Perceived Control

No recommendation addresses perceived control (e.g., availability of child care) for injuries among youth. However, the TRAC recommendations were designed to augment a national action plan (NCCAIP, 1996) to be addressed by the NIOSH National Childhood Prevention Initiative. Thus, this question is more comprehensively addressed in that program (Castillo et al., 1998).

Culture

R-23, to require youths to have formal tractor operator training, relates to culture. Moreover, R-7, which aims to require that all tractors have ROPS if operated by persons under the age of 18, also applies to changing the culture to protect youth from tractor-related injuries.

Discussion

Although the strategy for TRAC as addressed above is coherent for each of the four areas (tractor overturns, runovers, traffic collisions, and youth operators), it remains incomplete without organized effort. The following discussion indicates ways in which organizations can effect elements of the strategy by each of the four antecedent conditions so as to stimulate individual behavior toward preventing tractor-related injuries. The references provided below provide further details related to the suggested programs.

Changing Attitudes (TRAC Recommendations 2, 15-16, 21-22, and 25)

Ingrained risky attitudes and behaviors need to be changed, and new attitudes as well as knowledge must be taught. Upon notification of a death from a tractor injury, an action should be mounted within the county where it occurred. To accomplish this, NIOSH should launch a national sentinel event program (Seligman and Frazier, 1992) of tractor-related fatalities based upon its Fatality Assessment and Control Evaluation (FACE) program (Pratt and Hard, 1998). NIOSH should collaborate with the National Transportation Safety Board (NTSB) in the investigation of roadway fatalities involving tractors. Human parables can teach attitudes, which can change when a local farmer is killed, and when the solution is widely taught (Cole, 2000). These parables should be based upon fatality reports (from FACE and NTSB) and taught locally to change farmers' beliefs about the seriousness of the hazard and the intervention that is known to control the hazards (e.g., a ROPS).

The USDA needs to use its extension network to create a national agromedicine program in cooperation with the Office of Rural Health Policy (Schuman and Brittain, 1998). Both agency's budgets need to be expanded to provide for the program, and the program needs to inform the farm community and agribusiness of tractor hazards and known controls for those hazards. An example of an approach used to inform the farm community is the use of best management practices, which dates back at least to the 1950s as a part of FFA projects. Pennsylvania State University has developed a best practices manual for conducting hazard audits, including tractor hazards, and promoting safety on farms (Legault and Murphy, 2000).

The USDA also needs to create an internet extension program for tractor safety, such as the University of Minnesota Extension Service's Farm Safety and Health Information Clearinghouse (UMES, 2001). The USDA can expand its hosting of web

sites that assist the farmer, but it can also move from a passive to an active strategy by engaging in chat room discussions in which farmers discuss tractors and problems with safety. The farm population has already raised tractor safety issues through discussion forums at web sites such as at the Antique Tractor Shed (2000).

Changing Norms (TRAC Recommendations 1, 13, 19–20, and 24)

The National Education Center for Agricultural Safety of the National Safety Council should lead the numerous social marketing recommendations in the TRAC report. Materials and media will be needed to implement these recommendations: education and training materials, advertisements (e.g., for ROPS), and television and print. A conference may be a way to convene collaborators. It should include dealers, manufacturers, the insurance industry, commodity groups, and grassroots organizations such as Farm Safety 4 Just Kids.

The Federal Highway Administration needs to mount a “Sharing the Road” program related to farm equipment on public roads. The program should target both farm operators and the driving public, and it should give attention to operator training and lighting and marking. In addition, the Department of Transportation should update its 1971 “Report on Agricultural Tractor Safety on Public Roads and Farms” (Secretary of Transportation, 1971).

The National Center for Injury Prevention and Control at the Centers for Disease Control and Prevention needs to include “Safe Farm” in its “Safe America” campaign. Through this program, the NCIPC can coordinate injury control programs across the country and use of injury control research centers as well as trauma registries to establish and improve programs that prevent injuries related to farm tractors.

Changing Perceived Control (TRAC Recommendations 3–6, and 17)

NIOSH needs to take the lead in contacting the Equipment Manufacturers Institute to establish university funding for the design of ROPS for pre-ROPS and special-use tractors (e.g., low-clearance situations). In addition, the USDA should issue a request for applications to land grant universities to develop ROPS designs for pre-ROPS and special-use tractors. Finite-element simulation studies can be used to evaluate the efficacy of alternative ROPS designs (Harris et al., 2000; Wen et al., 1994).

The Farm Bureau and other insurance companies need to extend their financial incentives, in combination with public education, across the country to protect all of its farm members from recognized tractor hazards. This program can be modeled after the Virginia Farm Bureau Insurance Services, which has proven effective in helping farmers install ROPS. Moreover, the certified safe farm concept can be used as another motivator to help farmers invest in tractor safety.

The Office of Rural Health Policy needs to promote tractor safety programs through rural hospitals and use rebate systems modeled after the intervention program at the Gunthrie Healthcare System of Bradford County, Pennsylvania.

Changing Culture (TRAC Recommendations 7–12, 14, 18, and 23)

The National Safety Council, in collaboration with insurance and agribusiness companies, should disseminate the knowledge across rural America that every tractor owner has a duty to control recognized hazards related to tractor overturns, runovers, traffic collisions, and youth operators. This duty entails: installing a ROPS (including

a foldable ROPS in low-clearance areas) on non-ROPS production tractors, using a seatbelt in the presence of a ROPS, installing the latest ASAE-approved lighting and marking on farm equipment, banning extra riders on tractors, installing devices to prevent bypass starting, ensuring that tractor operators have a driver's license prior to driving on public roads, and requiring young operators to have formal tractor driver training.

The NIOSH Centers for Agricultural Safety and Health should follow the pattern that was used in Australia for gaining compliance with ROPS installation requirements and other interventions. Despite strong opposition, some countries have mandated that all tractors be retrofitted with ROPS (Springfeldt et al., 1998). Even though opposition could be also expected in the U.S., the action taken in Victoria, Australia, demonstrates that broad support is possible outside of Europe for a policy to place ROPS on all tractors.

NIOSH should maintain a surveillance program of tractor-related injuries in cooperation with the National Highway Traffic Safety Administration and the Department of Labor. This program should include all tractor-related fatalities so as to measure trends and the effect of interventions. Furthermore, NIOSH needs to conduct another survey of injuries among farm workers through the USDA, as it did in 1993, and repeat the survey every five years. This survey gauges the number of non-ROPS tractors, with information on make and model, which is useful in planning interventions and in measuring the progress of farmers in installing retrofits on their tractors. Other hazards and interventions should also be monitored using this survey (Myers, 1997).

Conclusion

This article reviews the lack of progress in tractor risk abatement and control, as a matter of public policy, over the last decade. To stimulate better progress, a TRAC policy conference convened in 1997 and issued 25 recommendations to reduce tractor-related injuries and deaths. This article analyzed the recommendations for strategic coherence in changing individual behavior so as to reduce the injury and death toll.

This article mapped the recommendations against four antecedent conditions (attitudes, social pressures, perceived control, and culture) that affect an individual's behavior and then discussed whether the recommendations represent coherent strategies to reduce injuries and deaths from tractor overturns, collisions, and runovers and as related to youth tractor operators. The recommendations were found to provide coherent strategies, as mapped against a model for the antecedent conditions and augmented by suggestions for applying the recommendations.

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