

Prominent Barriers and Motivators to Installing ROPS: An Analysis of Survey Responses from Pennsylvania and Vermont

P. L. Jenkins, J. A. Sorensen, A. Yoder, M. Myers, D. Murphy,
G. Cook, F. Wright, B. Bayes, J. J. May

ABSTRACT. *Tractor overturns contribute significantly to the number of work-related deaths that occur every year on U.S. farms. Although the agriculture, forestry, and fishing industries have the highest fatality rates of any industries, researchers predict that the elimination of tractor overturn fatalities could result in a noticeable reduction in the farm fatality rate. Rollover protection structures (ROPS) are 99% effective in preventing overturn fatalities. However, roughly 50% of U.S. tractors do not have a ROPS. In order to identify prominent barriers and motivators to installing ROPS, a phone survey was conducted with a random sample of farmers (n = 327) in Vermont and Pennsylvania, two states interested in developing ROPS installation programs. Results indicated that cost and perceived need were the most frequently highly rated barriers to ROPS installation in both states, while working near hills or ditches and concerns regarding liability were the most frequently highly rated motivators for installing ROPS. Additionally, older farmers identified limited use of a tractor as a highly rated barrier.*

Keywords. *Barriers, Motivators, ROPS, Tractor safety.*

Agriculture has the highest injury and fatality rates of any industry. The rate of agricultural fatalities is 25.4 per 100,000 full-time workers (NSC, 2011a), and the rate of occupational injuries and illnesses is 5.3 per 100 full-time workers (NSC, 2011b). Injury data do not include farms with less than 11 employees, which make up close to 92% of farms in the U.S. (Donham and Thelin, 2006). Although the rate of fatalities associated specifically with tractor overturns has declined by 28.5% from 1992 to 2007 (Myers, 2010), these events still account for the greatest proportion of work-related deaths on farms and a significant proportion of farm injuries.

Rollover protective structures provide a reliable source of protection for tractor operators who have the misfortune of overturning their tractor. These devices are 99% effec-

Submitted for review in September 2011 as manuscript number JASH 9368; approved for publication by the Journal of Agricultural Safety and Health of ASABE in March 2012.

The authors are **Paul L. Jenkins**, PhD, Director of Statistics and Computing, **Julie A. Sorensen**, PhD, Staff Scientist, **Aaron Yoder**, **ASABE Member**, PhD, Instructor and Pennsylvania Project Coordinator, and **Matt Myers**, MS, Vermont Project Coordinator, New York Center for Agricultural Medicine and Health (NYCAMH), Bassett Healthcare Network Research Institute, Cooperstown, New York; **Dennis Murphy**, **ASABE Member**, PhD, Professor, Department of Agricultural and Biological Engineering, Pennsylvania State University, University Park, Pennsylvania; **George Cook**, MA, Maple and Farm Safety Specialist, University of Vermont Extension, Morrisville, Vermont; **Flannery Wright**, MA Project Coordinator, **Barbara Bayes**, Hotline Coordinator, and **John J. May**, MD, Director, NYCAMH, Bassett Healthcare Network Research Institute, Cooperstown, New York. **Corresponding author:** Julie A. Sorensen, New York Center for Agricultural Medicine and Health, Bassett Healthcare, One Atwell Road, Cooperstown, NY 13326; phone: 607-547-6023; e-mail: julie.sorensen@bassett.org.

tive (NIOSH, 2004) when used with a seatbelt, but according to data from the NIOSH Occupational Injury Surveillance of Production Agriculture (OISPA), approximately 49% of U.S. tractors are not equipped with ROPS (Myers, 2010). Most of these unprotected tractors were manufactured prior to 1985, when the industry began requiring ROPS as standard equipment. For these older tractors, owners are required to find, price, order, and arrange installation of a ROPS device, a prospect that farmers find time-consuming, expensive, and unnecessary (Whitman and Field, 1995; Arcury, 1997; Hallman, 2005; Sorensen et al., 2008a).

Many approaches have been directed at encouraging farmers to install ROPS on unprotected tractors, such as tractor safety education (Myers et al., 2004), financial incentives (Hallman, 2005), community awareness campaigns (Morgan et al., 2002), and social marketing (Sorensen et al., 2008b). In New York State, social marketing has been particularly successful in increasing the number of ROPS-protected tractors. Launched in November 2006, the New York State ROPS Rebate Social Marketing Intervention has demonstrated shifts in farmer's readiness to install ROPS, as well as significant increases in ROPS sales (Sorensen et al., 2008b; Sorensen et al., 2011).

Social marketing is an intervention framework that relies on considerable formative research conducted with targeted populations. The resulting information is used to develop programs that alter the balance of motivators vs. barriers to make safe or healthy behaviors easier and more desirable. Social marketing has been used to reduce eye injuries in citrus harvesters (Luque et al., 2007), to reduce pesticide exposures among nursery workers (Flocks et al., 2001), and it has been identified as a promising strategy for increasing ROPS installation in a study of tractor dealers' attitudes toward retrofitting (Tonelli et al., 2009).

A key component for successfully motivating individuals to make healthier or safer decisions is a thorough understanding of the motivators and barriers to behavior change. In the New York intervention, important motivators and barriers to retrofitting were identified through in-depth interviews, which were analyzed using qualitative research methods. Although this information was critical in developing an intervention for the New York population, little was known about the generalizability of these results to other states.

The purpose of this study was to identify the necessary components (motivators and barriers) for developing successful ROPS rebate programs in two other states (Pennsylvania and Vermont). The second objective was to assess the similarities in the components identified between these two states and between different demographic groups, such as men and women. A survey was conducted in these two states that identified small crop farms in Pennsylvania and hay and vegetable farms in Vermont as having the highest proportion of tractors without ROPS. As a result, these strata were selected for the current study (Yoder et al., unpublished manuscript).

Methods

Subjects

In order to identify motivators and barriers to retrofitting in these populations, a sample that would provide 100 completed surveys in Pennsylvania (small crop) and 200 completed surveys in Vermont (100 hay and 100 vegetable) was drawn. These farms were drawn at random from the databases of the USDA National Agricultural Statistics Service for each state. These databases are compiled from a full national census and, as

such, are considered “a complete count of U.S. farms and ranches and the people who operate them.”

The sampling frame used for Pennsylvania included only small crop farmers, whereas the hay and vegetable farmers in Vermont were sampled without stratifying for size. To be eligible to take this survey, the farmer needed to have at least one unprotected tractor and more than \$1,000 in annual agricultural sales.

Many of the variables used in the survey had been identified previously in a qualitative study conducted with New York farmers (Sorensen et al., 2008a). To ensure that all potential motivators and barriers were represented in the survey, a draft was piloted at outreach events in Vermont and Pennsylvania. During this phase, farmers were asked to identify any additional motivators and barriers that should be included and to provide suggestions for improving the questions, as well as the survey format. Feedback from 56 farmers was incorporated into the final survey instrument.

The first section of the survey requested participants to specify the number of tractors they possessed, whether the tractors were ROPS-protected, and whether they had ever retrofitted a tractor with ROPS. In the next section, participants were asked to rate the degree of importance of each item in a list of barriers to retrofitting. Following this, a list of motivators was rated for importance (figs. 1 and 2). This was followed by a series of questions that ascertained where the subject was most likely to obtain information on farm management, machinery upgrades, and health and safety information. The survey concluded with a series of demographic questions.

The survey was administered by telephone by New York NASS. The contact protocol used for both this survey and the initial survey consisted of two daytime, two afternoon, two nighttime, and one weekend call. The telephone enumerators were allowed to modify this protocol in the event that a respondent suggested a better time to call. In contacting the farms, the enumerators asked to speak to the principal operator of the farm. If the principal operator was unavailable, the enumerators asked if the respondents were capable of answering the questions as they believe the principal operator would. If the respondents were not the principal operator, they were also asked to indicate their role on the farm and their gender. The study was approved by the Mary Imogene Bassett Institutional Review Board.

<i>Barriers to Retrofitting a Tractor</i>
I believe I have enough experience to avoid tractor overturn injury.
I don't have hills on my land, so it isn't necessary.
I wouldn't be able to fit my tractor into the barn.
It costs too much money to put a ROPS on my tractor.
It takes too much time to put a ROPS on my tractor.
Having a ROPS on my tractor would make work difficult.
I don't have hired help operating tractors.
I don't have children operating tractors.
The tractor isn't used much.
I am restoring the tractor and don't want to alter it.
I don't intend to wear my seatbelt.
I can't install it, and it would be a hassle to truck it to the dealer.
It isn't enough of a priority for me.

Figure 1. Barriers to retrofitting rated as “not at all important,” “somewhat important,” or “very important”.

<i>Motivators for Retrofitting a Tractor</i>
I experienced a rollover once, and I'm concerned about being hurt next time.
I have children operating tractors.
I have workers operating tractors.
I have ditches on my property.
I have hills on my property.
I have had a personal acquaintance that was killed by a rollover.
I have had a personal acquaintance that was injured by a rollover.
I have to use the tractor to do dangerous work.
I would like an awning for protection from the sun.
I am concerned about liability.

Figure 2. Motivators for retrofitting rated as “not at all important,” “somewhat important,” or “very important”.

Analyses

Frequencies for motivators and barrier ratings were created. These frequencies were compared between subjects who had retrofitted a tractor and those who had not using chi-square tests. Comparisons of frequencies were also made between the two states using chi-square tests. Age was compared across the three response levels for each motivator and barrier (not at all important, somewhat important, very important) using one-way analysis of variance (ANOVA). The proportion of subjects selecting “very important” for each of the motivators and barriers in Pennsylvania and Vermont was also calculated. Due to the low number of female principal operators, gender-specific analyses were not performed.

Additionally, the frequencies of motivators and barriers were assessed for their relationship to the proportion of retrofitted tractors on each farm. This was done by comparing this proportion across the levels of response (not at all important, important, or very important) for each motivator and barrier using a 1 by 3 ANOVA.

Results

A total of 126 eligible small crop farmers out of 516 contacted in Pennsylvania (24.4%) agreed to participate in the survey. There were no non-responder data available for responder versus non-responder comparisons. In Vermont, 201 of 528 farmers contacted (38.1%) participated, giving a total of 327 completed surveys. The mean age of Pennsylvania farmers (61.1 years, SD = 13.3) did not differ significantly from those in Vermont (58.7, SD = 12.8). There was a significantly higher proportion of female respondents in the Vermont sample (25.9%) than in the Pennsylvania sample (11.5%), $p = 0.004$.

State Comparisons of Barriers

As shown in figure 3, there was a general consensus between the two states in the relative importance of the barriers, with “costs too much money,” “don’t have hills,” and “have enough experience” being the top three barriers in both states. The correlation between the proportion of subjects rating the barriers as “very important” between the two states was 0.79 ($p = 0.001$).

As shown in table 1, the distribution of responses differed significantly between the two states for four barriers. For “have enough experience,” the proportion of subjects

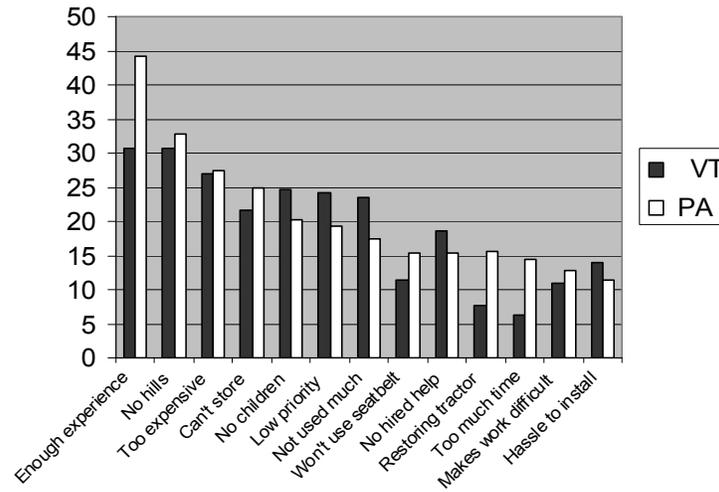


Figure 3. Percentage of subjects rating barriers to retrofitting as “very important” in Vermont (VT) and Pennsylvania (PA).

Table 1. Barriers to retrofitting between Pennsylvania and Vermont that differ significantly in importance.^[a]

Barrier	State	Proportion of Sample that Selected			Significance (p-value)
		Very Important	Somewhat Important	Not at all Important	
Have enough experience	Pennsylvania	44%	36%	20%	0.0026
	Vermont	30%	30%	40%	
Costs too much money	Pennsylvania	28%	41%	31%	0.0004
	Vermont	27%	21%	52%	
Takes too much time	Pennsylvania	14%	25%	61%	0.005
	Vermont	6%	16%	78%	
ROPS would make work difficult	Pennsylvania	13%	29%	58%	0.0005
	Vermont	11%	12%	77%	

^[a] Only response distributions that were significantly different at $\alpha = 0.05$ are included.

rating this barrier to be “somewhat or very important” was 20 percent higher in Pennsylvania than in Vermont (80% vs. 60%, $p = 0.0026$). This same tendency was seen for “costs too much money” (69% vs. 48%, $p = 0.0004$), “takes too much time” (39% vs. 22%, $p = 0.005$), and “ROPS would make work difficult” (42% vs. 23%, $p = 0.0005$).

State Comparisons of Motivators

As shown in figure 4, there was a general agreement in the relative ranking of motivators between the two states, with “have hills,” “concerned about liability,” and “have ditches” being the top three motivators in both states. The overall correlation between the proportion of subjects rating the motivators as “very important” between the two states was 0.84 ($p = 0.002$).

There were significant differences between the states in the distributions of ratings for two of the motivators (table 2). For “experienced a rollover,” the proportion of subjects

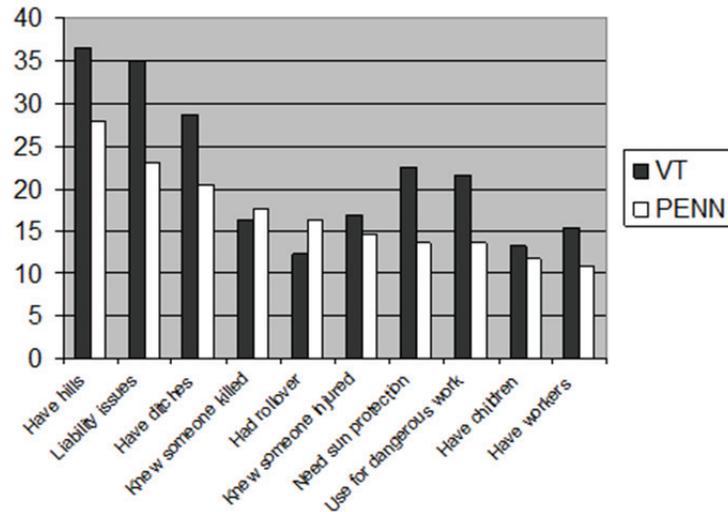


Figure 4. Percentage of subjects rating motivators for retrofitting as “very important” in Vermont (VT) and Pennsylvania (PENN).

Table 2. Rating distributions for motivators differing significantly between Pennsylvania and Vermont.^[a]

Motivator	State	Proportion of Sample that Selected			Significance (p-value)
		Very Important	Somewhat Important	Not at all Important	
Experienced a rollover	Pennsylvania	17%	17%	66%	0.0258
	Vermont	12%	8%	80%	
Would like sun protection	Pennsylvania	13%	32%	55%	0.0481
	Vermont	23%	21%	56%	

^[a] Only response distributions that were significantly different at $\alpha = 0.05$ are included.

rating this motivator as “very or somewhat important” was higher for Pennsylvania than Vermont (34% vs. 20%, $p = 0.0258$). For the motivator “would like sun protection,” the proportion in Vermont rating this as “very important” was higher (23% vs. 13%, $p = 0.0481$). However, when the “somewhat important” and “very important” categories were combined, the two states were virtually identical (44% vs. 45%).

Retrofitter versus Non-Retrofitter Comparisons for Both States

Because of the similarity of these results for the two states when considered separately, their data were combined. There were no significant differences in the ratings of the barriers between subjects who had retrofitted a tractor and those who had not. However, significant retrofitter versus non-retrofitter differences were seen for four of the motivators. As shown in table 3, the proportion of retrofitthers rating these four motivators as “very important” was significantly higher for all four.

Age Comparisons for Both States

Age was significantly related to the barriers “isn’t used much” and “isn’t enough of a priority.” Those rating “isn’t used much” as a very important barrier were significantly older than those rating it of lesser importance ($p = 0.024$). For “isn’t enough of a priori-

Table 3. Percent of subjects rating motivators as “very important” compared between retrofitters and non-retrofiters.^[a]

Motivator	Retrofitters	Non-Retrofitters	Significance (p-value)
Experienced a rollover, concerned about future injury	34.8%	12.1%	0.008
Had a personal acquaintance killed in rollover	43.5%	14.8%	0.002
Had a personal acquaintance injured in a rollover	39.1%	14.0%	0.003
Use tractor to do dangerous work	39.1%	17.2%	0.036

^[a] Only response distributions that were significantly different at $\alpha = 0.05$ are included.

ty,” those rating it as not important tended to be older than those rating it of greater importance ($p = 0.023$).

Significant age differences were also seen for the motivators “have hills” and “use the tractor for dangerous work.” Subjects rating “have hills” ($p = 0.004$) and “use the tractor for dangerous work” ($p = 0.004$) as “very important” tended to be younger than those rating it of lesser importance.

Relationship between Proportion of Tractors with ROPS and Motivators and Barriers for Both States

Subjects rating “have enough experience” as “not at all important” tended to have a significantly ($p = 0.03$) lower proportion of tractors with ROPS (22.4%) than subjects rating this to be very important (27.8 %). This same tendency was seen for the barriers “isn’t used much” (23.4% vs. 32.9%, $p = 0.046$) and “don’t intend to wear seatbelt” (24.6% vs. 36.8%, $p = 0.022$).

For motivators, subjects listing “have workers operating tractors” as “very important” had a higher proportion of tractors with ROPS than those rating it as “not at all important” (39.1% vs. 23.8%, $p = 0.0007$). This same relationship was seen for “have ditches” (35.8% vs. 25.7%, $p = 0.004$), “have hills” (34.1% vs. 24.5%, $p = 0.008$), and “concerned about liability” (33.7% vs. 24.2%, $p = 0.022$).

Discussion

There were two main goals of this study. The first was to identify crucial motivators and barriers to retrofitting tractors with ROPS in the Vermont and Pennsylvania target populations and to use this information to develop effective ROPS installation programs. The second goal was to assess how variable the importance of these motivators and barriers were between Vermont and Pennsylvania and between different demographic groups.

In relation to the first objective, the information gathered in Vermont and Pennsylvania indicates that cost and a perceived lack of need are considerable barriers to ROPS adoption, with the barriers most frequently selected as “very important” in both states being “costs too much money,” “don’t have hills,” and “have enough experience.” Results from the survey also identified potentially productive motivators, with environmental hazards such as hills or ditches and the liability of worker injuries and fatalities figuring prominently (i.e., “have hills,” “concerned about liability,” “have ditches”). Having a child operating a tractor was not a highly rated motivator in either state, which could mean either that children do not frequently operate tractors (and are thus not a potential concern) or that the participants had a low perceived risk for child tractor operators.

The prominence of cost and lack of perceived need as barriers to retrofitting have been identified in previous studies on ROPS retrofitting behaviors. In particular, a study con-

ducted by Hallman (2005) revealed that expense was a considerable barrier for farmers. In his study, researchers offered varying percentages of the entire cost to retrofit and showed that the highest percentage of farmers were interested when given 75% to 90% of the cost. Qualitative interviews and quantitative surveys conducted in New York State have also identified cost, as well as farmers' beliefs in their experience or a perceived lack of need, as being highly influential barriers (Whitman and Field, 1995; Arcury, 1997; Sorensen et al., 2006; Sorensen et al., 2008a). Likewise, a study of factors associated with non-ROPS tractors indicated that farms with greater economic activity and status tended to have fewer non-ROPS tractors (Myers, 2010).

The results from this survey also mirror results from previous surveys conducted in New York regarding concerns about worker injury and liability as prominent motivators for retrofitting (Sorensen et al., 2006; Sorensen et al., 2008a). One of these studies also identified environmental factors, such as working on hills or near ditches, as prominent reasons why ROPS are important (Sorensen et al., 2006).

One particularly interesting survey finding was that "concerned about liability" was a highly rated motivator for retrofitting, while only 16% of Vermont participants and 11% of Pennsylvania participants rated "have workers operating tractors" as a very important motivator. In light of this, it is difficult to say how effective ads featuring the liability of not having ROPS will be. These apparently disparate results may indicate that many farms do not have non-family members working on the farm or are not concerned about their ability to work safely.

Comparisons of motivators and barriers between states and different demographic groups were likewise informative. Although the proportion of subjects rating each barrier and motivator as "very important" was significantly correlated, certain barriers were more of a hindrance in Pennsylvania than in Vermont. As indicated in table 1, Vermont participants were more likely to rate the barriers "takes too much time," "costs too much money, and "ROPS would make work difficult" as "not at all important." Although data on the pricing, installation time, and logistical difficulty associated with ROPS were not gathered in the survey, information from subsequent hotlines established in these states indicates that ROPS may indeed be more expensive. According to hotline data, on average ROPS quotes for Pennsylvania farmers are \$150 more than ROPS quotes given to Vermont farmers, which largely relates to the type of tractors being retrofitted in each state (B. Bayes, multi-state ROPS hotline data, personal communication, 18 August 2011). In addition, a higher proportion of Pennsylvania farmers rated "have enough experience" as a "very important" barrier despite the fact that survey participants in both states were roughly the same age (the mean age of the Pennsylvania farmers was only 2.5 years greater than that of the Vermont farmers), although age is very likely not a consistently accurate marker of experience.

As stated previously, we were not able to do formal gender comparisons. However, studies conducted with male and female principal operators in Kentucky found essentially no differences in tractor safety beliefs between men and women (Cole et al., 2000), while qualitative studies conducted with male and female operators and farm wives in New York indicated that, in general, women were more concerned about farm safety (Sorensen, 2009).

As for age, comparisons in our study indicated that infrequent use of the tractor was more likely to be a barrier for older farmers. This barrier has been previously identified in a survey on factors influencing New York farmers' demand for ROPS (Kelsey et al., 1996). According to this study, these farmers were also more likely to feel that installing

ROPS was not a priority. Since older farmers have increased risk of a tractor overturn fatality (Hoskin et al., 1988; Myers, 1990; Myers and Hard, 1995; Fiedler et al., 1998; Hard et al., 1999; Hard et al., 2002; Meyer, 2005, Myers and Hendricks 2010), interventions aimed at older farmers may need to address these issues, in particular.

Based on these results and the results from previous research, ROPS installation programs in Vermont and Pennsylvania (and possibly other states) will need to reduce the cost of retrofitting and convince farmers that ROPS are indeed necessary. However, as noted by Yoder and Murphy (2012), effective behavior change interventions require both removing the barriers to change and providing appealing incentives (i.e., motivators). The information gathered in this survey indicates that an emphasis on the benefits of ROPS, i.e., reducing the risk of injury or fatality in the event of an overturn while working on hills or near ditches and reducing the risk to workers, could be productive concepts to feature prominently in promotional materials and trainings.

Conclusions

Based on the information gathered in the current study, persuasive ROPS installation programs in Vermont and Pennsylvania will need to address a number of prominent barriers and motivators in the farm community. Prominent barriers to be addressed include the cost of ROPS and the lack of a perceived need to install this type of protection, while hazards such as hills or ditches or the liability related to worker injuries or fatalities appear to be potentially promising motivators. This study also identified significant differences in barrier and motivator ratings between age groups. In particular, relatively limited use of the tractor was a more highly rated barrier for older farmers.

References

- Arcury, T. A. 1997. Occupational injury prevention knowledge and behavior of African-American farmers. *Human Org.* 56(2): 167-173.
- Cole, H. P., S. C. Westneat, S. R. Browning, L. R. Piercy, and T. Struttman. 2000. Sex differences in principal farm operators' tractor driving safety beliefs and behaviors. *J. American Med. Womens Assoc.* 55(2): 93-95.
- Donham, K. J., and A. Thelin. 2006. *Agricultural Medicine: Occupational and Environmental Health for the Health Professions*. Oxford, U.K.: Blackwell Publishing.
- Fiedler, D., S. Von Essen, D. Morgan, R. Grisso, K. Mueller, and C. Eberle. 1998. Causes of fatalities in older farmers vs. perception of risk. *J. Agromed.* 5(3): 13-22.
- Flocks, J., L. Clarke, S. Albrecht, C. Bryant, P. Monaghan, and H. Baker. 2001. Implementing a community-based social marketing project to improve agricultural worker health. *Environ. Health Persp.* 109(S3): 461-468.
- Hallman, E. 2005. ROPS retrofitting: Measuring effectiveness of incentives and uncovering inherent barriers to success. *J. Agric. Safety and Health* 11(1): 75-84.
- Hard, D. L., J. R. Myers, K. A. Snyder, V. J. Casini, L. L. Morton, R. Cianfrocco, and J. Fields. 1999. Identifying work-related fatalities in the agricultural production sector using two national occupational fatality surveillance systems, 1990-1995. *J. Agric. Safety and Health* 5(2): 155-172.
- Hard, D. L., J. R. Myers, and S. G. Gerberich. 2002. Traumatic injuries in agriculture. *J. Agric. Safety and Health* 8(1): 51-65.
- Hoskin, A. F., T. A. Miller, W. D. Hanford, and S. R. Landes. 1988. Occupational injuries in agriculture: A 35-state summary. NIOSH Contract Report No. DSR-87-0942. Morgantown, W.V.: National Institute for Occupational Safety and Health.

- Kelsey, T. W., P. L. Jenkins, and J. J. May. 1996. Factors influencing tractor owner's potential demands for rollover protective structures on farm tractors. *J. Agric. Safety and Health* 2(2): 35-42.
- Luque, J. S., P. Monaghan, R. B. Contreas, and E. August. 2007. Implementation evaluation of a culturally competent eye injury prevention program for citrus workers in a Florida migrant community. *Prog. Comm. Health Partnerships* 1(4): 359- 369.
- Meyer, S. 2005. Fatal occupational injuries to older workers in farming, 1995-2002. *Monthly Labor Rev.* 128(10): 38-48.
- Morgan, S. E., H. P. Cole, T. Struttmann, and L. Piercy. 2002. Stories or statistics? Farmers' attitudes toward messages in an agricultural safety campaign. *J. Agric. Safety and Health* 8(2): 225-239.
- Myers, J. R. 1990. National surveillance of occupational fatalities in agriculture. *American J. Ind. Med.* 18(2): 163-168.
- Myers, J. R. 2010. Factors associated with the prevalence of non-ROPS tractors on farms in the U.S. *J. Agric. Safety and Health* 16(4): 265-278.
- Myers, J. R., and D. L. Hard. 1995. Work-related fatalities in the agricultural production and services sector, 1980-1889. *American J. Ind. Med.* 27(1): 51-63.
- Myers, J. R., and K. J. Hendricks. 2010. Agricultural tractor overturn deaths: Assessment of trends and risk factors. *American J. Ind. Med.* 53(7): 662-672.
- Myers, M. L., H. P. Cole, and S. C. Westneat. 2004. Cost-effectiveness of a ROPS retrofit education campaign. *J. Agric. Safety and Health* 10(2): 77-90.
- NIOSH. 2004. *National Agricultural Tractor Safety Initiative*. E. Swenson, ed. Atlanta, Ga.: National Institute for Occupational Safety and Health. Available at: <http://nasdonline.org/document/1916/d001837/national-agricultural-tractor-safety-initiative.html>.
- NSC. 2011a. Unintentional injuries at work by industry (preliminary), United States, 2009. In *Injury Facts: 2011 Edition*, 52. Itasca, Ill.: National Safety Council.
- NSC. 2011b. Bureau of Labor Statistics estimates of nonfatal occupational injury and illness incidence rates and number of injuries and illnesses by industry sector, 2009. *Injury Facts: 2011 Edition*, 69. Itasca, Ill.: National Safety Council.
- Sorensen, J. A. 2009. Social marketing for injury prevention: Changing risk perceptions and safety-related behaviors among New York farmers. PhD diss. Umea, Sweden: Umea Universitet.
- Sorensen, J. A., J. J. May, P. L. Jenkins, A. M. Jones, and G. B. Earle-Richardson. 2006. Risk perceptions, barriers, and motivators to tractor ROPS retrofitting in the New York State farm community. *J. Agric. Safety and Health* 12(3): 215-226.
- Sorensen, J. A., J. J. May, K. Paap, M. A. Purschwitz, and M. Emmelin. 2008a. Encouraging farmers to retrofit tractors: A qualitative analysis of risk perceptions among a group of high-risk farmers in New York. *J. Agric. Safety and Health* 14(1): 105-117.
- Sorensen, J. A., J. May, R. Ostby-Malling, T. Lehmen, J. Strand, H. Stenlund, L. Weinehall, and M. Emmelin. 2008b. Encouraging the installation of rollover protective structures in New York State: The design of a social marketing intervention. *Scandinavian J. Public Health* 36(8): 859-869.
- Sorensen, J. A., P. L. Jenkins, M. Emmelin, H. Stenlund, L. Weinehall, G. Earle-Richardson, and J. J. May. 2011. The social marketing of safety behaviors: A quasi-randomized controlled trial of tractor retrofitting incentives. *American J. Public Health* 101(4): 678-684.
- Tonelli, S. M., K. J. Donham, K. Leedom-Larson, W. Sanderson, and M. Purschwitz. 2009. Retrofitting tractors with rollover protective structures: Perspective of equipment dealers. *J. Agric. Safety and Health* 15(4): 365-375.
- Whitman, S. D., and W. E. Field. 1995. Assessing senior farmers' perceptions of tractor and machinery-related hazards. *J. Agric. Safety and Health* 1(3):199-214.
- Yoder, A., and D. Murphy. 2012. Using social marketing to address barriers and motivators to agricultural safety and health best practices. *J. Agromed.* 17(2): (in press).
- Yoder A., J. A. Sorensen, M. Myers, D. Murphy, G. Cook, and J. May. Unpublished manuscript. Selecting target populations for ROPS retrofit programs in Pennsylvania and Vermont.