Injury and Illness Costs in the Certified Safe Farm Study

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ABSTRACT: ***Context:*** *The Certified Safe Farm (CSF) intervention program aims to reduce occupational injuries and illnesses, and promote wellness to reduce health care and related costs to farmers, insurers, and other stakeholders.* ***Purpose:*** *To evaluate the cost effectiveness of CSF.* ***Methods:*** *Farms (316) located in a 9-county area of northwestern Iowa were recruited and randomized into intervention and control cohorts. Intervention farms received occupational health screenings, health and wellness screening, education, on-farm safety reviews, and performance incentives. For both cohorts, quarterly calls over 3 years were used to collect self-reported occupational injury and illness information, including costs to the farmers and their insurers.* ***Findings:*** *Annual occupational injury and illness costs per farmer paid by insurers were 45% lower in the intervention cohort ($183) than in the control cohort ($332). Although out-of-pocket expenses were similar for both cohorts, combined costs of insurance and out-of-pocket expenses were 27% lower in the intervention cohort ($374/year per farmer) compared to the control cohort ($512/year per farmer). Within the cohort of intervention farmers, annual occupational injury and illness cost savings were directly associated with on-farm safety review scores. Reported health care costs were $237 per farmer in the safest farms (those farms scoring in the highest tertile) versus $485 per farmer in the least safe farms (lowest tertile).*
Conclusions: *Results suggest that farmers receiving the intervention had lower health care costs for occupational injuries and illnesses than control farmers. These cost savings more than cover the cost of providing CSF services (about $100 per farm per year).*

Agriculture has one of the highest occupational fatality rates (29 per 100,000 per year) in the United States, with 669 fatalities in 2004.[1,2] Estimates of nonfatal injuries, gathered via numerous methods, range from 1 to 29 per 100 farmers per year.[3,4] The estimated cost of these injuries was $4.5 billion per year, which was $2,400 per farm, or 2.8% of the value of farm sales and 15.0% of the net farm cash returns in the United States in 1992.[5,6] In addition to injuries, respiratory disease, musculoskeletal problems, noise-induced hearing loss, certain cancers, skin conditions, and zoonoses are also common occupational hazards.[7]

Regulatory interventions (eg, Occupational Safety and Health Administration [OSHA] inspections and enforcement) have little relevance to most family farms in the United States because of federal exemptions for businesses with fewer than 11 employees. Engineering interventions have decreased the hazard level of newer machinery and equipment, but older machines still in use lack modern safety engineering features. Although education is the most commonly used intervention method in agricultural safety, a systematic literature review of 25 farm safety programs found little evidence that traditional education-based farm safety programs

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The Certified Safe Farm study has been funded by NIOSH (#U06/CCU712913), Iowa Wellmark Foundation, Pioneer Hi-Bred International Inc., Iowa Pork Producers Council, National Pork Producer's Council, and Iowa's Injury Prevention Research Center. NIOSH funding was instrumental in initiating the project and has remained the main source of funding throughout the study. The AgriSafe Network of clinics provide CSF services to farmers at the local level, and the Spencer AgriSafe clinic and staff, including Carolyn Sheridan, Kristine Fisher, and Maureen Christensen, and farm safety consultants Mike McMullen, Carolyn Jones, and Jamie Abel were instrumental in conducting this study. The University of Iowa investigators (including Kelley Donham, Kendall Thu, Natalie Roy, Risto Rautiainen, Carol Hodne, LaMar Grafft, and Paul Whitten) initiated the program, obtained funding, provided coordination of research efforts, and trained health care providers and farm safety consultants. For further information, contact: Kelley J. Donham, DVM, DACVPM, University of Iowa, 100 Oakdale Campus, 132 IREH, Iowa City, IA 52242; e-mail kelley-donham@uiowa.edu.

have effectively led to a sustained decrease in injuries or illnesses.[8]

Based on previous studies, it is difficult to identify any single intervention modality in production agriculture that has been effective, sustainable, and transferable. Therefore, we developed a model that incorporates several modalities, theories, and principles of intervention and health promotion. The Certified Safe Farm (CSF) model is a multifaceted, voluntary, incentive-driven intervention program that aims to reduce the number and cost of injuries and illnesses in Iowa. CSF is based on an integration of theories, principles, and methods from diverse fields (the Iowa Integrated Model of Prevention)[9] including industrial hygiene, social psychology, epidemiology, and the medical-technical teamwork model.[10] The CSF model was based on our previous experience in multifaceted interventions[11-13] and the deployment of a community-based agricultural-occupational health service organization (ie, AgriSafe Network of clinics [www.agrisafe.org]).[14] The core components of CSF, which began in 1997, are clinical occupational health and wellness screenings, individualized safety and health education, workplace safety assessments with standards, and performance incentives.[15-21]

CSF services were provided at no charge to farmers, but experience suggested that while farmers appreciated and wanted the intervention they might have difficulty paying for it themselves. Focus groups with farmers revealed they felt they already paid high health insurance premiums, and their health insurance companies should share the cost savings from reduced claims.[3] The insurance industry showed an interest in the program but wanted evidence that it could reduce claims. In response, we designed a study to assess the self-reported health care costs associated with occupational injuries and illnesses among farms receiving the CSF intervention (intervention cohort) and farms not receiving the intervention (control cohort).

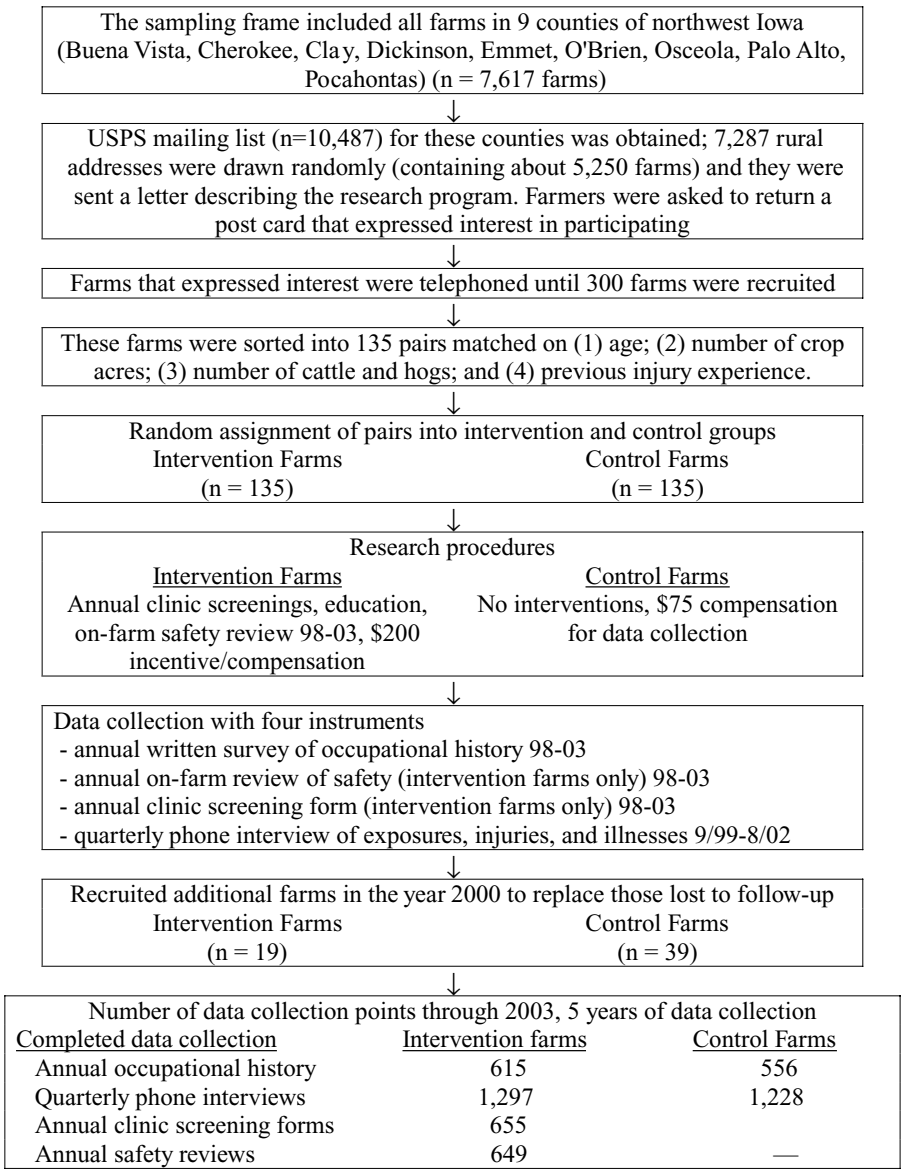
Methods

Study Population. Candidates for inclusion in the study included all farmers in 9 contiguous counties of Northwestern Iowa who had an identifiable rural mailing address (Figure 1). We used a table of random numbers to draw a sample and send letters (in random order) to farmers (in batches) inviting study participation. Enrollment began in 1997. Interested farmers were asked to return a self-addressed postcard giving permission to be called for a short survey and to discuss the study further. During these calls, respondent status as farmers was verified (USDA definition of having annual sales of agricultural products of at least $1,000 dollars). We obtained additional information about injury history (number of injuries occurring in the previous year), acreage, crops, and livestock. Calls were made until the targeted potential study population pool of 316 was identified. The pool of interested farmers was then pair-matched on age, type, and size of operation (crop and or livestock type), and previous injury experience. Individuals from each pair were then randomly assigned to the intervention and control groups (exceeding our goal of 125 matched pairs needed, according to our power calculations). Subjects agreed to enroll in the study without knowledge of the group to which they would be randomly assigned. Over the course of the 3-year study, there were 390 person-years of observation time on the intervention cohort, and 368 person-years for the control cohort. Due to dropouts during the study, 19 additional intervention and 39 additional control farms were recruited prior to the third year to maintain the goal of 125 pairs. The dropouts were mainly subjects who quit farming. However, one of the control subjects was lost as a result of a fatal farm injury (due to the high medical expense incurred, this control was excluded from the cost analysis to prevent skewing of the data). A few of the controls dropped out because of the time investment necessary. Replacements were recruited in the manner described above through a mass mailing and assigned into the study groups in the order they were recruited.

Intervention. The CSF intervention was designed to reduce injuries, illnesses, and related health care and disability costs. It included (1) an occupational and wellness health screening, (2) education, (3) an on-farm safety review, and (4) incentives based on achieving safety standards. The principal operator from each farm participated in study procedures and data collection (family members and employees did not).

Health Screening. The agricultural occupational health screening was designed to address specific risks from agricultural exposures. The screenings were conducted annually by an AgriSafe Network clinic nurse trained and certified in agricultural medicine in accordance with the University of Iowa Agricultural Medicine training program.[14] The screening took about 1.5 to 2 hours and included an occupational history assessment and the following occupationally targeted screenings or services: (1) pulmonary function testing, (2) hearing testing, (3) skin cancer screening, (4) cholinesterase testing, (5) tetanus immunization (if necessary), (6) back and spine assessment, (7) personal protective equipment (breathing, hearing protection, etc.) needs assessment, selection, and respirator fit-testing. Wellness screenings and services included (1) weight/height and BMI calculation, (2) cholesterol

Figure 1. Flowchart for the Identification of Study Population, Study Procedures, and the Collection of Data.



testing, (3) blood pressure check, (4) visual acuity, and (5) stress/depression screening using a standardized scale.

Education. The health educational component included one-on-one discussions between the nurse and intervention farmer regarding individualized occupational health and wellness concerns based on the farmer's test results, as well as proper selection, use, and fit-testing of personal protective equipment required for their farming operation. Referrals were made to the farmer's personal physician if there were any health or wellness concerns detected in the screenings, based on a standard set of criteria in the standing orders.

The farmers received additional safety education when they accompanied the farm reviewer on the inspection of their farm (see below). Safety hazards were pointed out and explained. The reviewer pointed

out hazards that prevented the farm from achieving CSF status and consulted with the farmer on making corrections.

In addition, group education was provided annually at local dinner meetings, where subjects such as respiratory health protection and injury prevention were discussed. These meetings also served as a point for feedback on the program. Furthermore, the intervention farmers received a quarterly newsletter that covered current occupational health and wellness topics, and progress of the CSF program generally.

On-farm Safety Review. The farm safety review was designed to detect injury and illness hazards in the farm work environment. A CSF checklist was developed to standardize the audit process and to score the farm. Farms must achieve a safety score of at least 85% to become certified. On-farm safety reviews were conducted annually by farm safety reviewers who were trained at the University of Iowa. The three reviewers also farmed in the area. All farmers in the CSF intervention were required to be present and accompany the reviewer during the farm site evaluation.

Incentives. Members of the intervention cohort received an incentive of $200 annually if they achieved and maintained Certified Safe Farm status. This incentive was to serve as a surrogate for possible future incentives from insurers, agribusinesses, farm groups, farm lenders, or other groups having a vested interest in a healthy farm population.

The cost of the intervention services was $75 per farmer for the occupational health and wellness screening, and $25 for the personalized safety and health education, and personal protection equipment selection, consultation, and fit testing. The cost of the farm safety review was $115 per farm.

Control Subjects. The control subjects received none of the services or education described above. They were paid $75 annually for their participation, allowing us to monitor their health and injury experience over the course of the study.

Data Collection. Health, injury, and illness data were collected from both intervention and control subjects by two survey methods: (1) a mailed annual occupational health questionnaire, and (2) a quarterly computer-aided telephone interview conducted over a 3-year period. Additionally, health history and clinical screening data were collected annually on the intervention farmers.

Regarding the quarterly phone survey, each interview took about 10-15 minutes to complete. The callers were trained interviewers, employed by the Iowa Social Science Institute on the University of Iowa campus. The callers were blinded as to whether the subject was a control farmer or an intervention farmer. The call script included questions on personal work exposures, injuries, illnesses, and related costs during the months prior to the telephone call. A total of 10 rounds of calls were completed. Prior to the beginning of the quarterly calls, every farmer was sent a specially designed calendar to be used for recording injuries and health problems, and to act as a memory trigger when the quarterly calls were made.

An injury question asked during every quarterly call was: "Did you experience any farm work-related injuries between [First month] and [Last month]?" Injury costs were addressed by four questions: "How was the cost (if any) for this injury paid for?"; "How much were your out-of-pocket expenses for medical care, drugs, and transportation?"; "What dollar amount was paid by insurance?"; and "How much were your costs other than medical care (like pay for hired help, damage to crops or animals, or cost to others helping with the injury situation)?". A similar set of questions was asked about farm-related hearing, respiratory, back, muscle and joint, skin, stress, and depression problems.

Data Analysis. This study was designed as a randomized intervention trial, measuring multiple outcomes (although this was similar to a conventional randomized control trial, study participants and those administering the intervention could not be blinded to group assignment; those collecting quarterly call data were blinded). Power calculations were based on expected injury rates, for which we had reliable prediction estimation data. Using power 0.8, alpha 0.05, baseline cumulative injury rate of 0.78 in 5 years, and sample size 125 + 125, we could detect a reduction of 23% (or greater) in the injury rate. Whereas the power calculations were based on injury, this study provides adequate power to measure meaningful differences in costs, which are reported in this article.

The primary data set reported here is the quarterly phone interviews that consisted of 10 repeated quarterly observations of exposures, injuries, illnesses, and costs for each person in the study. The cost data were first log-transformed (due to skewed distribution), and mean injury costs were compared using the repeated measures ANOVA provided by SAS (SAS Institute Inc., Cary, NC).[22]

Results

At the outset of the study, the intervention farms and the control farms were similar in demographic characteristics and history of injury (Table 1).

Table 1. Baseline Characteristics by Study Population

	Intervention Farms	Controls Farms
Total number of farms	152	164
Gender(%) male	98	97
Age in year 2000 (mean)	51	51
Hours of farming per week (mean)	38	38
Crop acres	640	610
Cattle farmers	33%	35%
Hog farmers	41%	41%
Number of hogs (mean)	2,300	3,300
Farmers with injuries in prior year	17%	17%

Based on participant self-report data, the overall cost to insurance of health care for occupational illnesses and injuries per farmer per year was 45% less for the intervention farmers compared to the control farmers ($183 for intervention farmers compared to $332 for control farmers). The out-of-pocket costs were similar for the intervention and control cohorts (6% difference between intervention and control farms). The total combined costs (out-of-pocket plus insurance costs) of occupational illness and injuries were 27% lower among intervention farmers compared to control farmers ($374 for the intervention farmers compared to $512 for the control farmers) (Table 2).

The difference in cost between the cohorts varied according to the type of occupational injury or illness (Table 2). The out-of-pocket costs were similar for the intervention and control farmers for injuries, skin conditions, and respiratory conditions. However, out-of-pocket expenses for back and joint conditions combined were 35% less in the intervention cohort, resulting in significant savings. On the other hand, out-of-pocket expenses for hearing outcomes were 45% higher in the intervention cohort. The reason for this difference was that hearing testing intervention resulted in the CSF health professionals referring farmers for hearing aids, which are expensive and not usually covered by insurance.

The costs covered by insurance were lower in the intervention group for injury, skin conditions, and joint conditions. The largest total dollar insurance cost savings were in the injury and joint conditions categories (as noted in the Methods section, the control group member who suffered a fatal occupational injury was excluded from the cost analysis to prevent skewing of the data.). Farmer-reported insurance costs for injuries were 27% lower in the intervention group, and 62% lower for joint conditions. The highest-cost joint condition cases involved joint replacements, of which there were two, both in control farmers (we truncated these costs at $20,000 to minimize the effect on the cost differential of these two expensive procedures). On the other hand, the intervention group had 47% higher costs for respiratory conditions. As the intervention involved lung function tests, referrals resulted with further examination, treatment, and related costs.

Among the intervention farms, the safest farms (ie, those with the highest safety scores) had lower total costs of occupational injuries and illness than less safe farms (Table 3). Those farms with the lowest farm review scores had medical costs that were about twice as high as the safest farms. The linear association between medical costs and safety score can be seen for injury, respiratory disease, and musculoskeletal conditions, whereas other conditions do not show the same trend.

Table 2. Rates and Costs of Injuries and Illnesses per Farmer by Intervention (Control Status)

	Injury or Illness Events*		Out-of-Pocket Costs†		Insurance Cost‡	
Type	Control	Intervention	Control	Intervention	Control	Intervention
Injury	0.41	0.43	$34	$34	$37	$27
Dermatology	0.10	0.15	$15	$15	$11	$8
Respiratory	0.14	0.20	$6	$9	$9	$17
Hearing	0.22	0.22	$44	$80	$1	$0
Back	0.62	0.56	$43	$24	$45	$45
Joint	0.40	0.40	$38	$29	$229	$86
Totals	1.89	1.96	$180	$191	$332	$183

* Annual rate of events per farmer per year.
† Average annual dollar cost per farmer, paid by farmer.
‡ Average annual dollar cost per farmer, paid by insurance company (according to farmer's self-report).

Table 3. Average Annual Cost (Out-of-Pocket and Insurance Cost) of Injury and Illness per Farmer by Safety Score* of the Farm

Type of Outcome	Safety Score (78–92) (30% of Farms)	Safety Score (93–95) (34% of Farms)	Safety Score (96–100) (36% of Farms)
Injury	$72	$59	$51
Respiratory	$37	$28	$20
Dermatological	$8	$25	$27
Hearing	$13	$151	$77
Back	$85	$104	$26
Joint	$270	$76	$36
Totals	$485	$443	$237

* The higher the safety score, the less hazards on the farm.

Discussion

In this study, total health care costs were lower in intervention farms than in control farms. The differences in these costs were primarily driven by what the insurer paid (as reported by farmers), rather than by out-of-pocket costs. As evidence of CSF effectiveness, among the intervention farms, those with higher safety scores incurred less costs.

Intervention farmers on average incurred $138 less than control farmers in medical costs (out-of-pocket plus amount paid by insurance) per year per farm. The costs were $140 less among those farmers who achieved or surpassed the stated CSF passing farm review score (85% or better). The costs for those farms with the highest safety scores (96% and above) were $275 less (53% savings) compared to costs for control farms.

In this study, the CSF intervention services (screening, education, and farm-safety review) were repeated in each of the three years at an annual cost of $215 per intervention farm. It is possible CSF could provide services less often (eg, every 2 or 3-year periods) and still retain effectiveness and increased cost effectiveness. However, this is an area for future research.

Recruitment for this program was challenging, but our focus groups of intervention farmers revealed that once in the program, the intervention farmers were very satisfied and supportive of the program and made efforts to improve their safety level. The vast majority of farmers made safety improvements on their farms, improving their safety scores over the 3-year study period. After the first round of farm safety reviews, 82% had reached the target score of 85. However, after year 3, 97% had reached certified status. Many farmers indicated that the $200 economic incentive was important, but some also indicated that they would participate without it. The economics of farming are marginal in many operations, enhancing the appeal of monetary incentives, especially when considering that purchasing and keeping health insurance coverage is a major economic burden for many farmers.

Assuming CSF services can be provided less frequently than they were in this study without reducing program effectiveness, this could be a cost-effective occupational health and wellness promotion program. Where supporting data are not yet available, the authors believe it may be possible to reduce the annual intervention cost to $100 per farm if farmers remain in the program at least 3 years. If so, our data suggest that enrollment in CSF may save sufficient funds to pay for the program and to provide incentives for participating farms.

Farm groups, agricultural-input businesses, insurance, related stakeholders and the individual farm operators may have an interest in giving incentives for occupational health, safety, and wellness. Incentives (monetary and social incentives) have been shown to be effective in other agricultural occupational health programs.[25,26] Data presented here appear to support the use of different incentive levels, based on the safety score.

The strengths of this study include a clearly defined population, randomized experimental design, consistent 3-year follow-up, and use of a well-established and trained community-based organization to provide screenings (the AgriSafe network [http://www.agrisafe.org]). Although the study population included a small sample of the eligible population (6%) the intervention and control groups were randomly selected and matched on basic demographic and farm production characteristics, and farm-related injury history. The summary demographic characteristics of the study subjects indicated they were representative of full-time farming operations in the region with an emphasis on corn, soybean, and hog production.

Limitations of the study included nonblinded design and data collection by self-report. This type of intervention study is difficult to conduct as a blinded study because of the nature of the intervention. Data collection by self-report is influenced by features of the research instruments.[23] The nature of the intervention may also introduce biases. Generally, intervention participants over-report outcomes.[24] The higher incentive compensation level for intervention farmers ($200 vs $75) may have enhanced the reporting bias toward increased reporting of occupational health and injury outcomes and costs in the intervention group. We recognize that health costs are highly variable. One severe single case of injury or illness could cost more

than the total cost of all outcomes in our entire study ($334,610). However, we made two adjustments in the control cohort data to compensate for a few high-cost events. For example, there was a fatal farm injury in the control cohort (a farmer in his 40s), which could well have been more costly than all other outcomes have been combined. Although this fatality could possibly have been prevented by CSF intervention, we excluded this case from analysis. Second, the insurance costs of two muscle/joint cases in the control cohort were truncated at $20,000. The actual costs may have been much greater. Not making these adjustments would have made the cost differential much more favorable for the intervention group. Finally, one would expect that in the early years of an intervention that included health screenings, in which increased medical services would be used because of referrals, and therefore increased health care costs would be incurred in the intervention cohort. In fact we did see this for respiratory and hearing conditions. In later years of this intervention, these initial costs may prove to be cost savings. Early diagnoses and interventions in the common respiratory conditions seen among farmers (chronic bronchitis and asthma-like condition[9]) could lead to prevention of COPD or emphysema, saving very high medical expenses for these chronic health conditions. Early diagnosis of hearing loss, and resultant expenses for hearing aids, could have a cost savings in the long run. In an earlier publication from the CSF study, we identified that hearing loss was a risk factor for farm injuries.[21] Correction of hearing loss with a hearing aid could potentially prevent future injuries. To summarize the effects of screenings, there were extra initial costs in heath care. However, the overall comparison of medical care costs between CSF intervention and control cohorts still favored the intervention group. This combined with the fact that the health conditions uncovered by the screenings could lead to cost savings in the long term, lends support to the probability that the CSF is cost effective in early years of the intervention, as well as out years.

A previous report of this project indicated that there was little difference in the injury rate between the control and intervention cohorts.[20] The significant cost difference in the present study can be explained by the fact that this study includes both illnesses and injuries, not injuries alone as in the previous report. Furthermore, the injuries in the control cohort were of a more serious nature, requiring more medical services.

Conclusions

This study found that self-reported total costs for farm-related injuries and illnesses were lower in the intervention group, compared to controls. The difference, $138 per farmer per year, would be adequate to pay for the intervention if its cost can be reduced from the $215 per year in this study to about $100 per year, which the authors believe possible if farmers remain in the program for at least 3 years. Reduction in medical costs was associated with higher farm review scores, indicating that the CSF program was able to correctly identify safe farms with lower injury and illness costs. The validity of these findings is bolstered by the strong correlation between higher farm safety scores and increased savings on occupational injury and health care costs. Continued research may assist in verifying our findings. Ideally, future research would utilize larger populations and objective health outcome and cost data from health insurers and worker's compensation claims sources.

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