Assessment of Iowa Farmers' Perceptions about Auger Safety

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ABSTRACT. *A survey of Iowa farmers was conducted to assess the farmers' perceptions and beliefs regarding auger safety and how these perceptions are put into practice. A questionnaire was designed to obtain information on the following auger–related topics: recognition of safe practices and appropriate shielding, personal practices and behaviors, risk perception, and personal beliefs. A random sample of 400 Iowa farmers (arrayed by county) was selected to be representative of Iowa farms. The response to the mailed survey was 23%. Some returned surveys were eliminated because the respondent was retired or did not own/operate augers, resulting in 57 usable questionnaires.*

Survey responses indicate that the majority of Iowa farmers who participated in this study can correctly identify appropriate shielding for auger intakes that meet or exceed ASAE standards. Survey responses suggest that it is common practice in Iowa for youth (age 13 to 19) to operate augers. Iowa farmers in this study perceive the most important contributing factors to auger–related injuries to be operating an auger without shielding, failure to pay attention on the job, moving augers in a raised position, and using hand or feet to redirect the flow of grain. Survey results also indicate that carelessness is perceived to be the leading cause of auger–related injuries, and that auger related injuries can be avoided by having respect for the equipment, being careful, and using common sense. The results also show that the Iowa farmers who participated in this study commonly perform auger–related practices (e.g., moving an auger in a raised position) that they identify as being unsafe.

Keywords. *Guards, Machinery, Questionnaires.*

Augers are one of the most visible and hazardous agricultural implements on farmsteads. The long cylindrical tube shape of an auger often punctuates the farmstead horizon as this piece of equipment rises above grain bins to perform its function. Doss and Pfister (1973) identified the auger as the most hazardous farm machine on a per hour of use basis. Since then, grain handling equipment has consistently been one of the leading causes of injury on farmsteads (Snyder and Bobick, 1995). The primary auger–related peril is the shear or cutting point hazard located at the auger intake. Hillers and Smith (1989) described the deep parallel cuts or avulsed tissue resulting from contact with the auger flighting. This common machine hazard defined by Murphy (1992) has caused 437 reported

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auger–related injuries in Iowa during the five–year period 1993 to 1997 (Harlan, 1998).

Scientific studies (Doss and Pfister, 1973; Snyder and Bobick, 1995; Schwab et al., 2000) have identified augers as sources of injuries and as dangerous machinery. But do farmers know of these hazards or how personal practices and behaviors can jeopardize a person's safety? A person's perceptions of risk are not always accurate (Murphy, 1992). Aherin and Murphy (1987) identified three common misperceptions of risk: (1) to overestimate dangers attributed to infrequent causes, (2) to consider dramatic or sensational deaths as greater risk, and (3) to underestimate risk that is under the individual's control. Overend (1985) observed such human perception inaccuracies with highway safety issues. Inaccurate information about grain suffocation dangers by Iowa farmers and their families were encountered by Schwab et al. (1998). Incomplete or inaccurate information about potential agricultural hazards is not uncommon.

Murphy (1981) reported that safety attitudes and involvement in farm injuries were not statistically linked. The overall process of injury prevention argued by Murphy is more intricate than just creating or having a good farm safety attitude. A positive safety attitude does not always translate into safe behavior. Acknowledging safe behaviors around augers and following those behaviors are two different issues. The apparent disconnect between knowledge of dangerous situations and action to prevent injuries is explored by Elkind (1993). Elkind suggests that knowledge and information about agricultural hazards that alters attitudes is simply not enough to change behaviors. Many intervening variables such as economic, societal, and family dynamics exist that greatly influence behaviors with regard to personal safety in the agricultural environment.

Without understanding current knowledge levels, safety attitudes, personal beliefs, and practiced behaviors of farmers, an accurate understanding of Iowa's auger safety issues is impossible. An assessment of farmers is required for a better appreciation of auger safety issues in Iowa. This research documents the risk perceptions and personal beliefs of Iowa farmers about auger safety. The research also includes information about Iowa farmers' personal practices and behaviors using augers.

Methods

Four individuals were selected from each of Iowa's 99 counties using a systematic selection process based on random numbers and the rural residents listed in the county plat books. Four additional people were randomly selected from the four geographically largest counties (one from each county) to provide an overall sample size of 400 individuals. The sampling technique is described in detail in Schwab et al. (2000), where the collected injury data were reported.

The preliminary questionnaire was developed and refined by an advisory committee consisting of safety professionals and statisticians with expertise in survey design. The questionnaire was then pilot tested to assess the clarity of the instructions and the usefulness of responses to the questions as written. Some additional modifications were made as a result of this process. Pretest subjects were grain farmers and non–farmers with a farm background. The survey instrument was then mailed to the 400 individuals selected.

The questionnaire, with an accompanying cover letter, was mailed to the identified sample with return postage affixed to the actual survey, which when folded and sealed

became the return mailer. Fifteen days later, reminder post cards were sent to subjects who had not yet responded. The deadline for receiving the completed questionnaires was one month from the initial mailing. As discussed in Schwab et al. (2000), 93 usable questionnaires were returned, for a response rate of 23%.

Limitations of this Methodology

As with any mailed survey, it is not possible to verify if the respondents accurately, or honestly, completed the questionnaire. The potential impact of this limitation was reduced by providing no incentive to the respondents that would bias their responses and by pilot testing the questionnaire, which indicated that the questions were clear enough to allow respondents to answer accurately. Another potential weakness of mailed surveys concerns the ability to obtain a representative sample of the population of interest, particularly when the response rate is low. However, the return rate was not unexpected. The Indiana Agricultural Statistics Service averages a response rate of about 30% for surveys mailed to farmers (Freeman et al., 1998). Information from the Iowa State University Statistical Service (Dr. Jean Opsomer, 1998, personal interview) indicated that surveys estimated to take longer than 10 minutes often result in lower return rates. It is likely that the response rate for this survey was impacted since it was estimated to take up to 15 minutes to complete and was mailed to Iowa farmers in mid–May during spring planting. While funding for this project did not allow for follow–up with non–respondents, no data exist to indicate to the authors that the respondents were biased concerning augers or auger safety and were thus unrepresentative of the perceptions of Iowa farmers in general regarding the issues addressed in the questionnaire.

Survey Findings

The findings of this survey are presented in five sections corresponding to the five areas of interest regarding farmer's perceptions and beliefs about auger safety (demographics, recognition of safe practices and appropriate shielding, personal practices and behaviors, risk perception, and personal beliefs). Of the 93 questionnaires returned, 36 were dropped because the individual was retired or did not own/operate augers. This resulted in an effective sample of 57 respondents. It is this sample (N = 57) that will be referred to as respondents in the findings reported here. Since few questionnaires were returned with 100% of the questions answered, the *n* reported is the number of usable responses for the individual items.

Demographic Data

Detailed information concerning the subject population and their augers can be found in Schwab et al. (2000). Information that was pertinent to this portion of the study (i.e., farmers' perceptions) and subsequent discussion is duplicated here in a summarized form for the convenience of the reader.

The respondents ranged in age from 30 to 85, with a median and average age of 55 years and over 36 years of experience in farming. Seventy–three percent (73%) of the respondents (n = 48) considered themselves full–time farmers. The acreage reported devoted to corn and soybeans ranged from 20 acres to 2,000 acres, with an average of 469 acres and a median of 350 acres.

While the average number of augers per producer was three, detailed information was only collected for the one or two augers that were most frequently used. Of these

augers, intake shielding was missing on 19% of the primary augers and on 48% of the secondary augers. The most common explanation for the lack of shielding was that the auger was purchased used without the shielding in place. Ninety–one percent (91%) of the primary augers and 64% of the secondary augers were powered by a tractor via the PTO, making PTOs the dominant power source for Iowa augers. Other power sources included electric motors, gasoline engines, and hydraulic motors.

Fifty–two percent (52%) of respondents indicated that all of the electrical wires in and around their farmstead were above ground on power poles. Approximately 13% indicated that all of their electrical lines were buried, while the remaining 35% had some combination of above ground and buried lines. Respondents also indicated that 52% of the primary augers and 35% of the secondary augers had been moved on a public roadway at least once in the past year.

Recognition of Safe Practices and Appropriate Shielding

Respondents were asked to pick safe auger–related practices and identify appropriate shielding for auger intakes. In the first question, respondents were asked to select the statement that best described their operation of an auger. The safest practice described a vigilant adult observing the auger operation from nearby, ready to turn off the power. Seventy–three (73%) of the 55 respondents who answered this question selected this practice as best describing themselves while operating an auger. An additional 24% selected marginally safe practices. Only approximately 4% of the respondents selected the unsafe behavior of using their hands to remove debris from

Table 1. Recognition of safe practices and appropriate shielding.

Item	Yes
Which one of the following best describes you while operating an auger?	
Alert adult holding shovel on auger intake in case grain flow needs redirected.	15%
Observant adult with foot resting on auger.	9%
Vigilant adult observing operation from nearby ready to turn off power.	73%
Adult using hand to remove debris from intake grating while grain is flowing.	4%
Who do you allow to be within 10 feet of an auger while it is in operation?[a]	
Other adults not working with you	21%
Other adults working with you	95%
Children (under age 14)	2%
Youth (14 to 19 years old)	16%
Animals or pets	9%
Do you allow (or have you allowed) children or youth to operate augers?	25%
Which dimensions do you believe to be adequate for an auger intake guard?	
Sturdy wire mesh that has openings that are 6 inches by 2 inches.	4%
Sturdy wire mesh that has openings that are 4 inches by 4 inches.	11%
Sturdy wire mesh that has openings that are 4 inches by 2 inches.	36%
Sturdy wire mesh that has openings that are 2 inches by 2 inches.	49%
How far away would expect the auger intake guard to be from the flighting?	
6.5 inches away from the flighting.	22%
4.5 inches away from the flighting.	42%
2.5 inches away from the flighting.	33%
1.5 inches away from the flighting.	4%

[a] Check all answers that apply.

the intake grating while the auger is operating as the best description of their operating practices (table 1).

Respondents were asked to indicate whom they allow within ten feet of an auger that they are operating. All 57 respondents answered this question. The most common answer was other adults working with the respondent (95%) and other adults not working (21%). Only 2% of the respondents indicated that they allow children under the age of 14 to be within ten feet of an operating auger, while 16% allow youth (age 14–19) to be within this range.

The respondents were also asked if they allowed children or youth to operate augers. This question did not provide the respondents with any specific age limits to consider. Twenty–five percent (25%) of the respondents indicated that they do allow, or have allowed, youth to operate augers. The respondents who answered this question affirmatively were then asked to indicate at what age this activity was first allowed. The ages provided by respondents ranged from 13 to 16 years, with 14 years being the average age at which auger operation was first allowed.

Respondents were asked two questions concerning appropriate shielding of the auger intake: one question about the dimensions of the grating, and a second question concerning the distance required between the guard and the auger flighting. ASAE standards indicate that the openings in grating–type guards must be no larger than 10 square inches with the largest dimension being no greater than 4.75 inches, and that the guard must be at least 2.5 inches from the flighting (*ASAE Standards*, 1998). Eight respondents (15%, n = 55) selected inadequate mesh dimensions as being appropriate. Thus, 85% of the respondents selected appropriate mesh dimensions that met, or in this case exceeded, ASAE standards. Additionally, 97% (n = 55) of the respondents selected a safe distance between the guard and the flighting, with 64% selecting a distance that exceeded the minimum established by ASAE. Table 1 provides details on respondents' abilities to recognize safe practices and appropriate shielding.

Personal Practices and Behaviors

The questionnaire included twenty practices and behaviors based on common "do's and don'ts" gleaned from auger operator's manuals (Farm King, 1997; Versatile, 1978). These practices and behaviors ranged from safety best practices to indisputably dangerous behaviors. Some of the practices were neutral by themselves, with the degree of risk depending on other factors. Respondents were asked to identify how often they performed each practice during the last two years using a scale of always, often, sometimes, seldom, and never. There was an additional category of not applicable if the described practice did not apply to their operation. Fifty–four respondents completed this portion of the instrument. However, response rates for individual questions ranged from 49 to 53, with an average of 51 respondents to each question. It is likely that the questions that were left unanswered were not applicable, since individual respondents who left a question blank did not select "not applicable" for any question. Additionally, individuals who selected "not applicable" for at least one question left no other questions blank. Table 2 lists the percentage of respondents in each category for each practice/behavior (excluding unanswered and "not applicable" responses).

Over half of the respondents indicated that they would never:

- Lubricate moving parts while the auger is operating.
- Move an auger in a raised position.
- Unintentionally hit overhead wires.

- Ramp–up an auger to reach a bin.
- Use their hands or feet to redirect the flow of grain.
- Perform minor adjustments while the auger is running.
- Run an auger empty.
- Leave grain in auger between uses.

However, over half of the respondents also indicated that they would never:

- Read or refer to the operator's manual before operating an auger.
- Anchor the intake end of an auger.

Risk Perceptions

Respondents' risk perception of auger hazards was addressed for four topics: set up and transportation practices, operating conditions, general safety issues, and management issues. For each topic, the respondents were given six items and asked to rank them in the order of importance to auger–related injuries (i.e., which items were most likely to contribute to auger–related injuries). Tables 3 through 6 contain the results of the risk perception rankings. Not every respondent provided a ranking for all six items in each topic (e.g., some would only rank their top two or three items). Thus, the table has an additional column labeled "blank" to indicate the number of respondents who did not rank a particular item. The weighted score for each item was calculated using the following formula:

Table 2. Personal practices and behaviors by percentage of respondents.

	Responses in %					
Over the last two years, how often did you. . .	Always	Often	Some-times	Seldom	Never	n
Read or refer to the instruction manual that came with the auger before operating.	2	4	20	20	54	46
Train family members, co–workers, and seasonal help on how to operate the auger.	31	17	19	17	17	48
Lubricate moving parts on the auger while it is in operation.	2	6	4	21	66	47
Wipe dust off warning labels to make sure they are readable.	0	13	28	21	38	47
Transport the auger on public roads.	4	26	34	17	19	47
Move the auger in a raised position.	4	6	20	20	51	51
Move the auger in a location where there are overhead power lines.	4	10	16	28	42	50
Unintentionally hit telephone wires or electrical wires while moving the auger.	0	0	0	4	96	51
Remove intake shields to service or clean the auger.	4	6	21	19	50	48
Use an auger over 10 years old.	31	39	22	4	4	49
Anchor the intake end of the auger to the ground.	4	4	13	6	73	48
Think about potential injuries when operating an auger.	36	34	14	14	2	50
Raise or "ramp up" an auger to reach a tall bin.	4	8	14	8	65	49
Allow youth (14–19 years old) to work with an auger.	4	4	33	21	38	48
Use hands or feet to redirect flow of grain into or out of the auger.	2	4	13	21	60	48
Perform minor adjustments while the auger is in operation.	2	2	6	18	72	50
Leave an operating auger unattended for any length of time.	2	4	16	30	48	50
Run the auger empty (other than momentarily to clean out).	6	8	0	20	66	50
Leave grain in the auger between uses.	2	4	6	16	72	50
Move the auger without hitching it to a vehicle.	4	6	30	34	26	50

$$WS = \frac{\sum R_i C_i}{\sum C_i} \quad (1)$$

where

WS = weighted score
R = rank (i.e., 1, 2, 3, 4, 5, 6)
C = count of respondents that selected each rank.

The lower the weighted score, the more likely the respondents considered that item to be a contributing factor for auger–related injuries. Respondents who did not rank

Table 3. Ranked perceptions of setup and transporting practices that contribute to auger–related injuries.[a]

	Number of Responses							
Practices	1st Choice	2nd Choice	3rd Choice	4th Choice	5th Choice	6th Choice	Blank	Weighted Score
Moving augers in a raised position.	28	9	6	4	0	0	6	1.7
"Ramping up" an auger to reach a tall bin.	15	14	6	6	3	2	7	2.4
Not blocking auger wheels during use.	2	6	15	11	6	2	11	3.5
Moving auger without hitching it to a vehicle.	3	12	4	10	10	7	7	3.7
Not having the intake end of the auger secured to the ground.	5	6	5	6	11	9	11	3.9
Transporting augers on public roads without a slow–moving vehicle (SMV) emblem.	0	2	5	3	12	19	12	5.0

[a] The survey respondents' 1st choice ranking was considered to be the largest (or most important) contributing factor; n = 53.

Table 4. Ranked perceptions of operating conditions that contribute to auger–related injuries.[a]

	Number of Responses							
Practices	1st Choice	2nd Choice	3rd Choice	4th Choice	5th Choice	6th Choice	Blank	Weighted Score
Operating auger without grates or other safety shields.	29	16	4	0	0	0	3	1.5
Using hands or feet to redirect the flow of grain.	21	20	5	4	0	1	4	1.8
Performing minor adjustments and service while the auger is in operation.	1	10	24	4	3	1	9	3.0
Operating auger at an angle that is steeper than recommended by the manufacturer.	0	4	3	14	19	3	9	4.3
Operating auger at a faster speed (RPM) than the manufacturer recommends.	1	0	3	11	6	20	11	5.0
Using auger in an unloading area that is not level.	0	1	2	10	12	15	12	5.0

[a] The survey respondents' 1st choice ranking was considered to be the largest (or most important) contributing factor; n = 52.

Table 5. Ranked perceptions of safety issues that contribute to auger–related injuries.[a]

Practices	Number of Responses							Weighted Score
	1st Choice	2nd Choice	3rd Choice	4th Choice	5th Choice	6th Choice	Blank	
Failure of the operator to pay attention on the job (daydreaming and carelessness).	34	13	2	1	1	0	2	1.5
Exhaustion or fatigue of the operator.	12	23	7	1	3	2	5	2.3
Lack of training on safe auger operations.	6	5	17	4	8	2	11	3.2
Using frayed winching cables (that raise and lower auger).	0	5	10	13	13	1	11	3.9
Using an older auger without modern safety designed features.	1	6	8	16	7	8	7	4.0
Failure to keep warning and caution labels readable and clean.	0	0	1	5	7	27	13	5.5

[a] The survey respondents' 1st choice ranking was considered to be the largest (or most important) contributing factor; $n = 53$.

Table 6. Ranked perceptions of management issues that contribute to auger–related injuries.[a]

Practices	Number of Responses							Weighted Score
	1st Choice	2nd Choice	3rd Choice	4th Choice	5th Choice	6th Choice	Blank	
Allow operators to have loose clothing, jewelry, or long hair.	25	5	6	6	4	3	4	2.3
Allow children (under 13 years) to operate auger.	9	15	9	9	3	0	8	2.6
Allow inexperienced seasonal help or family members to operate the auger.	12	14	8	6	5	2	6	2.7
Operate auger in muddy, slippery, or other poor footing conditions.	2	10	13	14	4	2	8	3.3
Operating the auger at night.	3	5	6	2	8	19	10	4.5
Working with an auger in a confined or cramped area.	2	5	2	4	15	14	11	4.6

[a] The survey respondents' 1st choice ranking was considered to be the largest (or most important) contributing factor; $n = 53$.

a particular item obviously considered that item to be unimportant in contributing to auger–related injuries. However, the degree of unimportance was impossible to gauge without a ranking, so items that were left blank were recorded and reported in the appropriate table but were ignored when calculating the weighted score.

Items concerning the initial set up and transportation of an auger are listed in table 3. The item perceived to be the largest contributor to auger–related injuries within this topic was moving the auger in a raised position (weighted score = 1.7). This practice may save the producer time in taking down and setting up the auger, but it exposes the producer to the hazards of upending and electrocution. The item ranked as the second most important contributing factor for this topic involved ramping up augers to reach into a bin taller than the auger was designed to reach (weighted score = 2.4). This practice involves raising the auger's wheels above ground level by positioning them on top of a platform of concrete blocks or other material. The

practice of ramping up an auger may result in stability problems such as upending or having the auger's wheels slip off the platform.

Items pertaining to operating conditions include environmental conditions and operator actions after the auger is positioned and operating (table 4). The items under this topic selected as being the most contributory to auger injury by respondents were operating an auger without the grates or safety shields (weighted score = 1.5) and using ones' hands or feet to redirect the flow of grain (weighted score = 1.8).

The items under the topic of general safety issues were all aspects controllable by the operator (table 5). The items selected as most contributory to auger–related injuries were the failure of the operator to pay attention on the job (weighted score = 1.5) and operator fatigue or exhaustion (weighted score = 2.3).

How an operator deals with controllable factors surrounding auger–related issues falls under the broad rubric of management. Examples of these management items include what the operator wears (e.g., clothing type, use of jewelry, etc.) and under what conditions the auger is allowed to operate (e.g., at night, on muddy cold days, in confined areas, etc.). The six management items the respondents were asked to rank for importance in contributing to auger–related injuries are listed in table 6. The three items ranked to be the greatest contributors to auger injuries all involved operator characteristics. The item perceived to have the greatest risk was allowing operators to have loose clothing, jewelry, or long hair (weighted score = 2.3), followed closely by allowing children under 13 years of age (weighted score = 2.6) and inexperienced seasonal help or family members (weighted score = 2.7) to operate the augers.

Considering all four topics, the top ten items the respondents perceived to be most important in contributing to auger–related injures are as follows (the weighted score is provided parenthetically):

- Operating auger without grates or other safety shields (1.5).
- Failure of the operator to pay attention on the job (1.5).
- Moving augers in a raised position (1.7).
- Using hands or feet to redirect the flow of grain (1.8).
- Exhaustion or fatigue of the operator (2.3).
- Allowing operators to have loose clothing, jewelry, or long hair (2.3).
- Ramping up an auger to reach a tall bin (2.4).
- Allowing children (under 13 years) to operate auger (2.6).
- Allowing inexperienced seasonal help or family members to operate the auger (2.7).
- Performing minor adjustments and service while the auger is in operation (3.0).

Personal Beliefs

The respondents' beliefs regarding personal safety were appraised by asking two open–ended questions: (1) "If you have never had an auger–related injury, what factor in your background or farming practices has made it possible for you to avoid auger injuries?" and (2) "What do you think is the number one cause of auger–related injuries?" Thirty–four respondents answered the question concerning their ability to avoid auger–related injuries, but some respondents provided more than one reason. The most common response involved the concept of having respect or fear for the equipment (26%), followed by being careful (21%), and use of common sense (18%). Other reasons given included simply being lucky (15%), keeping away or staying clear of operating equipment (15%), and the concept of having a safety first attitude and not taking chances (12%). Two respondents mentioned that farm–related injuries

to others had made them more careful. Only one respondent mentioned anything about education, and it involved his father teaching him respect for equipment not directly pertaining to any safety training concerning the operation of augers.

Forty–four respondents answered the question concerning the number one cause of auger–related injuries. Again, some respondents offered more than one cause. Nearly half of the respondents (48%) perceived carelessness to be the most common cause of auger–related injuries. Other causes listed included fatigue (16%), being in a hurry (16%), and the lack of shields and guards (14%).

Discussion

Appropriate Guards and Shields

The results of the survey indicate that most active farmers in Iowa have a clear understanding of appropriate shielding for the auger intake. Only 15% of the respondents selected mesh dimensions that did not meet ASAE standards, and only 4% selected a distance between the guard and the flighting that was less than the minimum distance defined in the standard. Respondents perceived operating augers without grates or other safety shields to be the number one contributing factor for auger–related injuries among the ranked items. Additionally, while carelessness was perceived to be the most common cause of auger–related injuries by nearly half (48%) the respondents, lack of shields or guards appeared fourth on the list, with 14% of the respondents considering this to be the most common cause.

Iowa farmers obviously recognize the importance of appropriate shielding in preventing auger–related injuries, yet Schwab et al. (2000) found that for this same population, approximately one–third of the primary and secondary augers were being used without shielding. The primary reason given for lack of shielding was that the auger was purchased or inherited without shielding, thus placing responsibility for the condition on previous owners. It is likely that the age of the augers — 59% were built prior to 1990 and some dated back to the 1960s (Schwab et al., 2000) — contributed to the lack of shielding. Some augers did not have intake shields when purchased new, and many have likely been removed and not replaced. Fifty percent (50%) of the respondents indicated that sometime in the last two years they had removed intake shields to service or clean an auger. Additional studies need to be conducted to determine why Iowa farmers place such a low value on keeping shielding and grates in place, replacing missing shields, or retrofitting older augers when they recognize the importance of shields in preventing auger–related injuries.

Contact with Overhead Electrical Wiring

Over half of the farmers (52%) reported that all of the electrical wiring around their farmstead was above ground on poles, and an additional 35% had some combination of above ground wiring and buried wiring (Schwab et al., 2000). Fatalities resulting from contacting overhead electrical lines while moving an auger have been documented by NIOSH (1986). The practice of moving an auger in a raised position is a commonly recognized hazard by safety professionals. The survey findings indicate that farmers also recognize this hazard, with the perception that moving augers in a raised position was the most important contributing factor for auger–related injuries during initial setup and transportation of an auger, and third overall in contributing to auger–related injuries. Yet nearly half of the respondents (49%) indicated that they had, sometime in the last two years, moved an auger in a

raised position. In addition, over half (58%) indicated moving an auger in a location where there were overhead power lines. In fact, of those who had moved an auger in a raised position, 72% had overhead power lines in locations where augers were being moved.

The best way to avoid contact with overhead wiring is to bury the electrical lines. The cost associated with burying the wiring may be indicative of why only 13% of the farmers reported that their wiring was below ground (Schwab et al., 2000). However, the reasons for acceptance of the risk associated with contact of overhead electric lines when the hazard is clearly recognized is unclear and needs to be studied more specifically.

Youth and Auger Operation

Traditionally, relatively young children have been given daily chores on parents' farms and increasingly included in production activities as they mature. It is common for youth 14 years of age and older to be employed in agricultural activities. However, the U.S. Department of Labor puts restrictions on youth employment in agriculture when hired by farmers other than the child's parents. The U.S. Department of Labor (1971) included operating augers as a hazardous occupation for youth less than 16 years of age.

While 62% of the respondents indicated that youth (age 14–19) had worked with (i.e., operated) an auger for them during the last two years, only 25% admitted to allowing children or youth to operate augers. The terms "children" and "youth" often do not have specific age definitions associated with them and thus are open to interpretation. The survey results show that allowing children (under 13 years) to operate augers is perceived to be a significant contributing factor to auger–related injuries. This is supported by the fact that the 25% who responded that they do allow children and youth to operate augers considered an appropriate starting age for this activity to be between 13 and 16. The hazards associated with children operating augers are recognized, yet it appears to be a prevalent practice for youth 14 to 19 to operate augers on Iowa farms.

Education/Training Regarding Auger Operation and Safety

Information on safe auger operation is readily available from many sources (e.g., manufacturers, Cooperative Extension Service, equipment associations). Accurate information on auger operation and safety is contained in the operator's manual supplied by the manufacturer. Additional signage concerning safe operating techniques and warning labels addressing hazards are included on all recently manufactured augers. However, operator's manuals are often misplaced or lost and are seldom passed on when an auger is purchased used. Even when an operator's manual is available, instruction is usually only sought on an as–needed basis for repairs or infrequent maintenance. Less than half of the respondents (46%) indicated that they had referred to their operator's manual in the last two years.

The survey results provide a mixed message about the perceived importance of safety education concerning auger operation. Inexperienced operators were considered to be an important contributing factor for auger–related injuries, and 83% of the respondents reported providing some type of training concerning auger operation during the last two years. Yet lack of training on safe auger operations was not perceived to be a major contributor to auger–related injuries, and was not specifically mentioned by anyone as being a factor that helped them avoid injury. Similarly, while

62% of respondents reported cleaning warning labels to ensure their readability, the failure to do so was not perceived to contribute to injuries.

Using Hands to Move Grain or Redirect Grain Flow

Even in the best conveying systems, grain often spills. A temptation and easy solution is to use hands or feet to correct the spills. Respondents considered this to be a dangerous practice and ranked it as the fourth highest contributor to auger–related injuries. However, hazard recognition did not always translate into safe behavior. Redirecting the flow of grain using hands or feet was a practice admitted by 40% of the producers in the last two years.

Safety Attitudes and Beliefs

Iowa farmers who responded to this survey often performed practices that they identified as hazardous. Some insight into this may be gleaned from their responses to the open–ended questions assessing their beliefs regarding personal safety. They perceived the primary causes of auger–related injuries and their reasons for avoiding injury to be indeterminate, vague, and abstracted concepts rather than specific behaviors or actions. With this mindset, the causes of injuries can be explained away by fatigue, hurrying, or the vaguest excuse of all — just plain carelessness. Similarly, they avoid injury through their general respect for equipment, being careful, and using common sense rather than because of specific safety behaviors or practices. They are willing to accept risks and hazards associated with unsafe practices because they are "careful" while performing these dangerous activities. It is likely that they are not even aware of the inconsistencies brought on by these attitudes and beliefs. It appears that Iowa farmers are capable of identifying the risks associated with auger operation, but they may be lacking in their ability to make a realistic assessment of those risks, which would then translate into better decisions regarding safety practices.

The SMARTRISK Foundation identifies three steps that are necessary for making good decisions regarding personal safety, which they call smart risk decision making (SMARTRISK, 2002):

1. Recognizing that risk exists in every situation; it's part of life.
2. Assessing the degree of risk involved.
3. Choosing behavior to avoid or minimize potential injury.

The third step, choosing the behavior, cannot happen without a good assessment of the risk involved. Many farm safety initiatives have focused on hazard and risk identification. In the case of auger–related injuries, these efforts appear to have been successful, yet the identification of the risks has not resulted in safer behavior. While SMARTRISK targets youth, agricultural safety educators may be able to borrow from this concept to provide educational messages and programming that targets agricultural populations. The key to producers choosing safer practices regarding their use of augers may be in helping them more accurately assess the risks they have already identified.

Conclusions and Recommendations

This study provides a profile of Iowa farmers' perceptions and beliefs regarding auger safety and how these perceptions are put into practice. Based on this study, the following conclusions were drawn by the authors:

- The majority of Iowa farmers who participated in this study can identify appropriate shielding for auger intakes that meet or exceed ASAE standards.
- It is a common practice for youth, age 14–19, to operate augers on the Iowa farms in this study.
- Iowa farmers who participated in this study considered operating an auger without shielding, failure to pay attention on the job, moving augers in a raised position, and using hands or feet to redirect the flow of grain to be important contributors to auger–related injuries.
- Carelessness was perceived, by the participants in this study, to be the leading cause of auger–related injuries.
- The general ideas of having respect for equipment, being careful, and using common sense were perceived, by the participants in this study, to be the most important factors in the ability to avoid auger–related injuries.
- Iowa farmers participating in this study commonly perform auger–related practices (e.g., moving an auger in a raised position) that they identify as unsafe.

The authors also believe that the results of this study clearly identify the need for continued study and intervention efforts addressing auger–related safety issues. While a variety of future studies may be beneficial, the following specific recommendations are the most needed:

- More detailed studies are needed to fully understand why Iowa farmers consider the lack of shielding to be a significant contributor to auger–related injuries, yet place such a low value on having shielding in place. Intervention efforts to increase the prevalence of appropriate shielding of augers are unlikely to have a significant impact unless this question is addressed as part of the intervention.
- Additional studies are needed to explain why Iowa farmers routinely accept auger–related risks for behaviors and practices that they have identified as hazardous. Similarly to the first recommendation, this information is critical to the design of effective intervention strategies.
- New intervention programs addressing auger–related safety issues need to be developed that go beyond hazard/risk recognition and focus instead on risk assessment in an effort to develop safe behaviors and practices that will correlate with correctly identified risks.

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