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An Educational Intervention Program for Prevention of Occupational Illness in Agricultural Workers*

Kristi J. Ferguson, Craig L. Gjerde, Cornelia Mutel, Kelley J. Donham, Carolyn Hradek, Kay Johansen and James Merchant

ABSTRACT: *This study assessed attitudes, knowledge and behavior related to respiratory health among 198 swine confinement operators, half of whom were assigned to an educational intervention and half of whom served as controls. The project identified significant gaps in knowledge regarding the swine confinement environment and the hazards posed by working in such an environment. Attitudes toward improving the environment were generally favorable, though barriers such as cost and time existed for some confinement operators. An educational program, consisting of six booklets mailed out at two-week intervals and a group meeting, resulted in significant knowledge gains for the intervention group in areas related to respiratory health and confinement. For example, while fewer than half of the participants recognized on the pretest the recommended levels of potentially hazardous substances such as dust, carbon monoxide, ammonia and hydrogen sulfide, more than 85 percent recognized the recommended levels on the posttest. Evaluations of the units and the group meetings indicate that confinement operators have responded favorably to the project. Follow-up evaluation is underway to determine whether changes in knowledge have led to changes in behavior.*

Swine confinement, a relatively new development in agricultural technology, poses significant health risks to the increasing number of workers in the confinement industry (Donham, Rubino, Thedell & Kammermeyer,

* This project was funded by the National Heart, Lung and Blood Institute, Grant #HL33128-04. An earlier version of this paper was presented at the annual meetings of the National Rural Health Association, Nashville, Tennessee, May 1988. Special thanks are due to other project staff: Pete Knapp hosted group meetings and advised the project of at all stages; Deb Lassise coordinated project activities, including scheduling field visits; Nita Lee and Wayne Johnson collected individual health-related data from participants and controls; Alan Weinrich collected industrial hygiene data and provided special consultation to intervention participants; Bill Popendorf oversaw the industrial hygiene component; Leon Burmeister developed and implemented the sampling scheme; Beth McCabe entered the data; and P.K. Sharma coordinated overall data analysis for the project. We also thank the swine confinement farmers who participated in the project. Requests for further information should be sent to: Dr. Kristi J. Ferguson, Associate Research Scientist, Office of Consultation and Research in Medical Education, College of Medicine, The University of Iowa, 2351 Steindler Building, Iowa City, Iowa, 52242.

1977). Although expansion has declined since 1980, in 1977 an estimated 500,000 to one million workers were occupationally exposed to livestock confinement. A 1975 survey showed that 30,000 to 40,000 confinement buildings were constructed yearly (Comparative Costs, 1975).

The confinement system applies principles of industrial mass production to livestock production. In contrast to the traditional open feedlot, pasture or range method of livestock production, confinement animals are raised in high densities (a few cubic feet of space per animal) in structures that either totally or partially separate them from the outside environment. The majority of swine units are totally enclosed, which increases the potential for workers' exposure to airborne hazards. Animal wastes are either kept within the building in a pit under a slatted floor, or they are mechanically or hydraulically transported outside the building.

Project staff first became suspicious of health problems resulting from exposure to the confinement environment in 1974, when physicians and farmers in Iowa and across the country began calling about adverse symptoms associated with working in these buildings. In 1977 we reported pilot studies which suggested that workers exposed to the swine confinement environment had a high prevalence of respiratory symptoms (Donham & Gustafson, 1982). In 1979 we conducted a random sample survey which demonstrated symptoms of airway disease in 70 to 90 percent of the exposed population and occasional episodic occurrences of acute malignant respiratory distress (Donham, Zavala & Merchant, 1982). The current project developed from a concern about how to prevent respiratory disease by teaching swine producers about these problems and by encouraging health-promoting attitudes and behaviors. We hoped that these health-promoting attitudes and behaviors would lead farmers to use personal protective equipment, to assess their work environment and to take steps to improve the work environment.

Project Description

The project started in 1984 through a five-year grant from the National Heart, Lung and Blood Institute and is being conducted in two geographically separate Iowa locations, one of which has been designated as the intervention group and the other as a control group. The project has two major components, research into the human respiratory hazards associated with confinement work and an examination of the efficacy of education and consultation in reducing those hazards.

The health education program, a home study course supplemented by community educational meetings, sought to change knowledge, attitudes and behavior regarding respiratory health protection in the confinement environment. An environmental and engineering consultation program builds on the knowledge base gained through the educational program to encourage confinement operators to make specific environmental modifications. Since individual respiratory protection offers at best

a short-term solution, the project's ultimate goa environment within buildings. The educational pro *why* such changes were necessary, while the c individualized recommendations about *how* to ma

Participant Recruitment: The Iowa Crop a Service (ICLRS) helped identify study participant confidentiality of the mailing list, the ICLRS cor Participants were recruited in three phases (Figur

During the first recruitment phase, the ICLRS ers having 400 or more hogs and operating in state. Of the 3,301 producers who met study were randomly selected and surveyed to dete operation, equipment and systems used in con low-up yielded 558 responses (56%) of whom 3 had confinement. These confinement farms wer size of operation and worker exposure time.

Based on geographic clusters of respondent farms from survey data, the study designated fan ern counties for the intervention group and fan ern counties for the control group, with a tier limit interaction between the groups and allow of the education/consultation program. This s

Figure 1. Participation Identification Swine Confinement Farmer Selected Counties in Eastern

Recruitment Level	Group 1 400 hogs or more marketed per year	Group 2 400 hogs or more marketed per year
Number Contacted	1000	1019
Number of Responses	558	374
Response rate	56%	37%
Number with Confinement	330	120*
Number Selected for enrollment	51	62
Number of Farms enrolled	46	54
Percent Enrolled	90%	87%
Number of Participants enrolled	80	85
Number of Participants/farm	1.7	1.6

*Indicates confinement and interest in participating in t

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a short-term solution, the project's ultimate goal was to improve the environment within buildings. The educational program taught participants *why* such changes were necessary, while the consultation phase gave individualized recommendations about *how* to make such changes.

Participant Recruitment: The Iowa Crop and Livestock Reporting Service (ICLRS) helped identify study participants. In order to maintain confidentiality of the mailing list, the ICLRS contacted farmers directly. Participants were recruited in three phases (Figure 1).

During the first recruitment phase, the ICLRS identified pork producers having 400 or more hogs and operating in the eastern half of the state. Of the 3,301 producers who met study criteria, 1,000 producers were randomly selected and surveyed to determine size and type of operation, equipment and systems used in confinement. Telephone follow-up yielded 558 responses (56%) of whom 330 (59%) indicated they had confinement. These confinement farms were then stratified based on size of operation and worker exposure time.

Based on geographic clusters of respondents and characterizations of farms from survey data, the study designated farms from seven southeastern counties for the intervention group and farms from seven northeastern counties for the control group, with a tier of counties in between to limit interaction between the groups and allow more focused evaluation of the education/consultation program. This selection process also en-

Figure 1. Participation Identification and Enrollment of Swine Confinement Farmers from Fourteen Selected Counties in Eastern Iowa.

Recruitment Level	Group 1 400 hogs or more marketed per year	Group 2 400 hogs or more marketed per year	Group 3 5000 hogs or more marketed per year	Total
Number Contacted	1000	1019	40	2059
Number of Responses	558	374	22	954
Response rate	56%	37%	55%	46%
Number with Confinement	330	120*	15*	465
Number Selected for enrollment	51	62	8	121
Number of Farms enrolled	46	54	8	108
Percent Enrolled	90%	87%	100%	89%
Number of Participants enrolled	80	85	33	198
Number of Participants/farm	1.7	1.6	4.1	1.8

*Indicates confinement and interest in participating in the study.

couraged the interactions of a community-based educational program, allowed for optimal use of travel resources and insured the representation of various farm operations.

Of the 51 confinement farms who received recruitment letters and enrollment questionnaires, 46 enrolled (90%) for a total of 80 participants — this yielded 1.7 participants per farm, lower than the expected 2.7. A second recruitment effort following the same procedure in the 14 selected counties yielded 85 participants from 54 of the 62 randomly selected farms (87%) — an average of 1.6 participants per farm.

In a third and final recruitment effort, the ICLS identified 40 large commercial producers (5,000 or more hogs or more than 300 sows farrowing). Of the twenty-two who responded (55%), fifteen (68%) were involved in confinement and indicated an interest in the study. To reach our target number of farms and participants, we then selected eight farms, all of which enrolled in the study. Thirty-three participants from these eight farms enrolled, for a total of 4.1 participants per farm. Thus, the total study group included 108 farms (56 intervention and 52 nonintervention) and 198 participants (97 intervention and 101 nonintervention). In addition, 3 manager/operators who did not work in the buildings participated in some aspects of the program. The average age of confinement workers was 36 years and the average educational level was 13 years. Eighty-eight percent were men and 19 percent were current smokers.

Several project aims addressed educational issues:

1. To evaluate swine confinement units operators' knowledge about human respiratory health hazards and the causes and control of associated health problems.

2. To test the effectiveness of a comprehensive educational program designed to change swine confinement operators' health and safety-related knowledge, attitudes and behavior.

3. To recommend strategies for implementing similar education and consultation programs in other states by such groups as state agricultural extension services, the American Lung Association, Farm Bureau, rural clinics and rural hospitals.

Theoretical Background

We based interventions on the Health Belief Model, a model developed to explain an individual's health-related behavior (Janz and Becker, 1984). For example, in terms of perceived susceptibility, the Health Belief Model would suggest that individuals who believed strongly they could develop respiratory disease due to occupational exposure presumably would take measures to protect themselves, while those who believed the risk to be minimal would not.

Regarding perceived benefits, the Model confinement workers who recognized the short fits gained from wearing a dust mask would effective dust mask. Conversely, those who pe with dust mask use, such as cost, inconvenien less likely to wear a mask.

In addition, the Health Belief Model sugg may be necessary, it will not necessarily char individuals can believe that something would the barriers to be relatively minimal, yet still behavior, perhaps because they lack social s because they forget to do it. Sometimes ren take a particular action — for example, a sig building door may remind workers to put on

Educational interventions for this project as well as knowledge of confinement hazards. changing knowledge alone influenced beha some workers wore one-strap masks becaus one-strap masks provided inadequate prote willing to change once they learned why or quate.

In other cases, workers needed to change edge. For example, workers may have seen h reduction practices in handling feed, but th changing their practices was not worth the ef attitudes, educational efforts addressed the practices *relative* to their inconvenience.

Finally, workers served as role models discussed changes they had made with wor making similar changes. Behavior change ba a primary goal of our community educational

Methods

Research activities were conducted in thre commenced in 1987 and is still in progress. assessed workers' health status before and af building (Lassise, Merchant, Lee & Donham, 1 knowledge and attitude survey, and measure in the confinement environment.

During Phase II, workers in the interven cational program that included a six-unit, se and community educational meetings. The f ments again following Phase II.

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Regarding perceived benefits, the Model would suggest that swine confinement workers who recognized the short-term and long-term benefits gained from wearing a dust mask would be more likely to wear an effective dust mask. Conversely, those who perceived barriers associated with dust mask use, such as cost, inconvenience or discomfort, would be less likely to wear a mask.

In addition, the Health Belief Model suggests that while knowledge may be necessary, it will not necessarily change behavior. For example, individuals can believe that something would benefit them and perceive the barriers to be relatively minimal, yet still not engage in a preventive behavior, perhaps because they lack social support for the behavior or because they forget to do it. Sometimes reminders alert individuals to take a particular action — for example, a sign outside the confinement building door may remind workers to put on their dust mask.

Educational interventions for this project targeted individual attitudes as well as knowledge of confinement hazards. For some target behaviors, changing knowledge alone influenced behavior directly. For example, some workers wore one-strap masks because they did not know that one-strap masks provided inadequate protection, and said they were willing to change once they learned why one-strap masks were inadequate.

In other cases, workers needed to change attitudes as well as knowledge. For example, workers may have seen benefits associated with dust reduction practices in handling feed, but they may have thought that changing their practices was not worth the effort. When trying to change attitudes, educational efforts addressed the potential benefits of certain practices *relative* to their inconvenience.

Finally, workers served as role models for each other, e.g., they discussed changes they had made with workers who were considering making similar changes. Behavior change based on such discussion was a primary goal of our community educational meetings.

Methods

Research activities were conducted in three phases, the third of which commenced in 1987 and is still in progress. During Phase I, a field crew assessed workers' health status before and after work in the confinement building (Lassise, Merchant, Lee & Donham, 1988), administered a worker's knowledge and attitude survey, and measured the airborne contaminants in the confinement environment.

During Phase II, workers in the intervention group received an educational program that included a six-unit, self-instruction mail-out course and community educational meetings. The field crew performed assessments again following Phase II.

During Phase II, now nearing completion, an industrial hygiene consultant has visited farms in the intervention group and developed an

individualized prescription for improving the confinement environment of each farm. This consultation program and a more intensive consultation offered to interested farmers will be described in detail in other publications (Mutel, Ferguson, Gjerde, Weinrich, Lassise, & Donham, 1988; Weinrich, Popendorf & Donham, 1988). Follow-up assessments, including the swine producer survey and the unit pre-tests and post-tests, were administered at uniform intervals for all participants.

Advisory Council: We believed it would be important for confinement workers to feel that they were part of the decision-making process, rather than only subjects of a research study. To develop this sense of belonging, we made signs for farmers to hang on their fences to indicate their participation in the project. We sent periodic newsletters to inform participants of progress to date, introduce them to project team members and inform them about upcoming project activities. Finally, we developed an Advisory Council, comprised of six of the project's intervention confinement operators. Council members suggested ways to organize group meetings, advised us on methods to improve participation in group meetings and called farmers to invite them to attend. In addition, they served as local contact persons for the project and gave us the farmer's point of view as we implemented various components of the project.

Educational Intervention: While the project's primary objective was to change behavior, we recognized that knowledge and attitudes were key to behavior change. To facilitate knowledge change, we developed six written units which were sent to participants at two-week intervals. Each unit contained about six pages of written material; participants completed a pre-test and post-test for each unit. Topics covered included the following: (1) Confinement Dusts and Gases; (2) Confinement and Human Health; (3) Hog Health and Confinement; (4) Measuring Confinement Dusts and Gases; (5) Reducing Confinement Dusts and Gases; and (6) Using Respirators in Confinement.

Group meetings were designed to facilitate discussion and demonstrate equipment. Meetings took place in locations within 40 miles of each participant's farm. This distance was far from ideal, but it was difficult to reduce the driving time further since farms participating in the project were scattered over a large geographic area.

Group meetings consisted of a meal and social time, demonstration of testing equipment and respirators, and a group problem-solving discussion related to the confinement environment. The group meetings actively involved the participants. After project staff showed participants how to use respirators and how to measure gases in the confinement environment, participants tried the equipment themselves. Case studies generated discussion about problems associated with implementing the project's recommendations and encouraged participants to apply information presented in the written units.

The results described here were taken from two main sources: a baseline swine producer survey, completed by both intervention and control participants (N=172), and the pre-test and post-test results, admin-

istered only to those in the intervention participants, or 68%, completed at least the corresponding pretests and posttest better than some projects of this nature mailed reminder cards and phone follo comparing those who completed at lea showed similar pretest performance in in larger operations had a somewhat l and posttests.

Results

The baseline swine producer survey edge deficits among participants (Table finement noise levels can damage worl one-strap dust masks provided inadeq the other hand, many knew that dust n gas hazards (85% correct) and many re even when exposure time was less tha

The attitude results demonstrated p example, 34 percent said that wearing work, 34 percent felt they could not a 26 percent did not regularly inspect or

Table 1. Summary of Knowle Survey (N = 172).

Dust masks protects from manure gas hazards (F)*
Workers should wear masks even when in buildings less than 3 hours (T)
Rapid agitation reduces the release of dangerous gases (F)
Confinement noise levels can damage workers' hearing (T)
One-strap disposable dust masks trap most airborne particles (F)

*Letter within parentheses indicates whether re

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istered only to those in the intervention group (66 of the 97 intervention participants, or 68%, completed at least five of the six units and returned the corresponding pretests and posttests). This response rate, which was better than some projects of this nature have reported, was achieved by mailed reminder cards and phone follow-ups to nonresponders. Analysis comparing those who completed at least five units to those who did not showed similar pretest performance in both groups. Those who worked in larger operations had a somewhat higher return rate on the pretests and posttests.

Results

The baseline swine producer survey revealed several important knowledge deficits among participants (Table 1). Most did not know that confinement noise levels can damage workers' hearing (40% correct) or that one-strap dust masks provided inadequate protection (23% correct). On the other hand, many knew that dust masks *cannot* protect from manure gas hazards (85% correct) and many recognized the need for dust masks even when exposure time was less than three hours (71% correct).

The attitude results demonstrated potential areas for intervention. For example, 34 percent said that wearing a dust mask interfered with their work, 34 percent felt they could not afford to make buildings safer, and 26 percent did not regularly inspect or maintain their ventilation systems

Table 1. Summary of Knowledge Measures from Baseline Survey (N = 172).

	Percent Correct	Percent Don't Know
Dust masks protects from manure gas hazards (F)*	85	10
Workers should wear masks even when in buildings less than 3 hours (T)	71	28
Rapid agitation reduces the release of dangerous gases (F)	55	38
Confinement noise levels can damage workers' hearing (T)	40	32
One-strap disposable dust masks trap most airborne particles (F)	23	29

*Letter within parentheses indicates whether response is true or false.

Table 2. Summary of Attitude Measures from Baseline Survey (N = 172).

	Percent Who Responded Strong Agree or Agree
Air quality important to hog health and profit	95
Regular equipment cleaning and upkeep important	94
Concerned about long-term health effects of swine confinement work	80
Often not careful about health and safety	62
Could improve health and safety in confinement buildings	55
Dust mask interferes with work	34
Can't afford to make buildings safer for humans and animals	34
Not sure how to make buildings safer	33
Usually do not regularly inspect and maintain ventilation system	26
Maintaining healthy air environment costs too much	20
Coughing is part of swine confinement work	12
Dust mask does not do much good	11
Building and equipment maintenance necessary only when problems develop	5
Helpful information sources:	
veterinarians	75
magazines	70
other farmers	61
county extension agent	42
extension publications	41

(Table 2). On the other hand, most did not agree that coughing is part of the job (12% strongly agreed or agreed), most expressed concern about long-term health effects of working in confinement (80% strongly agreed or agreed), most did not agree with the statement that dust masks do no good (11% strongly agreed or agreed), and almost all viewed air quality as important to hog health and profit (95% strongly agreed or agreed). Veterinarians received the most favorable ratings as sources of information (75% strongly agreed or agreed that they were helpful), followed by

Table 3. Participants' Reported N (N = 172).

Behavioral measures:
In a year, how often do you inspect and service your building heaters for repair?
never
once
twice
three or more times
How often do you inspect them for preventative maintenance?
never
once
twice
three or more times
How often do you perform systematic inspection and maintenance of your ventilation systems?
never
once
twice
three or more times

magazines (70%) and other farmers (61 sion publications received less favorabl tively).

Since properly functioning equipme hazards in confinement, we asked respo maintenance on heaters and ventilation (38%) said they never inspected or ser almost as many (36%) said they never di One-fourth (26%) said they never inspe tion systems. Only 6 percent used the tion, a finding that confirmed most farm need for slow pit agitation to reduce rel

Another way to reduce exposure to regularly clean confinement buildings. A sure spray for cleaning buildings, but n for wash-down cleaning while half (49%

Pre-test and Post-test Results fr post-test analysis showed substantial kn

le Measures from Baseline

	Percent Who Responded Strong Agree or Agree
ɔfit	95
nportant	94
ɔf swine	80
	62
·ment buildings	55
	34
nans and animals	34
	33
in ventilation system	26
ɔo much	20
k	12
	11
sary only when	5
	75
	70
	61
	42
	41

lid not agree that coughing is part of eed), most expressed concern about ın confinement (80% strongly agreed the statement that dust masks do no d), and almost all viewed air quality fit (95% strongly agreed or agreed). ·rable ratings as sources of informa- that they were helpful), followed by

Table 3. Participants' Reported Maintenance Procedures (N = 172).

Behavioral measures:	N (Percent)
In a year, how often do you inspect and service your building heaters for repair?	
never	66 (38%)
once	49 (29%)
twice	39 (23%)
three or more times	16 (9%)
How often do you inspect them for preventative maintenance?	
never	62 (36%)
once	38 (22%)
twice	41 (24%)
three or more times	31 (18%)
How often do you perform systematic inspection and maintenance of your ventilation systems?	
never	44 (26%)
once	31 (18%)
twice	52 (30%)
three or more times	44 (26%)

magazines (70%) and other farmers (61%); extension agents and extension publications received less favorable ratings (42% and 41% respectively).

Since properly functioning equipment can reduce respiratory health hazards in confinement, we asked respondents how often they performed maintenance on heaters and ventilation systems (Table 3). Over one-third (38%) said they never inspected or serviced building heaters for repair; almost as many (36%) said they never did so for preventive maintenance. One-fourth (26%) said they never inspected or maintained their ventilation systems. Only 6 percent used the slowest possible speed for agitation, a finding that confirmed most farmers' lack of understanding of the need for slow pit agitation to reduce release of dangerous gases.

Another way to reduce exposure to hazardous gases and dust is to regularly clean confinement buildings. Almost all (87%) use a high pressure spray for cleaning buildings, but most (71%) never used hot water for wash-down cleaning while half (49%) never used detergent (Table 4).

Pre-test and Post-test Results from Written Units. Pre-test and post-test analysis showed substantial knowledge gains (Table 5). For ex-

ample, participants learned that it is important to discard dust masks when they lose their shape (76% correct pre-test, 97% post-test), that it is important to pump fluid off the manure pit if the level is high in the spring (73% correct pre-test, 100% post-test), and that the normal nose cannot warn of hydrogen sulfide hazard (70% pre-test, 95% post-test). They also learned that ammonia is the gas most commonly found at dangerous levels in confinement buildings (62% correct pre-test, 88% post-test), that it is wise to wear a respiratory when feeding animals (62% correct pre-test, 100% correct post-test), and that wire mesh floors are better for reducing ammonia buildup (38% correct pre-test, 90% correct post-test). In addition, they learned that good ventilation will not solve most air quality problems (28% correct pre-test, 76% correct post-test). When presented with options about the recommended levels of various substances, 28 to 55 percent got the answers correct on the pre-test, compared to 88 to 100 percent on the post-test.

There were several items that respondents already knew on the pre-test and therefore did not need to learn, e.g., virtually all of them knew that workers had died by going into the manure pit during agitation, that feed is a major source of dust and that ammonia is found in confinement houses. There were some items, however, that respondents did not answer correctly on the post-test. For example, many responded that manure agitation increases ammonia levels (45% incorrect) and methane levels (44% incorrect), and that good ventilation will solve most air quality problems (41% incorrect).

Participants' Evaluation of Written Units. Forty-one participants (42 percent) completed educational program evaluations. Most who responded found the written units to be readable and felt they learned

Table 4. Participants' Reported Cleaning Procedures and Respiratory Protection Measures (N = 172).

Variable	Percent Responding Never	Percent Responding Sometimes	Percent Responding Always
Performs wash-down with hot water	73	9	18
Performs wash-down with detergent	56	34	10
Wears a respirator or dust mask (when cleaning buildings)	38	52	9
Wears a dust mask while in the confinement buildings	32	58	10
Uses a power (high pressure spray) washer for washdown	2	11	87

Table 5. Summary of Pretest to Post (Based on those participant units).

Important to discard dust masks when they lose their shape (T)**
Pump fluid off manure pit if level is high in spring (T)
Normal nose cannot warn of hydrogen sulfide hazard
Ammonia is gas most commonly found at dangerous levels (T)
Wise to wear a respirator when feeding animals (T)
People with heart conditions may not be able to wear respirators safely (T)
Wire mesh floors better for ammonia (T)
Good ventilation will solve most air quality problems (F)
Could recognize recommended levels of various substances:
Dust (4.5 mg/cubic meter)
Carbon monoxide (50 ppm)
Ammonia (7 ppm)
Hydrogen sulfide (5 ppm)
Carbon dioxide (1500 ppm)

*All McNemar Chi-Square tests for difference in proj .05.

**Correct answers are noted in parentheses.

from them. They also said the materials w the pacing of the educational component v that they planned to use dust masks mo learned, and some reported that they plan housekeeping changes.

In phone follow-ups to some of the n some of them felt the two-week interval Even though we tried to plan the mail-o

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at ammonia is found in confinement
wever, that respondents did not an-
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ritten Units. Forty-one participants
program evaluations. Most who re-
be readable and felt they learned

d Cleaning Procedures and n Measures (N = 172).

Percent Responding Never	Percent Responding Sometimes	Percent Responding Always
73	9	18
56	34	10
38	52	9
32	58	10
2	11	87

Table 5. Summary of Pretest to Posttest Knowledge Gains (Based on those participants who completed units).

	Percent Correct Pre-test	Percent Correct Post-test*
Important to discard dust masks when they lose their shape (T)**	76	97
Pump fluid off manure pit if level is high in spring (T)	73	100
Normal nose cannot warn of hydrogen sulfide hazard (T)	70	95
Ammonia is gas most commonly found at dangerous levels (T)	62	88
Wise to wear a respirator when feeding animals (T)	62	100
People with heart conditions may not be able to wear respirators safely (T)	57	100
Wire mesh floors better for ammonia (T)	38	90
Good ventilation will solve most air quality problems (F)	28	76
Could recognize recommended levels of various substances:		
Dust (4.5 mg/cubic meter)	55	88
Carbon monoxide (50 ppm)	53	88
Ammonia (7 ppm)	37	88
Hydrogen sulfide (5 ppm)	33	100
Carbon dioxide (1500 ppm)	28	90

*All McNemar Chi-Square tests for difference in proportions statistically significant at $p < .05$.

**Correct answers are noted in parentheses.

from them. They also said the materials were not too technical and that the pacing of the educational component was appropriate. Many reported that they planned to use dust masks more because of what they had learned, and some reported that they planned to make environmental or housekeeping changes.

In phone follow-ups to some of the non-responders, we learned that some of them felt the two-week interval between units was too short. Even though we tried to plan the mail-out course around planting and

harvesting time, some felt they did not have time to participate as fully as they wanted to participate.

Evaluation of group meetings. Forty-nine group participants completed evaluation forms immediately following the group meeting's conclusion. Sixteen strongly agreed (33%) and 33 agreed (67%) that the meeting was worthwhile. Most said they would attend another meeting (90%) and those interested wanted additional information about dust control. Staff who attended group meetings were impressed with the interest and enthusiasm shown by the swine producers. Most operators who did not attend said either that they had a time conflict or the meeting was scheduled at a bad time of year for them. Although our participation rates for the meetings were not as high as we would have liked, we were gratified with the knowledge gains demonstrated by those who completed the educational units and by the response from those who did attend the meetings.

Discussion

Despite the fact that farmers are very busy people, they have responded enthusiastically to this project. Most have read the written units, as shown by their performance on the written post-tests. One reason for such impressive knowledge gains is that for the post-test the confinement workers had the written materials available to look up the information if they wished to do so. We did not necessarily expect them to memorize the answers and believed that looking up the answers might reinforce the information.

In addition to knowledge gains, many have shown interest in changing their behavior. We have made every effort to make our recommendation relevant to farmers by linking those recommendations to potential economic as well as health benefits. We believe that rural hospitals, extension services, veterinarians, or farm organizations interested in developing outreach activities should consider developing an educational effort of this type as a way to serve their constituents. Another Institute Project, called WorkSafe, is currently testing the feasibility of different methods of disseminating information about health and safety in general, and this information in particular, to those interested in rural health and safety.

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Appendix A: An Example of A Patier Human Health and Con

Spend a few moments thinking about h been working in your swine confinement bui you ever noticed that you cough or spit mo your eyes burn? Have you ever felt achy, like flu?

For many years, farmers have realized and gases in confinement buildings affected recently have researchers documented physiol confinement work. Most changes, e.g., coug tion, scratchy throat, or runny nose, occur ir irritated eyes, headache, and a flu-like syndr short for "toxic organic dust syndrome") alsc dusts and gases.

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Appendix A: An Example of A Patient Education Handout Human Health and Confinement

Spend a few moments thinking about how you feel after you have been working in your swine confinement building for a few hours. Have you ever noticed that you cough or spit more? That your nose runs or your eyes burn? Have you ever felt achy, like you had a mild case of the flu?

For many years, farmers have realized that the concentrated dusts and gases in confinement buildings affected their bodies. However, only recently have researchers documented physiological changes resulting from confinement work. Most changes, e.g., cough, increased sputum production, scratchy throat, or runny nose, occur in the respiratory system. But irritated eyes, headache, and a flu-like syndrome (called TODS, which is short for "toxic organic dust syndrome") also are caused by confinement dusts and gases.

Three points are particularly important. First, a confinement worker who smokes will probably experience more of these symptoms, and will experience them more severely and more persistently than a worker who does not smoke.

Secondly, these symptoms are greatest among persons who have worked over five years in confinement operations, among persons in operations with the largest number of hogs, and among persons who previously suffered from respiratory problems, heart trouble, or allergies.

Thirdly, *anyone* who enters confinement units can experience health problems as a result. This includes your family members who may work only a few hours a week in the units, and children who may play or watch while parents work. In fact, some people have experienced minor problems (chest tightness, coughing, running eyes and nose) a half hour after entering a confinement unit for the first time. Some veterinarians have been forced to give up practicing in confinement units for health reasons, even though they entered the units only sporadically.

When should you see your doctor?

As a general guide, see your physician if you are experiencing one or more of these symptoms:

Persistent cough, especially if it is accompanied by coughing up lots of phlegm or a feeling of tightness in the chest.

Wheezing which develops while working in the units.

Episodes of a flu-like illness, with fever, muscle aches, cough, and chest tightness that develop several hours after working in these units.

Excessive and persistent shortness of breath.

Excessive fatigue or intolerance to exercise.

Any respiratory symptoms following a known exposure to high levels of gas associated with manure pit agitation.

When you go to your doctor, be sure to point out that you are a confinement worker, tell how much time you spend in a confinement unit, and tell how many years you have done this.

In addition to seeing your physician for specific problems, we recommend that anyone who works in a confinement building have a yearly physical exam. This exam enables your physician to establish your respiratory condition, and then to compare your condition to that of earlier years in order to determine whether any change has occurred. The earlier such change is identified, the better your chances at reversing any deterioration of your lungs.

To assess your health status, your physician may want to use the following procedures:

An occupational history: This involves questions about your present and past work, both on and off of the farm.

Spirometry: This is a simple breathing test, which assesses your ability to breathe and your lung volume. We recommend that con-

finement workers have this done ann
accurate results if spirometry is done in
the confinement unit and then compa
after you leave the confinement unit.

Chest x-ray: This usually is necessar
only if the patient has symptoms of re

Skin tests, blood tests: These can ass
specific dusts associated with swine co
identify specific infectious diseases ass
Blood tests give the most sensitive res
is compared to blood drawn soon
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Ask your physician which of these te
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Remember that the best way to treat
your work is to prevent them. Preventio
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and gases, and that you wear a respirato
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For additional information about the s
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tional information about the Agricultural
Series, which addresses more general ag
the American Lung Association of Iowa,
West Des Moines, Iowa 50265.

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finement workers have this done annually. This test gives the most accurate results if spirometry is done in the morning before you enter the confinement unit and then compared with readings taken soon after you leave the confinement unit.

Chest x-ray: This usually is necessary at the initial exam, and later only if the patient has symptoms of respiratory illness.

Skin tests, blood tests: These can assess whether you are allergic to specific dusts associated with swine confinement; blood tests also can identify specific infectious diseases associated with agricultural work. Blood tests give the most sensitive results when early morning blood is compared to blood drawn soon after leaving the confinement building at the end of the work day.

Ask your physician which of these tests would be most useful in assessing your respiratory status.

Remember that the best way to treat health problems resulting from your work is to prevent them. Prevention means that you modify your work environment to decrease the concentrations of the harmful dusts and gases, and that you wear a respirator to prevent inhalation of these substances.

For additional information about the swine confinement project's educational units, contact Cornelia Mutel, Institute of Agricultural Medicine and Occupational Health, University of Iowa, Iowa City 52242. For additional information about the Agricultural Respiratory Hazard Education Series, which addresses more general agricultural health issues, contact the American Lung Association of Iowa, 1025 Ashworth Road, Suite 410, West Des Moines, Iowa 50265.