AN EXPLORATORY EDUCATIONAL NEEDS ASSESSMENT OF E. COLI 0157:H7 KNOWLEDGE HELD BY PETTING ZOO PARTICIPANTS

Abstract

Participants at a regional fair petting zoo were randomly solicited to answer questions to determine their knowledge level about the dangers of E. coli 0157:H7. The instrument contained questions in four construct areas: general knowledge, transmission, prevention and implications. Demographic information was also collected from the 382 respondents. Statistical analysis of this descriptive/correlational research project indicated that, while 73% of the participants were aware that hand washing was recommended for prevention of illness, participants provided correct responses at a much lower rate in the areas of general knowledge of E. coli, implications of contracting and transmission of the bacteria. Correlational analysis indicated that several low correlations existed between demographic variables and individual items as well as construct areas. Previous participation in FFA or 4-H was positively correlated to construct areas 2 and 3. This participation also had a low positive correlation with the overall score on the instrument indicating that involvement in one of these youth agricultural leadership organizations was related to a higher level of knowledge about the dangers of E. coli 0157:H7. Researchers plan to replicate this study on a national level as an educational needs assessment of materials for distribution to managers and promoters of petting zoos. These materials can include signage, brochures, pen layout diagrams as well as other beneficial documentation. Recommendations for petting zoo participant safety are included.

Introduction

The American family tradition of attending the local petting zoo has been threatened by frightening headlines about the dangers of contracting illnesses such as *Escherichia coli* (*E. coli*) 0157:H7 at the local fair. Infectious disease outbreaks reported during the previous decade have been attributed to various organisms, including *E. coli* 0157:H7. Such incidents have substantial medical, public health, legal, and economical effects (CDC, 2005).

E. coli 0157:H7 causes 73,500 illnesses in the United States annually, 2000 hospitalizations, and 60 deaths (Mead et al., 1999). *E. coli* 0157:H7 is a pathogenic strain of *E. coli* that causes serious illness including: hemorrhagic colitis, hemolytic uremic syndrome, and even death (Kaper, 1994).

In September of 2006, a large outbreak of illness related to ingesting *E. coli* 0157:H7 contaminated spinach leaves grabbed national headlines from California to New Jersey. Spinach was pulled from grocery shelves nationwide as consumer awareness about the safety of raw vegetables increased. It should be noted, however, that recent outbreaks of *E. coli* 0157:H7 are not limited to spinach or ground beef but have been attributed to the

all of the following causes: eating raw or undercooked meat, consumption of contaminated fruits or vegetables, unpasteurized milk and juice, swimming in or drinking contaminated water, and by direct contact with animal feces (Bowman & Lindstrom, 2005). Direct animal contact, or contact with animal feces is the newest recognized route of transmission. In 1996, visiting a farm with cows was identified as an important risk factor in contracting *E. coli* 0157:H7 (Kassenberg et al., 1998).

In 2000, outbreaks of *E. coli* 0157:H7 infections in school children in Pennsylvania and Washington resulted in 56 illnesses and 19 hospitalizations. These illnesses and hospitalizations were directly associated with school and family visits where children came in direct contact with farm animals (CDC, 2001).

More recently, reports of attendees contracting *E. coli* 0157:H7 from petting zoos in Florida and North Carolina prompted officials at the State Fair of Texas to discontinue their petting zoo because of rising insurance premiums associated with the liability of this long-time fair attraction (Menzer, 2005). The 2005 South Plains Fair in Lubbock, Texas, took similar precautionary action by prohibiting the sale of livestock feed to fair-goers entering the 4-H petting zoo.

The Texas Tech University Departments of Agriculture Education and Communications and Animal and Food Sciences, the Texas Tech University College of Human Sciences, and the International Center for Food Industry Excellence (ICFIE) joined forces in a multi-phased, inter-disciplinary project to assess the knowledge and public perceptions of fair-goers at the 2005 South Plains Fair. This research was conducted to gain insight into public perceptions and knowledge related to *E. coli* issues at petting zoos.

The objectives of this research study were to:

1) Describe the demographics of individuals who participate in a regional fair petting zoo.
2) Determine participant knowledge of *E. coli* issues at a regional fair petting zoo in the construct areas of: general knowledge, transmission, prevention and implications.
3) Explore relationships between participant knowledge about *E. coli* and pertinent demographic variables.

Theoretical Framework

Witkin and Altschuld (1995) proposed the three-phase plan for needs assessment that was used to guide the planning, data collection and recommendations for this research. In phase 1, (Figure 1) the researchers conducted a preassessment of the research topic by synthesizing data collected from peer-review publications and the popular press. The major issue of the preassessment was determined to be a lack of knowledge about the perceptions and information held by the general population who attended petting zoos in regards to safety from *E. coli* 0157:H7. Researchers determined that data collection could take place at a local petting zoo produced by the cooperative extension at a regional fair.

Figure 1
Three-Phase Plan for Needs Assessment (Witkin & Altschuld, 1995)

PHASE 1 **Preassessment** (explore)	**PHASE 2** **Assessment** (data gathering)	**PHASE 3** **Post-assessment** (utilization)
Set-up management plans for needs assessment (NA). Define general purpose of the NA.	Determine context, scope and boundaries of the NA. Gather data on needs.	Set priorities on needs at all applicable levels. Consider alternative solutions.
Identify major need area and/or issues. Identify existing information regarding need areas.	Set preliminary priorities on needs – Level 1 Perform casual analysis at Levels 1, 2 and 3.	Develop action plan to implement solutions. Evaluate the NA.
Determine: • Data to collect • Sources • Methods • Potential uses of data	Analyze and synthesize all data.	Communicate results.
Outcomes Preliminary plan for Phases 2 and 3, and plan for evaluation of the NA	**Outcomes** Criteria for action based on high-priority needs.	**Outcomes** Action plan(s), written and oral briefings, and reports.

During phase 2, the researchers determined the scope and context of the needs assessment to be limited to participants of the regional petting zoo and not inferable to other populations. The researchers also determined that this study, while small in context, would lead to refined methods and instrumentation for a national study of the same topic. This project was conducted in order to develop preliminary data for inclusion in a USDA grant application for conducting this study on a national level. In addition to determining context and scope of the project, the researchers developed the objectives, created and pilot tested the instrumentation, collected the data, and analyzed the results using correlations, ANOVA and descriptive statistics.

According to Witkin and Altschuld (1995), the purpose of phase three of the needs assessment model to "bridge the use of the data and plans for action" (p. 14). The researchers used the data collected during this project to set the priorities of educational needs as well as develop action plans for future research and suggestions for petting zoo coordinators to help protect the public health. These recommendations are discussed in detail in the "recommendations" section of this paper.

Using the three-phase model for needs assessment, the researchers determined educational need areas, collected and analyzed data and made recommendations for improvement of programming delivered to the public. This topic is of special importance to extension educators who work with 4-H or FFA chapters who regularly provide petting zoos for local or regional events.

Methodology

This descriptive/correlational research was designed to measure participant knowledge about the dangers of *E. coli* 0157:H7 in the context of the traditional petting zoo. The participants of this study included a purposive selection of visitors at the 2005 South Plains Fair Petting Zoo in Lubbock, Texas. Instrument administrators positioned themselves at the two entrances of the facility and solicited possible respondents as they entered the building. Participants in the study were given a small battery-powered fan as an incentive to complete the study. All adults and children over the age of 8 were encouraged to participate. Bilingual facilitators assisted participants who were Spanish speaking only by verbally translating the instrument and recording the results. In the same manner, facilitators were required to verbally administer the questionnaire to a small number of participants who were illiterate.

The cooperative extension office, who sponsored the petting zoo, estimated that 75,000 visitors attended the petting zoo during the 10 days it was open at the same fair in the previous year. Based on this estimate, the researchers selected a sample size of 382 (Krejcie & Morgan, 1970). Researchers randomly selected days and two-hour blocks to collect data and followed that schedule until the sample size of 382 respondents was reached. The data collection was completed in six hours over three days.

The instrument was a researcher – developed, multiple-choice exam with questions divided into four constructs. This exam was created in cooperation with the university's food science department. The faculty in food science provided the construct areas of knowledge as well as the individual items within each construct area. This process was conducted in order to ensure construct validity of the instrument.

Constructs for the instrument were as follows:

- General knowledge of *E. coli*
- Knowledge of *E. coli* prevention
- Knowledge of the implications of *E. coli*
- Knowledge of *E. coli* transmission

In addition to the knowledge questions, a section was included for the respondents to provide demographic data such as age, place of residence and whether they owned pets or livestock. Reliability analysis was conducted using a local 4-H meeting as a pilot test group. This group of 38 individuals included children and adults from both rural and urban backgrounds. SPSS 13 was used to calculate a KR-20 coefficient for the multiple choice questions which were coded either correct (1) or incorrect (0). The resulting coefficient was .67. While the reliability coefficient is not in the .8 range that is typically

acceptable, Nunnally (1967) suggests that .5 could be considered adequate in the early stages of a research line or with new instrument development. Demographic data were also coded and included in the data set. The analysis for this study used descriptive tools, correlations and ANOVA to explain results of the data collection.

Results and Discussion

Demographics.
Three hundred, eighty-two petting zoo participants completed the questionnaire. The descriptive statistics of these subjects are detailed in Table 1.

Table 1
Petting zoo participants' descriptive statistics.

Variable	Frequency	Percentage
Gender		
Female	243	63.6
Male	130	34.0
Missing	9	2.4
Total	382	100.0
Place of Residence		
Urban	253	66.2
Rural	123	32.2
Missing	6	1.6
Total	382	100.0
Pet Owners		
Yes	297	77.7
No	73	19.1
Missing	12	3.2
Total	382	100.0
Current or Former FFA/4-H members		
Yes	76	19.9
No	251	65.7
Missing	55	14.4
Total	382	100.0

The respondents in the sample were 63.6% (n=243) female, with 66.2% (n=253) living in an urban community, operationally defined as a population greater than 10,000. Nearly 78% (n=297) of the respondents currently owned pets. Nearly 20% (n=76) were current or former members of FFA or 4-H organizations. The average age of the participants was 33.2 with a range of 8 to 83. The standard deviation of the age was 13.5. The data collected on participant age was categorically reduced to "children" and "adults" with any respondent 18 years or younger being categorized as "child" (n=53) and individuals 19 and over categorized as "adult" (n=325).

The questionnaire solicited participant responses in four construct areas related to *E. coli* 0157:H7 safety at petting zoos. These construct areas were: 1) general knowledge about the dangers of *E. coli*, 2) tactics that participants could employ to prevent themselves and their families from becoming infected with *E. coli*, 3) implications to a person's health from contracting *E. coli*, and 4) how *E. coli* is transmitted from the environment to people. The multiple choice questions in each construct area were score either right (1) or wrong (0) and entered into the database. Results are seen in Table 2.

Table 2.
Percentage of correct answers for constructs 1-4.

Construct	Responses	Correct	Incorrect	Total
1. General knowledge	382	37.3%	62.7%	100%
2. Prevention	382	73.5%	26.5%	100%
3. Implications	382	46.0%	54.0%	100%
4. Transmission	382	28.8%	71.2%	100%

Participants were most knowledgeable about how to prevent sickness from *E. coli* (construct two, 73.5% correct) in response to questions regarding hand washing, the use of sanitizers and avoiding direct contact with animal manure. They were least knowledgeable about how *E. coli* is transmitted (construct four, 28.8% correct) from animals to objects in the environment, and to humans. Construct three included questions about how to recognize early symptoms of illness for facilitating appropriate medical attention. Participants correctly answered 46 % of the questions in construct three. Construct one asked participants about their general understanding of what *E. coli* is and why they should be concerned when attending petting zoos. The respondents correctly answered 37.3 % of the questions in construct one.

Correlations

Demographic variables were correlated to each construct area score as well as the total score on the instrument. Significant correlations were identified using the Davis (1971) naming convention. Results from this correlational analysis are presented in Table 3.

Table 3.
Correlations between demographic factors and knowledge of construct areas of *E. coli* 0157:H7.

Construct	Gender	Age	FFA/4-H members	Pet Ownership
1. General knowledge	.035	.009	.081	-.004
2. Prevention	-.038	.061	.145*	.089
3. Implications	-.013	.130*	.169**	.017
4. Transmission	-.027	.108*	.067	.025
Total Score	-.019	.142**	.209**	.058

* significant at .05
** significant at .001

The demographic variables of gender and pet ownership resulted in no significant correlations to the construct variables or the total score; however, age and FFA/4-H membership yielded six significant relationships. The correlation between age of respondent and implications, transmission and total score resulted in low, positive (Davis, 1971) relationships, indicating that, generally, older participants scored higher in those areas than younger participants. FFA/4-H membership also produced low, positive correlations with prevention, implications and total score.

Because age had a positive correlation with two construct areas and total score, the researchers determined the need to categorize the interval data into "child" and "adult" for the purpose of the needs assessment. A new variable was created in the database with a "1" representing respondents who reported their age at 19 or greater. A "0" was entered in this column if the respondent indicated their age to be 18 or less. Four individuals declined to reveal their age. A one-way ANOVA was conducted to determine if the mean scores of the two groups differed on any of the construct areas or on the total instrument score. Results of the ANOVA analysis can be seen in Table 4.

Table 4.
Differences in mean scores of adults and children of the four construct areas and total instrument score. (N=382)

	Source	SS	df	MS	F	p	Cohen's d
Construct 1	Between	.03	1	.031	.07	.788	.04
	Within	158.59	376	.422			
	Total	158.62	377				
Construct 2	Between	1.39	1	1.39	3.46	.063	.28
	Within	150.79	376	.40			
	Total	152.18	377				
Construct 3	Between	2.62	1	2.62	5.73	.017	.36
	Within	172.15	376	.45			
	Total	174.77	377				
Construct 4	Between	2.51	1	2.51	6.87	.009	.39
	Within	137.60	376	.36			
	Total	140.11	377				
Total Score	Between	17.72	1	17.72	9.18	.003	.45
	Within	725.66	376	1.93			
	Total	743.38	377				

Note. construct 1 = general knowledge, construct 2 = prevention, construct 3 = implications, construct 4 = transmission

The ANOVA indicates that there are significant differences in mean scores between children and adults in Constructs 3 and 4 as well as the total instruments score. Effect sizes (as calculated using Cohen's d) were small for Constructs 3 and 4 and medium for the total score (Thalheimer & Cook, 2002). These results indicate that adults significantly outscored children in the construct areas of Implications, Transmission and overall knowledge of the dangers of *E. coli* 0157:H7.

Conclusion and Implications

The researchers used Witkin and Altschuld's (1995), three-phase model of needs assessment to guide this exploratory research study. Phase one involved the creation of the following research objectives:

1) Describe the demographics of individuals who participate in a regional fair petting zoo.
2) Determine participant knowledge of *E. coli* issues at a regional fair petting zoo in the construct areas of: general knowledge, transmission, prevention and implications.
3) Explore relationships between participant knowledge about *E. coli* and pertinent demographic variables.

Phase two consisted of instrument creation, data collection and analysis which resulted in the following conclusions and recommendations for phase three. Recommendations take the form of future research but also practical educational techniques that can be used by fair managers to help prevent the spread of *E. coli* 0157:H7 at petting zoos.

Recent outbreaks of *E. coli* 1057:H7 at public venues, such as fair petting zoos, have increased the need for administrators of such events to provide appropriate educational information to the petting zoo attendees. Legal liability issues add to the concerns of fair organizers who wish to reduce risk of illness for its patrons. In order to maintain the educational opportunity that these events provide, it is important to reduce the risk involved for those who chose to participate. That can be done through direct educational efforts during the event itself. While most petting zoo attendees were aware that they should wash or sanitize their hands, scores for the remaining construct areas were below 50 percent. Organizations that promote and host petting zoos should take an active role in educating their patrons in all four areas but should focus added attention to adolescents.

While it was not an original objective of this research to compare children and adults, it became obvious to the researchers that there were differences in knowledge levels from the respondents. This is perhaps the most important finding of this study. Phase 3 of the needs assessment model indicates that priorities should be set. Priorities determined through the implementation of this research project would include focusing the educational material at a higher level toward participants less than 19 years of age. The significant decline in scores by adolescents would indicate less exposure to educational sources such as formal education and media that would assist older individuals in making correct choices. The positive correlation between construct scores and FFA/4-H membership would suggest that these organizations have an impact on educating young people about this issue. The researchers suggest more in-depth analysis with future research to determine exact sources of this information.

Future plans for this research include making improvements to the instrument in order to increase the reliability coefficient to ensure that questions in each construct area are

consistently producing valid responses. The researchers intend to use this improved instrument to replicate this study on a national scale to further identify specific educational needs of petting zoo attendees. Once those detailed needs are identified, educational materials will be developed and disseminated via the Internet to administrators for use during their event. These materials will include posters, brochures, signage, traffic flow recommendations and other materials. These educational items will be provided on a website free of charge and advertised to extension personnel, FFA advisors, fair administrators and other parties who participate in creating and managing their own local petting zoos.

Recommendations for Improvement of Practice

Although the United Kingdom and a few states have recommendations for petting zoo exhibitors and other animal exhibition venues, there are no federal laws in the United States that address the risks involved with the transmission of pathogens at events where the public has direct contact with animals (CDC, 2005). However, in 2001 the Center for Disease Control and Prevention issued a set of guidelines. Due to the lack of petting zoo safety knowledge, this section briefly highlights their established recommendations.

The first recommendation by the Center for Disease Control (2005) pertains to education. It is recommended that the operators of petting zoos are familiar themselves with the basic risks associated with animal contact. The staff should also be trained and familiarized before working at the petting zoo to reduce the risk of injury or disease associated with animals. Finally, petting zoo operators should provide educational materials to the visitors at the entrance to animal contact areas (CDC, 2005).

Once attendees have entered the petting zoo, the Center for Disease Control (2005) recommend s the following regarding the control of direct animal contact. Food or beverages should be disallowed from the animal area. Containers should be positioned at the entrance with signs asking participants to dispose of food or drink before they enter the facilities. Manure and soiled bedding should be removed promptly by the petting zoo staff. It should be disposed of properly and implements and containers that handle animal waste should be stored out of reach of the petting zoo participants.

Hand washing facilities should be easily accessible and visible at all exits along with signs directing participants to thoroughly wash their hands. In the event that hand washing is not possible, hand sanitizer should be provided. Children should be closely supervised to prevent hand-to-mouth activities and the petting zoo staff should be present in all areas where animal contact is permitted. Finally, animals should be fed only feed provided by the petting zoo and all pens should be cleaned and disinfected following the event.

Safety of petting zoo participants is of concern because of the negative backlash toward agriculture when an outbreak occurs. Those less familiar with livestock handling procedures are also less knowledgeable about *E. coli* 0157:H7, what it is, how to recognize symptoms and prevent illness. This needs assessment has outlined several

constructs for providing educational programs as well as brought into focus the target audience of the educational materials. Expanding the scope of this study is necessary in order to infer these findings to a national audience and the researchers recommend this line of study be continued in a timely manner.

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