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Assessment of Bio-Security Risks Associated with 4-H Animal Science Exhibition Practices in California

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Abstract: *Bio-security related to animal agriculture is a high priority issue, and recent incidents demonstrate the potential for disease transmission and proliferation involving animals exhibited at public venues. Data collected at the California State Fair and eight county fairs in the north central region of California were used to assess existing bio-security risks associated with 4-H project animals. Outcomes revealed disease transmission risks associated with exhibition practices including housing and visitor contact and highlight the need to develop and provide relevant education resources to 4-H youth, volunteers, and staff.*

Introduction

National and state agencies and institutions have identified bio-security related to animal agriculture as a matter of high priority. The United States Department of Agriculture has a long-term goal of safeguarding the animal production industry from intentional or accidental outbreaks of animal disease (Animal and Plant Health Inspection Service, 1998, 2010); disease control and surveillance and food systems security are high priority issues of the University of California (UC), School of Veterinary Medicine's Center for Food Animal Health (Center for Food Animal Health, 2008); and the UC Division of Agriculture and Natural Resources (ANR) has identified food safety and security as a key component of the Division's Strategic Vision 2025 (Regents of the University of California, 2009).

Analysis of past events, as well as hypothetical research modeling provide compelling evidence of the large-scale economic impacts a widespread disease outbreak would have on the U.S. animal agricultural industry (Paarlberg, Seitzinger, Lee, & Mathews, 2008; Pedersen et al., 2004). Most commercial farms practice strict bio-security measures intended to mitigate the risk of on-farm animal diseases. However, commercial agriculture does not operate in isolation from other animal enterprises such as hobbyists and small farmers, as evidenced by the 2002-2003 Exotic New Castle disease outbreak that originated in backyard poultry flocks and spread to commercial farms housing approximately 1.2 million birds (Nolen, 2003). Because backyard farms can serve as sources and vectors of pathogens (Food and Agriculture Organization of the United Nations, 1999; World Health Organization, 2006), it is critical that efforts to prevent or control the introduction or reintroduction of economically important animal diseases address individuals who raise animals in these settings.

Many 4-H Animal Science project animals are kept as part of backyard farms. Data collected during a survey study of California 4-H youth participants revealed that 66% of project animals are housed in "backyard herds" with an average group size of 8.6 animals of same or mixed species (Smith, 2009). These same respondents indicated that they traveled with their project animal to an average of two project meetings where mixing with other animals occurred (Smith, 2009). In addition, youth reported travelling to an average of 2.5 fairs, shows and exhibitions within and beyond their home counties (Smith, 2009).

Disease outbreaks involving animals exhibited at public venues illustrate some of the practices and concerns associated with the risk of disease incursion. In one recent incident, dairy and beef cattle were housed in direct contact with lambs at the Puyallup Fair in Washington State. Of the 133 cattle housed in one barn, 24 contracted malignant catarrhal fever and died. The source of the virus was infected lambs owned by youth exhibitors, and the affected cattle were owned by youth, small producers, and a commercial dairyman (Moore et al., *in press*). Additionally, occurrences of enteric disease outbreaks caused by pathogens such as *E. coli* and *Campylobacter* among visitors to public venues where contact with animals is permitted (e.g., fairs, exhibitions, petting zoos) have been on the rise over the last 10 years, accounting for 55 outbreaks and 1,175 cases from 1996-2005 (Steinmuller, Demma, Bender, Eidson, & Angulo, 2006). Investigators have also determined that poultry handling practices at county exhibitions may be a risk factor for animal-to-human transmission of Avian Influenza (Olson & Gray, 2006).

A disruption in production of animal agriculture and its associated products could have a profound negative impact on the California economy and the health of its population (Regents of the University of California, 2005), and it is imperative that issues relative to bio-security in 4-H Animal Science projects be addressed. Thus, researchers from the UC School of Veterinary Medicine, Veterinary Medicine Extension assessed existing disease transmission risks associated with 4-H project animals at the California State Fair and eight county fairs in the north central region of California. The overarching goal of the research was to gain an understanding of these risks for the purpose of developing and providing relevant education resources and programming for 4-H youth, volunteers, and staff.

Methods

Observational data of animal barns, wash racks, judging arenas, and visitor interactions were collected by three research staff at nine fairs in the north central region of California.

Data Collection Procedures

Animal Barns

General observations were conducted in all animal barns that were visited. Observers noted and recorded the number and location of hand- and foot-washing stations, the presence or absence of hand-washing instructions, general physical attributes of the location, and the animal population of the barn (number of pens, number of animals per pen, and organization/individuals represented by the animals present).

Visitors were also observed as they entered, moved through, and exited the animal barns. Observers randomly selected 10 visitors per animal barn. The observers recorded whether or not the visitors washed or sanitized their hands upon entering the barn, the number of contacts with animals the visitor made while in the barn, and whether or not the visitor washed or sanitized their hands before exiting the barn.

Animal Pens

Observers selected 12 pens from each barn for detailed observations. Each pen observation included the recording of the number and species of animals present in the pen and an assessment of several specific risk factors related to bio-security. Scoring of risk factors was completed using a numerical system of 1-3 (lowest risk to highest risk) (Table 1).

Table 1.
Risk Assessment Guidelines for Pen Observations

	Bedding	Tools	Food	Water	Vectors/Vermin
Low Risk 1	Clean & Dry	Clean and not	Clean & fresh	Clean water/contained (ex. Lixit)	No visible signs of insects or rodents

		shared			
Medium Risk 2	Soiled / Damp	Clean and shared or dirty and not shared	Food is in contact with bedding or ground	Clean water/standing/not contained (ex. open trough)	Some visible signs of insects or rodents
High Risk 3	Foul / Wet	Dirty and shared	Food is moldy, soiled or in contact with fecal material	Contaminated with bedding, dirt, fecal material etc.	Many visible signs of insects or rodents.

Wash Racks

Observers visited wash racks and recorded the number of youth and animals present over the course of a 10-minute period. In addition, they made an assessment of bio-security risks associated with standing water and animal waste using a numerical system of 1-3 (lowest risk to highest risk) (Table 2).

Table 2.
Risk Assessment Guidelines for Wash Rack Observations

	Standing Water/Animal Waste (scored separately)
Low Risk 1	None present or no contact observed
Medium Risk 2	Some present and/or minimal contact observed
High Risk 3	Significant amount present and/or significant contact observed

Judging Arena

Observers visited judging arenas during shows and recorded information on human-animal contacts, sanitization practices, and bio-security risks associated with standing water and animal waste using the tool in Table 2.

All data collection tools were pilot-tested, and inter-rater reliability was calculated at 85%.

Data Analysis

Data from all nine fairs were combined for analyses. All-occurrence data were recorded as counts and reported either as counts, means, or as percentages. Risk assessment data were reported as means.

Results

Animal Barns

Observations were made in a total of 19 animal barns among the nine fairs visited. Each barn held an average of 62 pens. Animals from an average of 10 different organizations (e.g., 4-H, FFA, Grange, commercial producers) and four counties were represented in each barn. Animal species in the barns observed included beef and dairy cattle, meat and dairy goats, sheep, and swine.

Of the 19 barns observed, 18 were equipped with hand-washing stations. Fifty percent of these stations were classified as easy to locate by observers, and 50% were classified as somewhat difficult to locate. Instructions for proper hand-washing technique were posted in 53% of the barns. No disinfecting foot mats were provided in any of the barns observed.

Visitor Interactions

Visitor interactions with animals were observed in all 19 animal barns. Of the 190 visitors observed entering the barns, only seven (4%) used a hand-washing station before proceeding to the animal area. Fifty-four percent of visitors made direct contact with at least one animal during their visit. Of the visitors who made direct contact with animals, 70% made consecutive direct contacts with different animals without intervening hand sanitizing. Additionally, only 5.6% of the visitors observed sanitized their hands before leaving the barn area.

Animal Pens

Observations were made at 228 pens. Twenty-five percent of the pens held a single animal. Of the pens that held multiple animals, the range in group size was from two to nine, with an average of three animals per group. Ninety-four percent of these groups were single-species, and 6% were mixed-species.

Bio-Security risks in each pen were scored on a scale of 1-3 (lowest risk to highest risk). Results are presented in Table 3.

Table 3.
Risk Assessment Results for Pen Observations

Bio-Security Risk Category	Mean Score
Water	1.96
Vectors or Vermin	1.54
Tools	1.93
Bedding	1.47
Food	1.33

Wash Racks

One hundred and thirty-eight 10-minute observations were made at wash racks. The number of animals present at the wash racks during the observations ranged from zero to four, and during 65% of the observations only one animal was present. Bio-Security risks associated with standing water and animal waste were scored on a scale of 1-3 (lowest risk to highest risk). Results are presented in Table 4.

Table 4.
Risk Assessment Results for Wash Rack Observations

Bio-Security Risk Category	Mean Score
Standing Water	2.47
Animal Waste	2.25

Judging Arenas

Fifty-three 10-minute observations were made of 26 judging arenas. Observers collected data at Market, Breeding, Showmanship, and Performance shows for cattle, sheep, goats, dairy, and swine. Bio-Security risks associated with standing water and animal waste were scored on a scale of 1-3 (lowest risk to highest risk). Results are presented in Table 5.

Table 5.
Risk Assessment Results for Judging Arena Observations

Bio-Security Risk Category	Mean Score
Standing Water	1.00
Animal Waste	1.26

Additionally, 81% of all arenas had bedding covering the floors, and in every case where consecutive observations were made of the same judging arena (n=16 arenas) observers noted that multiple groups of animals used the same judging arena without intervening sanitation or bedding change. Furthermore, during 90% of the shows, judges contacted the mouths, hooves ,and/or coats of multiple animals consecutively. In none of these cases was intervening hand sanitization observed.

Discussion

Research outcomes from the study reported here indicated numerous disease transmission risks associated with 4-H project animals at California fairs where data were collected. Risks identified included: stall and equipment sanitation; availability and use of hand- and foot-sanitizing stations for fair visitors; multiple contacts between fair visitors and animals; sanitation at wash rack areas and in judging arenas; and practices used by show judges. Some of the risks identified in this investigation could be categorized as owner/exhibitor responsibility (e.g., water quality; food quality; stall and equipment cleanliness); several other risks fell more within the purview of the fairs (e.g., presence and/or location of hand sanitizing stations; absence of disinfecting foot mats; judging practices); and a few risks could be classified as joint responsibility (e.g., wash rack cleanliness; presence of vectors and vermin). Thus, it is essential that coordinated educational strategies involving multiple stakeholders be developed and implemented.

One example of bio-security education program development and implementation that included diverse stakeholders occurred in California as a response to the outbreak of Exotic Newcastle Disease in 2002/2003. Bio-security education programs designed for clientele who raise and show poultry and game fowl were developed through collaboration between the University of California Cooperative Extension and the California Department of Food and Agriculture and implemented statewide (Bradley, 2007). These programs have been effective in changing policy in that every county and district fair, as well as the state fair in California now requires that poultry and game fowl undergo a mandatory health check performed by a trained Poultry Health Inspector prior to entry (Bradley, 2007).

With respect to other market animal species, no systematic professional development or educational opportunities on bio-security to inform California 4-H staff, volunteers, and youth of risks and preventative measures, and no standardized bio-security guidelines or protocols exist currently (Animals in Education Settings Workgroup, 2004). In response to this, educational materials that focus on issues of bio-security and traceability have been developed. Specifically, researchers from the University of California, School of Veterinary Medicine, Veterinary Medicine Extension, in collaboration with campus and county-based Cooperative Extension colleagues, developed and tested the *Bio-Security in 4-H Animal Science* curriculum (Smith et al., 2011). The curriculum includes hands-on, inquiry-based activities, as well as risk assessment tools for youth to use at their home settings and at fairs and exhibitions. Furthermore, data have been collected from multiple stakeholders—4-H youth and volunteers, fair administrators, veterinarians, and producers—or the purpose of designing comprehensive, systematic educational programming to address bio-security and traceability issues as they relate to 4-H project animals at fairs, shows, and exhibitions (Smith & Meehan, 2010). To this end, a Bio-

Security Proficiencies Project that encompasses animal health, disease transmission, and risk analysis and mitigation in authentic settings has been developed and pilot tested (Smith & Meehan, 2011).

Conclusion

Learning about bio-security risks and disease prevention is critical for 4-H members (Rusk, Egger, Machtmes, & Richert, 2002). The lack of knowledge about bio-security contributes to poor practice (Gillespie, 2000; Sanderson et al., 2000; O'Bryen & Lee, 2003); however, when systematic bio-security education programs are provided, youth can develop the necessary observational, problem-solving, and decision-making skills necessary to reduce risks and respond to such threats, help deepen their appreciation for their roles and responsibilities as animal caregivers, and broaden their understanding of the connections between the industry of animal agriculture and society. Furthermore, bio-security education efforts can also be extended to fair operators and visitors. According to Duffy (2008), improved education of venue operators, exhibition staff, and the general public about disease transmission and preventative measures, particularly preventative hand washing, is essential.

The findings of the study reported here identify several key areas where efforts can be directed to improve site operations and the knowledge and skills of staff and fair participants relative to disease transmission risk identification and mitigation. Ultimately, effective education that results in improved practice by addressing the prevention, early detection, and rapid response to a disease incursion will help ensure human, animal, and environmental health, and agricultural and economic stability (Meyerson & Reaser, 2003).

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