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Zoonotic disease awareness survey of backyard poultry and swine owners in southcentral Pennsylvania

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Abstract

Owners of small backyard poultry and swine operations may be at higher risk of zoonotic diseases due to husbandry inexperience and/or a lack of knowledge. Backyard poultry and swine owners in southcentral Pennsylvania were surveyed regarding their knowledge and attitudes towards zoonotic disease prevention. One hundred and six backyard poultry and/or swine owners completed the survey (74 poultry, 15 swine, 17 both), which included questions on demographics, flock/herd characteristics, recognition of selected zoonotic diseases and clinical signs in animals, and biosecurity practices for visitors and owners. Most responded that they were aware of avian (92.2%) and swine (84.4%) influenza, and were less aware of other zoonotic diseases such as salmonellosis and brucellosis. The majority of backyard poultry and swine owners combined (62.9%) reported allowing visitors freely around their animals and did not require any special precautions. Backyard poultry and swine owners most commonly reported rarely (32.7%) or never (28.9%) wearing work gloves and never (57.1%) wearing nose/mouth coverings, such as a respirator mask, while handling animals or manure. The study findings indicated that veterinarians (61.5%) and the Internet (50.0%) are the main sources where small-scale farm producers seek animal disease information. Approximately one-third (34.9%) of the respondents reported receiving seasonal influenza vaccine. The findings of this study will be utilized to provide targeted veterinary and public health education for the prevention of zoonotic diseases in backyard farm animal settings in Pennsylvania.

Keywords

backyard; education; poultry; public health; swine; zoonotic diseases

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CONFLICTS OF INTEREST

None.

1 | INTRODUCTION

The self-sufficient and sustainable raising of food animals is a growing and popular agricultural trend in the United States. In particular, families are raising farm animals in their backyards in increasing numbers for three main reasons including: (a) the need to be “in control” of where their food comes from, (b) the desire to educate children about food agriculture, and (c) as pets for fun (Bailey & Larson, 2013; USDA, 2005). Backyard poultry and small pastured swine are animal production systems that have been increasing in popularity (Bailey & Larson, 2013; Beam, Garber, Sakugawa, & Koprak, 2012; Weiss, 2018). While most backyard chickens are raised as pets and for home egg consumption (Elkhorabi, Blatchford, Pitesky, & Mench, 2014; McDonagh et al., 2018), the backyard ownership of domestic swine is mainly limited to meat production (Fournier, 2017).

Inexperience in animal husbandry and the lack of general knowledge of livestock diseases, especially those of public health concern, can place backyard raised animals at a higher risk for acquiring zoonotic diseases (Behraves, Brinson, Hopkins, & Gomez, 2014; Linares & Nixon, 2011), with the subsequent risk that humans having contact with these animals may be exposed. It is also likely that backyard poultry and swine owners may live in areas with limited access to veterinary care (Pires et al., 2019), which can lead to undiagnosed animal cases and subsequent human disease. Inadequate sanitation and biosecurity measures also have the potential to facilitate farm-to-farm spread of zoonotic diseases to humans (Bailey & Larson, 2013).

From a public and animal health perspective, it is imperative that owners of backyard farm animals are knowledgeable about zoonotic diseases and potential health risks associated with rearing these animals. This would also include a good understanding and consistent application of appropriate biosecurity measures to prevent disease occurrence and transmission among their animals, themselves, and their family members. It is also important that backyard animal owners know when and where to seek both medical and veterinary assistants, and how zoonotic disease concerns should be reported.

Understanding the knowledge, attitudes, and practices of owners of backyard poultry and swine owners is important from a public health perspective, to help guide the development of focused educational outreach programmes with the goal of reducing zoonotic disease risk among backyard farm animal owners. A review of the literature revealed that no studies have been conducted in the Commonwealth of Pennsylvania to inform on the need of public health educational interventions for small-scale farm animal owners. Therefore, a survey was developed and administered to backyard poultry and swine owners in agricultural counties in southcentral Pennsylvania to help guide and develop producer, veterinary, and human public health outreach.

2 | MATERIALS AND METHODS

2.1 | Study design and population

According to USDA National Agricultural Statistics Service (NASS) data for 2012, Lancaster County Pennsylvania had the most poultry farms of any size (1,577) of all

Pennsylvania counties (USDA NASS, 2012). York County, which is located adjacent to Lancaster County, was ranked third highest for the number of poultry farms (375) reported (USDA NASS, 2012). There was no statistical data available on the number of swine farms per county in Pennsylvania.

The U.S. Code of Federal Regulations defines commercial poultry based on the number of birds and poultry type (Office of the Federal Registrar, 2018). For the purposes of this study, poultry farms were considered “backyard operations” if they maintained fewer than the U.S. Code of Federal Regulations definitions of “commercial poultry” (i.e., table egg layers > 5,000 birds, broiler chickens > 100,000 birds, meat turkeys > 30,000 birds, waterfowl > 25,000 birds). Backyard swine were defined as pigs with outdoor access because commercial swine in the United States are raised in strict confinement indoors (Pitcher & Seraphin, personal communication, 23 March 2018; USDA, 2008).

Between 1 April and 31 August 2018, an anonymous, Web-based and paper-copy survey was made available by Pennsylvania Department of Health (PA DOH) to backyard poultry and swine owners in agricultural counties of southcentral Pennsylvania. The project was proposed and funded by the PA DOH. The PA DOH provided personnel technical support, survey hard copies and return mail cost. In addition, the PA DOH offered an electronic version of the survey on the department’s commercial Web-based survey service. Survey recruitment was advertised via multiple venues, which included Pennsylvania State University Agriculture Extension, Lancaster and York Co Poultry and Swine 4-H Clubs, PennAg Industries, local livestock and poultry auctions, and Tractor Supply Co stores, local businesses, Facebook, Craigslist, the Lancaster Farming Newspaper and door-to-door visits. Approximately 200 flyers with the Web link to the survey, and 400 paper copies were emailed, posted and/or handed out through various groups and individuals.

2.2 | Survey design

The survey was designed to obtain information about backyard poultry and swine operations in agricultural counties of southcentral Pennsylvania. Survey questions were multiple-selection, multiple-choice and open-ended responses. No personal identifiers such as names, addresses, race or ethnicity were collected. The questionnaire was administered online via SurveyMonkey (Palo Alto, CA, USA). Completed and returned paper versions of the survey were subsequently entered into SurveyMonkey. This project was determined to be public health practice by Pennsylvania and did not require full institutional review board review.

2.3 | Analytic approach

Data analysis was completed with SAS 9.4 (SAS Institute Inc., Cary, NC, USA) and SurveyMonkey. Descriptive analysis was conducted for each survey question, including percentages for each answer based on the number of responses. For questions that were split between poultry and swine, percentages were adjusted by removing the number of respondents that selected the response “not applicable” because they reported not having swine or not having poultry.

3 | RESULTS

3.1 | Demographic characteristics of respondents

One hundred and six (106) owners of backyard poultry and/or swine responded (Table 1) to the survey (77 online responses, 29 hard copy surveys). Sixty per cent ($n = 64/106$) of respondents were from Lancaster County, and 34.9% ($n = 37/106$) were from York county. The median age of the respondents was 41 years (range 14 to 73); the majority were female ($n = 59/103$, 57.3%). The majority of the respondents reported English as their primary language ($n = 98/102$, 96.1%). The highest percentage household education level was reported as a bachelor's degree ($n = 33/103$, 32.0%).

3.2 | Animal flock/herd characteristics

Of the 106 total respondents, 74 (69.8%) were poultry owners, followed by those who owned both poultry and swine ($n = 17$, 16.0%), and then 15 (14.2%) pig caretakers (Table 2). The median number of poultry per premises was 15.5, while the median number of swine per premises was three (3). According to the 90 backyard poultry owners who responded, poultry were mainly used for egg production ($n = 81/90$, 90.0%), with other reasons for use being pets ($n = 33/90$, 36.7%), meat ($n = 19/90$, 21.1%), show or exhibition ($n = 11/90$, 12.2%) and other uses such as 4-H club, selling chicks and hobby ($n = 4$, 4.4). Of the 32 respondents with backyard swine, most swine were used for meat ($n = 20/32$, 62.5%), then show or exhibition ($n = 12/32$, 37.5%), pets ($n = 8/32$, 25.0%) and other reasons ($n = 2/32$, 6.3%) such as eating excess produce and 4H club. The majority of poultry and swine were housed with mixed indoor and outdoor access ($n = 45/90$, 50.0% and $n = 18/31$, 58.1%), respectively. The main poultry sources reported were as follows: hatchery ($n = 37/88$, 42.1%), home raised ($n = 34/88$, 38.6%), neighbours/friends/family ($n = 22/88$, 25.0%) and animal sale/auction ($n = 20/88$, 22.7%). The top three reported swine sources included the following: animal sale/auction ($n = 14/32$, 43.8%), neighbour/friends/family ($n = 12/32$, 37.5%) and home raised ($n = 10/32$, 31.3%).

3.3 | Wild animal contact and control

Approximately half of the backyard poultry owners reported their poultry having contact with wild animals ($n = 44/90$, 48.9%), as compared with just over one-quarter of backyard swine owners reporting wild animal contact with their swine ($n = 9/32$ 28.1%). For poultry, rodents were the most common wild animal contact reported ($n = 22/44$, 50.0%), followed by other predator animals such as hawks, opossums, skunks, weasels, owls ($n = 20/44$, 45.5%), raccoons ($n = 15/44$, 34.1%), deer ($n = 15/44$, 34.1%) and wild ducks/geese ($n = 9/44$, 20.5%), out of 44 participants with poultry. Animal caretakers stated that they used rodent or insect control for poultry or swine areas ($n = 62/85$, 72.9% and $n = 29/31$, 93.5%), respectively (Table 2).

3.4 | Clinical signs related to seeking urgent assistance and disease recognition

Figure 1 presents clinical signs for which backyard poultry and swine owners reported they would seek immediate help for the future. The three most common resources reported where information or help was sought when their animals get sick were as follows: veterinarian (n

= 64, 61.5%), Internet ($n = 52$, 50.0%) and friends or family ($n = 41$, 39.4%), out of 104 (Figure 2). Most respondents stated that they never submitted a dead animal to the state veterinary laboratory for disease confirmation ($n = 86/105$, 81.9%).

Avian and swine influenza were reported as the most known zoonotic diseases among survey respondents ($n = 83/90$, 92.2%, and $n=27/32$, 84.4%, respectively). See Figures 3 and 4 for zoonotic diseases recognized by backyard poultry and swine owners, respectively. Sixteen per cent ($n = 14/90$) of poultry owners stated that they were not familiar with any diseases on the list, and 6.3% ($n = 2/32$) of swine owners had not heard of any listed.

3.5 | Disease prevention methods for visitors

Approximately three-quarters of backyard poultry ($n = 65/91$, 71.4%) and swine ($n = 25/32$, 78.1%) owners reported allowing visitors around their animals (Table 3). Most reported that they did not require visitors to follow any special precautions when entering animal areas ($n = 57/79$, 72.2%) or exiting animal areas ($n = 42/79$, 53.2%) for both poultry and/or swine. Biosecurity precautions for visitors leaving animal areas were slightly more compared to entering animal areas, such as asking them to use hand sanitizer or wash their hands after handling any animals ($n = 27$, 34.2%) or after leaving the animal area ($n = 23$, 29.1%), out of 79.

When asked about the type of visitors received, most backyard owners responded that they were friends or family without swine or poultry ($n = 68/84$, 81.0%). However, 35.7% ($n = 30$) reported that visitors could be friends that have swine or poultry, and 40.5% ($n = 34$) reported visitors not specifying previous animal contact for visitors wanting to see animals, out of 84 respondents.

3.6 | Disease prevention methods for animal owners

The majority of respondents reported that they always use soap and water or hand sanitizer after handling animals or their manure ($n = 74/105$, 70.5%) (Table 4). The majority of backyard poultry and swine owners reported not allowing animals inside their home with high adherence rates ($n = 80/90$, 88.9%; $n = 27/31$, 87.1%, respectively). Backyard poultry and swine owners rarely wore gloves when handling animals or their manure ($n = 34/104$, 32.7%), and 28.9% ($n = 30/104$) reported never wearing protective work gloves. Over half of respondents also stated that they never wear ($n = 60/105$, 57.1%) any protective nose and mouth coverings when handling animals or their manure. Most respondents stated that members of their household did not receive this year's seasonal influenza vaccine ($n = 69/106$, 65.1%).

4 | DISCUSSION

Our study had similar demographics as a nationwide survey conducted in 2014 of backyard chickens (Elkhorabi et al., 2014). The majority of the survey respondents were middle-aged, with slightly more than half being females who were well educated, with most possessing a bachelor's degree. Both studies also supported that most backyard poultry were used for eggs for the household, and represented small backyard flocks less than 20 birds. In our study, summaries were made from the poultry and swine groups separately, with more

emphasis placed on the poultry results due to the larger response rate as compared to the swine owner response rate.

Housing is important for protecting livestock and poultry from wild animals. It was reported in this study that about half of backyard poultry and swine were housed in a mixed indoor/outdoor setting, which allows for contact with wild animals, a potential source for zoonotic disease transmission (CDC, 2018a). Small backyard farm owners mainly house their animals with outdoor access, because generally these producers foster the belief that raising animals with access to pasture is more beneficial for their health and well-being (Geoffreys, 2017). Rodents were the most common type of wild animal contact reported by backyard poultry owners, which are common carriers of *Salmonella* (Meerburg & Kijlstra, 2007). It was reported that interaction with other predators such as hawks, opossums and skunks ranked second. Interestingly, wild ducks and geese, which are known carriers for avian influenza viruses (Biswas et. al, 2009), were ranked relatively low for wild animal contact for backyard poultry.

The vast majority of the survey respondents reported that they were aware of avian or swine influenza, but fewer reported awareness of *Salmonella*. Due to several recent avian/swine influenza nationwide outbreaks, USDA Veterinary Services, Pennsylvania Department of Agriculture (PDA) and CDC have developed extensive educational outreach campaigns (CDC, 2018d; PDA, 2019; USDA, 2016, 2018). CDC also has a very active educational campaign focused on salmonellosis prevention, especially associated with keeping backyard poultry (CDC, 2019). In this study, just over half of backyard poultry owner respondents reported that they have heard of salmonellosis (58.9%), which is slightly higher when compared to the 2010 USDA National Animal Health Monitoring System (NAHMS) analysis of urban backyard chicken flocks (Miami = 40%, Los Angeles 30.2%) (Beam et al., 2012). In 2017, CDC reported a record number of human salmonellosis outbreaks linked to backyard poultry contact, with 1,120 cases in 48 states (CDC, 2017). Between 1990 and 2014, an increase in salmonellosis cases associated with live poultry contact was reported (Basler, Nguyen, Anderson, Hancock, & Behravesh, 2016).

Bacterial shedding of *Salmonella* in poultry can persist for long periods of time, resulting in environmental contamination (Behravesh et al., 2014). Environmental persistence of *Salmonella* is also a concern for outdoor swine (Callaway et al., 2005). Only a third of backyard swine owners in this survey reported being aware of salmonellosis (31.9%).

Other zoonotic diseases covered in this survey reported lower rates of recognition by backyard poultry and swine owners; *Brucella suis*, a bacterial disease of swine, and virulent Newcastle disease in poultry had low recognition rates (28.1% and 24.4%, respectively). Both diseases have the potential to cause human disease in backyard owners and cause serious disease outbreaks among animals. *B. suis* can easily be spread among backyard swine with outdoor access and potential contact with feral pigs (Spickler, 2004). From a public and occupational health perspective, human brucellosis infection can occur when there is direct contact with infected swine, their tissues, body fluids or indirect contact with contaminated environments (CDC, 2012; CDC, NCEZID, 2017; Glazier, 2017). In 2017, a multistate survey of the east coast outdoor swine producers concluded that most swine

owners had heard of swine brucellosis, but 44% knew very little about the disease (Seraphin, Pitcher, & Free, 2018). In 2002–2003, an outbreak of exotic Newcastle disease in backyard poultry in southern California spread to large commercial poultry premises and several states, causing an estimated \$5 billion in losses to the poultry industry (USDA, 2014). A similar 2018–2019 outbreak of virulent Newcastle disease (USDA, 2019) started around the time this survey was administered in spring 2018.

Following strict biosecurity practices is essential for preventing disease introduction and spread, especially regarding visitors' access to farm animals. If precaution measures were taken, they were implemented when visitors left animal areas, particularly hand-washing after handling animals. While hand sanitation when leaving animal areas is beneficial for human disease prevention, it does not protect animals from disease introduction. Very low percentages of entrance precautions were reported to be required for visitors. More than one-third of visitors were reported to be friends with swine or poultry of their own, or visitors that wanted to see the animals possibly having had previous animal contact, which is concerning if often no biosecurity is required for entering animal areas.

Despite most backyard poultry and swine owners washing their hands after handling animals or their manure, and not allowing animals inside the home, work gloves were rarely (32.7%) or never worn (28.9%). This practice is risky especially for immuno-compromised individuals, such as young children, the elderly and persons with weakened immune systems, that are more susceptible to disease after animal contact (CDC, 2014). A survey of backyard poultry owners in the Seattle, Washington, also highlighted that animal caretakers may not be self-aware of actions that may facilitate faecal–oral disease transmission and risk-reducing practices may not be consistently performed (Kauber, Fowler, Lipton, Meschke, & Rabinowitz, 2016). Wearing gloves while cleaning animal areas provides an extra protective barrier against faecal–oral disease transmission, and should be considered more by farm animal owners. When gloves are not worn while cleaning animal areas contaminated with manure or direct animal handling, zoonotic disease risk and pathogen exposure can be increased (NASPHV, 2015). Hand-washing is shown to drastically reduce the risk of diseases; however, if not done properly, disease agents may persist (Burton et al., 2011; Huang, Ma & Stack, 2012; McGinley, Larson & Leydon, 1998), especially in the absence of wearing gloves.

The airborne or droplet spread of various zoonotic diseases should also be of concern to owners of backyard poultry and swine. More than half of survey respondents reported that they never wear any personal protective equipment (PPE) covering the nose and mouth such as dust masks, handkerchief or surgical mask when handling animals or their manure. The proportion of animal caretakers who received the seasonal influenza vaccination (34.9%) was slightly lower than the 37.1% Pennsylvania estimate for the 2017–2018 season which had also decreased from the previous year for adults (CDC, 2018b). Seasonal influenza vaccination can protect caretakers against circulating influenza human strains and reduce the risk of transmitting human seasonal influenza from ill people to pigs and poultry (CDC, 2014, 2018d; MacMahon et al., 2008). Vaccination decreases the potential for people, pigs or swine to become co-infected with both human and animal influenza viruses, which can

lead to genetic reassortment and a new influenza A virus with pandemic potential (CDC, 2014, 2018d).

It was reported that veterinarians (61.5%), Internet (50.0%) and friends/family (39.4%) were the main resources where backyard owners seek information when their animals get sick. Veterinary health staff, including practices that focus on more traditional companion animal medicine and surgery, should be knowledgeable about poultry and swine diseases, resources available to educate small farm animal owners about animal husbandry, disease prevention and reporting requirements associated with notifiable disease conditions (Larson, 2004; Linares & Nixon, 2011; Wohl & Nusbaum, 2007). Furthermore, people are increasingly seeking veterinary expertise via Web-based resources. Compared to the 2004 USDA Poultry NAHMS study, with a small percentage of backyard flock owners that rated the Internet as a very important health information source (9.7%) or used a veterinarian (2.9%) (USDA, 2005), this contrasted to our findings.

In our survey, it was disappointing that Department of Agriculture (6.7%), local animal club (15.4%) and university agriculture extension (17.3%) were the lowest rated health resources, since they represent an excellent source of information on animal disease identification, prevention and control. In a Maryland study of backyard poultry flock biosecurity practices, about half of participants reported observing sick birds within the past 6 months and only 14.6% sought assistance from the veterinary diagnostic laboratory (Madsen, Zimmerman, Timmons & Tablante, 2013), which is similar to the 18.1% of the respondents in Pennsylvania who reported never submitting dead or sick animals to the laboratory. Veterinary diagnostic laboratories are vital resources for communicating disease control and knowledge to both small flock owners and veterinarians.

One limitation of this study is the inability to calculate a response rate as the number of farms maintaining backyard poultry and swine is not known, and by extension, so is the generalizability of the results. Due to the sizable Amish and Mennonite populations especially in Lancaster County, the survey was offered in paper-based form in addition to the online questionnaire.

Details regarding the religious background of respondents were not collected. Nevertheless, we believe findings in this study still provide a snapshot of backyard poultry and swine owners' husbandry and disease prevention practices, allowing for the development of focused educational messages for these select animal producers.

Targeted education to increase awareness of zoonotic diseases and resources for multiple stakeholder groups that interact with backyard farm animal owners is crucial in reducing the acquisition and spread of zoonotic diseases. Even with the increase in small farm animal ownership, most local departments of agriculture and city municipalities do not require registration of backyard animals, making it difficult to identify and directly communicate with backyard farm animal owners (Pollock, Stephen, Skuridina & Kosatsky, 2012). An integrated One Health educational approach involving healthcare providers, paediatricians, veterinarians, feed stores, mail-order hatcheries (Behraves et al., 2014) and livestock

auctions, youth 4-H clubs, university agriculture extension, agriculture and public health government agencies is essential to improve awareness and disease prevention.

4.1 | Future direction

A higher proportion of backyard poultry and swine owners reported seeking animal health information from their veterinarians and the Internet in this study, as compared with results from the 2004 USDA Poultry NAHMS study (USDA, 2005). Recently, a USDA National Institute of Food and Agriculture grant was awarded to a Pennsylvania State University (PSU) Agriculture Extension, for training of small and large animal veterinarians in diseases commonly seen in backyard poultry. The instruction material will consist of a mixture of in-person lectures and laboratories, with online Web-based training modules. The goal of the PSU training is to increase the number of veterinary professionals capable of servicing small poultry flocks, particularly those in rural areas where there is a shortage of veterinarians.

5 | CONCLUSION

The findings of this One Health study highlights important gaps in animal disease knowledge, biosecurity and public health practices associated with ownership of backyard poultry and swine operations, related to zoonotic disease prevention. The study revealed that Pennsylvania backyard poultry and swine owners were most aware of avian and swine influenza, while other important zoonotic diseases of veterinary and public health concern, such as *Salmonella*, *Brucella suis* and virulent Newcastle disease, were less familiar to these groups.

Backyard poultry and swine owners may not understand the significance of practising biosecurity measures to prevent on-farm introduction and disease spread. Most respondents reported that they allow visitor access to their animals with no special biosecurity precautions, which exposes them to possible disease introduction and outbreaks. Personal protective equipment (PPE) such as work gloves or masks is rarely worn by backyard poultry or swine owners while handling animals or cleaning animal areas. This practice is critical since PPE can reduce the risk of zoonotic diseases by significantly reducing pathogen loads. Despite awareness of influenza, a low rate of seasonal human influenza vaccination was reported among the backyard farm animal owners, which could pose a risk for pandemic influenza virus reassortment (Cardona, Xing, Sandrock, & Davis, 2009; CDC, 2015, 2010; Perdue & Swayne, 2005). The main resources that backyard poultry and swine owners reported seeking out for help with their animals were veterinarians and the Internet, which emphasizes the need for continued targeted public health and biosecurity education, especially for small animal veterinary practitioners and reputable, Web-based information sites. These gaps discussed represent areas that should be targeted in order to improve the success of future educational outreach programmes for backyard poultry and swine animal owners in the prevention of zoonotic diseases.

6 | DISCLAIMER

The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

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Impacts

- The raising of backyard poultry and pastured swine is increasing in popularity, however the general lack of knowledge in farm animal husbandry and livestock diseases may place owners and their animals at risk of contracting zoonotic diseases.
- Provides information on zoonotic disease knowledge and biosecurity practices of backyard poultry and swine owners, which can be utilized for targeted veterinary and public health educational outreach.
- Veterinarians (61.5%) and the internet (50%) were reported as the main sources where small farm owners seek animal disease information, which highlights the importance of veterinary staff education and reliable web-based resources regarding zoonotic diseases related to farm animals and biosecurity education.

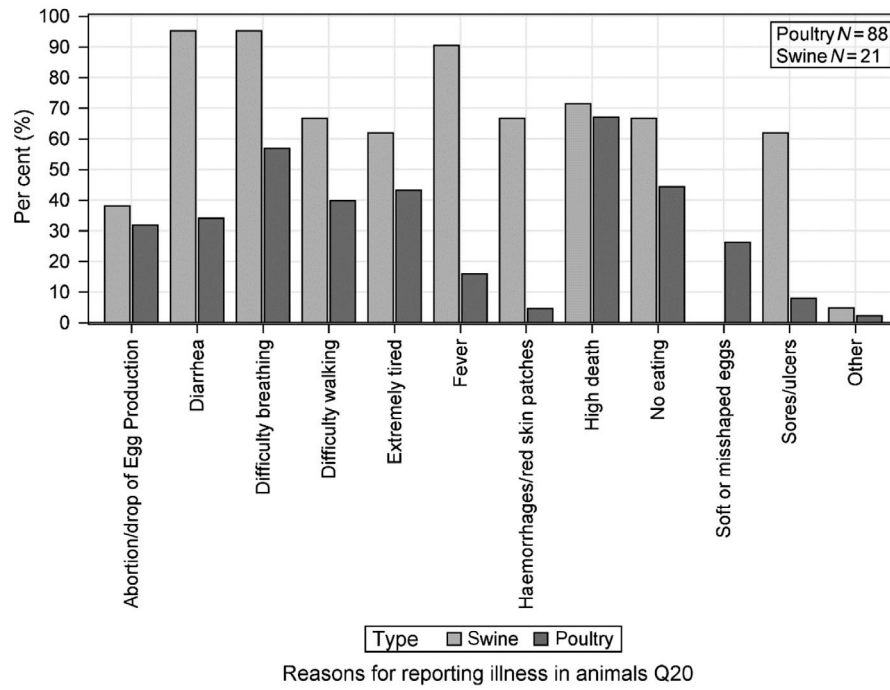


FIGURE 1.
Reasons for reporting illness in animals

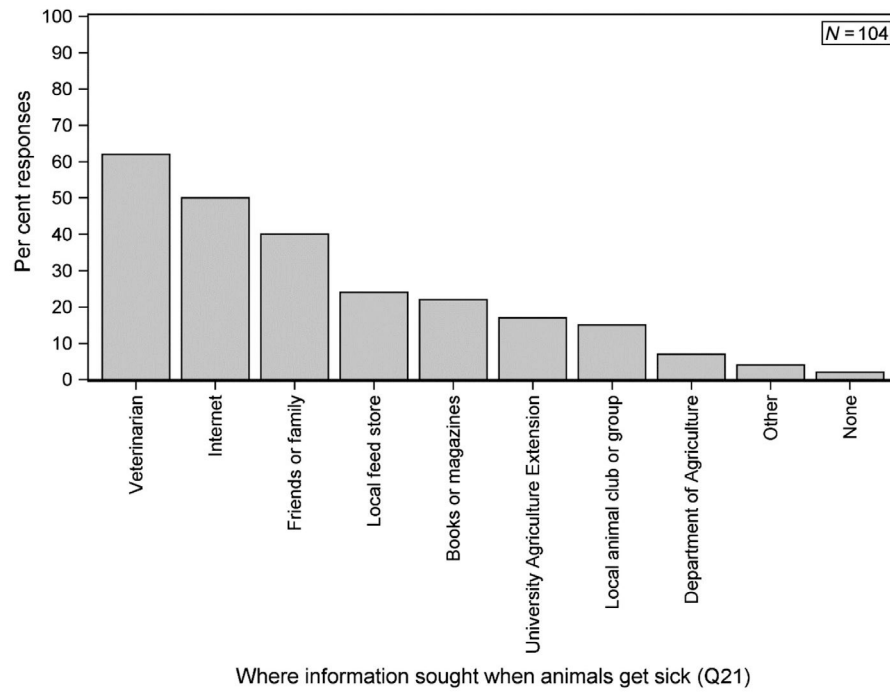


FIGURE 2.
Where information sought when animals get sick

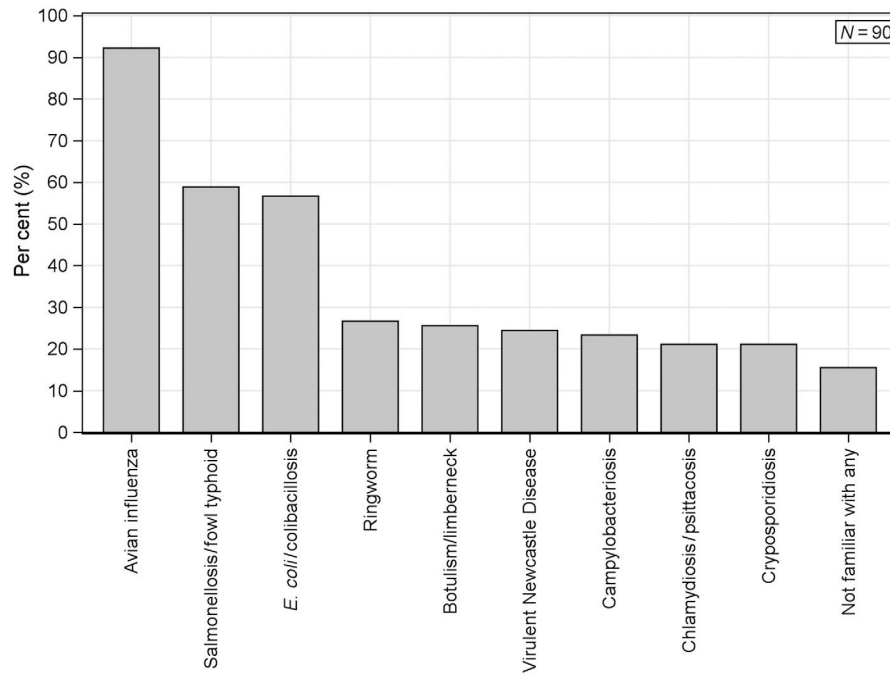


FIGURE 3. Select zoonotic and veterinary disease recognition among backyard poultry owners

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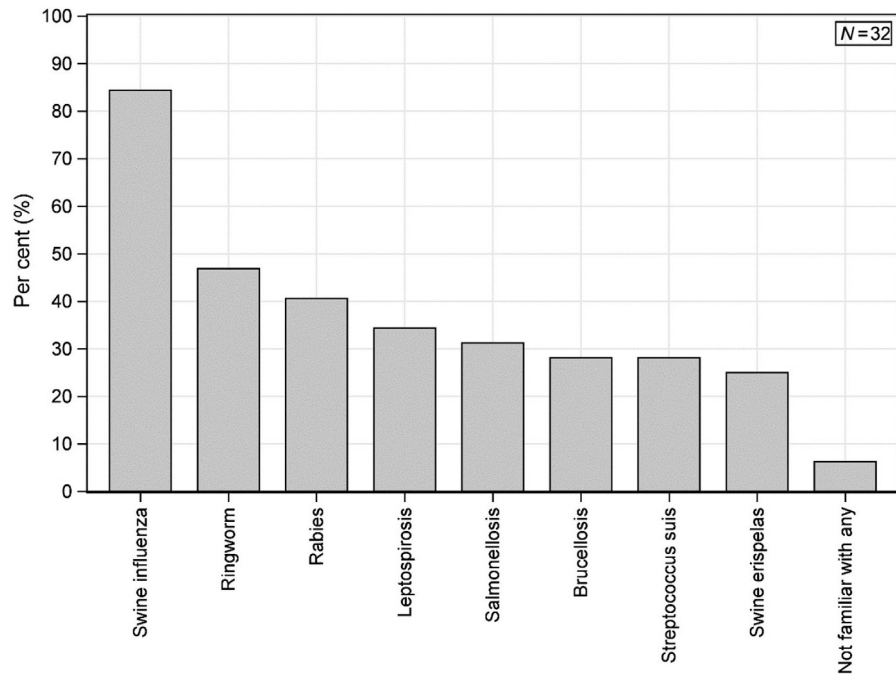


FIGURE 4.
Zoonotic disease recognition among backyard swine owners

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TABLE1

Demographic characteristics of backyard poultry and swine respondents in southcentral Pennsylvania, 1 April to 31 August 2018

Age (Q44)	Value
Median (Years)	41
Range (Years)	14–73
Gender (Q45)	<i>n</i> (%)
Male	43 (41.0%)
Female	60 (57.1%)
Prefer not to answer	2 (1.9%)
Total	105
County (Q46)	
Lancaster	64 (60.4%)
York	37 (34.9%)
Other	5 (4.7%)
Total	106
Residence setting (Q47)	
Rural (country)	85 (80.2%)
Suburban (just outside city)	20 (18.9%)
Urban (city)	1 (0.9%)
Total	106
Highest educational level in household (Q48)	
Elementary School	4 (3.9%)
Junior High School	6 (5.8%)
High School	23 (22.3%)
G.E.D.	4 (3.9%)
Technical School	5 (4.9%)
Associate degree	9 (8.7%)
Bachelor's degree	33 (32.0%)
Graduate degree	11 (10.7%)
Professional degree	4 (3.9%)
Prefer not to answer	4 (3.9%)
Total	103
English primary language (Q49)	
Yes	99 (93.4%)
No	5 (4.7%)
Prefer not to answer	2 (1.9%)
Total	106

TABLE 2

Animal flock/herd characteristics of backyard poultry and swine respondents in southcentral Pennsylvania, 1 April to 31 August 2018

Animal species (Q1)	Type	n (%)
	Poultry	74 (69.8%)
	Swine	15 (14.2%)
	Both poultry and swine	17 (16.0%)
Median number of animals (Q2)		
	Poultry	15.5
	Swine	3
Animal use (Q3) ^b	<i>Poultry n (%)</i>	<i>Swine n (%)</i>
Pets	33 (36.7%)	7 (21.9%)
Meat	19 (21.1%)	20 (62.5%)
Shows/Exhibition	11 (12.2%)	12 (37.5%)
Eggs (poultry only)	81 (90.0%)	N/A
Other	4 (4.4%)	2 (6.3%)
Total respondents ^a	90 (100.0%)	32 (100.0%)
Animal source (Q10) ^b		
Nursery or hatchery	37 (42.1%)	3 (9.4%)
Home raised	34 (38.6%)	10 (31.3%)
Animal sale/auction	20 (22.7%)	14 (43.8%)
Neighbours/friends/family	22 (25.0%)	12 (37.5%)
Online source	17 (19.3%)	3 (9.4%)
Other	15 (17.1%)	3 (9.4%)
Total respondents ^a	88 (100.0%)	32 (100.0%)
Housing (Q4)		
Strictly indoors	8 (8.9%)	8 (25.8%)
Mixed indoors/outdoors	45 (50.0%)	18 (58.1%)
Strictly outdoors	37 (41.1%)	5 (16.1%)
Total respondents ^a	90 (100.0%)	31 (100.0%)
Contact with wild animals (Q7)		
Yes	44 (48.9%)	9 (28.1%)
No	45 (50.0%)	22 (68.8%)
Don't know	1 (1.1%)	1 (3.1%)
Total respondents ^a	90 (100.0%)	32 (100.0%)
Types of wild animal contact (Q8) ^b		
Wild ducks/geese	9 (20.5%)	4 (40.0%)
Coyotes	2 (4.6%)	2 (20.0%)
Rodents	22 (50.0%)	4 (40.0%)
Raccoons	15 (34.1%)	2 (20.0%)

Animal species (Q1)	Type	n (%)
Deer	15 (34.1%)	5 (50.0%)
Feral/wild swine	0 (0.0%)	0 (0.0%)
Other (predators)	20 (45.5%)	2 (20.0%)
Total respondents ^a	44 (100.0%)	10 (100.0%)
Rodent/insect use (Q9)		
Feeding area	30 (35.3%)	15 (48.4%)
Living area	32 (37.7%)	14 (45.2%)
No-not utilized	34 (40.0%)	8 (25.8%)
Don't know	0 (0.0%)	2 (6.5%)
Other	10 (11.8%)	1 (3.2%)
Total respondents ^a	85 (100.0%)	31 (100.0%)
Allow animals inside home (Q39)		
No	80 (88.9%)	27 (87.1%)
Yes	10 (11.1%)	4 (12.9%)
Total respondents ^a	90 (100.0%)	31 (100.0)

^aNot applicable responses were excluded from the analysis;

^bQuestion with option to select all that applied.

TABLE 3

Summary of responses related to visitor interaction with the animals, types of visitors and precautions taken before and after the interaction

Question	Yes	No	Total
Do you allow visitors around your animals? ^a			
Swine	25 (78.1%)	7 (21.9%)	32
Poultry	65 (71.4%)	26 (28.5%)	91
If yes to previous question (swine and/or poultry), what types of visitors? (Choose all that apply)			
Family/friends without swine or poultry	68 (81.0%)		
Family/friends that have swine or poultry	30 (35.7%)		
Visitors wanting to see animals	34 (40.5%)		
Veterinarian/animal health technician	23 (27.4%)		
People who wish to purchase animals or product	18 (21.4%)		
Other	3 (3.6%)		
			84
Are any special precautions taken before visitors <i>enter</i> the animal area (swine and/or poultry)? (Choose all that apply)			
No special precautions taken	57 (72.2%)		
Ask if they have sick animals at home, or if they have been around sick animals	9 (11.4%)		
Ask if they are sick themselves	6 (7.6%)		
Ask if they have travelled to another country or area that might have disease	1 (1.3%)		
Ask them to wear boots or shoe covers that you provide	9 (11.4%)		
Ask them to use the foot bath provided	2 (2.5%)		
Other	7 (8.9%)		
			79
Are any special precautions taken before visitors <i>leave</i> the animal area (swine and/or poultry)? (Choose all that apply)			
No special precautions taken	42 (53.2%)		
Ask them to use foot bath provided	1 (1.3%)		
Ask them to use hand sanitizer or wash their hands after leaving the animal area	23 (29.1%)		
Ask them to use hand sanitizer or wash their hands after handling any animals	27 (34.2%)		
Other	8 (10.1%)		
			79

^a N/A answers were excluded from the analysis.

TABLE 4
 Summary of responses related to hand-washing, using gloves and PPEs and frequency of cleaning the animal areas

Question	Always	Usually	Sometimes	Rarely	Never	Total	
Is hand-washing using soap and water or hand sanitizer practised after handling animals or their manure?	74 (70.5%)	20 (19.1%)	5 (4.8%)	3 (2.9%)	3 (2.9%)	105	
Are work gloves worn by those handling animals or their manure?	16 (15.4%)	13 (12.5%)	11 (10.6%)	34 (32.7%)	30 (28.9%)	104	
Are any protective nose and mouth coverings such as dust masks, handkerchief and surgical mask being worn by those handling animals or their manure?	7 (6.7%)	7 (6.7%)	11 (10.5%)	19 (18.1%)	60 (57.1%)	104	
How often do you clean out the animal areas? ^a	Daily	Every 2–3 days	Weekly	Monthly	Between animal groups	Never	Total
Swine	9 (28.1%)	7 (21.9%)	7 (21.9%)	7 (21.9%)	2 (6.3%)	0 (0.0%)	32
Poultry	7 (8.0%)	13 (14.8%)	8 (9.1%)	25 (28.4%)	35 (39.8%)	1 (1.1%)	88

^a N/A answers were excluded from the analysis.