

Bangladeshi backyard poultry raisers' perceptions and practices related to zoonotic transmission of avian influenza

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Abstract

Introduction: Highly pathogenic avian influenza (H5N1) virus (known as “bird flu”) is an important public health concern due to its potential to infect humans and cause a human pandemic. Bangladesh is a high-risk country for an influenza pandemic because of its dense human population, widespread backyard poultry raising, and endemic H5N1 infection in poultry. Understanding poultry raisers' perceived risks and identifying their risk exposures can help to develop interventions to reduce the risk of avian influenza transmission. This paper explores the perception of Bangladeshi backyard poultry raisers regarding poultry sickness and zoonotic disease transmission and relevant practices.

Methodology: We conducted a qualitative study using social mapping (n=2), in-depth interviews (n=40), household mapping (n=40) and observation (n=16), in two backyard poultry-raising communities.

Results: The poultry raisers recognized various signs of poultry illness but they did not distinguish among diseases using biomedical classifications. They perceived disease transmission from poultry to poultry, but not from poultry to humans. They usually kept sick poultry under the bed. If the poultry did not recover, they were slaughtered and consumed or sold. The poultry raisers had close contact with sick birds while handling and slaughtering poultry.

Conclusions: The poultry raisers are unlikely to follow instructions from health authorities to prevent “bird flu” transmission because many of the instructions ask low-income producers to change their existing practices and require time, money, and financial loss. Villagers are more likely to comply with interventions that help to protect their flocks and address their financial interest.

Key words: backyard raisers; poultry; qualitative research; avian influenza; perception; Bangladesh

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Introduction

Highly pathogenic avian influenza is an important public health concern due to its potential to infect humans and cause a human pandemic [1]. Since 2003, fifteen countries have reported human infections with highly pathogenic H5N1 strains; 11 of these countries were in Asia [2]. Between 28 January 2004 and 21 April 2011, the World Health Organization (WHO) reported 552 confirmed human infections with H5N1, of whom 322 (58%) died [2]. Close contact with infected or dead poultry, including slaughtering and preparing infected poultry for consumption, are the primary recognized pathways of transmission of human infection with H5N1 [3-5]. Wild waterfowl are the natural reservoir of avian influenza. Ducks may act as a silent reservoir of avian influenza, shedding virus but not showing symptoms [6-8].

Bangladesh is a densely populated country with 980 population per square kilometer [9], where 90% of

the rural households raise poultry [10,11] with close proximity between birds and people [12]. Backyard poultry in Bangladesh are very susceptible to H5N1 infection because chickens are in close contact with domestic ducks and wild birds [13]. The government of Bangladesh (GoB) announced the first confirmed H5N1 outbreak in poultry in March 2007, and the first recognized human case was reported in May 2008 [14]. Loth *et al.* [15] confirmed that the same strains of the H5N1 virus had been re-emerging in farm outbreaks across the country during March 2007 to July 2009, which suggests that the virus is circulating in backyard chickens and ducks and has become endemic in the country. In this setting, humans or animals could be co-infected with H5N1 and other strains of influenza, from which a new strain might emerge, potentially with a high case fatality rate and easy transmissibility from person to person.

As a part of the avian influenza prevention and control campaign in Bangladesh, the World Health Organization (WHO), Food and Agriculture Organization (FAO), and the World Organization for Animal Health (OIE) recommended a set of 10-step messages to prevent poultry to human transmission [16]. The GoB further expanded this set of messages and circulated them through posters, brochures, television advertisements, and newspapers.

Controlling and preventing infectious disease depend heavily on people's compliance with recommendations on precautionary behavior [17,18]. This compliance in turn depends on people's knowledge, level of perceived risk, and willingness to adopt precautionary behavior [18]. One reason people change their behavior is that they perceive a threat to their health and livelihoods [18,19].

In Bangladesh, the ongoing endemic transmission suggests that backyard poultry raisers are particularly at high risk. Understanding poultry raisers' perceived risks and identifying their risk exposures can assist in developing interventions to reduce the risk of avian influenza transmission in backyard farms [20]. This paper aims to explore backyard poultry raisers' perceptions of poultry sickness and zoonotic transmission and their associated practices.

Methodology

Settings

A research team of trained anthropologists and sociologists conducted this qualitative study to understand poultry disease and transmission from local people's perspective. We conducted this study in two villages of the Netrokona and Rajshahi districts in north and northwest Bangladesh. We collected data in Netrokona from February to March 2008 and in Rajshahi in July 2008. We selected these sites to include different geographical features, assuming that we might find differences in poultry-raising practices. Netrokona is a rural low-lying area, where seasonal monsoon floods inundate the village and interrupt transportation to other areas. The village has no electricity. Rajshahi is a plain land area, where seasonal floods do not affect the residents or the infrastructure; it has a well-connected transportation system and electricity services.

Sampling through social mapping

We mapped these two villages using the participatory rural appraisal [21] tool of social mapping to identify major landmarks, number of poultry raisers, number of poultry, common places for

poultry scavenging, and the wealth status of the villagers. In the mapping exercise, according to villagers' descriptions, we found that women are the primary poultry raisers in the households. The villagers categorized all the households into two groups according to the number of poultry they had. In Netrokona, the villagers considered having five or fewer poultry, as a small flock and more than 5 birds as a large flock; in Rajshahi, having 10 or fewer poultry was considered a small flock and more than 10 birds as a large flock. Similarly, the villagers divided all the households into poor, middle and rich groups based on the area of land owned and the income of family members in relation to the size of the family and occupation. Assuming that differences in poultry-raising practices are dependent on the wealth status of the backyard poultry raisers and the flock size, we purposively selected 20 households in each village, five from each of the four categories: poor-small; poor-large; middle-small, middle-large.

Methodology and data collection

We interviewed 40 women who were responsible for caring for their flocks, to explore their understanding of poultry illness and caring practices and recorded the interviews using audio recorders. The interviews lasted between 40 and 110 minutes. We observed 16 households for six to seven hours, two from each of the four categories, both from morning until noon and from afternoon until night, to record household members' everyday practices and interactions with poultry at different times of the day.

Data analysis

We reviewed and expanded the field notes and transcribed interviews verbatim. We reviewed the data and retrieved the emerging themes. Through an iterative process, we discussed and finalized the code list. We inserted summaries of codes from all interviews in a spreadsheet, keeping the codes in the columns and informants in the rows. Later we summarized coded data according to the study objectives and relevant themes. We cross-checked the findings by comparing the data from all research tools.

Ethical considerations

We explained the study purpose to the community members and asked the community to participate in social mapping. We obtained informed consent from the informants of the study households before data collection. The Ethical Review Committee of icddr,b,

Table 1. Demographic information of the informants from the villages of Netrokona and Rajshahi, Bangladesh, 2008

| Demographic information | Netrokona (N = 20) | (%) | Rajshahi (N = 20) | (%) | Total (N = 40) | (%)* |
|------------------------------------|-----------------------|---------|----------------------|---------|-------------------|---------|
| Age Median [range] | 40 | [18-60] | 29 | [20-63] | 35 | [18-63] |
| Formal education | | | | | | |
| Grade 0 | 13 | (65) | 10 | (50) | 23 | (58) |
| Grade 1-5 | 4 | (20) | 4 | (20) | 8 | (20) |
| Grade 6-9 | 3 | (15) | 6 | (30) | 9 | (22) |
| Median [range] | 0 | [0-8] | 5 | [0-9] | 0 | [0-9] |
| Occupation | | | | | | |
| Housewife | 18 | (90) | 16 | (80) | 34 | (85) |
| Work in rice mill | 2 | (10) | 0 | (0) | 2 | (5) |
| Work in insurance co. | 0 | (0) | 1 | (5) | 1 | (3) |
| Handicraft | 0 | (0) | 3 | (15) | 3 | (7) |
| Religion Islam | 20 | (100) | 20 | (100) | 40 | (100) |
| Main income source of HH | | | | | | |
| Agriculture | 10 | (50) | 14 | (70) | 24 | (60) |
| Day labor | 7 | (35) | 4 | (20) | 11 | (27) |
| Selling cattle | 1 | (5) | 0 | (0) | 1 | (3) |
| Grocery shop | 1 | (5) | 0 | (0) | 1 | (3) |
| <i>Imam</i> | 1 | (5) | 0 | (0) | 1 | (3) |
| Handicraft | 0 | (0) | 1 | (5) | 1 | (3) |
| Work abroad | 0 | (0) | 1 | (5) | 1 | (3) |
| Duration of poultry raising | | | | | | |
| 1-5 years | 7 | (35) | 4 | (20) | 11 | (27) |
| 6-10 | 1 | (5) | 3 | (15) | 4 | (10) |
| >10 | 12 | (60) | 13 | (65) | 25 | (63) |
| Median [range] | 15.5 | [1-51] | 14 | [2-38] | 14 | [1-51] |

* Some summaries exceed 100% because of rounding

Bangladesh, reviewed and approved the study protocol.

Results

Informants' profiles

Most informants were the leading female members of the household, usually the wife of the head of the household and the mother of young children. We found no difference in the perceptions and practices regarding poultry sickness related to differences in wealth status or number of poultry owned. The demographic information of the informants is described in Table 1.

Poultry diseases and signs

All the poultry raisers in both villages told us about the signs of diseases they observed in their poultry rather than naming the disease. Only in the case of *boshonto* (the Bengali word for *fowl pox*) in chickens could they name the disease as well as described the signs. Informants frequently mentioned drowsiness as the most common sign for any illness in chickens. Others were watery and greenish feces;

lime-like feces; remaining quiet; not eating; swollen head and neck; fever; and sudden death. They commonly mentioned *lengra/lula* (the Bengali word for paralysis of the limbs of fowl) as the most common disease of ducks. They said when a duck became sick it sat quietly, became drowsy, did not go to water, ate less, limped, defecated green- and lime-colored feces, and had swollen heads. They stated that currently poultry diseases exist throughout the year, but in previous times, summer was the primary season.

Awareness about "bird flu" or "unknown disease"

The awareness about "bird flu" was different between the two study sites. Many informants (8/20) in Rajshahi mentioned hearing about "bird flu," whereas only two informants in Netrokona had heard about it (Table 2). Over half (11/20) of the informants in Netrokona and five informants in Rajshahi talked about a new "unknown disease" which they could not name (Table 2). The information they shared about this "unknown disease" closely resembled clinical descriptions of "bird flu".

Table 2. Informants' responses regarding poultry disease and "bird flu" and related practices of Netrokona and Rajshahi, Bangladesh, 2008

| Issues | Netrokona | | Rajshahi | | Total | |
|--|-----------|-------|----------|-------|--------|-------|
| | N = 20 | (%) | N = 20 | (%) | N = 40 | (%) |
| Causality of disease | | | | | | |
| Fate/ Gods will | 5 | (25) | 3 | (15) | 8 | (20) |
| Gas or air | 0 | (0) | 3 | (15) | 3 | (7) |
| Dirt/clay | 2 | (10) | 3 | (15) | 5 | (13) |
| Don't know | 8 | (40) | 4 | (20) | 12 | (30) |
| Said nothing | 5 | (25) | 7 | (35) | 12 | (30) |
| Heard about "bird flu" or unknown disease | | | | | | |
| <i>Heard about "bird flu"</i> | | | | | | |
| Television | 0 | (0) | 7 | (35) | 7 | (18) |
| Family and neighbor | 1 | (5) | 0 | (0) | 1 | (3) |
| Public announcement | 1 | (5) | 0 | (0) | 1 | (3) |
| NGO | 0 | (0) | 1 | (5) | 1 | (3) |
| <i>Heard about unknown disease</i> | | | | | | |
| Television | 0 | (0) | 3 | (15) | 3 | (7) |
| Family and neighbor | 9 | (45) | 2 | (10) | 11 | (27) |
| Public announcement | 2 | (10) | 0 | (0) | 2 | (5) |
| Heard nothing | 7 | (35) | 7 | (35) | 14 | (35) |
| Disease transmission from poultry to poultry | | | | | | |
| Disease can transmit from poultry to poultry | 19 | (95) | 18 | (90) | 37 | (93) |
| Don't know | 1 | (5) | 2 | (10) | 3 | (7) |
| Disease transmission from poultry to human | | | | | | |
| Disease cannot transmit from poultry to human (who heard about "bird flu" or unknown disease) | 7 | (35) | 11 | (55) | 18 | (45) |
| Disease cannot transmit from poultry to human (who never heard about "bird flu") | 7 | (35) | 7 | (35) | 14 | (35) |
| Have doubt that disease can transmit from poultry to human (heard about "bird flu" or unknown disease) | 6 | (30) | 2 | (10) | 8 | (20) |
| Slaughtering and selling practices of sick poultry | | | | | | |
| Slaughter and/or sell | 20 | (100) | 20 | (100) | 40 | (100) |
| Slaughter and sell | 7 | (35) | 10 | (50) | 17 | (43) |
| Slaughter only | 4 | (20) | 9 | (45) | 13 | (32) |
| Sell only | 9 | (45) | 1 | (5) | 10 | (45) |
| Throwing and burying offal/carcasses before hearing about "bird flu" | | | | | | |
| Throwing in the bushes | 5 | (25) | 14 | (70) | 19 | (48) |
| Throwing in the nearest water body | 13 | (65) | 3 | (15) | 16 | (40) |
| Burying under the soil | 2 | (10) | 3 | (15) | 5 | (12) |
| Throwing and burying offal/carcasses after hearing about "bird flu" | | | | | | |
| Throwing in the bushes | 4 | (20) | 9 | (45) | 13 | (32) |
| Throwing in the nearest water body | 13 | (65) | 2 | (10) | 15 | (38) |
| Burying under soil | 3 | (15) | 9 | (45) | 12 | (30) |

Informants from both the villages and all wealth groups reported that television and neighbours were common sources of information about "bird flu" or an "unknown disease" In Rajshahi, informants heard it from television. In Netrokona, informants heard it from their neighbours or family members and none mentioned television (Table 2). Informants of Netrokona also mentioned that there had been announcements in neighboring areas about poultry culling and "bird flu" nearly two months before our data collection.

In both villages, two-thirds of the informants (26/40) said that they heard about "bird flu" or an unknown disease and also reported that this disease did not occur in their village (Table 2). The rest of the informants reported that they never heard it, and did not know anything about it.

Table 3. Informants' recalling "bird flu" messages compared to the 10 steps messages circulated by the government of Bangladesh (GoB) during 2008 in Netrokona and Rajshahi districts, Bangladesh*

| "Bird flu" messages recalled by informants | Netrokona | Rajshahi | Matched 10-Step messages** |
|--|-----------|----------|--|
| Touching or handling sick poultry will transmit the disease to humans | 1 | 2 | Message 1. Do not touch or handle sick birds, or those that have died unexpectedly |
| Slaughtering can transmit disease to humans | 3 | 2 | Message 2. Do not remove feathers or slaughter or handle infected birds at home |
| Wash hands with soap or ash after burying poultry | | 2 | Message 4. Always wash hands with soap and water after handling birds |
| Do not eat egg and meat. If someone eats then it will cause serious disease | 1 | | Message 6. Cook poultry meat and eggs well before eating; raw poultry products should not be eaten |
| Egg or meat should be boiled properly | 2 | 4 | |
| Broiler chickens are harmful and consumption of broiler chicken can cause cancer | | 1 | |
| Consumption of broiler chicken can transmit this disease to the human body | | 1 | |
| Consumption of sick poultry can transmit the disease to humans | 4 | 2 | |
| Consumption of sick poultry causes a pain in the human body and the person will die within five minutes | 1 | | |
| Bury dead poultry by covering hand with polythene | | 3 | Message 9. Report unusual death of birds to local authorities. Precaution should be taken while disposing dead birds |
| Bury dead poultry | | 4 | |
| Bury dead poultry by covering hand with cloth | 1 | | |
| Chickens die suddenly or by jumping | 2 | 2 | |
| Kill the sick poultry and bury. | 1 | | |
| 10-step messages that informants did not recall | | | |
| <u>Message 3.</u> Children should not be allowed to touch, carry or play with birds since they may carry the virus | | | |
| <u>Message 5.</u> Wear a mask or cover the nose and mouth with a thick cloth when handling birds, especially chickens. Be careful not to rub your eyes, nose or mouth after touching birds | | | |
| <u>Message 7.</u> If you live in an area where there are "bird flu" outbreaks, avoid going to places where live birds are sold or slaughtered | | | |
| <u>Message 8.</u> Chicken droppings should not be used as fertilizer | | | |
| <u>Message 10.</u> Immediately consult a doctor if you or someone you know develops flu-like-illness after contact with birds. Visit the nearest health center or hospital for check-up and treatment. Inform them of your contact with sick, dying or dead birds. | | | |

* Data are given as number of persons who reported the messages

** Source: http://www.mofl.gov.bd/bird_flu.aspx

"I cannot say why chickens get this disease, but when chickens get this disease, water drops from their eyes, (chickens) make unusual sound. I heard this from TV. This disease did not occur in our village yet, we did not see it. We see it in TV." [Informant from Rajshahi]

The messages the informants heard from different sources in both the study areas were similar to the 10-step messages, but most of the time, they could only repeat a part of the original messages (Table 3).

"I have heard that if people eat broiler chicken, they get cancer and harmful diseases. For that reason, broiler chickens are burnt and killed. But I can't say the name of that disease." [Informant from Rajshahi]

In Netrokona, informants also reported that they heard people were coming to kill poultry. After hearing this news, they hid their poultry in the nearest bushes or bodies of water. They also reported slaughtering and consuming their poultry out of fear of losing it.

"We heard that people are taking poultry to a place and killing those by giving injection.... Then we took all the poultry hurriedly to the jungle and let the ducks in the river... then two ducks got lost." [Informants from Netrokona]

Causal explanations of poultry disease

Many of the informants from both study sites and all wealth groups said that they did not know why their poultry got sick (Table 2). Informants explained the causality of disease as “fate” or “God’s will” or gas/air. They said that keeping ducks and chickens together inside the poultry shed creates a bad smell or gas, which makes poultry sick as duck feces are dirtier and smell worse.

“I cannot say from where the disease had come. Allah has given this disease. It occurs suddenly.” [Informant from Netrokona]

Disease transmission from poultry to poultry and other animals

The majority of the informants (37/40) perceived that poultry disease can be transmitted from chicken to chicken or duck to duck, but not between chickens and ducks. Netrokona informants frequently mentioned sick and healthy poultry being together and sharing food as the route of transmission, whereas Rajshahi informants often mentioned it as related to healthy poultry eating offal or blood of sick and dead poultry.

“When one of my chickens gets sick, my other five healthy chickens also get sick.... I keep sick poultry separate (in my room) because if healthy chickens eat sick chicken’s saliva or leftover food, the healthy chickens will also get the same disease.” [Informant from Netrokona]

“If I slaughter a sick chicken... I will dig a hole with a hoe and cover the blood with soil so that other (healthy) chickens cannot eat that.... If those fall on ground, other poultry will peck on that and get diseased.” [Informant from Rajshahi]

Informants from both the study areas and all wealth groups stated poultry disease cannot be transmitted from poultry to other animals. They opined that poultry and cattle diseases are different.

“We do not believe that our duck, cow or goat can be infected with chickens’ diseases. Goat will get goat’s disease and cow will get cow’s disease” [Informant from Netrokona]

Poultry to human transmission

The backyard poultry raisers’ understanding about transmission of disease from poultry to humans was related to “bird flu” or an unknown disease. Raisers

who did not hear about “bird flu” said that poultry disease could not transmit to humans (Table 2). The majority of the informants who heard about “bird flu” said that recently they had heard about this disease but they thought that this disease could not be transmitted to humans.

“A disease occurred in chicken.... If human consumes chicken with this disease, it can spread in human body.... We are hearing this recently.... Then we asked, ‘What is this disease? We didn’t hear about it before.’ People replied, ‘Yes, it occurred... You’ll see.’ We just didn’t believe.” [Informant from Netrokona]

“I have heard about ‘bird flu’. I watched people saying in TV that the migratory bird comes and the disease spread from those birds to the chickens. From this, it can spread to humans. Chickens should be buried under the ground, if infected in that disease. We are hearing this, but not paying any attention. I think that this disease will not transmit from poultry to human body.” [Informant from Rajshahi]

Some informants (8/40) were suspicious about poultry-to-human transmission (Table 2). They said they heard that this disease can transmit to humans but they were not sure about it and they did not see it in their areas.

Common practices for caring for sick poultry

Informants reported that when their poultry got sick they tried to treat their illnesses. Most of the time, they went to the nearest drug shop where medicines for poultry and cattle were available. They also had government livestock authorities at the sub-district level but they did not usually go to these facilities because their services focused more on cattle health compared to poultry health. They described the signs of the diseased poultry to the shopkeepers to get medicine. They also provided home remedies to their sick poultry, such as feeding sour fruits, chili, and warm water. They opened the beak of the chicken with one hand and put the sour fruit or medicine mixed with rice inside its throat, while they pushed the food down with the other hand.

The poultry raisers reported that they kept their sick poultry under a basket in the yard or veranda during the daytime to separate it from their healthy poultry; this was common in both study sites and all wealth groups. At night, they kept their sick poultry under a basket under the bed to observe if the poultry

were about to die. When they thought that poultry would not recover, they slaughtered and consumed it. Slaughtering poultry before consumption is compulsory in Islamic dietary practice; it is taboo to eat the meat of animals that die of natural causes [22]. Informants also mentioned that if there was any news of a poultry die-off in or near their area, they sold their poultry. All the informants from both study sites and from all wealth groups reported either selling or slaughtering or practicing both selling and slaughtering their sick poultry (Table 2).

"When we see that the sick chicken is about to die, we slaughter and eat the meat. Or we look if there is someone to take [i.e., buy] it. And if we see that chickens became little drowsy...we sell those to the local poultry trader... . A chicken of this size costs US\$3. We cannot bear if a chicken dies.... If a chicken becomes drowsy, I wake up and see it five to seven times at night.... When I see that the chicken is in serious condition at night, I slaughter it. We cook the meat, waking up in the morning and consume." [Informant from Rajshahi]

Common practices of slaughtering sick poultry

We found one occurrence of sick poultry slaughtering. The description of the slaughtering from the observation note is given below:

Two persons, aged 20 and 16 years, slaughtered the sick poultry near the household's main entrance. The chicken was about two feet away from their faces. The one who held the head cut the throat of the chicken using a traditional knife, without separating the head, and blood dripped on the ground. After slaughtering, there was no initiative to clean the place. After a while, a dog licked the blood from the ground. The boy who slaughtered the chicken rinsed his hands in the nearest tube-well. The one who assisted did not wash his hands. Later on a woman took the chicken in a basket and started defeathering while sitting on the ground. She gathered the feathers and entrails in the basket and started to cut the chicken into pieces. Two children surrounded the woman while processing and were often playing with the poultry meat, picking up pieces of meat with their hands. The woman threw the entrails and feathers in a bamboo bush adjacent to her house. She rinsed the meat and the traditional knife

under the tube-well. She did not wash her hands separately after processing the chicken.

[Sick poultry slaughtering observation in Rajshahi]

The majority (34/40) of informants said that they usually threw offal or dead poultry in the bushes or nearest body of water (Table 2). Informants also reported that crows, dogs and foxes took them away from the bushes.

In both of the study areas, 12 informants reported burying carcasses (Table 2). Among them three reported burying because of disease, while the remaining nine explained that burying minimized odor, fertilized the soil, or reduced conflict with neighbors.

"If I slaughter a diseased and dying chicken and dump that chicken's entrails/offal in my neighbours' house, their (healthy) chickens will also get diseased if those peck or eat those (entrails/offal). For this reason, I bury the entrails/offal in the soil when I slaughter that (sick) chicken.... Otherwise, this will cause conflict with the neighbors. So we remain cautious." [Informant from Rajshahi]

Discussion

Backyard poultry raisers did not follow the 10-step preventive practices (outlined in Table 3) circulated by the GoB. They ignored these recommended practices because they did not recognize the disease, did not consider themselves at risk, and their resource constraints limited their choices for prevention.

The signs of illness villagers mentioned matched with fowl pox (*Fowl pox virus*), salmonellosis (*Salmonella gallinarum* or *Salmonella pullorum*), Newcastle (*Newcastle disease virus*) and fowl cholera (*Pasteurella multocida*), which are also prevalent backyard poultry diseases in Bangladesh [23]. Since the backyard poultry raisers did not understand the existence of "bird flu" and did not recognize various sign of illness in their flocks and did not believe it was transmissible to humans, they are unlikely to perceive the potential risk and adopt protective behavior [17,24]. Similarly, poultry raisers of Central Java, Indonesia, and of Haining, China, did not consider avian influenza as a threat to human health as they never witnessed such cases and so did not alter their high-risk poultry-raising practices [25,26].

Poultry raisers want to recover at least some of their investment by keeping sick poultry under the bed with

the intention to slaughter it if the bird's health deteriorates, which in turns puts the Bangladeshi backyard poultry raisers at risk of avian influenza infection [5,27]. A similar behavioral pattern was observed by Rugalema *et al.* [28] in their studies in Tanzania and Uganda, where agricultural farmers destroyed only infected banana trees because of the high market value of bananas, despite the government's recommendation to destroy all the banana trees in the outbreak area. The 10-step messages emphasized the risk of poultry-to-human transmission of avian influenza, whereas backyard poultry raisers linked the risk of avian influenza to the notion of loss of poultry, which could affect their livelihood. This suggests that backyard poultry raisers may not always perceive risk the same way as health professionals [29].

Better access to electronic communication, infrastructure and transportation play an important role in dissemination of information [30], but may not build trust in the community. Television is an important means of information dissemination [25] which could reach the community in a short time but might not influence the perception of risk in the local people [17,-24]. In a study on sources of information and risk perception of Chinese communities regarding avian influenza and severe acute respiratory syndrome (SARS), Voeten *et al.* [31] described that information coming from family and friends was trusted more than information from other formal sources and thus contributed to the perception and practices. Similarly, the information from neighbours and family members might influence the awareness and risk perception of the informants of Netrokona, whereas Rajshahi informants were more likely to recall the name of the disease "*bird flu*."

In both communities we studied, sick poultry were slaughtered and consumed, which is also common in Indonesia and China [25,26]. During slaughtering, the processing and caring for sick poultry, as well as the direct contact with blood, offal, raw meat and saliva puts the poultry raisers at high risk of avian influenza transmission [4,5]. Moreover, the indirect contact through fomites and inhalation because of aerosolization can also cause infection [5,32].

We conducted this qualitative study in only two villages of Bangladesh, so it is not possible to generalize all the findings of this study to all poultry raisers throughout the country. However, the in-depth approach of this study describes the perception of the situation from the poultry raisers' perspective, which not only explains what they believe, but can also

describe the reasons behind such beliefs. Moreover, the attitudes and practices described in this study were largely similar to the findings of UNICEF's Bangladesh countywide survey that explored the knowledge, attitude and practices of poultry raisers, suggesting that our in-depth findings are not unusual for the country [33].

The poultry raisers are unlikely to follow instructions from health authorities to prevent "*bird flu*" transmission because many of the instructions ask low-income poultry producers to make changes to their existing practices that require time and money and cause financial loss. Moreover, the instructions do not explicitly describe the signs of "*bird flu*" and its routes of transmission. Developing a communication campaign along with specific focus on "*bird flu*" signs and routes of transmission may be effective to ameliorate the risk perception. Another alternative approach to reduce risk could be encouraging safe slaughtering procedures. However, the intervention should be linked with protecting villagers' poultry, since villagers are much more likely to comply with the interventions that help to protect their flocks and improve their profitability. Poultry raisers could also be encouraged to bury offal or carcasses, linking the need to follow the 10-step program with issues that poultry raisers value, such as the safety of their poultry and maintaining good relationships with their neighbors.

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