Knowledge, Attitudes, Practices and Emotional Reactions among Residents of Avian Influenza (H5N1) Hit Communities in Vietnam

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Abstract

Background: Awareness of individuals’ knowledge and predicting their behavior and emotional reactions is crucial when evaluating clinical preparedness for influenza pandemics with a highly pathogenic virus. Knowledge, attitude, and practice (KAP) relating to avian influenza (H5N1) virus infection among residents in communities where H5N1 patients occurred in Vietnam has not been reported.

Methods and Principal Findings: Face-to-face interviews including KAP survey were conducted in Bac Kan province, located in the northeast mountainous region of Vietnam. Participants were residents who lived in a community where H5N1 cases have ever been reported (event group, n = 322) or one where cases have not been reported (non-event group, n = 221). Data on emotional reactions of participants and healthcare-seeking behavior after the event in neighboring areas were collected as well as information on demographics and environmental measures, information sources, and KAP regarding H5N1. These data were compared between two groups. Higher environmental risk of H5N1 and improper poultry-handling behaviors were identified in the event group. At the time of the event, over 50% of the event group sought healthcare for flu-like symptoms or because they were scared. Awareness of the event influenced KAP scores. Healthcare-seeking behavior and attention to H5N1 poultry outbreaks diminished in the event group as time passed after the outbreak compared with the non-event group. Factors that motivated participants to seek healthcare sooner were knowledge of early access to healthcare and the risk of eating sick/dead poultry, and perception of the threat of H5N1.

Conclusions: Awareness of H5N1 patients in neighboring areas can provoke panic in residents and influence their healthcare-seeking behavior. Periodic education to share experiences on the occurrence of H5N1 patients and provide accurate information may help prevent panic and infection and reduce mortality. Local conditions should be taken into account when emphasizing the need for early access to healthcare.

Introduction

Avian influenza A(H5N1) virus infection in humans remains rare and sporadic; however, it presents a continuous global pandemic threat associated with high mortality [1]. H5N1 infection is considered a very serious disease, especially among people living in high risk countries [2]. H5N1 infection can rapidly lead to severe pneumonia, acute respiratory distress syndrome (ARDS), and death [3]. Early initiation of antiviral treatment is recommended to treat H5N1 patients [4,5] and the timing of such treatment is vital in effecting a positive outcome [6]. In cases of influenza A(H1N1)pdm09 virus infection, despite low lethality globally, there have been large numbers of hospitalized patients with acute and severe illness, and fatalities have occurred worldwide [7,8,9,10,11]. A study in Mexico indicated that early initiation of antiviral treatment can reduce the occurrence and severity of pneumonia including ARDS [12]. A study in Canada also showed that delayed antiviral treatment is independently associated with disease severity due to influenza A(H1N1)pdm09 virus infection [13]. Thus, regardless of the type of virus, early initiation of antiviral treatment is crucial in treating critically ill patients with influenza virus infection. However, early initiation of antiviral treatment requires early healthcare-seeking behavior on the part of the patient, and physicians who quickly initiate antiviral treatment after symptom onset [14].

Two laboratory-confirmed cases of H5N1 in humans were reported from a community in Bac Kan province, a mountainous region in northeastern Vietnam, in spring 2010 [15] during the
H5N1 poultry outbreaks [16]. These two cases fortunately recovered. In one of these a successful outcome resulted from the short time (2 days) between symptom onset and hospitalization. Studies in previous years in Vietnam have reported elapsed time from symptom onset to hospitalization as several days [3,17,18,19]. We hypothesized that the awareness of H5N1 patients would influence the knowledge and behavioral patterns of people who live in high-risk communities in Vietnam. Understanding of emotional reactions of H5N1 patients at the time of an occurrence can contribute to clinical preparedness for further highly pathogenic influenza pandemics. We conducted a face-to-face knowledge, attitude, and practice (KAP) survey regarding H5N1 in two communities in Bac Kan province, Vietnam, one with H5N1 patients in 2010 (event group) and one without patients (non-event group). The aim of the present study was to assess KAP and emotional reactions to H5N1 to facilitate the

Figure 1. Locations of study sites. Bac Kan province is located in the mountainous region of northeast Vietnam. The white boxes denote study sites.
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| General characteristics of subjects | Event group (Nhu Co) | Non-event group (Minh Kai) | P value |
|-------------------------------------|----------------------|--------------------------|---------|
| Gender - male (%)                  | 103 (32.0)           | 72 (32.6)                | 0.926   |
| Age –median (IQR) yr.              | 36.0 (26–47)         | 40.0 (32–52)             | 0.001   |
| Education, No. (%)                 |                      |                          | <0.001  |
| Illiterate or only can read and write | 15 (4.7)             | 2 (1.0)                  |         |
| Elementary school                  | 110 (34.2)           | 11 (5.0)                 |         |
| Junior high school                 | 147 (45.7)           | 63 (28.5)                |         |
| High school                        | 39 (12.1)            | 77 (34.8)                |         |
| Specialty school                   | 2 (0.6)              | 37 (16.7)                |         |
| College/University                 | 9 (2.8)              | 31 (14.0)                |         |
| Occupation                          |                      |                          | <0.001  |
| Farmer                             | 283 (87.9)           | 27 (12.2)                |         |
| Housewife                          | 6 (1.9)              | 15 (6.8)                 |         |
| Government employee                | 11 (3.4)             | 67 (30.3)                |         |
| Employed worker                    | 5 (1.6)              | 44 (19.9)                |         |
| Student                            | 2 (0.6)              | 12 (5.4)                 |         |
| Unemployment                       | 0 (0.0)              | 26 (11.8)                |         |
| Others                              | 9 (2.8)              | 30 (13.6)                |         |
| Economic condition*                |                      |                          | <0.001  |
| 1                                  | 95 (29.7)            | 12 (5.4)                 |         |
| 2                                  | 87 (27.2)            | 30 (13.6)                |         |
| 3                                  | 66 (20.6)            | 34 (15.4)                |         |
| 4                                  | 47 (14.7)            | 68 (30.8)                |         |
| 5                                  | 25 (7.8)             | 77 (34.8)                |         |
| Health insurance                   | 290 (90.1)           | 183 (82.8)               | 0.014   |
| Life environment                    |                      |                          |         |
| Number of participant owning household poultry | 298 (92.5) | 112 (50.7) | <0.001 |
| Number of poultry raised at the participants' house | | | |
| Chickens                           |                      |                          | <0.001  |
| <10                                | 43 (13.4)            | 42 (19.0)                |         |
| ≥10                                | 270 (83.8)           | 70 (31.7)                |         |
| Ducks                              |                      |                          | <0.001  |
| <10                                | 19 (5.9)             | 1 (0.5)                  |         |
| ≥10                                | 50 (15.6)            | 3 (1.4)                  |         |
| Musk ducks                         |                      |                          | <0.001  |
| <10                                | 21 (6.5)             | 3 (1.4)                  |         |
| ≥10                                | 56 (17.4)            | 0 (0.0)                  |         |
| How often do you have contact with poultry? | 264 (82.0) | 91 (41.2) | <0.001 |
| Frequently                         | 53 (16.5)            | 118 (53.4)               |         |
| Sometimes                          |                      |                          |         |
| Have your poultry been vaccinated against AI? | 276 (85.7) | 174 (78.7) | 0.037 |
| How do you protect backyard poultry form AI infection | | | |
| Vaccination                        | 276 (85.7)           | 174 (78.7)               | 0.037   |
| Clean or disinfect poultry cage    | 150 (46.6)           | 130 (58.8)               | 0.005   |
| Keep poultry in good condition     | 114 (35.4)           | 82 (37.1)                | 0.716   |
| Built fence around the area        | 46 (14.3)            | 79 (35.7)                | <0.001  |
| Do nothing                         | 10 (3.1)             | 3 (1.4)                  | 0.257   |
development of effective prevention and treatment strategies for H5N1 infection and further influenza pandemic, including early diagnosis and initiation of treatment.

Materials and Methods

Study Sites and Subjects

The study was performed in two communities: Nhu Co Commune in Cho Moi District and Minh Khai Ward in Bac Kan Township in Bac Kan province (Figure 1). The numbers of residents and households at each site were approximately 2,800 and 630, respectively, in Nhu Co and 4,600 and 750, respectively, in Minh Khai. Nhu Co is located in a more mountainous area of Bac Kan province than Minh Khai, which is located in the central town. At the time of the study, the average annual incomes per capita in Nhu Co and Minh Khai were $320 (US) and $680 (US), respectively. Bac Kan province has reported frequent H5N1 epizootic outbreaks among birds and domesticated poultry, including a report from Nhu Co Commune, Cho Moi District in spring 2010 [11]. Two H5N1 human cases were also reported in Cho Moi District between March and April 2010 [10]. The distance between the two study communities is approximately one hour by motorbike. There were commune health centers (CHC) in each study site to provide primary care services to residents including medical doctor and nurse.

The study investigators included healthcare providers at Bac Kan General Provincial Hospital who worked closely with the health department in Bac Kan province. The population list of study communities was maintained by that health department in Bac Kan province. All questions were either closed-ended or multiple-choice. The questionnaire was collected during face-to-face interviews conducted by previously-trained local healthcare workers. Interviews were held three times on a single day at meeting halls at each study site to avoid exchange of information among participants regarding the contents of the interviews. KAP associated with H5N1 infection were compared between the groups. A knowledge score was calculated according to correct answers. An attitude-practice score was also calculated to evaluate the factors influencing each score, including individuals’ health-care behaviors. Economic conditions were classified according to quintiles of family income and were qualified on the basis of the possession of assets such as a television, radio, telephone, water server, refrigerator, buffalo/cow, bicycle, motorbike, car and air conditioner. Household poultry was defined as domesticated birds raised in backyards such as chickens, ducks, and musk ducks for the purpose of meat and eggs for daily meals and/or selling.

Ethics

Ethical approval was provided by the Institutional Review Board of the Ministry of Health, Vietnam, Bach Mai Hospital and the National Center for Global Health and Medicine, Japan. All study participants provided either written informed consent or verbal consent if they were illiterate. This method was approved for the present study in Vietnam by ethical review boards. Consent was documented with the participants’ signature or figure prints if they were illiterate, according to rules for scientific research in Vietnam.

Statistical Analysis

Survey data were double-entered and analyzed using SPSS Statistics ver. 20 (IBM, Armonk, NY, USA). Continuous variables were compared using Mann-Whitney U or Kruskal-Wallis tests. Categorical variables were analyzed using chi-square tests and Fisher’s exact tests. A maximum of three points was assigned to the answer ‘agree’ for each question, two points were assigned to ‘undecided,’ and one point to ‘disagree,’ according to a three-point Likert-type scale. KAP scores were calculated according to the answers using factor analysis, adjusted to give a total score of 10. Factors influencing KAP scores were analyzed by logistic regression analysis. Independent factors influencing early access to healthcare were analyzed using a step-wise selection method to select variables from the baseline backgrounds of participants. For all analyses, significance levels were two-tailed, and a P value of <0.05 was considered significant.
a. Education background

![Bar chart showing education background: Literate, Elementary school, Junior high school, High school, Speciality school, University. Comparison between event group and non-event group.]

b. Occupation

![Bar chart showing occupation: Farmer, Employee, Employed worker, Housewife, Student, Unemployment, Others. Comparison between event group and non-event group.]

c. Economic condition*

![Bar chart showing economic condition: Condition 1, Condition 2, Condition 3, Condition 4, Condition 5. Comparison between event group and non-event group.]

Figure 2. General backgrounds of study participants. Backgrounds on education (a), occupation (b), and economic condition (c) of study participants are compared between the event group and the non-event group. *Economic condition was qualified based on the possession of assets such as a television, radio, telephone, water server, refrigerator, buffalo, bicycle, motorbike, car and air conditioner, and was divided into quintiles according to family income.

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Results

General Background of Study Participants

Totals of 322 (median age, 36 [IQR 26–47] years) and 221 (median age, 40 [IQR 32–52] years) participants from the event group and non-event group, respectively, agreed to participate in the present study. The general backgrounds of the participants are shown in Table 1 and Figure 2. The educational level was lower in participants in the event group, which included 4.7% with no educational background, compared with 1% in the non-event group (P < 0.001). There was a significant difference in occupations between the groups (P < 0.001), with most participants in the event group being farmers (87.9%), compared with government employees (30.3%) and employed workers (19.9%) in the non-event group. Participants in the non-event group also had a significantly higher economic condition (≥condition 4) compared with the event group (P < 0.001). More than 80% of participants overall had health insurance, but significantly more participants in the event group had insurance compared with the non-event group (P < 0.014).

Table 2. Information sources and reactions to knowing there were H5N1 patients in neighboring areas.

| Information | Event group (Nhu Co) | Non-event group (Minh Kai) | P value |
|-------------|----------------------|---------------------------|---------|
| Ever heard about AI | 313 (97.2) | 217 (98.2) | 0.263 |
| Information source | | | |
| Television | 238 (73.9) | 202 (91.4) | <0.001 |
| Radio | 191 (59.3) | 106 (48.0) | 0.011 |
| Newspaper | 13 (4.0) | 61 (27.6) | <0.001 |
| Poster | 2 (0.6) | 25 (11.3) | <0.001 |
| Friend | 29 (9.0) | 30 (13.6) | 0.122 |
| Healthcare worker | 100 (31.1) | 77 (34.8) | 0.402 |
| Advertisement of women’s association | 82 (25.5) | 79 (35.7) | 0.013 |
| Others | 3 (0.9) | 7 (3.2) | 0.099 |
| Ever attended any educational programs relating to H5N1? | 216 (67.1) | 161 (72.9) | 0.130 |
| Requested more information on AI | 303 (94.1) | 213 (96.4) | 0.262 |
| News about the occurrence of H5N1 patients in Cho Moi District in 2010 | | | |
| Know about the news* | 280 (87.0) | 168 (76.0) | 0.001 |
| Scared if get AI | 287 (89.1) | 160 (72.4) | <0.001 |
| Visited hospital with some symptoms | 174 (54.0) | 87 (39.4) | 0.001 |
| Kind of symptoms that you got | | | |
| Fever | 149 (46.3) | 61 (27.6) | <0.001 |
| Dyspnea | 33 (10.2) | 10 (4.5) | 0.015 |
| Cough | 145 (45.0) | 48 (21.7) | <0.001 |
| Sneezing | 39 (12.1) | 39 (17.6) | 0.081 |
| Nasal discharge | 54 (16.8) | 43 (19.5) | 0.427 |
| Just scared | 17 (5.3) | 9 (4.1) | 0.548 |
| After the news* | | | |
| Pay more attention to dead/sick poultry | 297 (92.2) | 213 (96.4) | 0.066 |
| Seek healthcare earlier once get symptoms | 293 (91.0) | 220 (99.5) | <0.001 |

*Occurrence of H5N1 patients in Cho Moi District, Bac Kan province in the spring of 2010. AI: avian influenza (H5N1) virus infection in humans. doi:10.1371/journal.pone.0047560.t002
More participants in the event group knew about the occurrence of H5N1 patients in Cho Moi District in the spring of 2010 (event) compared with participants in the non-event group (P = 0.001) (Table 2). Participants from both groups who knew about the event were scared when they heard the news. Upon receiving the news, 54.0% of participants in the event group and 39.4% in the non-event group went to the hospital with symptoms of fever, cough, sneezing, nasal discharge, or just because they were scared. After the event, significantly more participants in the non-event group tended to seek healthcare earlier when they developed symptoms, compared with the event group (P < 0.001).

KAP of Study Participants Related to Avian Influenza (H5N1)

Some of the KAP results are shown in Tables 3 and 4. Although participants in both groups displayed a high level of knowledge, the non-event group provided significantly more correct answers to questions related to whether H5N1 was an infectious disease, its mode of transmission, whether it can be prevented or cured, and the likelihood of dying. Increased awareness about the importance of early access to healthcare for treating H5N1 was assessed, and approximately half of the participants in the non-event group tended to seek healthcare earlier when they developed symptoms, compared with the event group (P < 0.001).

Significantly fewer participants in the event group compared with the non-event group said that they sought healthcare immediately if they developed a fever after touching sick poultry (P < 0.001). The preferred healthcare organization that they accessed first when they got a fever was the commune healthcare center in the event group (90.4%) and the provincial hospital in the non-event group (62.0%).

The median knowledge and attitude-practice scores in the event and non-event groups were 8 vs. 9, and 6.9 vs. 7.4, respectively, out of a total of 10. The differences between the groups in terms of both scores were significant (P < 0.001) (Table 5).

Factors Influencing Early Access to Health Care

In the logistic regression analysis using baseline background data of the participants, factors that influenced early access to healthcare once participants developed symptoms were knowledge about the necessity of early access to healthcare, not eating sick and dead poultry, and considering avian influenza to be a life-threatening disease (Table 6).

Discussion

The present study demonstrated that the occurrence of H5N1 in neighboring areas had an emotional impact, and also increased people’s attention to preventive measures and their knowledge about the necessity of early access to healthcare. Information and education delivery need to take into account the local conditions of the population.

Most human cases of avian influenza (H5N1) occur through direct or indirect contact with poultry [20,21,22]. Contaminated water has also been identified as a potential risk factor [23,24]. Bac Kan province is in a mountainous part of northeast Vietnam, with 95% of its area dominated by forest. The event group in Cho Moi District was located in a more deeply-forested area than the non-event group even though the districts are located side-by-side in Bac Kan province (Figure 1). Along with the study participants,

Table 3. Knowledge of study participants regarding avian influenza (H5N1).

| Event group (Nhu Co) | Non-event group (Minh Kai) | P value |
|---------------------|---------------------------|---------|
| (n = 322)           | (n = 221)                 |         |
| **No. (%)**         | **No. (%)**               |         |
| AI is a kind of infectious disease | 303 (94.1) | 216 (97.7) | 0.042 |
| People get AI by touching sick poultry | 293 (91.0) | 214 (96.8) | 0.003 |
| AI can be prevented | 292 (90.7) | 214 (96.8) | 0.001 |
| AI can be cured | 276 (85.7) | 198 (89.6) | 0.001 |
| People can die of AI | 298 (92.5) | 214 (96.8) | 0.021 |
| Do not eat sick/dead poultry | 165 (51.2) | 158 (71.5) | <0.001 |
| Early access to healthcare is the key to treat AI | 312 (96.9) | 215 (97.3) | 0.805 |
| What is the most serious disease that you concern |  |  |
| Diarrhea | 57 (17.7) | 38 (17.2) | 0.909 |
| Cough/pneumonia | 38 (11.8) | 18 (8.1) | 0.197 |
| Avian influenza (H5N1) | 236 (73.3) | 157 (71.0) | 0.625 |
| Malaria | 50 (15.5) | 19 (8.6) | 0.018 |
| Tuberculosis | 52 (16.1) | 20 (9.0) | 0.020 |
| Others | 10 (3.1) | 11 (5.0) | 0.003 |

AI: avian influenza (H5N1) in humans.
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most residents in Cho Moi district were farmers and raised chickens, ducks, buffalo, and pigs. The non-event group lived in a more urban environment. Even though high awareness of H5N1 infection was observed in both groups, the event group had more chance to come into contact with poultry, thus increasing their risk for H5N1 infection compared with the non-event group. These results were compatible with a previous study in China that compared a typical urban area with a rural area in the middle of China [25]. More participants in the event group had experienced H5N1 infection and unexplained sudden death in their household poultry, and a higher awareness of the importance of vaccination of poultry was observed. However, when their poultry died suddenly, participants in the event group were more likely than those in the non-event group to sell the rest of their live poultry, eat dead poultry, or throw carcasses into a river or pond. These results indicate that, participants in the event group maintained traditional habits and did not sufficient knowledge about the risks of H5N1 infection, with economic difficulties possibly contributing

| Table 4. Attitude-practices related to avian influenza (H5N1). |
|---------------------------------------------------------------|
| **Hygiene practices**                                         |
| Use soap when you wash your hands 318 (98.8) 220 (99.5) 0.766 |
| Use clean water when you wash your hands 245 (76.1) 208 (94.1) <0.001 |
| What would you do if your household poultry suddenly die? (multiple choices)* |
| Sell rest of live poultry 10 (3.1) 1 (0.5) 0.032 |
| Eat them 3 (0.9) 1 (0.5) 0.649 |
| Throw them in a river or pond/outside 6 (1.9) 2 (0.9) 0.482 |
| Bury them 301 (93.5) 177 (80.1) <0.001 |
| Disinfect poultry cage 137 (42.5) 101 (45.7) 0.001 |
| Report to government authorities 173 (53.7) 149 (57.4) 0.002 |
| Do nothing 2 (0.6) 0 (0.0) 0.516 |
| When slaughtering poultry, how can you protect yourself from AI? (multiple choices) |
| Wear gloves 155 (48.1) 142 (64.3) <0.001 |
| Wear mask 159 (49.4) 123 (55.7) 0.162 |
| Do it away from house 40 (12.4) 60 (27.1) <0.001 |
| Wash hands afterwards with soap 279 (86.6) 195 (88.2) 0.603 |
| Clean area afterwards… 110 (34.2) 160 (72.4) <0.001 |
| Healthcare-seeking behavior |
| After touching sick or dead poultry, if you are sick with fever, how fast do you seek treatment? 0.002 |
| Immediately 250 (77.6) 200 (90.5) |
| 1–2 days after onset 55 (17.1) 16 (7.2) |
| If get really sick 11 (6.4) 3 (1.4) |
| Nothing 1 (0.3) 1 (0.5) |
| Which organization do you seek treatment at first? |
| Community health center 291 (90.4) 56 (25.3) <0.001 |
| District hospital 52 (16.1) 30 (13.6) 0.465 |
| Provincial hospital 2 (0.6) 137 (62.0) <0.001 |

AI: avian influenza (H5N1) virus infection in humans.
*participants who did not have household poultry answered as if they have household poultry.
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| Table 5. Knowledge and attitude-practices scores. |
|--------------------------------------------------|
| **Knowledge score**                              |
| Event group (Nhu Co) 8 1–10 –4.542 <0.001 |
| Non-event group (Minh Kai) (n = 221) 9 2–13 |
| **Attitude-practice score**                      |
| Event group (Nhu Co) 6.9 3–10 –6.482 <0.001 |
| Non-event group (Minh Kai) (n = 221) 7.4 4–9 |

*The Z statistic was obtained from the Mann-Whitney test for two independent samples.
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factor. Their economic difficulties in the event group might contribute for these behaviors. Although the role of water in transmission could not be confirmed, people’s behavior can contribute to the production of contaminated water. The results also indicated a lower knowledge score in the event group than in the non-event group. The main information sources about H5N1 infection for both groups were the television and radio. However, differences in economic conditions, which were qualified on the basis of household possessions, explained the difficulty in receiving information from television and radio, given that most participants in the event group did not have access to these. Educational background was also an important factor in understanding the information. Over 34% of participants in the event group had only an elementary school education, were illiterate, or had no educational background. Increased knowledge and appropriate attitude-practices relating to H5N1 infection were influenced by education, occupation, and economic conditions among the study population in an H5N1-affected community, as well as by the awareness of the presence of H5N1 patients in the community. These findings are compatible with previous surveys relating to H5N1 in China, Afghanistan, Laos, and Italy [25,26,27,28], and suggest that appropriate information delivery needs to be adjusted to local conditions [2,25].

More participants in the event group knew about the occurrence of H5N1 patients in neighboring areas (P = 0.001) and were scared when they heard the news of an event (P < 0.001). At the time of the event, 174 (54%) of participants in the event group and 168 (76%) of participants in the non-event group visited the hospital with flu-like symptoms such as cough, fever, and nasal discharge, or just because they were scared. The occurrence of H5N1 infection in humans in their neighbors caused the residents to panic and be unable to make calm decisions. They were unsure if their symptoms were attributable to H5N1 or to infection by another influenza virus, and their resulting behaviors made it more difficult for medical providers to take care of those who really needed medical intervention. After the event, almost all participants in the non-event group and over 90% in the event group sought healthcare early once they developed symptoms (e.g., fever). The event thus had an impact on their healthcare-seeking behaviors.

Logistic regression analysis identified factors influencing immediate access to healthcare once participants developed a fever after touching sick/dead poultry as knowledge about not eating such poultry, knowledge about the necessity for early access to healthcare, and recognition of H5N1 as a life-threatening disease. The results indicate that healthcare providers in high-risk areas need to stress the necessity of early access to healthcare, and promote proper knowledge about poultry handling to prohibit habits that favor H5N1 infection. Participants in the event group visited their local health center, while participants in the non-event group visited the provincial hospital. It is difficult to change behaviors and customs, especially in residents of rural areas. However, closer relationships between local healthcare providers and residents could promote early healthcare behaviors in people living in rural communities in deeply-forested regions. Educational programs conducted by local healthcare providers might be effective, but the attitudes of local residents must be taken into consideration when planning health education in communities with H5N1 patients in neighboring areas.

This study was limited to a comparison of participants living in one community affected and the other unaffected by the H5N1 outbreak in 2010, representing a rural and an urban setting in a province of Vietnam. Participants who did not have household poultry were included in the study participants and they need to answer some questions as if they have household poultry. Further investigations comparing subjects with similar socioeconomic conditions and common educational and environmental backgrounds are required to further assess the influence of an H5N1 outbreak.

Awareness of H5N1 patients in neighboring areas can cause panic in residents. However, it can also contribute to early healthcare-seeking behavior. Providing information from experiences of occurrence of H5N1 patients and clinical preparedness are crucial if further influenza pandemics occurred. Periodic educational interventions using locally-adjusted methods could contribute to preventing panic, motivating early access to healthcare, and reducing infection and mortality.

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Author Contributions
Performed the experiments: TM TTH DML DTHV PTPT DTTH TTMP DHM JT NQC LQT KK. Analyzed the data: TM KK. Wrote the paper: TM.

References
1. World Health Organization (2010) Cumulative Number of Confirmed Human Cases of Avian Influenza A(H5N1): Reported to WHO. August 19 2011. Available: http://www.who.int/csr/disease/avian_influenza/country/cases_table_2011_08_19/en/index.html. Accessed 2011 Jul.
2. Manabe T, Pham TPT, Vu VC, Takasaki J, Dinh TTH, et al. (2011) Impact of Educational Intervention Concerning Awareness and Behaviors Relating to Avian Influenza (H5N1) in a High-risk Population in Vietnam. PLoS ONE 6(8): e23711.
3. Hien TT, Liem NT, Dung NT, San LT, Mai PP, et al. The World Health Organization International Avian Influenza Investigative Team (2004) Avian influenza A (H5N1) in 10 patients in Vietnam. N Engl J Med 350: 1179–88.

4. World Health Organization (2007) Clinical Management of human infection with avian influenza A (H5N1) virus. Available: http://www.who.int/csr/disease/avian_influenza/guidelines/ClinicalManagement07.pdf. Accessed 2010 Jan 10.

5. World Health Organization (2010) Update on human cases of highly pathogenic avian influenza A (H5N1) virus infection, 2010. Wkly Epidemiol Rec. 85(17): 161–6.

6. Adams S, Sandrock C (2010) Avian Influenza: Update. Med Princ Pract 19: 421–432.

7. Perez-Padilla R, de la Rosa-Zamboni D, Ponce de Leon S, Hernandez M, Quisiones-Falconi F, et al. (2009) Pneumonia and Respiratory Failure from Swine-Origin Influenza A (H1N1) in Mexico. N Engl J Med 2009;361: 680–689.

8. Writing Committee of the WHO Consultation on Clinical Aspects of Pandemic (H1N1) 2009 Influenza, Bautista E, Chopitayasuondh T, Gao Z, Harper SA, Shaw M, et al. (2010) Clinical aspects of Pandemic 2009 Influenza A (H1N1) virus infection. N Engl J Med 362: 1708–1719.

9. Echevarria-Zuno S, Mejia-Arangure JM, Mar-Obeso AJ, Grajales-Muniz C, Robles-Perez E, et al. (2009) Infection and death from influenza A H1N1 virus in Mexico: a retrospective analysis. Lancet 374: 2072–2079.

10. Dominguez-Cherit G, Lapinsky SE, Mariscal AL, Pinto R, Espinosa-Perez L, et al. (2010) Critically Ill Patients with 2009 Influenza A(H1N1) in Mexico. JAMA 302(17): 1880–1887.

11. Grijalva-Otero I, Talavera JO, Solorzano-Santos F, Vázquez-Rosales G, Adams S, Sandrock C (2010) Avian Influenza: Update. Med Princ Pract 19: 421–432.

12. Higuera Iglesias AL, Kudo K, Manabe T, Corcho Berdugo AE, Baeza AC, et al. (2009) Critical analysis of deaths due to atypical pneumonia during the onset of the influenza A (H1N1) virus epidemic. Arch Med Res 40(3): 662–668.

13. Higuera Iglesias AL, Kudo K, Manabe T, Gorcho Berthou GE, Baeza AC, et al. (2011) Reducing Occurrence and Severity of Pneumonia Due to Pandemic H1N1 2009 by Early Oseltamivir Administration: A Retrospective Study in Mexico. PLoS ONE 6(7): e21838. doi:10.1371/journal.pone.0021838.

14. Manabe T, Thuy PTP, Kudo K, Van VTT, Takasaki J, et al. (2012) Impact of Education and Network for Avian Influenza H5N1 in Human: Knowledge, Clinical Practice, and Motivation on Medical Providers in Vietnam. PLoS ONE 7(1): e30384. doi:10.1371/journal.pone.0030384.

15. World Health Organization (2010) Avian influenza – situation in Vietnam – update 11. Available: http://www.who.int/csr/don/2010_04_21/en/index.html. Accessed 2011 Jul.

16. World Organization for Animal Health (2010) OIE daily update on avian influenza situation in birds. Available: http://www.oie.int/wahis/reports/en_fup_0000010146_20110110_20110110_121831.pdf. Accessed 2012 Jan 12.

17. Le MTQ, Wertheim HFL, Nguyen HD, Taylor W, Hoang PVM, et al. (2008) Influenza A H5N1 Clade 2.3.4 Virus with a Different Antiviral Susceptibility Profile Replaced Clade 1 Virus in Humans in Northern Vietnam. PLoS ONE 3(10): e33339. doi:10.1371/journal.pone.0003339.

18. Liem NT, Tung CV, Hien ND, Hien TT, Chau NQ, et al. (2009) Clinical features of human infection A(H5N1) in Vietnam: 2004–2006. Clin Infect Dis. 15;6812: 1639–46.

19. Hien ND, Ha NH, Van NT, Ha NT, Liem TT, et al. (2009) Human infection with highly pathogenic avian influenza virus (H5N1) in northern Vietnam, 2004–2005. Emerg Infect Dis. 15;1: 19–23.

20. Pham ND, Hoang TL, Nguyen KT, Nguyen TH, Mai LQ, et al. (2006) Risk Factors for Human Infection with Avian Influenza A H5N1, Vietnam, 2004. Emerg Infect Dis. 12; 1841–47.

21. Chotpitayasunondh T, Ungchusak K, Hanshaoworakul W, Chaowsithiwat S, Sawanpanyalert P, et al. (2005) Human Disease from Influenza A(H5N1), Thailand, 2004. Emerg Infect Dis. 11: 201–9.

22. Kandun IN, Wibisono H, Sedyaningrisi ER, Yusharmen, Hadiyosoarono W, et al. (2006) Three Indonesian Clusters of H5N1 Virus Infection in 2005. N Engl J Med 355: 2186–94.

23. Vong S, Ly S, March S, Holl D, Buchy P (2008) Environmental Contamination during Influenza A Virus (H1N1) Outbreaks, Cambodia, 2006. Emerg Infect Dis. 14; 1303–5.

24. Vong S, Ly S, Van Kerhove MD, Achenbach J, Holl D, et al. (2009) Risk Factors Associated with Subclinical Human Infection with Avian Influenza A(H5N1) Virus-Cambodia, 2006. J Infect Dis. 199: 1744–52.

25. Xiang N, Shi Y, Wu Jiabing, Zhang S, Ye M, et al. (2010) Knowledge, attitudes and practices (KAP) relating to avian influenza in urban and rural areas of China. BMC Infectious Diseases 10: 34.

26. Zarychanski R, Stuart TL, Kumar A, Doucette S, Elliott L, et al. (2010) Correlates of severe disease in patients with 2009 pandemic influenza (H1N1) virus infection. CMAJ 25:1823(2): 257–264.

27. Barrynes H, Martinez-Aussel B, Vongdhirachanh P, Strobel M (2007) Avian Influenza Risk Perceptions, Laos. Emerg Infect Dis. 13(7): 1126–1128.

28. Di Giuseppe G, Abbate R, Albaso L, Marinielli P, Angello IF (2008) A survey of knowledge, attitudes and practices towards avian influenza in an adult population of Italy. BMC Infect Dis. 17:8; 36.