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# Evaluating interest in an influenza A(H5N1) vaccine among laboratory workers who work with highly-pathogenic avian influenza viruses in the United States

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## Abstract

**Background—**Highly pathogenic avian influenza A (HPAI) viruses found in poultry and wild birds occasionally infect humans and can cause serious disease. In 2014, the Advisory Committee on Immunization Practices (ACIP) reviewed data from one licensed ASO3-adjuvanted influenza A(H5N1) vaccine for consideration of use during inter-pandemic periods among persons with occupational exposure. To guide vaccine policy decisions, we conducted a survey of laboratory workers to assess demand for HPAI vaccination.

**Methods—**We designed an anonymous web survey (EpiInfo 7.0) to collect information on demographics, type of work and time spent with HPAI viruses, and interest in HPAI vaccination. Eligible participants were identified from 42 entities registered with United States Department of Agriculture's Agricultural Select Agent program in 2016 and emailed electronic surveys. Personnel with Biosafety Level 3 enhanced (BSL-3E) laboratory access were surveyed. Descriptive analysis was performed.

**Results—**Overall, 131 responses were received from 33 principal investigators, 26 research scientists, 24 technicians, 15 postdoctoral fellows, 6 students, and 27 others. The estimated response rate was 15% among the laboratory personnel of responding principal investigators. One hundred respondents reported working in a BSL-3E area where HPAI experiments occurred with a mean time of 5.1–11.7 h per week. Overall, 49% were interested in receiving an A(H5N1) vaccine. By role, interest was highest among students (80%) and among those who spent >50% of their time in a BSL-3E area (64%). Most (61%) of those who said they might be or were not interested in vaccine believed it would not provide additional protection to current safety practices.

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**Disclaimer**

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

**Conflict of interest**

The authors do not have an association that might pose a conflict of interest.

**Conclusions—**Half of responding laboratory workers was interested in receiving an influenza A(H5N1) vaccine. HPAI vaccination of laboratory workers at risk of occupational exposure could be used along with existing safety practices to protect this population.

### Keywords

Influenza; Human; Influenza A virus; A(H5N1) subtype; Influenza vaccines; Vaccination; Research personnel; Occupational Exposure/prevention & control

## 1. Introduction

Highly pathogenic avian influenza (HPAI) viruses, including influenza A(H5N1) viruses, cause severe respiratory disease and death in birds and have been found in poultry and wild birds in Africa, Asia, Australia, Europe, and North America [1]. A(H5N1) viruses can also cause severe disease in humans. From 2003 through 2016, 16 countries reported 856 human infections of A (H5N1) virus, with 452 deaths (53% case fatality proportion), to the World Health Organization (WHO) [2]. Most human infections with A(H5N1) virus occur from contact with infected birds or environments, but limited human-to-human transmission has been reported [3–6].

A(H5N1) viruses are considered to have moderate pandemic potential, and research to understand transmission and adaptability, and to develop vaccines, are public health priorities [7–10]. Laboratory work with A(H5N1) viruses is necessary to further our understanding of these viruses and the risk they pose to public health, and to develop vaccines. While best practices for working with HPAI viruses protect individuals from exposure, including enhanced BSL3 practices, some risk of inadvertent exposure exists [11–13]. In 2014, there were 173 principal investigators in the United States registered through the United States Department of Agriculture (USDA) Select Agent Program to work with HPAI viruses [personnel communication, Mark Hemphill]. Between 2007 and 2013, registered HPAI Select Agent laboratories reported a total of 44 incidents to the USDA, including needle sticks, animal bites, personal protective equipment failure, inadvertent leakage or spillage of materials, or work outside of containment areas [personnel communication, Mark Hemphill]. However, there has never been a laboratory-associated infection with an HPAI virus.

Vaccination is the primary method of preventing seasonal influenza and an important tool to prevent pandemic influenza [14]. In recent years, substantial research has been conducted on A(H5N1) vaccines, resulting in the development of licensed vaccine products for use during future pandemics and for pandemic stockpiles [7]. In 2013, the WHO Strategic Advisory Group of Experts (SAGE) Working Group on Influenza Vaccines and Immunizations updated their general recommendations on A(H5N1) vaccines to include use before pandemics (i.e., inter-pandemic) and strongly recommended vaccination of laboratory personnel working with A (H5N1) viruses [7]. In 2013, the Centers for Disease Control and Prevention Division of Select Agents and Toxins made specific recommendations for vaccination with an A(H5N1) vaccine for all laboratory workers working with influenza viruses containing hemagglutinin from the influenza A/goose/Guangdong/1/96 lineage [13].

However, without a licensed, available vaccine for use during the inter-pandemic period, access to A(H5N1) vaccine among laboratory personnel in the United States has been limited to participation in clinical trials.

A(H5N1) vaccines are not commercially produced in the United States, but the U.S. government supported limited production for testing and for pandemic stockpiles [15,16]. There are currently doses of four A(H5N1) monovalent vaccines in the U.S. stockpile. The U.S. Federal Drug Administration (FDA) licensed two of these for use in the United States during a pandemic [17]. FDA licensed Q-Pan H5N1 in 2013 for use in persons aged ≥18 years at increased risk of occupational exposure to influenza A(H5N1) virus. The vaccine contains antigen from the influenza A/Indonesia/05/2005 virus strain (Clade 2.1.3.2) and is intended to be administered with an oil-in-water emulsion adjuvant, AS03. The vaccine was prepared under contract with the U.S. Department of Health and Human Services as part of the national pandemic preparedness initiative. The U.S. Advisory Committee on Immunization Practices (ACIP) recently considered the use of a small amount (<3000 doses) of stockpiled Q-Pan H5N1 vaccine for persons with occupational exposure to HPAI virus (e.g., laboratory workers) during the inter-pandemic period [18].

To assess the demand for an A(H5N1) vaccine among laboratory personnel working with HPAI viruses, we conducted a survey to help guide decisions as to whether the stockpiled vaccine should be made available for persons at risk of occupational exposure during the inter-pandemic period. The primary objective was to quantify the demand for Q-Pan H5N1 vaccine among persons working in laboratories registered with the USDA to work with HPAI viruses. Secondary objectives were to describe and categorize the type and amount of work with HPAI viruses among laboratory workers, quantify the average weekly person-hours of work with various HPAI viruses, and identify access to an occupational health clinic through which a vaccine could be administered.

## 2. Materials and methods

### 2.1. Survey participants and study period

HPAI viruses are designated as Select Agents in the United States, and therefore any entity working with HPAI in the United States must register with the USDA Animal and Plant Health Inspection Service, Agriculture Select Agent Services. USDA identified 42 entities registered to work with HPAI in 2016, and sent an email containing information and a link to the electronic survey to all Responsible Officials and Alternate Responsible Officials at each of the identified entities. Each entity was requested to share the survey with principal investigators (PIs) working with HPAI viruses and all laboratory workers with access to their biosafety level 3 enhanced (BSL-3E) laboratory in which work with HPAI viruses are carried out. No identifying information was collected from respondents. CDC had no direct contact with respondents or institutions. The survey period was from August to September 2016. The survey and report were determined not to constitute human subjects research, but rather public health response.

### 2.2. Survey design and distribution

A web survey was created using Epi Info 7.0. The survey contained 21 questions pertaining to demographic characteristics, type of work with HPAI viruses, weekly person-hours of work with HPAI viruses, interest in HPAI and A(H5N1) vaccines, and access to vaccination through occupational health clinics. Additional information about Q-Pan H5N1 was not provided in the survey. PIs were asked to complete the self-administered electronic questionnaire accessed through a secure link, and to forward the secure link to all staff in their laboratory with access to a BSL-3E laboratory area where HPAI experiments occur. PIs were asked to request that all such staff complete the survey. PIs were also asked to report the number of persons in their laboratory with access to the BSL-3E laboratory in order to obtain the number of persons who would have received the survey. A reminder email was sent to all Responsible Officials and Alternate Responsible Officials at each of the identified institutions 2 weeks after the initial email.

### 2.3. Statistical analysis

Descriptive analysis of survey responses was performed using SAS 9.3. To estimate a response rate among PIs, we used a denominator of 173, the number of PIs registered in 2014 (database limitations prevented estimation of this number in later years). We estimated the response rate by occupational category using the numbers provided by each PI. Analysis was limited to those respondents who reported working in the BSL-3E area where HPAI experiments occur (and therefore could have been exposed to live virus or virus particles) with sub-analyses limited to those who worked directly with A(H5N1) viruses. Given that laboratory personnel may have varying work schedules in the BSL-3E area depending on occupational category and work (e.g., concentrated intermittent vs. regularly scheduled weekly hours), we asked respondents to estimate percentages of their total work time spent on various types of work with HPAI or A(H5N1) (<10%, 10–25%, 26–50%, 51–75% or >75%). To calculate the average time spent on each type of work with HPAI viruses, we multiplied the lower (1% for <10%, 10% for 10–25%, 26% for 26–50%, 51% for 51–75%, and 76% for >75%) and upper range (9% for <10%, 25% for 10–25%, 50% for 26–50%, 75 for 51–75% and 100% for >75%) of time spent performing each type of activity by either 40 h per week (if the respondent indicated that they were full-time staff), or 20 h per week (for part-time staff/employees). The means of the lower percentage and upper percentage were calculated across occupational categories to give a mean range of hours per week.

## 3. Results

### 3.1. Response rate

We received 131 responses, including 33 who self-identified as PIs (33 of 173 registered with USDA, 19% response rate) (Fig. 1). The 33 PIs reported a combined 126 research scientists, 70 postdoctoral fellows, 230 research technicians, 33 students, 86 animal care workers, and 102 other staff with access to their BSL-3E laboratories where HPAI experiments occurred. The overall response rate among laboratory workers of responding PIs was 98 of 647 possible respondents (15%). The response rate varied by occupational category (Fig. 1). We received responses from 26 research scientists (26/126, 21%), 15 post-doctoral fellows (15/70, 21%), 24 research technicians (24/230, 10%), 6 students (6/33,

18%), 1 animal care worker (1/86, 1.2%) and 26 from other roles, such as bio-safety program staff and laboratory management (26/102, 25%).

### 3.2. Demographics

All further analysis was limited to the 100 respondents who reported working in the BSL-3E area where HPAI experiments occur (Fig. 1). This included 26 PIs, 21 research scientists, 10 post-doctoral fellows, 20 research technicians, 6 students, 1 animal care workers, and 16 other workers. Half of respondents were female and 63% were between 25 and 44 years of age (Table 1). The majority of respondents worked at universities (49%) or federal government institutions (34%). Respondents reported a median of 8 years working in a BSL-3E laboratory and 6 years specifically working on HPAI viruses.

### 3.3. Work type and time

Respondents reported a mean of 5.1–11.7 h per week in the BSL-3E laboratory. Seventy-eight (78%) reported working directly with either HPAI viruses or specimens from suspected HPAI cases, or animals infected or inoculated with HPAI viruses. The most common HPAI viruses with which respondents worked were A(H5N1) (65%), A(H5N2) (26%), A(H5N8) (21%) and A(H7N7) (21%).

Sixty-six respondents (66%) reported working with live HPAI virus (e.g., in cell culture) for an average of 4.2–9.3 h per week. The occupational category of research scientists reported the greatest amount of time spent working with live HPAI virus (mean of 8.9–15.3 h per week) (Table 2a). Thirty (30%) reported working with clinical samples from suspected cases (human or animal) of HPAI virus infection, and the average amount of time was 7.9–14.1 h per week. Students reported the greatest amount of time spent working with samples from suspected cases (15.4–25.0 h per week). Sixty-one (61%) reported working with experimentally inoculated or infected animals or their secretions, and the average amount of time was 4.1–9.4 h per week. Students reported the greatest amount of time spent working with HPAI-inoculated or -infected animals (7.2–15.0 h per week).

Sixty-five respondents (65%) reported working with A(H5N1) viruses. The most common A(H5N1) virus strains reported were A/Vietnam/1203/2004 (83%), A/Anhui/1/2005 (42%), and A/Indone-sia/05/2005 (37%). Fifty-nine (59%) reported working with live A (H5N1) virus, with a mean time of 3.5–8.4 h per week. Research scientists reported the greatest amount of time spent working with live A(H5N1) virus (mean of 7.4–13.9 h per week) (Table 2b). Twenty-one (21%) reported working with samples from suspected A(H5N1) human or animal cases and the average amount of time was 5.4–10.9 h per week. The occupational category of other workers reported the greatest amount of time spent working with A (H5N1) virus from suspected cases (10.4–20.0 h per week). Fifty (50%) reported working with animals infected or inoculated with A(H5N1) and the average amount of time was 3.6–8.6 h per week. Students reported the greatest amount of time spent working with A(H5N1) inoculated or infected animals (10.4–20.0 h per week).

### 3.4. Interest in vaccines

Of the 100 respondents who reported working in a BSL-3E area where HPAI experiments occurred, 88 of 90 respondents (98%) reported receiving a 2015–16 seasonal influenza vaccine and 12 of 93 respondents (13%) had participated in a vaccine trial for an influenza vaccine (either seasonal or pandemic). Forty of 92 respondents (43%) had heard of the Q-Pan H5N1 vaccine prior to the survey. When asked if they would be interested in receiving Q-Pan H5N1 vaccine if offered at their institution, 45 of 91 respondents (49%) said "Yes," 35 (38%) said they "Might be interested but needed more information," and 11 (12%) said "No." Interest in receiving Q-Pan H5N1 varied by occupational category and was highest among students (80%) and lowest among PIs (42%), post-docs (40%) and other workers (33%) (Fig. 2). Interest in receiving the vaccine also varied with the amount of reported time spent working in the BSL-3E laboratory (Fig. 3). Interest was highest among those who spent >50% of their time in a BSL-3E laboratory (64%) and lowest in those who spent <10% of their time in the BSL-3E laboratory (39%). Interest in Q-Pan H5N1 vaccine was similar by type of work performed with HPAI viruses (e.g. work with live virus, suspect cases, or infected or inoculated animals). Of those who had participated in an influenza vaccine trial in the past, 8 (or 67%) reported that they would be interested in receiving Q-Pan H5N1 vaccine.

Of the persons who replied that they might be interested or they were not interested in the vaccine, the most common reasons were "I don't think the vaccine would provide any further protection on top of my current safety practices" (61%), followed by "I have concerns about the safety of the adjuvant in the vaccine" (26%) (Table 3). In addition to Q-Pan H5N1 vaccine, 69 of 90 respondents (77%) answered that they would be interested in vaccines against other HPAI viruses if they were licensed by FDA and available. Eighty-six of 91 respondents (95%) reporting having an occupational health clinic at their place of work and 73 of those (85%) had received any vaccine at this clinic previously.

## 4. Discussion

In our survey of laboratorians working with HPAI viruses, A (H5N1) was the most commonly used virus. Multiple different A (H5N1) virus strains were used by respondents and one third worked with A/Indonesia/05/2005, the strain included in the Q-Pan H5N1 vaccine. Respondents spent an average of 5.1–11.7 h per week working in a BSL-3E area where HPAI experiments occur, with the most time spent working with specimens from suspected HPAI cases. Half of respondents were interested in receiving the Q-Pan H5N1 vaccine, and another 38% wanted more information. Reasons given for lack of interest in the vaccine related to belief that the vaccine would not provide additional benefit on top of current safety practices and safety concerns about the adjuvant.

We found that among our respondents, students were among those with the most time spent working with HPAI viruses, including working with live virus, samples from suspect cases, and inoculated animals. In general, laboratory-acquired infections associated with any work in BSL-3 or 4 laboratories are rare [19,20]. Information about occupational categories or years of experience in advanced biosafety laboratories are not usually reported, but at least one student is known to have been infected with SARS coronavirus in the laboratory [21].

Student respondents in our survey also had the highest interest in receiving the Q-Pan H5N1 vaccine. However, we had few student respondents and those who worked more closely with HPAI viruses may have been more likely to complete the survey. Although this could introduce response bias, we would expect this same bias to occur across each occupational category.

Nearly half of respondents were interested in receiving the Q-Pan H5N1 vaccine and of the remaining, the majority responded that they might be interested but wanted more information. If vaccine were to be offered to laboratory workers, education should be provided about protection provided by the vaccine and its safety profile. The majority of respondents were also interested in receiving vaccines against other HPAI viruses if available and licensed. The most commonly selected reason for a lack of interest in Q-Pan H5N1 vaccine or wanting more information about the vaccine was a belief that the vaccine would not provide further benefit to current biosafety practices. If an A(H5N1) vaccine were to be recommended, it would be used in tandem with current laboratory training and biosafety practices and, in the event of an accident, recommended post-exposure prophylaxis with anti-viral medication [22–25].

Safety concerns were also given as a reason for lack of interest in the Q-Pan H5N1 vaccine, and these mostly centered on the adjuvant. Q-Pan H5N1 was the first licensed influenza vaccine with adjuvant in the United States [26]. Adjuvants are used to increase the magnitude and breadth (e.g., production of cross-strain neutralizing antibodies) of the immune response to the vaccine, which is especially important for vaccines containing influenza strains for which little or no prior antibodies are present, such as novel influenza A viruses [27–29]. During the 2009 influenza pandemic, some AS03-adjuvanted monovalent influenza A(H1N1)pdm09 vaccines were associated with an increased risk of narcolepsy in children and adolescents in some countries [30,31], though it is unknown whether this was related to the antigen, the adjuvant, some genetic susceptibility, or a combination of these factors. The acceptable safety profile of Q-Pan H5N1 was demonstrated in several studies prior to licensure and is comparable with seasonal influenza vaccines, though larger sample sizes are needed to assess for rare adverse events such as narcolepsy [29,32,33]. Furthermore, the ASO3 adjuvant used in Q-Pan H5N1 has been shown to have a better immune response than the MF59 adjuvant when used in an A (H7N9) vaccine [34].

An ideal vaccine candidate would provide at least some level of cross-protection across multiple H5 subtype strains (i.e., heterologous protection). Development of neutralizing antibodies against other clades was seen in some participants of Q-Pan H5N1 immunogenicity trials [35,36]. Adjuvanted A(H5N1) vaccines have been found to prevent mortality from heterologous strains in mice models [37] and some studies have found cross-reacting antibodies in humans after a booster with a heterologous vaccine (for example, receiving a first dose of an influenza A/Vietnam/04 vaccine followed by a booster dose of an A/Indonesia/05 vaccine resulting in antibody development to multiple strains) [38]. However, Q-Pan H5N1 vaccine would be offered with the main intent to protect primarily against the A/Indonesia/05 strain.

The risk of laboratory-acquired influenza A(H5N1) virus infection is likely extremely low. A review of reported select agent laboratory-acquired infections reported to CDC between 2004 and 2010 identified a total of 11, giving an estimated rate of 1.57 per 10,000 laboratory worker-years in the United States [20]. There have been no cases of laboratory-acquired HPAI virus infections reported to date; however, the risk of laboratory-acquired infection is not zero and A(H5N1) virus remains a moderate pandemic threat [10]. In addition to laboratory workers, avian influenza outbreak responders are also at increased risk of occupational exposure. There have been several serosurveys among poultry workers in Asia responding to A(H5N1) virus outbreaks in poultry, all of which have demonstrated low levels of seropositivity [39–41]. Vaccination may provide a safe addition to current biosafety practices for the relatively small population at increased risk of occupational exposure. Based on estimates presented to ACIP, approximately 6000 doses would be needed to provide 2 doses to an estimated 2500 laboratory personnel and 500 public health responders in the United States [18].

Our survey has several limitations. The estimated response rate was low and our findings may not be representative of U.S. laboratory personnel working with HPAI viruses. In addition, our survey results may not be generalizable to other occupations with potential occupational exposure to HPAI viruses (e.g., avian influenza outbreak responders). We also had difficulties assessing accurately the time spent working with HPAI or A(H5N1) viruses. Estimates were based on respondents' reported typical work schedules, which may vary in time spent in the BSL-3E area working with HPAI. Individuals who work more with HPAI or influenza A (H5N1) viruses may have been more likely to respond to the survey introducing response bias. Finally, the survey was designed to collect information relevant for vaccination policy in the United States and distributed to laboratories registered with the USDA, so the results may not be generalizable to the broader global community.

## 5. Conclusion

The majority of respondents were interested in or wanted more information about the Q-Pan H5N1 vaccine. HPAI vaccination of laboratory workers at risk of occupational exposure could be used along with existing biosafety practices to protect this population. If other HPAI vaccines are available and licensed, further research will be needed to determine which, if any, should be offered to HPAI laboratory workers during the inter-pandemic period.

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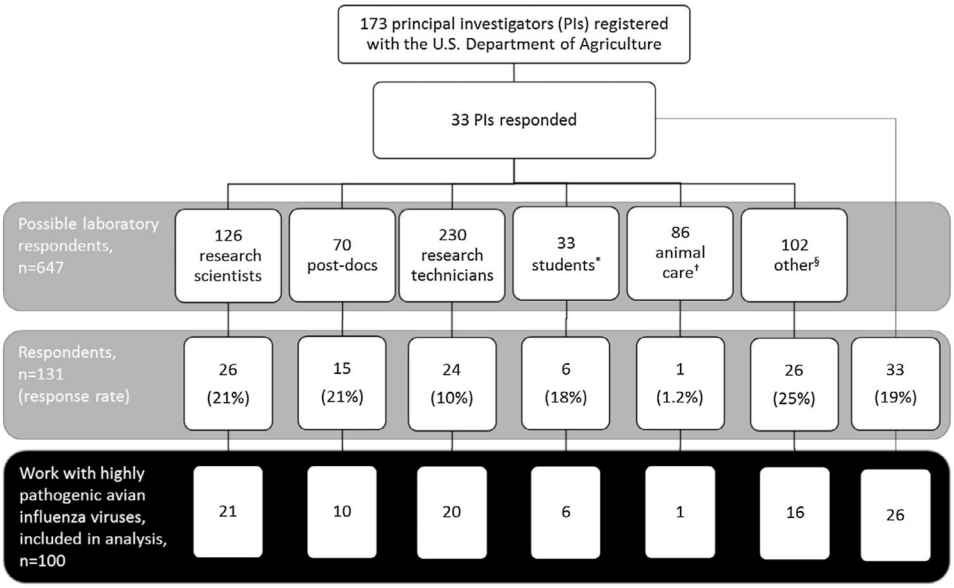


**Fig. 1.**

Number of respondents and response rate by primary occupational category. *Students include graduate or other students, †Animal care includes husbandry or veterinary practices, §Other includes biosafety program staff or laboratory management.

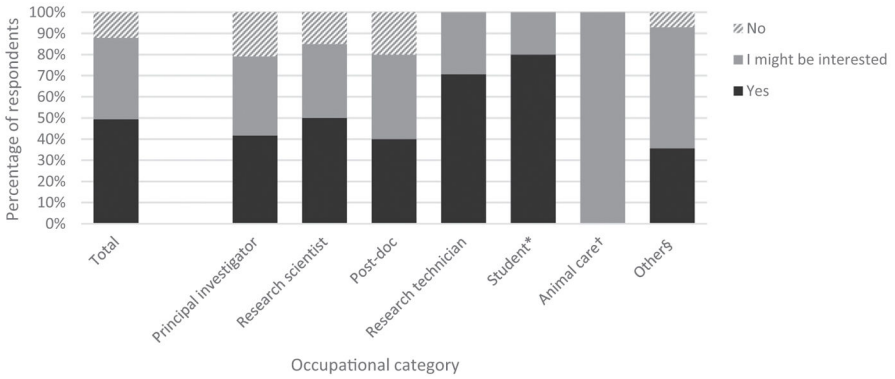


**Fig. 2.**

Interest in Q-Pan H5N1 vaccine by occupational category among respondents who report working in a biosafety level 3 enhanced (BSL-3E) area where HPAI experiments occur. *Students include graduate or undergraduate students, †Animal care includes husbandry or veterinary practices, §Other includes biosafety program staff and management.


**Fig. 3.**

Interest in Q-Pan H5N1 vaccine by percentage of time spent working in the biosafety level 3 enhanced (BSL-3E) laboratory among respondents who report working in a BSL-3E area where HPAI experiments occur.

## Table 1

Descriptive characteristics of survey respondents who reported any work in a biosafety level 3 enhanced (BSL-3E) area where experiments with highly pathogenic avian influenza (HPAI) viruses occur (n = 100).

| **Characteristics** | | |
|---|---|---|
| Primary Role (n = 100) | n | (%) |
| Principal investigator | 26 | 25% |
| Research scientist | 21 | 21% |
| Post-doc | 10 | 10% |
| Research technician | 20 | 20% |
| Student (graduate or other) | 6 | 6% |
| Animal care (veterinary or husbandry practices) | 1 | 1.0% |
| Other (i.e., biosafety program staff, management) | 16 | 16% |
| Place of work (n = 87) | n | (%) |
| Academic/university | 43 | 49% |
| Manufacturer/industry | 3 | 3.4% |
| Federal government | 30 | 34% |
| Non-profit | 5 | 5.7% |
| Other[a] | 6 | 6.9% |
| Sex (n = 99) | n | (%) |
| Female | 52 | 53% |
| Age (n = 99) | n | (%) |
| <45 years | 62 | 63% |
| ≥45 years | 37 | 37% |
| Work history (n = 96) | median | (Q1, Q3) |
| Years working in a biosafety level 3 enhanced laboratory (BSL-3E) | 8 | (3, 12) |
| Years working in a BSL-3E laboratory with HPAI | 6 | (2.75, 10) |

[a]Other includes biomedical research, research hospital, and contract research organizations.

**Table 2a**

Amount and types of work with highly pathogenic avian influenza (HPAI) viruses among respondents who reported working in a biosafety level 3 enhanced area where HPAI experiments occur (n = 100) (estimated mean hours per week).

| | Live HPAI virus | | HPAI suspect cases[a] | | HPAI inoculated animals | |
|---|---|---|---|---|---|---|
| | **n** | **Range (hours per week)** | **n** | **Range (hours per week)** | **n** | **Range (hours per week)** |
| All | 66 | 4.2–9.3 | 30 | 7.9–14.1 | 61 | 4.1–9.4 |
| Principal investigator | 22 | 3.4–8.0 | 3 | 0.4–3.6 | 21 | 3.8–8.7 |
| Research scientist | 16 | 8.9–15.3 | 9 | 6.0–11.6 | 13 | 6.2–12.4 |
| Post-doc | 9 | 2.0–6.4 | 2 | 4.0–10.0 | 8 | 3.0–8.1 |
| Research technician | 11 | 1.1–4.8 | 11 | 11.6–18.6 | 10 | 3.4–8.5 |
| Student[b] | 2 | 5.4–11.8 | 2 | 15.4–25.0 | 2 | 7.2–15.0 |
| Animal care[c] | 0 | – | 1 | 0.4–3.6 | 1 | 0.4–3.6 |
| Other[d] | 6 | 3.9–9.5 | 2 | 7.2–15.0 | 6 | 2.7–7.4 |

**Table 2b**

Amount and types of work with highly pathogenic avian influenza (HPAI) viruses among respondents who reported any work with A(H5N1) viruses (n = 65) (estimated mean hours per week).

| | Live A(H5N1) virus | | | A(H5N1) suspect cases[a] | | | A(H5N1) inoculated animals | | |
|---|---|---|---|---|---|---|---|---|---|
| | n | Any HPAI (hours per week) | A(H5N1) (hours per week) | n | Any HPAI (hours per week) | A(H5N1) (hours per week) | n | Any HPAI (hours per week) | A(H5N1) (hours per week) |
| All | 59 | 4.5–9.6 | 3.5–8.4 | 21 | 7.6–13.6 | 5.4–10.9 | 50 | 4.2–9.5 | 3.6–8.6 |
| Principal investigator | 21 | 3.5–8.2 | 2.9–7.5 | 3 | 0.4–3.6 | 0.4–3.6 | 20 | 4.0–9.0 | 3.7–8.4 |
| Research scientist | 14 | 9.5–16 | 7.4–13.9 | 7 | 7.1–13.0 | 6.2–11.5 | 10 | 7.2–13.7 | 6.6–12.7 |
| Post-doc | 7 | 1.9–6.3 | 1.4–5.4 | 1 | 4.0–10.0 | 4.0–10.0 | 5 | 1.8–6.2 | 0.4–3.6 |
| Research technician | 11 | 1.1–4.8 | 0.9–4.6 | 7 | 11.8–18.7 | 7.2–13.5 | 7 | 3.3–8.3 | 2.0–6.7 |
| Student[b] | 2 | 5.4–11.8 | 2.2–6.8 | 1 | 10.4–20.0 | 4.0–10.0 | 1 | 10.4–20.0 | 10.4–20.0 |
| Animal care[c] | 0 | – | – | 1 | 0.4–3.6 | 0.4–3.6 | 1 | 0.4–3.6 | 0.4–3.6 |
| Other[d] | 4 | 5.6–12.5 | 4.7–10.9 | 1 | 10.4–20.0 | 10.4–20.0 | 6 | 2.7–7.4 | 2.7–7.4 |

[a] Human or animal.

[b] Students include graduate or other students.

[c] Animal care includes husbandry or veterinary practices.

[d] Other includes biosafety program staff or laboratory management.

**Table 3**

Reasons for lack of interest or only possible interest in Q-Pan H5N1 vaccine.

| | n | (%)[a] |
|---|---|---|
| I don't think the vaccine would provide any further protection on top of my current safety practices | 28 | (61) |
| I have concerns about the safety of the adjuvant in the vaccine | 12 | (26) |
| I have concerns about the safety of the ASO3 adjuvant | 11 | (24) |
| I would rather protect myself by taking antivirals after a potential exposure | 10 | (22) |
| I have others concerns about the safety of the vaccine | 8 | (17) |
| I don't work with A(H5N1) viruses | 7 | (15) |
| Other reasons | 6 | (13) |

[a]Percentages equal to greater than 100% as respondents were able to choose more than one answer.