



## **Guidelines for Avian Influenza Viruses**

**Prepared by**

**U.S. Department of Agriculture**

**Animal and Plant Health Inspection Service**

**Agricultural Select Agent Program**

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## **Purpose**

The staff of the Agricultural Select Agent Program (ASAP) has prepared this document to assist individuals and entities develop policies and implement procedures for working safely with avian influenza viruses (AIV) in the laboratory. The guidelines provide a basic understanding of AIV as well as a baseline to meet the requirements of title 9, *Code of Federal Regulations* (CFR) Parts 121 (Possession, Use, and Transfer of Select Agents and Toxins) and 122 (Organisms and Vectors).

## **Introduction**

AIV is one the most important viruses of concern to the poultry industry in the United States and around the world. The main focus of the U.S. Department of Agriculture is the domestic poultry population that is comprised of chickens and turkeys; they make up the largest percentage of the U.S. commercial poultry industry. However, under the broader definition, domestic poultry also includes ducks, quail, pheasants, and pigeons.

Avian influenza (AI) is an infectious disease of birds caused by type A strain of the influenza virus. Type B and C influenza viruses are not known to infect poultry or do not cause disease in poultry. AI is a highly contagious disease and some strains can cause high mortality in poultry. Influenza A virus in the natural environment is generally spread by ingestion or inhalation. The virus is found in high concentrations in saliva, nasal secretions, and feces. AIV can remain viable for long periods in tissues, feces, and water, especially at low temperatures. Virus-laden feces and respiratory secretions present on fomites such as equipment, clothing, flies, and contaminated feed and water are effective means of transmitting the virus. Airborne dissemination is also an important means of transmission. However, AIV is among the easiest viruses to inactivate using disinfectants or heat treatment.

The highly pathogenic form of the disease is systemic and may be characterized clinically by severe depression, ocular and nasal discharges, snicking, decrease in egg production, nervous system changes, edema of the head, tissue necrosis, sudden death, and high mortality. Morbidity and mortality associated with outbreaks of this highly pathogenic form may reach 90–100 percent within 1–2 weeks in susceptible poultry.

Morbidity and mortality associated with the low pathogenic form is usually low unless complicated by secondary bacterial or viral infections, and environmental stressors.

Depending on the size of an outbreak, the measures taken to control and eradicate the virus and the speed to implement control and eradication strategies, trade restrictions may be regional or affect the entire country resulting in significant economic losses in the poultry industry and increased costs to consumers. The magnitude and duration of these events will ultimately determine the overall impact to the economy. For example, the 1983 Pennsylvania outbreak of highly pathogenic H5N2 cost the U.S. government approximately \$60 million and industry and consumers more than \$250 million (2, 20). APHIS' goal is to prevent major outbreaks (8).

## **Categorizing Influenza A and Nomenclature**

Influenza A viruses are divided into subtypes and are identified on the basis of two surface glycoproteins or antigens: hemagglutinin (HA or H) and neuraminidase (NA or N). There are sixteen known HA subtypes (H1 to H16) and nine known NA subtypes (N1-N9); each virus has one HA and one NA protein on the surface. For example, an “H5N1 virus” designates an influenza A subtype that has an HA 5 surface protein and a NA 1 surface protein. The nomenclature of AIVs is based on a standardized format: Type/species/location/virus identification/year of isolation (HxNx), representing the influenza type, the host origin, the place of isolation, the strain number, and the influenza A subtype. For example, A/Ck/TX/309402/04 (H5N2) represents an H5N2 influenza A virus that was isolated from a chicken in Texas in 2004 and assigned strain number 309402.

AIV strains are further classified as low or highly pathogenic on the basis of specific molecular determinants of the HA protein and the biological behavior of the virus in in-vitro and in-vivo tests. Most AIVs are associated with mild disease in poultry and are termed low pathogenic avian influenza viruses (LPAIVs). By contrast, AIVs that are associated with severe illness and high mortality in poultry are termed highly pathogenic avian influenza viruses (HPAIVs). To date, all outbreaks of the highly pathogenic form of the disease have been caused by influenza A viruses of the subtypes H5 or H7. However, it is important to emphasize that the majority of H5 and H7 subtypes isolated from birds have been LPAIVs.

All influenza A viruses circulate in their natural hosts, wild aquatic birds (e.g., ducks, geese, and swans) and shorebirds (e.g., gulls and terns). Traditionally, HPAIVs have not been observed in reservoir hosts. However, there is evidence to suggest that some migratory waterfowl can now carry the H5N1 virus in its highly pathogenic form in many parts of the world (11, 12). It remains unclear whether wild migrating birds are an established reservoir for H5N1 in its highly pathogenic form. From previous investigations of outbreaks of highly pathogenic avian influenza (HPAI), it is generally recognized that most HPAIVs evolve after transmission of LPAIV H5 and H7 subtypes from a wild reservoir host to a poultry host.

The virus adapts to poultry hosts and mutates to a HPAIV through multiple replication cycles and/or bird transmissions. Low pathogenic H5, H7, and H9 subtypes have adapted to and circulate in domestic poultry (15). HPAIV field isolates are utilized in laboratories and are subject to regulation as select agents pursuant to 9 CFR Part 121. The pathotype of an AIV cannot be determined simply by knowing its subtype. For example, there are H5N1 subtypes that are highly pathogenic (i.e., the Asian H5N1 lineage) and H5N1 subtypes that are low pathogenic (i.e., the North American H5N1 lineage).

The ability of LPAIV H5 and H7 subtypes to mutate into highly pathogenic forms and result in outbreaks of HPAI will often result in the immediate placement of restrictions on trade in poultry and poultry products. Additionally, outbreaks of LPAIV H5 or H7 subtypes in poultry may result in trade restrictions because of the capacity of LPAIV H5 and H7 subtypes to adapt and mutate to HPAIV in poultry. Therefore, all H5 and H7 subtypes of AIV are required to be reported to the World Organization for Animal Health (OIE) and are classified as notifiable AIVs (22). However, only HPAIVs are regulated as select agents in the United States.

## **Defining Highly Pathogenic Avian Influenza Virus**

HPAI or virulent AI may be described as a highly contagious viral infection and/or disease of many avian species including poultry, wild and exotic birds, ratites, shorebirds, and migratory waterfowl caused by influenza A strains of influenza virus. Simply put, it refers to poultry infected with virulent strains of influenza A virus. The defined and internationally recognized criteria used for classifying an AIV as low or highly pathogenic is based on the biological characteristics of the virus in-vitro and in-vivo. More specifically, it is based on an intravenous pathogenicity index in chickens and the amino acid sequence at the cleavage site of the HA protein (6,22).

The HA protein of AIV is responsible for viral attachment and entry into cells. The amino acid patterns of the HA are uniquely different between LPAIVs and HPAIVs. While HA is not the only determinant of virulence in poultry, it is certainly the driver. Other gene segments and factors have been identified as virulence factors in poultry, so virulence in poultry is multigenic (3, 15, 16). However, the HA is the protein we understand most and is a prerequisite for the virus' high pathogenicity in poultry. Replication requires that the HA be cleaved into two subunits in order to infect host cells. If there is no cleavage, then there will be no infection, no replication, and no disease.

The cleavage site of the HA protein of most AIVs is comprised of only one to two basic amino acids at specific positions. Trypsin-like proteases expressed at surface cells lining the respiratory and gastrointestinal tracts recognize this motif. Therefore, virus replication is restricted to these tissue types and cause only mild disease. These viruses are classified as LPAIV. By contrast, AIVs that express multiple basic amino acids (i.e., arginine and lysine) at the cleavage site are recognized by a wide range of proteases that are distributed ubiquitously and results in virus replication in many tissues and causes systemic disease. These viruses are classified as HPAIV. This difference in the ability of certain proteases to cleave to AIVs is just one piece of information to help make the distinction between HPAIV and LPAIV (1, 6).

Field isolates are traditionally tested to differentiate HPAIVs from LPAIVs because of the reporting requirement at the State, national, and international levels.

## **Understanding Influenza A Reassortant Viruses**

Influenza A virus is an enveloped, negative-sense, single stranded ribonucleic acid (RNA) virus with a segmented genome that codes for ten conserved proteins. Each gene segment encodes one or two proteins. Some influenza A viruses may encode an additional protein, PB1-F2 (9). The eight gene segments of influenza A virus encode the ten proteins listed in red in Table 1. below. The PB2, PB1, PA, NP, M, and NS genes are often referred to as the internal genes of AIV. Although the M gene encodes for the surface exposed protein M2, it is still referred to as an internal gene.

**Table 1. Influenza A Gene Segments**

<b>RNA Gene Segment</b>	<b>Encoded Protein(s)</b>
1	HA–hemagglutinin
2	NA–neuraminidase
3	M1 + M2–matrix proteins
4	NS1 + NS2–nonstructural proteins
5	NP–nucleocapsid protein
6	PB1 (+/–PB1–F2)–polymerase protein
7	PB2–polymerase protein
8	PA–polymerase protein

The segmented genome of influenza A virus facilitates genetic reassortment when two influenza A viruses infect the same cell. This provides another means by which HPAIVs may arise. Advancements in biotechnology has led to methods for generating experimental reassortants (i.e., created by using reverse genetics systems) and permits the strategic creation of a large number of influenza A virus reassortants for study in the laboratory (4). Theoretically, 254 viral progeny (excluding the parental genomic constructs) could be created from the 16 RNA segments contributed from two different parent influenza viruses. Progeny viruses that inherit RNA segments from at least two different parent influenza A viruses are known as reassortants.

We do not understand exactly why virulence is restricted to just H5 and H7 subtypes. The predictability of biological behavior of a reassortant influenza virus is often uncertain. Thus, the biological behavior associated with reassortants composed of avian–avian gene segments or avian–mammalian gene segments cannot always be predicted. There have been rare exceptions where field isolates have not conformed to the multibasic cleavage site correlating with virulence and vice versa (7, 13). It appears that the composition of certain gene segments and sequences work together better than others. Thus, there is frequently a need to document the genotypic and phenotypic characteristics of reassortant viruses using a set of established criteria to validate biological behavior. The authority to regulate reassortant influenza viruses stems from 9 CFR §121.3(c).

We consider certain influenza reassortant viruses, based on their construct, to be select agents until demonstrated to be sufficiently attenuated pursuant to 9 CFR §121.3(e).

## **Regulating**

### **Avian Influenza Virus**

All AIVs that have been subtyped and classified as highly pathogenic must be regulated as select agents pursuant to 9 CFR § 121.3(b). However, AIVs subtyped and classified as low pathogenic, including H5 and H7 subtypes, are not regulated as select agents but are regulated as viruses pursuant to 9 CFR Part 122 (Organisms and Vectors).

## Experimental Reassortant Influenza Viruses

The influenza A virus infects a variety of species, including humans. The H1 and H3 subtypes cause significant morbidity and mortality annually in humans (21). The outbreak of highly pathogenic H5N1 AI in Hong Kong in 1997, East and Southeast Asia in 2003, and its subsequent spread throughout Asia, Europe, and Africa had a significant impact not only on agricultural trade in poultry and poultry products, but the infection in humans posed a considerable public health threat (9, 10, and 17). While the highly pathogenic H5N1 viruses do not spread efficiently among humans, infection with highly pathogenic H5N1 has resulted in high human mortality and morbidity (9, 10). The Asian H5N1 strains continue to circulate in avian species and occasionally transmit and infect humans (10).

As a result of these developments, there has been concern over the potential emergence of a pandemic virus associated with highly pathogenic H5N1 or a variant. Early in the 21st century, research intensified on preparedness and focused on understanding the genetic determinants of pathogenicity in humans, the molecular determinants that might contribute to efficient human transmission, and development of vaccine candidates.

AIVs and experimental reassortant influenza viruses meeting the internationally recognized definition of HPAIV are regulated in the United States as select agents pursuant to 9 CFR §121.3(c). The use of reverse genetic approaches to create experimental reassortant influenza viruses allows for the potential generation of thousands of influenza reassortants, ranging from insignificant to significant. The criteria or data points used to determine the virulence of reassortant viruses in poultry are outlined in Table 2. below. The preferred cell line for the plaque characterization assays is the chicken embryo fibroblast cell line; however, other suitable cell lines are acceptable, e.g., Madin–Darby canine kidney cell line (1, 6).

**Table 2. Data Required for Classifying Avian Influenza Reassortant Viruses**

<b>Parameter</b>	<b>Method</b>	<b>Outcome Specification</b>
Source of all genes in construct; description of modification.	Reference source material for viruses, plasmids, etc.	Description of gene composition of recombinant/attenuated strain
Complete nucleotide sequence analysis of the entire HA gene and analysis of the amino acid motif at the HA cleavage site	Standard laboratory methods	Confirmation of expected sequence for attenuated strain. Demonstration of HA cleavage site that is consistent with low pathogenic virus.
Pathogenicity testing in chickens.	As described in the current OIE Manual of Standards for Diagnostic Tests and Vaccines	Confirmation of low pathogenic phenotype in chickens.
Plaque characterization on chicken embryo fibroblast (CEF) cells (or other suitable cell line) without trypsin.	Test duplicate dilutions of strain in CEF cells with and without trypsin.	Demonstration of inability to form clearly defined plaques in the absence of trypsin.
Plaque characterization on CEF cells (or other suitable cell line) with trypsin.	Determine plaque formatting units/ml of representative product.	Demonstration of ability to form viral plaques in the presence of trypsin.

We understand that the virulence of HPAIV is multigenic and the predominant virulence determinant of HPAIV in poultry is the multibasic cleavage site of HA. Thus, there are some reasonable deductions we have made regarding the regulation of reassortant influenza viruses to assist in reducing laboratory time and financial burden on laboratories. The outline below may be used to determine whether or not it would be necessary to provide the data listed in Table 2. to validate the attenuation of a reassortant virus.

**1. Avian-mammalian reassortants (HPAIV-HA):** When a reassortant is composed of RNA segments from a mammalian influenza virus and AIV, and the HA RNA segment is contributed by a HPAIV, the reassortant virus is to be regulated as a select agent unless it has been excluded pursuant to 9 CFR §121.3(e).

**2. Avian-avian reassortants:** When a reassortant is composed of RNA segments from at least two AIVs, and at least one parental virus is a highly pathogenic AIV, the reassortant virus is to be regulated as a select agent if the HA RNA segment is contributed by an HPAIV unless it has been excluded pursuant to 9 CFR §121.3(e).

**3. Avian-mammalian reassortants (Mammalian-HA):** When a reassortant is composed of a mammalian HA RNA segment and the NA RNA segment and/or internal RNA segments originate from a highly pathogenic AIV, the reassortant virus is not regulated as a select agent but is regulated as a virus pursuant to 9 CFR Part 122.

**4. Influenza A virus reassortants with synthetic HA (HPAIV cleavage site):** When a reassortant is composed of an AI A virus HA RNA segment of any subtype that has a change within the cleavage site compatible with an HPAIV, and the other seven gene segments of any influenza A virus, the reassortant virus is regulated as a select agent unless it has been excluded pursuant to CFR §121.3(e).

**5. Avian influenza-other virus constructs:** When a reassortant virus is constructed by assembling an RNA segment (usually HA or NA) or RNA segments from a highly pathogenic AIV, short of all eight segments, with nucleic acid(s) from a different virus, the construct is not regulated as a select agent but is regulated pursuant to 9 CFR Part 122.

Individuals and entities are reminded that 9 CFR §121.3(e)(2) states if an excluded attenuated strain is subjected to manipulation that restores or enhances its virulence, the resulting select agent will be subject to the requirements of the regulations. We do not consider mutants created from reassortant viruses that have been excluded to be altered sufficiently to revert to virulent, provided the established motif at the HA cleavage site has not been changed. While some reassortants may not be subject to select agent regulations, they are still subject to regulation pursuant to 9 CFR Part 122.

Unlike field strains of AIV where the nomenclature has been standardized, there is no standard format for naming reassortants. However, most reassortants bear some reference to the parent viruses. Thus, the nomenclature of reassortants will vary from laboratory to laboratory and named according to individual laboratory protocol.

## **Nucleic Acids**

### **Fully Intact Genome**

The segmented genome of AIV is of negative polarity or negative-sense. Unlike genomes of positive polarity, the AIV genome cannot be directly or immediately translated by host cells into proteins, and not considered to be infectious. Therefore, the fully intact genome of HPAIV is not considered a select agent, but is regulated pursuant to 9 CFR Part 122. However, the method by which nucleic acid is extracted from a system must ensure that no viable virus will cross-contaminate the extracted RNA preparation.

### **Nucleic Acids**

Individual RNA segments from an HPAIV genome are not regulated as select agents. They are not considered infectious. However, the method by which nucleic acid is extracted from a system must ensure that no viable virus will cross-contaminate preparations. Also, intermediaries carrying HPAIV nucleic acid used to express individual proteins or generate an influenza A virus are not regulated as select agents. This would include viral complementary deoxyribonucleic acid (cDNA) (plasmids), (-) viral RNA, (+) mRNA, and the expressed viral proteins. These nucleic acids and proteins are regulated pursuant to 9 CFR Part 122.

## **Introduction to Biocontainment Provisions**

Biocontainment may be described as safe methods implemented at a facility to manage infectious materials or agents in a laboratory. These methods reduce the risk of exposure to laboratory personnel and unintentional release in the environment. From an agricultural perspective, of most concern while working with AIV in the laboratory is maintaining proper biocontainment. Laboratory containment of AIV must be sufficient to mitigate the risk of exposure to the environment and ultimately to poultry. The economic impact that HPAI may have on domestic and international trade, the poultry industry, and ultimately the consumer can be significant. Facilities and practices must meet standards that will reduce the probability of an unintentional release that could lead to an outbreak.

All laboratories are not built the same, and the scope of work conducted in each laboratory varies. Therefore, determining the appropriate exclusion criteria should begin with a robust risk assessment for the type and scope of work to be undertaken in a laboratory. To paraphrase 9 CFR §121.12(a), a registered entity is required to develop and implement a written biosafety plan that is commensurate with the risk of the select agent. No containment system is perfect; however, there is no substitute for proper and thorough training in operations and procedures to reduce unintentional releases from a facility.

This guideline document is not intended to focus on how to design a facility for proper biocontainment or to address all of the generally accepted requirements of basic laboratory practices. Those standards can be found elsewhere (18, 19). Instead, this document is intended to match the scope of work conducted in a laboratory with minimal additional provisions or exclusion criteria to mitigate risks while working with AIV. If an institution has determined that it is unable to meet one or more of the mitigating factors discussed below, and can provide a risk assessment to justify an alternative, the ASAP will consider the proposal at the applicant's request.

## **Biosafety Level 4 and Animal Biosafety Level 4**

Laboratory work with HPAIV conducted in Biosafety Level-4 (BSL-4) and Animal Biosafety Level-4 (ABSL-4) laboratories do not require additional provisions. Meeting the BSL-4 and ABSL-4 criteria are sufficient for appropriate biocontainment.

## **Biosafety Level 3 Agriculture**

Animals that are housed loosely on the floor or in open caging systems and have been infected with HPAIV must be contained in a Biosafety Level 3 (BSL-3Ag) facility. However, under most circumstances the BSL-3Ag facility is reserved for large animal species, e.g., adult swine, in which the use of primary biocontainment housing would not be practical. The animal room is an airtight barrier serving as primary containment for the animal.

The additional provision is:

**Personnel quarantine policy:** As an added precaution, we require a restriction policy for personnel working with the virus. APHIS requires entities to implement a written policy for visitors as well as staff. The restriction prevents laboratory staff and visitors from having contact with susceptible avian species for a minimum of 5 days after last engaging work with the virus.

The prohibition is for avian wildlife, pet birds, backyard poultry, fair birds, commercial poultry operations, and zoos. The policy must be read and signed by staff to ensure compliance.

## **Biosafety Level 3**

In-vitro laboratory work with HPAIV can be diverse and laboratories engaging in such activities may include clinical, diagnostic, teaching, and research facilities. HPAIV may be aerosolized, amplified or propagated in eggs, cell culture, or tissue culture. HPAIV may also be used in procedures with known concentrated virus preparations. All of these activities must be conducted in Biosafety Level (BSL-3) laboratories with the following provisions:

**Air handling:** High efficiency particulate air (HEPA) filtration of the laboratory air is mandatory on the exhaust system. The exhaust system should have a sealed ductwork system from the containment barrier to the filter. Supply HEPA filtration is not necessary if directional airflow is maintained inward through entry doors. However, the supply and exhaust air handling systems must be interlocked. Ideally, there should be independent air supply and exhaust systems. However, it is not a requirement that air handling systems are independent, but they must be isolated from other areas.

**Showers:** A gown-in, shower-out procedure is used to enforce a change of street clothing. The value of forcing a change of clothing is to reduce the risk of fomite transmission of this highly contagious agent. Ideally, personal showers should be located at the containment/non-containment interface.

**Decontamination of laboratory liquid effluents:** Liquid effluents originating from laboratories should be collected locally and chemically disinfected or heat treated, or collected and processed in a central effluent decontamination system before being released into the local sanitary system. The decontamination of shower and toilet effluents is not a requirement, provided appropriate practices and procedures are in place for primary containment.

**Protective clothing:** Change of clothing prior to entering the laboratory is important. The attire donned for gowning should include the following: 1) disposable hood or head cover; 2) protective eyewear (e.g., safety glasses); 3) respiratory protection; 4) disposable double gloves; 5) disposable Tyvek gown or coveralls; 6) and disposable shoe covers.

**Personnel quarantine policy:** HPAIV is a highly contagious virus that is readily transmitted through fomites. APHIS requires entities to implement a written policy for visitors as well as their staff. The restriction prevents laboratory staff and visitors from having contact with susceptible avian species for a minimum of 5 days after last working with the virus. The prohibition is for avian wildlife, pet birds, backyard poultry, fair birds, commercial poultry operations, and zoos.

The policy must be read and signed by staff to ensure compliance. There is no need for a proximity restriction to avian species located outside of the facility because exhaust air from the laboratory must be HEPA- filtered. Also, this policy does not apply to susceptible avian species housed within the same facility, provided appropriate practices and procedures are in place to prevent cross- contamination.

### **Animal Biosafety Level 3**

Animal species that may be used in the laboratory to study HPAIV may range from small (e.g., mice) to large (e.g., swine). This creates additional concerns for containing higher viral loads, aerosols, primary containment caging, and animal husbandry practices. These additional areas of concern must be given special attention while working with animals. This work can be conducted in Animal Biosafety Level 3 (ABSL-3) laboratories with additional provisions.

It is important to re-emphasize the innate ability of influenza viruses to reassort. One needs to be cognizant of this when two or more experiments are proposed to be conducted at the same time with HPAIV and the 1918 influenza virus, a U.S. Department of Health and Human Services select agent. The possibility of naturally generating a reassortant influenza virus that is both deadly and efficiently transmitted from person-to-person must be realized. These experiments must be separated temporally, meaning such experiments are not to be conducted simultaneously in the same laboratory room; and/or spatially. If such experiments are conducted simultaneously in the same facility, they must be conducted in separate laboratory rooms and the airspace must not be shared (i.e., independent air systems).

The additional provisions are:

**Air handling:** HEPA filtration of laboratory air is mandatory on the exhaust system. The exhaust system should have a sealed ductwork system from the containment barrier to the filter. Supply HEPA filtration is not necessary if directional airflow is maintained inward through entry doors. However, the supply and exhaust air handling systems must be interlocked. Ideally, there should be independent air supply and exhaust systems. However, it is not a requirement that air handling systems are independent, but they must be isolated from other areas.

**Special caging:** Animals infected with HPAIV must be placed in appropriate biocontainment units for animal housing. Containment at the cage level may be achieved in several ways depending on preference and animal size. For example, primary biocontainment housing may be a containment cage or rack system, flexible film isolator, or glove box. Caging must be ventilated and the exhaust air HEPA filtered in all instances. Static micro-isolators are not effective in achieving the desired effect of preventing air leakage into the laboratory space.

**Showers:** A gown-in, shower-out procedure is implemented to enforce a change of street clothes. The value of forcing a change of clothing is to reduce the risk of fomite transmission of this highly contagious agent. Ideally, personal showers should be located at the containment/non-containment interface.

**Decontamination of laboratory liquid effluents:** Liquid effluents originating from laboratories should be collected locally and chemically disinfected or heat treated, or collected and processed in a central effluent decontamination system before being released into the local sanitary system. The decontamination of shower and toilet effluents is not a requirement, provided appropriate practices and procedures are in place for primary containment.

**Decontamination of solid animal wastes:** All animal tissues, carcasses, and bedding originating from the animal room must be decontaminated by an effective and validated method (e.g., use of a tissue autoclave) before leaving the containment barrier. There should be an appropriate final method of disposal (e.g., incineration).

**Protective clothing:** Change of clothing prior to entering the laboratory is important. The attire donned for gowning should include the following: 1) disposable hood or head cover; 2) protective eyewear (e.g., safety glasses); 3) respiratory protection; 4) disposable double gloves; 5) disposable Tyvek gown or coveralls; 6) and disposable shoe covers.

**Personnel quarantine policy:** HPAIV is a highly contagious virus that is readily transmitted through fomites. We require a restriction policy for personnel working with the virus as an added precaution. APHIS requires entities to implement a written policy for visitors as well as their staff. The restriction prevents laboratory staff and visitors from having contact with susceptible avian species for a minimum of 5 days after last working with the virus. The prohibition is for avian wildlife, pet birds, backyard poultry, fair birds, commercial poultry operations, and zoos.

The policy must be read and signed by staff to ensure compliance. There is no need for a proximity restriction to avian species located outside of the facility because exhaust air from the laboratory must be HEPA filtered. Also, this policy does not apply to susceptible avian species housed within the same facility, provided appropriate practices and procedures are in place to prevent cross-contamination.

## **Biosafety Level 2 and Animal Biosafety Level 2**

In-vitro and in-vivo laboratory work with H5 and H7 subtypes of LPAIV as well as reassortant AIVs that are not categorized as select agents can be conducted in Biosafety Level 2 (BSL-2) and Animal Biosafety Level 2 (ABSL-2) laboratories with certain provisions outlined below. In-vitro and in-vivo work with all other LPAIV subtypes may be conducted in laboratories meeting BSL-2 and ABSL-2 criteria.

Many laboratories, e.g., veterinary diagnostic laboratories, conduct routine screening surveillance on samples collected from wild birds as well as domestic poultry. Laboratories are usually surveying for early detection of highly pathogenic H5N1 in migrating wild birds and detection of AIV that may be circulating in domestic poultry. We consider the specimens collected domestically or from regions around the world that are declared free of HPAIV to be low risk materials. When handling unknown samples for diagnostic screening (e.g., commercial enzyme-linked immunosorbent assay (ELISA) kits, commercial antigen capture kits, and agar-gel immunodiffusion tests (AGID), in-vitro testing of unknown samples may be conducted in laboratories meeting BSL-2 criteria.

More sophisticated or specific testing using reverse-transcription polymerase chain reaction or real-time polymerase chain reaction may also be conducted in laboratories meeting BSL-2 criteria. However, the detection of H5 or H7 antigen would then require additional work with such specimens to be handled at a higher biocontainment level: BSL-2 with provisions or BSL-3. Confirmation of H5 or H7 HPAIV nucleic acid would require all additional work to be performed at BSL-3 with provisions.

By contrast, specimens collected in regions around the world that are known to be affected with HPAIV, and especially where it is endemic, e.g., Bangladesh, China, Egypt, India, Indonesia, and Vietnam, are considered high risk materials. Such materials are viewed as containing HPAIV until otherwise demonstrated. Diagnostic work with such specimens begins at containment level 3 with provisions as described under BSL-3 and ABSL-3 to offset the lack of processing, ineffective or insufficient processing methods, and the inherent high risk of the material.

The provisions for BSL-2 and ABSL-2 are:

**Air handling:** There are no specific requirements for an air handling system. However, where there is no air handling system, a restriction must be in place whereby avian species are not in close proximity to the facility. Where there are susceptible animals or avian species in the same facility, the air handling system is to be independent or isolated from these laboratory areas.

**Decontamination of solid animal wastes:** Each laboratory must have a written protocol or procedure for the disposal of solid animal wastes. Waste disposal of carcasses, tissues, and bedding is preferably by incineration, but validated methods of decontamination by heat treatment (e.g., use of a tissue autoclaving) is acceptable.

**Protective clothing:** Change of clothing prior to entering the laboratory is necessary. Disposable clothing should not be reused and disposed of appropriately, and reusable clothing (e.g., scrubs) must be autoclaved out of the laboratory and laundered. Protective clothing should not leave the laboratory area.

**Personnel quarantine policy:** As an added precaution, we require a restriction policy for personnel working with the virus. APHIS requires entities to implement a written policy for visitors as well as their staff. The restriction prevents laboratory staff and visitors from having contact with susceptible avian species for a minimum of 5 days after last working with the virus. The prohibition is for avian wildlife, pet birds, backyard poultry, fair birds, commercial poultry operations, and zoos. Also, there should be no commercial poultry within 1/2 mile of the facility,

or any other avian colonies (e.g., aviaries and zoos) within 100 meters of the facility if HEPA filtration of exhaust is not a component of containment. The policy must be read and signed by staff to ensure compliance.

**Administrative:** The permittee must notify the biosafety officer for the facility that the laboratory intends to receive the viral agent.

## **Transfer and Permitting of Highly Pathogenic Avian Influenza Viruses and Low Pathogenic Avian Influenza Viruses**

HPAIV may not be moved or transferred from one entity to another, or imported, unless the receiving entity is registered with a select agent program to possess, use, or transfer HPAIV. The appropriate document for such a transfer is the “Request To Transfer Select Agents and Toxins” (APHIS/Centers for Disease Control Form 2), and the transfer must be executed in accord with 9 CFR §121.16 (Transfers). The Form 2 may be obtained at <http://www.selectagents.gov>. In addition, domestic transfer or importation of HPAIV will require the receiving entity to have a valid VS permit. The application for a VS permit (VS-13-Application for Permit to Import Controlled Material or Transport Organisms or Vectors or Animal Products and By-Products) may be obtained at [http://www.aphis.usda.gov/animal\\_health/permits](http://www.aphis.usda.gov/animal_health/permits). If an individual is already a current holder of a VS permit for agents other than HPAIV, it may be possible to amend the current permit

LPAIV, reassortant influenza viruses that have been excluded from 9 CFR Part 121, nucleic acids of AIV, intermediaries (e.g., cDNA and mRNA) and expressed viral proteins of AIVs require a VS permit for importation and domestic transfer under most circumstances. These are not select agents; therefore, Form 2 is not required. Additional information concerning transfer of select agents, domestic transfers, and/or importation may be obtained by contacting the Organisms, Vectors, and Select Agents staff by telephone at (301)734-5960, or by email at [agricultural.select.agent.program@aphis.usda.gov](mailto:agricultural.select.agent.program@aphis.usda.gov), or [organisms.vectors@aphis.usda.gov](mailto:organisms.vectors@aphis.usda.gov).

## **Summary**

HPAIV is one of the most significant pathogens of agricultural concern worldwide, mainly because of the potential economic impact of HPAI. The zoonotic potential of some AIVs, particularly the H5N1 Asian lineage, has also contributed to this virus’ significance. Our understanding of this virus has advanced in recent years, but there remains a great deal more to be learned. As advances are made, it may be necessary to modify our regulations and/or this document.

It is our attempt to make transparent what we view as minimal essential principles and practices to maximize our efforts to prevent unintentional releases of AIVs and ultimate exposure to domestic poultry. This is not meant to serve as a one-size-fits-all approach. There may be alternative approaches to a given scenario or work description that can be considered. This alternative approach should begin with a properly conducted risk assessment. All inquiries by registered entities should first be made by contacting your CDC or APHIS file owner, or the ASAP for all others.

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## **Contact Information**

### **Agricultural Select Agent Program**

Telephone: (301) 734-5960

Fax: (301) 734-3652

E-mail: [Agricultural.Select.Agent.Program@aphis.usda.gov](mailto:Agricultural.Select.Agent.Program@aphis.usda.gov)

### **Organisms & Vectors Staff**

Telephone: (301) 734-5960

Fax: (301) 734-3652

E-mail: [Organisms.and.Vectors@aphis.usda.gov](mailto:Organisms.and.Vectors@aphis.usda.gov)

### **Centers for Disease Control and Prevention, Division Select Agents and Toxins**

Telephone: (404) 718-2000

Fax: (404)718-2096

E-mail: [LRSAT@cdc.gov](mailto:LRSAT@cdc.gov)