Avian Influenza Vaccines: Focusing on H5N1 High Pathogenicity Avian Influenza (HPAI)

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Background

CAST partnered with U.S. Agency for International Development (USAID)

Completed 3 phase project on concernsing HPAI vaccination

- Assembled team of scientific experts to prepare a comprehensive literature review
- Convened a peer-review panel with representatives from various organizations
- Developed and published a CAST Special Publication summarizing the issues surrounding HPAI vaccination
**Important Features of CAST Special Publication**

- **Comprehensive Bibliography**
  - Over 270 published or presented works concerning AI vaccination assembled in one publication

- **Analysis of Previous AI Vaccine Campaigns**
  - Organized by 3 goals or outcomes
  - Expert review of past use of AI vaccine for both HPAI and LPAI

- **Includes List of AI Vaccine Manufacturers (FAO)**
**Avian Influenza**

- Acute, viral disease of birds
  - Waterfowl, shorebirds
  - Infect a variety of avian species
  - Poultry are non-natural hosts

- Identified by surface glycoproteins
  - 16 Hemagglutinin types
    - H1-H16
  - 9 Neuraminidase types
    - N1-N9
**OIE Definitions**

**Notifiable Avian Influenza (NAI)**

- An infection of poultry caused by any influenza A virus of the H5 or H7 subtypes or by any AI virus with an intravenous pathogenicity index (IVPI) greater than 1.2 (or as an alternative at least 75% mortality) as described below.

Further divided into:

- Highly pathogenic notifiable avian influenza (HPNAI)
- Low pathogenicity notifiable avian influenza (LPNAI)

- Based on standard OIE standard tests
  - Intravenous pathogenicity index (IVPI) in 6-week-old chickens greater than 1.2 = HPNAI
  - Genomic sequencing determines whether multiple basic amino acids are present at the cleavage site of the hemagglutinin molecule (HA0)

» If similar to that observed for other HPNAI isolates, should be considered as HPNAI;

- LPNAI are all influenza A viruses of H5 and H7 subtype that are not HPNAI viruses
Timeline of Global H5N1 HPAI 
Epizootic

1996 - Guangdong China
- First isolation of this lineage of Asian-origin H5N1 HPAI

1997 - Hong Kong
- Poultry markets infect with same virus, 1st fatal human infections

2003-2005 - Active spread throughout Asia and Europe
- Infections reported in poultry and wild birds

2008 - Endemic in many countries and new outbreaks in 2008
- Recent outbreaks in Vietnam, Korea, India, Saudi Arabia – 21 countries have reported the virus to OIE
H5N1 HPAI Current Situation

HPAI outbreaks: Outbreaks reported in poultry and cases in wild birds
Six months period (9 October 2007 - 9 April 2008)

LEGEND
- April
- March
- February
- January
- December
- November
- October
- Self-declared free country

This map represents occurrences of HPAI observed from 9 October to 9 April 2007. H5 cases are represented on this map only for countries in which H5N1 is known to be endemic and where N-subtype characterization is not being performed for secondary cases. Countries with HPAI occurrence only in wild birds are not considered as infected according to OIE status. The original data have been collected and aggregated at the most detailed administrative level and for the units available for each country.

NOTE: FAO compiles information from numerous sources (FAO representatives or country missions, FAO reports, OIE, official government sources, EC, Reference laboratories and others) and produces these composite maps in a representative effort to provide full and accurate information. Omissions and errors are regretted, but FAO welcomes messages to that effect with supporting documentation to make the required changes based on FAO validation and verification procedures. Send messages to EMPRES-livestock@fao.org
Science Behind HPAI Vaccines

Commercially available vaccines will not prevent infection completely.

Experimental and field studies have shown that properly used vaccines can accomplish multiple goals:

1) Protect against clinical signs and death,
2) Reduce shedding of field virus if vaccinated poultry become infected,
3) Prevent contact transmission of field virus,
4) Protect against challenges by low to high doses of field virus,
5) Protect against a changing virus, and
6) Increase a bird’s resistance to AI virus infection.
Available Vaccines

Two main types of vaccine that are licensed widely by countries have proven efficacy:

1. Inactivated, whole-virus vaccines from several manufacturers
2. A recombinant fowl pox vectored-vaccine with an H5 insert from Merial

Novel vaccines

- Reverse genetics-derived H5N3 vaccine (Fort Dodge)
- Chinese Manufactured Vaccines
  - Reverse genetics-generated LPAI H5N1 reassortant virus
  - Recombinant fowl pox-vectored vaccine that co-expresses the HA and NA of the A/goose/Guangdong/1/96 virus
  - A recombinant LaSota strain of Newcastle disease virus (NDV) expressing an H5 HA insert
Art of AI Control

Components of a control strategy generally include five basic categories:

1) Biosecurity and quarantine
2) Diagnostics and surveillance
3) Elimination of infected poultry or controlled marketing of convalescent poultry,
4) Decreasing host susceptibility to the pathogen by vaccination
5) Education of personnel, owners, and villagers on disease transmission, prevention, and control
Arguments Against Vaccination

Discussed surrounding recent Asian-lineage HPAI H5N1 outbreaks:

- Vaccination will drive antigenic change in the viruses.
- These changes may create a virus that has increased transmissibility to humans.
- Use of vaccine in poultry will hide clinical signs and mortality in poultry, which is currently used as an alert for human health professionals to look for human cases.
- Vaccination will allow the virus to be maintained in the poultry population through inapparent infections and lead to increased pathogenicity.
- A vaccination campaign that is not managed appropriately is likely to result in endemic AI infection.
The Decision to Vaccinate

Goals must be determined:

1. routine vaccination in endemic areas,
2. emergency vaccination during an epidemic, and
3. preventive or prophylactic vaccination when the risk of AI virus introduction is high

Part of a science-based control strategy

- Enhanced biosecurity, an eradication plan, controlled vaccination for flocks deemed to be at risk, suitable monitoring of all flocks at risk and of all vaccinated flocks, and a repopulation plan
Surveillance of Vaccine Use

- Depends on program goals
- If control and eradication – strong system needed
- Serological and virological monitoring of the vaccinated birds
- Monitoring program is necessary to promptly identify field-exposed birds in the vaccinated population
- Identify viruses that emerge as vaccine-resistant strains and to identify problems with the vaccine protocol or vaccine quality that is providing inadequate protection
Conclusions

Aggressive eradication programs of mass depopulation may not be successful in all situations.

Tools such as vaccination, used within a defined control program, are available to allow protection of public health, food security, and profitability, as well as disease control.
Thank You

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