Assessment of National Strategies for Control of HPAI and H5/H7 LPNAI
With an Emphasis on Vaccination Programs

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Control Strategies

Eradication is the only strategy for HPAI

Historical “Stamping-out” Components:

- Diagnostics and surveillance
- Enhancements in biosecurity (including modifications to the way poultry are reared and sold, movement management, and cleaning and disinfection)
- Elimination of infected poultry
- Education (including behavioral change communications)
- Decreasing host susceptibility (vaccines/vaccination & host genetics)
26 epizootics used comprehensive control programs with stamping-out; mostly leading to eradication
5 epizootics added vaccination as a component
Vaccination used as a tool to reduce infection pressure, allow food security (poverty prevention), control of the disease, and development of infrastructure to eradicate

There is no “one control strategy”
Objective: Compare HPAI control (outbreak duration in days, eradication time in days, mortality rate and culling rate) against a country’s poultry density, economic indicators, and performance of Veterinary Services

- High density poultry farms in least developed countries was a risk factor for easy transmission of virus and prolonged HPAI outbreaks
- No significant association between pure economic indicators (GDP, AGDP, %AGDP, GDP/capita, GNI and HDI) with HPAI outbreak control
- OECD members (high-income economies, transparency and good governance) had shorter and significantly fewer HPAI outbreaks, quicker eradication times, lower mortality rates and higher culling rates than non-OECD members
**OIE PVS tool critical competencies:**

- Staffing of veterinarians/paraveterinarians
- Professional competencies of veterinarians
- Continuing education
- Emergency funding
- Veterinary laboratory diagnosis
- Epidemiological surveillance
- Availability of veterinary medicines and biologicals
- Transparency
- Disease prevention, control and eradication measures

Increased critical competencies of veterinary services was associated with an improvement in the HPAI outbreak control.
HPAI: National Control Programs

All countries had national HPAI/LPNAI control programs with common components including:

- Quarantine and additional movement restrictions or controls
- Tracing of poultry in outbreak area
- Enhanced biosecurity measures
- Farmer and public education and awareness about the disease
- Monitoring
- Rapid diagnostics
- Stamping-out of positive cases
- Disinfection of facilities and equipment
- Decontamination and disposal of infectious materials
- Compensation

*From 2002-2010 survey to OIE Delegate for countries with HPAI outbreaks (69 of 80; 86%) as part of 16 month sabbatical to OIE
Some countries had additional components including:

- Crisis management framework
- High-throughput rapid diagnostic testing
- Early processing of at-risk non-infected poultry
- Emergency vaccination
- Pen-side testing as a screening tool
- Zoning of movement restrictions & surveillance

Practice of culling varied with country:

- Infected premise
- Dangerous contacts/contiguous premises
  - Zonal approach – 0.5, 1 or 3 km

Quantitative implementation of each component varied with country
Vaccines/Vaccination in National Control

Why some countries have not used H5/H7 vaccines – top five responses*:

- Absence of AI in the country
- No immediate risk for outbreaks
- Stamping-out proved successful
- Lack of adequate resources for vaccination
- High cost of vaccines

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Why are some countries using, have used or may use H5/H7 vaccines – top five responses:

- Stamping-out measures were not enough in large outbreaks
- Control of localized infection “persistent” in some population of poultry species (i.e. domestic ducks)
- To protect expensive breeds and birds
- Enzootic disease was present
- Resources for vaccination were adequate

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Vaccines/Vaccination in National Control

- 58% had vaccination option for HPAI control strategies with written plans
  - Emergency – vaccine bank, field trials, exercised;
  - Preventive – high risk for introduction; and/or
  - Routine – enzootic infection
- 14% had completed AI vaccination simulation exercises or worked-out the logistics of implementing a vaccination program
  - Delayed implementation in 2006 in Egypt – no vaccine bank, no in country manufacturing and no logistics developed ahead

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Vaccine Banks (13 of 69 countries)

- H5 (n=10) and both H5 & H7 (n=3) vaccine
- 0.5-55m doses/subtype, but most countries ≤3.5m doses/ subtype
- Vaccines acquired in 2006 - 2010; Expiration dates 1-4 yrs
- Two future options as vaccines expire:
  - Rotating stocks from commercial vaccine manufacturers
  - Most countries did not indicated desire to purchase more vaccines for a bank (perceived reduction in risk)

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Vaccines/Vaccination in National Control

Field use:

- 30% for HPAI control:
  - Poultry (16%),
  - Zoo/other collections of birds (10%)
  - Both (4%)
- 12% for control of H5/H7 LPNAI
- 17% for control of non-H5/H7 LPAI
  - H9N2 was the most common
  - H1 & H3 swine influenza viruses in breeder turkeys
  - Sporadic H2, H4 & H6

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How Has Vaccination Been Used

• H5/H7 Vaccination used in different ways:
  • Zoo birds and captive held non-poultry (i.e. 14 EU and 2 other countries)
  • Single poultry farm (ex. Israel ostriches)
  • Ring vaccination zone after outbreak (Pakistan, Mexico)
  • Targeted for high risk poultry – ex. outdoor ducks (France), free-range layers (the Netherlands)
  • Focused sector-specific vaccination – (ex. Italy in turkeys & capons 2003-2005 N. Italy H5/H7 LPNAI, & Mexico H7N3 HPAI)
  • Routine vaccination of poultry: ex. China (including Hong Kong), Egypt, Vietnam, Indonesia

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Doses of H5 HPAI Vaccination (2002-2010*)

Doses (Millions)

* Data is preliminary; does not include all 2010

>113b doses for at risk national poultry population of 131b (41.9% coverage); global production of 520b (10.9%)

Swayne et al., OIE Scientific and Technical Review 30(3):839-870, 2011
HPAI Vaccination (2002-2010)

- 95.5% inactivated whole virus vaccine while 4.5% recombinant virus (rNDV and rFPV)
- 14 countries vaccinated poultry against HPAI (2002-2010)
  - Preventive (<0.2%): Mongolia, Kazakhstan, France and The Netherlands
  - Emergency (<0.8%): Cote d’Ivoire, Sudan, PDR Korea, Israel, Russia, Pakistan
  - Routine (99%): China (including Hong Kong), Egypt, Indonesia and Vietnam

Swayne et al., OIE Scientific and Technical Review 30(3):839-870, 2011
Enzootic countries: >99% of vaccine

Swayne et al., OIE Scientific and Technical Review 30(3):839-870, 2011
National Verses Targeted Vaccination

Average National Coverage Rate (%) for All Years of AI Vaccine Usage

*Using higher village poultry estimates of Egyptian Government, suggests 27.8-48.6% national coverage

Swayne et al., OIE Scientific and Technical Review 30(3):839-870, 2011
Other HPAI Vaccination

• 1995: Mexican H5N2 HPAI; 393m doses used
• 1995-2002: Pakistan H7N3 HPAI; unknown doses used
• 2012: Mexico, approximately 128m doses of H7N3 vaccine in layers (Jalisco)
• 2012: Bangladesh, pending H5N1 in comm. poultry
Vaccine Seed Strains: Indonesia

- Historical H5 Vaccines – Similar antigenicity
- Drifting of HA away from root
  - Good protection: Ck/HK/220/97, Ck/Legok/03, VN/1203/04, Ck/WJ/HAMD/06
  - Intermediate protection: Ck/Papua/06
  - Poor protection: PWT/06

Swayne, Smith and Fouchier, 2008
Antigenic Drift

• Egypt (2006-): Some field strains from commercial farms are resistant to immunity from Mexico/94 and Re-1 vaccines

• China (2004-):
  – Re-5 (rgA/dk/Anhui/1/2006 [H5N1](2.3.4): 2008-12
    – Re-6 (rgA/dk/Guangdong/S1322/2010 [H5N1] (2.3.2): 2012-

• Vietnam: 2011 2.3.2.1B resistant to immunity from Re-1 & Re-5 (future will use Re-6)

• Hong Kong (2008): clade 2.3.4

• Antigenic drift is being continually addressed
Conclusions

- Economic indicators of a country do not predict better HPAI control, but OCED membership did.
- High poultry density in least developed countries had a negative impact on HPAI control.
- Low competency of Veterinary Services was associated with reduced HPAI control.
- Stamping-out is the preferred method for HPAI control and is associated with shorter eradication times.
- Vaccination has provided immediate positive impact on HPAI prevention and control.
Conclusions

• Emergency AI vaccination programs need advanced planning, exercise of plans and logistics, and development of vaccine banks with risk based, targeted applications

• Routine national AI vaccination programs can be used to maintain rural livelihoods & food security, but they are logistically difficult to implement and expensive to sustain

• As AI outbreak matures and epidemiological data becomes available, vaccination programs should be updated to become risk-based, with resources focused on highest risk populations and reservoirs

• Exit strategies should be developed based on field conditions and refocus of resources to high risk conditions/populations
Conclusions

• Problems in control strategies have involved both vaccine efficacy and vaccination effectiveness
  • Vaccine quality has improved greatly over the past 7 years
  • Antigenic drift of H5N1 HPAI viruses has occurred in the field, but ongoing corrected by designer rg vaccines
  • Most field vaccination failures have been the result of improper or suboptimal application of vaccines

• No one solution for all countries; must be country- and production-sector specific
  • Targeted approach to at risk poultry (not national program)
  • Age/production cycle based in sector 1 & 2, but may boost in campaign-system (use in sector 3 & 4)
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