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

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***Detailed to OIE, Paris, France (5/2010 – 9/2011)**

Control Strategies

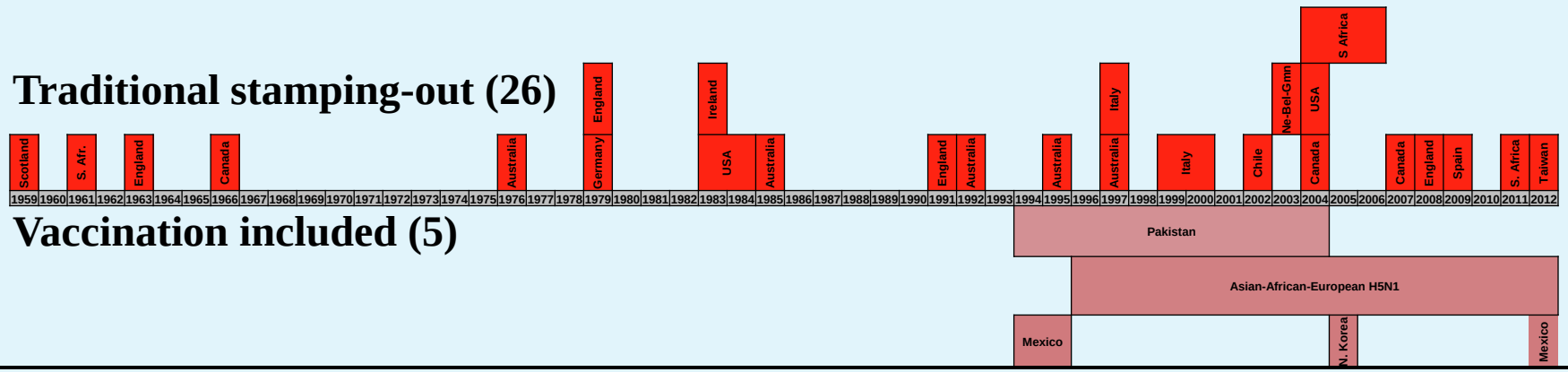
Eradication is the only strategy for HPAI

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)**

31 HPAI Epizootic

Timeline HPAI



- 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”

HPAI Control: National Predictors

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**

HPAI Control: National Predictors

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


Rev. sci. tech. Off. int. Epiz., 2011, 30 (3), 661-671

The influence of economic indicators, poultry density and the performance of Veterinary Services on the control of high-pathogenicity avian influenza in poultry

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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**

HPAI: National Control Programs

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

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

Rev. sci. tech. Off. int. Epiz., 2011, 30 (3), 839-870

Assessment of national strategies for control of high-pathogenicity avian influenza and low-pathogenicity notifiable avian influenza in poultry, with emphasis on vaccines and vaccination

D.E. Swayne [1, 2]*, G. Pavade [1], K. Hamilton [1], B. Vallat [1] & K. Miyagishima [1]

Vaccines/Vaccination in National Control

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**

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

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**

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

Vaccines/Vaccination in National Control

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)

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

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**

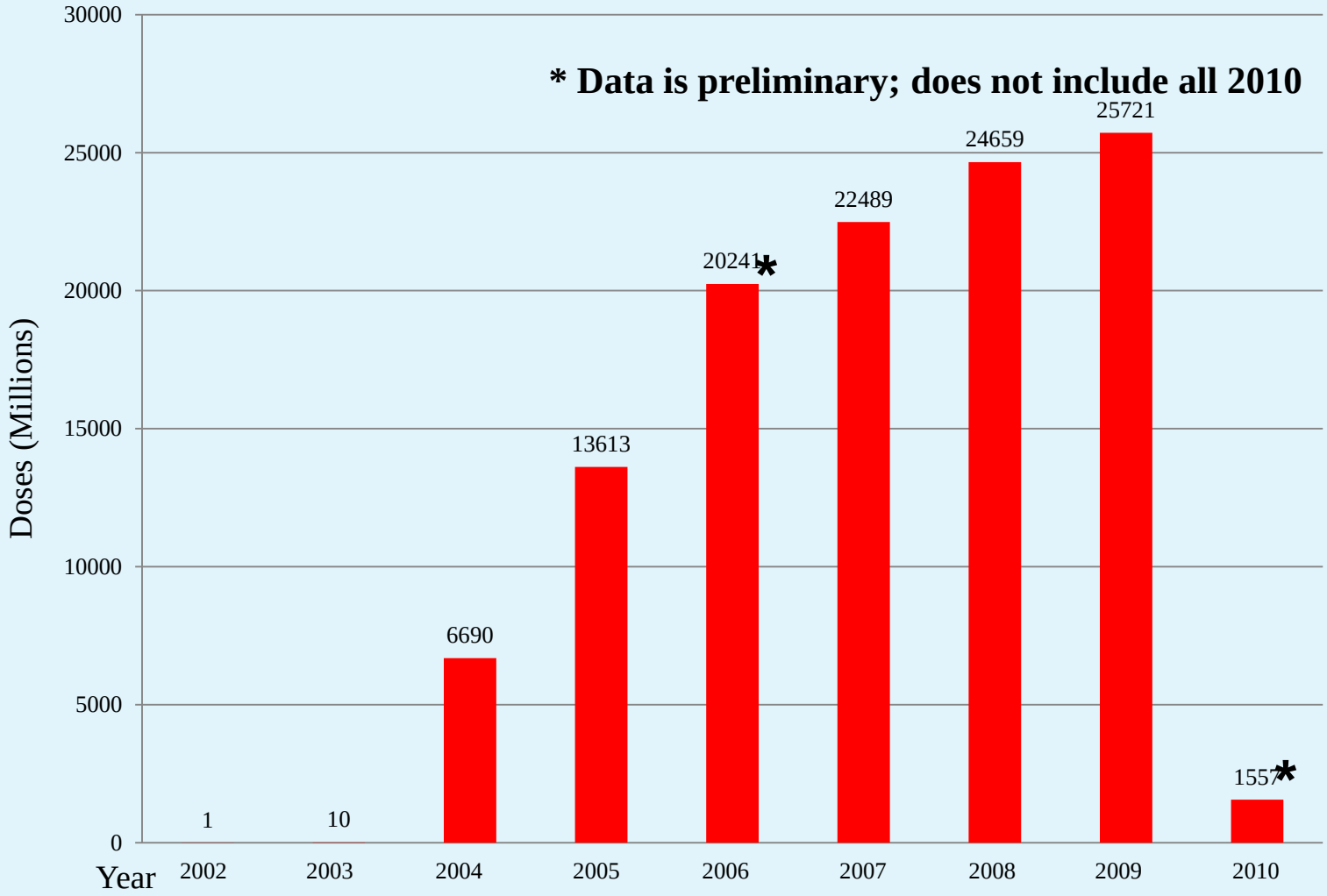
***From 2002-2010 survey to OIE Delegate for countries with HPAI outbreaks (69 of 80; 86%) as part of 16 month sabbatical to OIE**

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**

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

Doses of H5 HPAI Vaccination (2002-2010*)



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

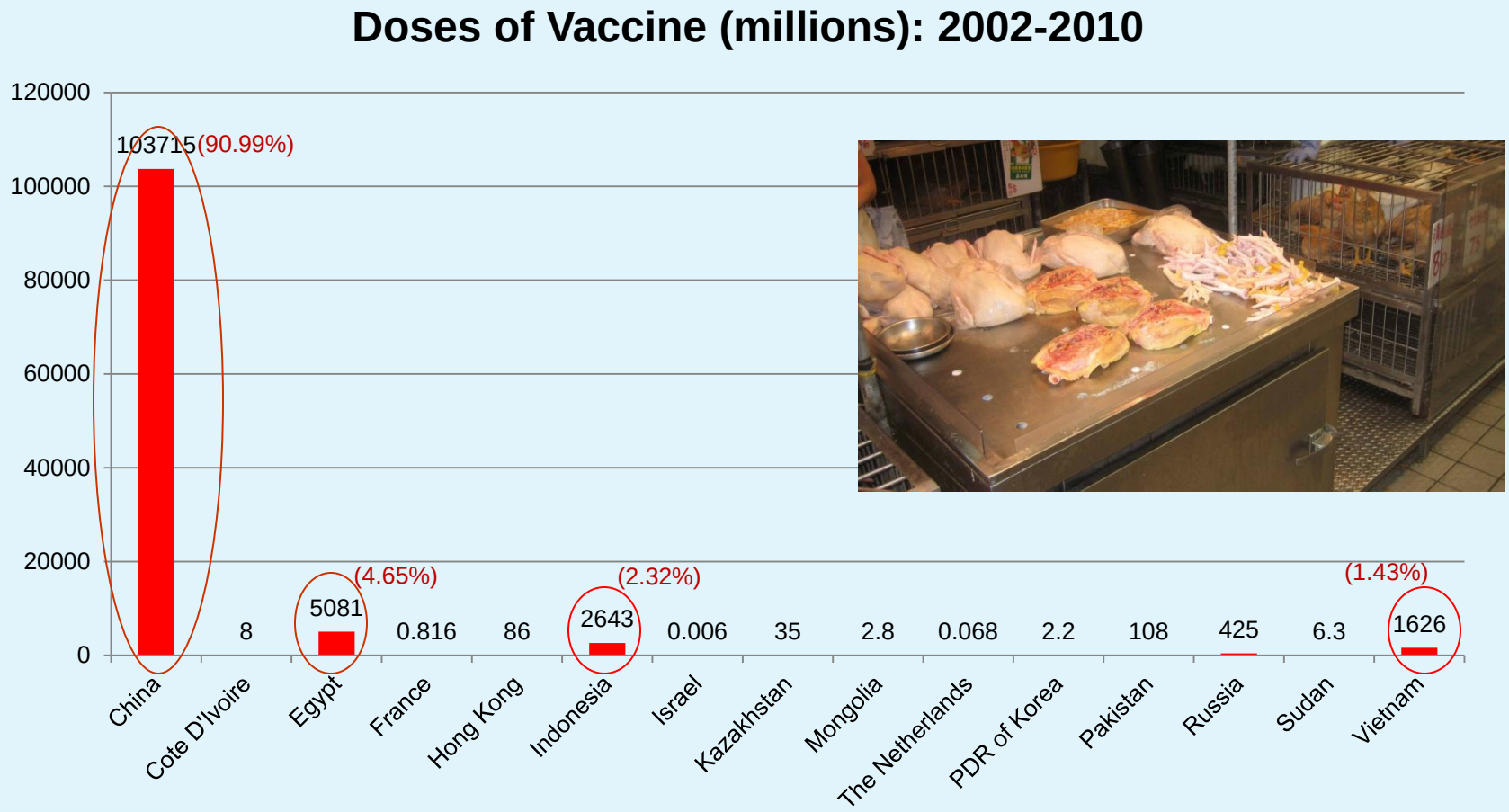
Swayne et al., OIE Scientific and Technical Review 30(3):839-870, 2011

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

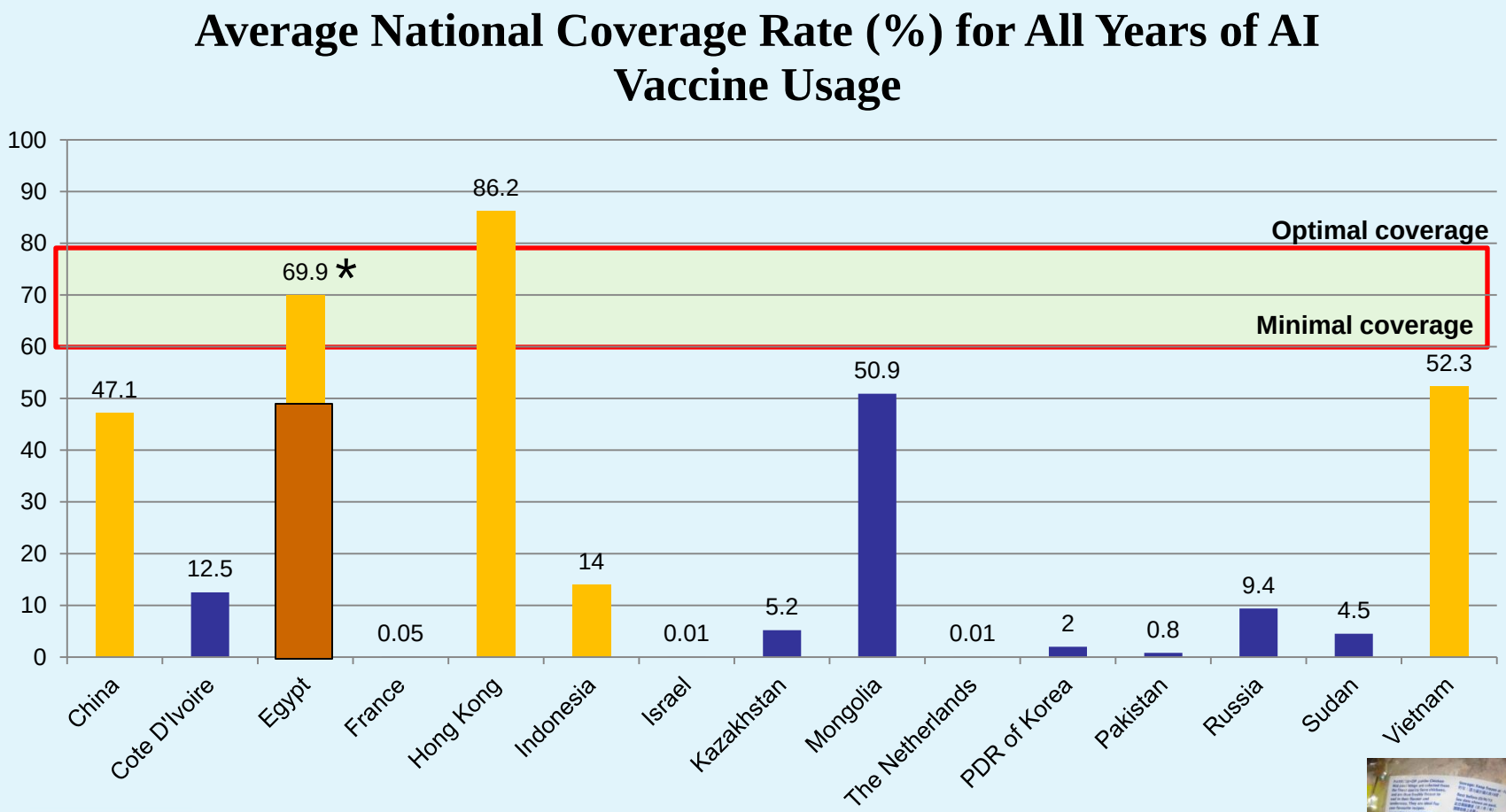
HPAI Vaccination (2002-2010)



Enzootic countries: >99% of vaccine

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

National Verses Targeted Vaccination



***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

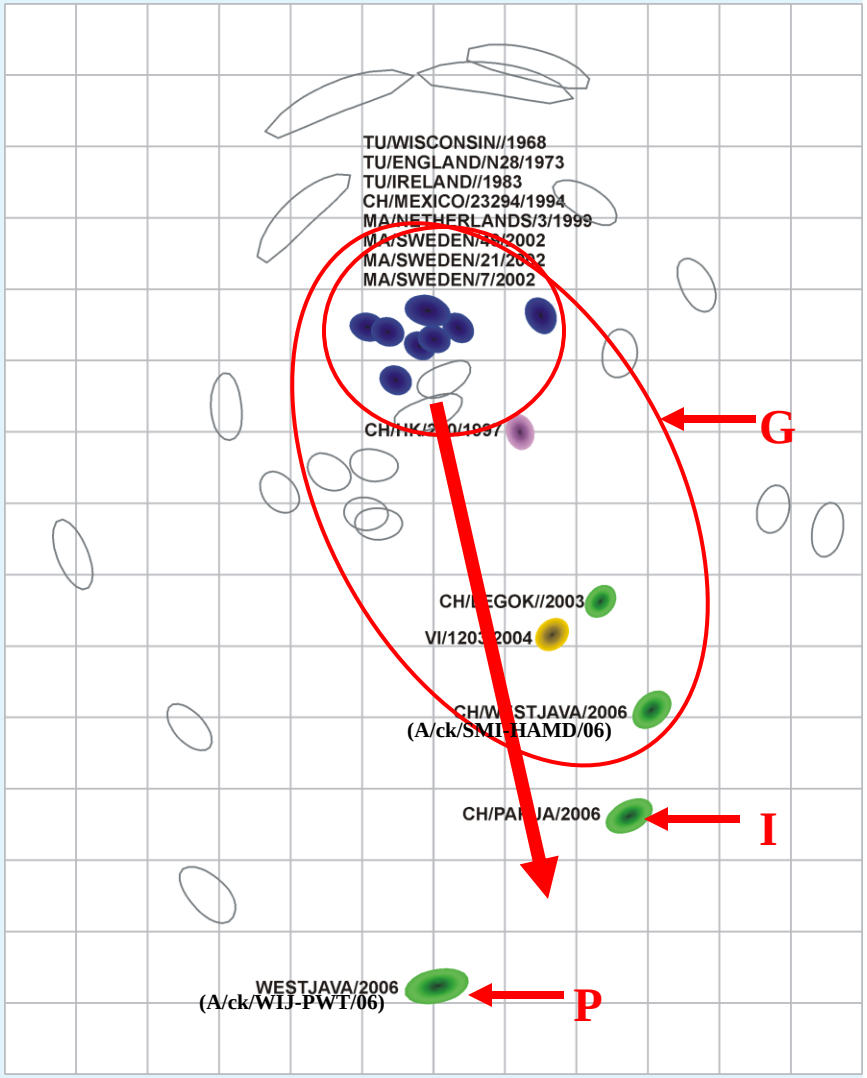
Other HPAI Vaccination

- **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**

Antigenic Drift

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-):**
  - **Tk/England/1973 [H5N2]: (2004-6)**
  - **Re-1 (rgA/gs/Guangdong/1/1996 [H5N1] (0): 2004-8**
  - **Re-4 (rgA/ck/Shanxi/2006 [H5N1](7): 2006-7**
  - **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 *on going* 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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