

Statement on Pandemic Influenza Preparedness

ASA Committee on Trauma and Emergency Preparedness

Bonnie M. Tompkins, M.D., Robin Stackhouse, M.D., Jill Antoine, M.D., Paul Barach, M.D., MPH

ASA Committee on Occupational Health

Robin Stackhouse M.D., Jonathan D. Katz M.D.

11/24/06

Anesthesiologists will likely encounter avian influenza patients early in a pandemic due to their roles in airway management and as critical care physicians. This Statement presents information anesthesiologists can use to protect patients, healthcare workers, and themselves.

World-wide concern has been focused on the H5N1 Highly Pathogenic Avian Influenza A (HPAI) virus. In 1997, 18 human cases and 6 deaths were associated with HPAI infected chickens in Hong Kong.^{1,2} The World Health Organization (WHO) has reported 258 confirmed human cases and 153 deaths as of November 13, 2006.^{3,4}

To date, Avian influenza has occurred in small family clusters only, corresponding to Phase 3 of the WHO Pandemic Phases.⁵ If the virus acquires the capacity for sustained human-to-human transmission, the probability of a pandemic is high. The Department of Health and Human Services (HHS) Pandemic Influenza Plan estimates that in a medium to severe pandemic, 25-35% of the U.S. population would be affected. Forty percent of those would be children and 20% working adults. Half of the 90 million clinically ill would seek out-patient treatment, 0.8-10 million would be hospitalized, 0.13-1.5 million would require intensive care, 65-740 thousand would require mechanical ventilation, and an estimated 0.2-1.9 million would die.¹ The first case in the U.S. is expected no later than three months following sustained human-to-human transmission elsewhere. A pandemic is expected to last a year and occur in waves.¹

An all-hazard disaster response plan provides a useful template on which health care providers and facilities may prepare for pandemic influenza. In addition to the logistics of patient management, an all-hazard approach includes principles of responder safety and correct use of personal protective equipment (PPE). Familiarity with decontamination procedures and locations of facilities will enhance safety and limit the disaster. Personal and family preparedness and safety is a fundamental principle of effective disaster response.⁶⁻⁸ The Department of Homeland Security (DHS) Home Preparedness Plan provides comprehensive checklists for home, hospital and business preparedness.⁶

Anesthesia departments can appoint interested members to represent the department on the hospital's emergency preparedness committee and to organize and develop response capability. Staffing issues, surge capacity, triage protocols, legal and ethical issues, treatment protocols, medications, supplies, and equipment alternatives are just a few of the important issues that must be addressed in pandemic and all-hazard disaster planning.^{1,7-9} A table of equipment alternatives is provided at the end of this statement.

Clinical Course of Avian Influenza

The clinical course of H5N1 HPAI can be mild, fulminant, or protracted. Many of those presenting for medical care will be in the fulminant group. However, about 1/3 of the 18 Hong Kong cases previously mentioned, mostly children, had only a mild respiratory infection.²

The incubation period is typically 2-4 days, but can be up to 8 days, with non-specific early symptoms that can be mistaken for a common cold or seasonal flu.¹⁰ Most cases have presented with the abrupt onset of fever, headache, cough, sore throat, rhinorrhea, myalgia, diarrhea, malaise and sometimes otitis. Over 50% of identified cases have died, many with fulminant acute respiratory distress syndrome (ARDS), sepsis, pulmonary hemorrhage, and multi-organ system failure. Markedly elevated cytokine and chemokine levels in the fulminant cases suggest that, as the 1918 victims who died within hours, the explosive clinical course in HPAI is a consequence of “cytokine storm”, or massive cytokine effect.¹¹⁻¹³ In Avian influenza the mortality is greatest in young healthy adults, in contrast to seasonal influenza where it is highest at the extremes of age. Death without respiratory involvement has been reported.²

Ten percent of the initial survivors of a pandemic influenza, 4-10 million cases in the U.S., are expected to acquire post-influenza bacterial pneumonia, with a prolonged course and delayed mortality. Post-influenza pneumonia presents with a productive cough, pleuritic chest pain, and fever following initial improvement in the original influenza symptoms. *Streptococcus pneumoniae*, *Staphylococcus aureus*, and *Haemophilus influenzae* pneumonia are the most common agents in adults. Post-influenza pneumonia in children is usually viral.¹

Management Principles and Treatment of HPAI and Pandemic Influenza

Treatment of HPAI is supportive medical and intensive care and antiviral therapy. The neuraminidase inhibitors, Oseltamivir (Tamiflu) and Zanamivir (Relenza), are effective when given within the first 48 hours.^{1,10} Resistance to Oseltamivir has been reported in two H5N1 fatal cases in Vietnam.^{10,14} The adamantanes, Amantadine and Rimantadine, are ineffective.¹ Antiviral supplies are expected to be limited during a pandemic. Community leaders and the lay public should be given accurate information about the limited availability of resources.⁷ Antibiotics are indicated for secondary infection and post-influenza bacterial pneumonia. Preemptive pneumococcal vaccination may reduce post-influenza pneumonia.¹ Detailed treatment guidelines for HPAI and pandemic influenza are provided by the HHS, CDC, and WHO.^{1,15,16}

Potential treatments for HPAI and pandemic influenza include immunomodulators and statins for their anti-inflammatory effect, convalescent blood transfusion, and cytotoxic therapy.¹⁷⁻¹⁹

A seasonal human influenza vaccine is recommended to reduce coincident human and Avian influenza infection, which could result in genetic re-assortment and emergence of a pandemic strain.^{1,10,16} A seasonal vaccine may also provide limited immunity to a re-assortment pandemic strain.¹ A vaccine for a newly emerged pandemic virus will be months in development. Initially, vaccine will be very limited and therefore will not be a dependable early mitigation measure.^{1,5,10,16}

Evaluation of Persons with Suspected Avian Influenza

During the interpandemic period (before sustained human-to-human transmission), clinical symptoms plus epidemiologic criteria (possible exposure) are necessary prior to laboratory testing for suspected Avian influenza. In a pandemic period, clinical criteria alone are sufficient to initiate testing(9)(12).^{10,15}

Lessons Learned from SARS

Experience gained from the SARS epidemic is helpful in preparing for an influenza pandemic. In Toronto, minimal advanced warning of the initial outbreak was a contributing factor in exposure and illness among many health care workers (HCWs), including anesthesiologists. In contrast, an epidemic was aborted and no HCWs were infected in Vancouver, British Columbia. Success there has been attributed to a unified public health system, advanced warning through effective surveillance, and application of the “Precautionary Principle”. Strict isolation and use of personal protective equipment (PPE) were instituted preemptively in suspected cases prior to confirmation of diagnosis.²⁰ Extensive infection control measures were deployed effectively during the 2003 Singapore SARS outbreak.²¹

Personal Protective Equipment (PPE) and Infection Control

Avian flu is transmitted by direct contact with infected animal tissues or feces, by indirect or secondary contact with a contaminated surface (fomite), and by respiratory droplet (particles 5 microns or larger, which drop from the air within 3 feet). Short-range aerosol transmission has not been definitively ruled out.¹ Contact (gloves, gown, goggles) and droplet precautions (surgical mask if within 3 feet) are commonly indicated for these types of exposures.^{22,23} However, like SARS, Avian Influenza is highly lethal, and its precise modes of transmission are incompletely understood. Therefore, enhanced respiratory precautions, described below, are recommended by the Centers for Disease Control (CDC) when caring for any suspected case of Avian Influenza.^{1,24-26} The HHS has issued a recent clarification of mask recommendations.²⁵

All invasive airway procedures, including tracheal intubation and suctioning, plus high flow oxygen and nebulizers, generate fine aerosol. The CDC recommended enhanced respiratory protection for invasive airway procedures in SARS and Avian Influenza is a fit-tested and fit-checked N95 (or higher) respirator.^{1,22-26} If facial hair or features preclude successful fit testing, then a Powered Air Purifying Respirator (PAPR) should be used. An alternative to the N95 and PAPR is a full face-piece non-disposable elastomeric negative-pressure (non-powered) respirator with N, R, or P-100 filters.²⁷

Individual hospitals may elect a different respiratory protection method than the CDC recommendations.^{1,28} For endotracheal intubation, Canadian HCWs during the Toronto SARS outbreak used the PAPR, N95 mask, and maximal body coverage.²⁰ The California Department of Health Services Pandemic Influenza Plan states that the PAPR should be used when performing aerosol generating procedures.²⁹

Training and practice in safe and effective use of PPE for infectious and chemical exposure is essential. There is growing awareness of problems associated with incorrect or inappropriate use of PPE.^{30,31} Routine functions such as tracheal intubation and IV placement are difficult and time consuming while wearing protective gear.³²

A potential source of HCW self-innoculation is contaminated exposed skin especially around the neck and wrists.^{33,34} Successful avoidance of HCW infection requires strict attention to hand washing and recommended PPE donning and removal protocol.^{21,33,34} HCW infection during the SARS epidemic is thought to have resulted from PPE protocol breaches as opposed to PPE failure, or “through-precautions” transmission.^{28,33,34}

Aerosol generating airway procedures should be performed in an Airborne Isolation Room (AIR) whenever possible. An AIR should have a negative inside air pressure with 6-12 air exchanges per hour (ACH) and an outside exhaust or HEPA filtration system if the air is re-circulated.^{1,10,35}

A designated hospital for SARS victims is optimal.^{20,21} However, the case load in an influenza pandemic would be many times greater than that in a SARS outbreak, and most hospitals would be overwhelmed.^{7,9} Detailed isolation and infection control recommendations can be found at the CDC websites, in the HHS Plan, the California Plan, and the WHO SARS Infection Control Guidelines. Recommended Avian influenza precautions are the same as those for SARS.^{5,22-26,29,36}

Operating Room (OR) and Intensive Care Unit (ICU) Infection Control Procedures

With extensive planning and meticulous infection control measures, no OR HCWs were infected in a 2003 Singapore SARS outbreak.²¹ The OR and ICU are at high risk for aerosol transmission. Normally the OR air pressure is positive relative to the surrounding perioperative areas. In the presence of airborne infectious disease the positive inside pressure may force contaminated air into the surrounding operating room suites. An operating room with an antechamber reduces this risk. Commercial portable environmental containment units have a sealed negative pressure antechamber, a UV light over the door, and HEPA filtration. The hospital facilities manager can assist with OR infection control issues.²¹

Non-essential surgical procedures should be delayed until the patient is no longer infectious. The patient should be transferred directly to the operating room for urgent and emergent procedures, bypassing the pre-operative areas. The patient should wear a surgical mask and the transport team members should wear a gown, gloves, eye protection and an N-95 mask. Surgical procedures should be performed in the most remote OR when the least number of people would be exposed. All non-essential equipment should be removed from the room prior to the arrival of the patient. The anesthesia circuit should be protected by bacterial/viral filters. Recovery should occur in the same OR or in a respiratory isolation room. Following surgery on a TB patient the OR is to be left vacant until 99.9% of the air is exchanged.³⁵ The time required depends on the number of air exchanges per hour. This strategy could be considered for pandemic influenza cases also. Standard procedures for OR decontamination using an EPA-registered disinfectant should be followed. Wastes are handled in standard fashion in accordance with state and local regulations.^{21,28}

Equipment for Pandemic and All-hazard Disaster

1. Ventilator alternatives - small, portable, disposable, hand held, automatic units:

- pNeuton A <http://www.pNeuton.com>
- Uni-Vent® Eagle Model 754.
http://www.impactinstrumentation.com/portable_ventilators.htm
- Oxylator® EM-100 and EMX <http://www.lifesavingsystems.com> or <http://www.cprmedic.com> also multiple head O2 manifold for mass casualty.
- Surevent™ MCI kit-multiple patient miniature ventilator system
<http://www.HartwellMedical.com>
- VTM-1 (Vortran Medical Technology).

2. Suction Devices:

- Laerdal Portable suction unit, compact suction unit, and V-VAC Manual Suction Unit
<http://www.laerdal.com/document.asp?docid=1433081>

3. Personal Protective Equipment:

- 3M Safety Products-filtering facepiece respirators (N95 masks), 3M Air-Mate-high efficiency powered air purifying respirator (PAPR).
- Global Protection- PAPRs, masks and suits <http://www.protectivesuits.com>
- Sundstrom Air-purifying respirator <http://www.sea.com.au> PureAir Bio Response Kit™ (PAPR)
<http://www.safetytechint.com/products/first-receivers.php>

4. Surge Capacity systems:

Vericor Mass Casualty Response System <http://www.VeriCorMed.com>

Disclaimer Note: This list was extracted from the Exhibitor Guide for the 2006 Disaster Response and Recovery Expo, co-located with the National Disaster Medical System (NDMS) Conference in Reno, Nevada 2006

Equipment referred to, listed, or suggested in this article has not been evaluated by, nor is endorsed by the American Society of Anesthesiology or its Committees on Trauma and Emergency Preparedness (COTEP) and Occupational Health

REFERENCES

1. HHS Pandemic Influenza Plan:
<http://www.hhs.gov/pandemicflu/plan/pdf/HHSPandemicInfluenzaPlan.pdf>, accessed 11/11/06
2. Beigel JH, et al.: Writing Committee of the World Health Organization (WHO) Consultation on Human Influenza A/H5, Avian influenza A (H5N1) infection in humans. *N Engl J Med* 2005; 353: 1374-85
3. CDC new outbreaks of Avian flu-birds, humans:
<http://www.cdc.gov/flu/avian/outbreaks/current.htm>, accessed 11/24/06
4. World Health Organization (WHO) current cases:
http://www.who.int/csr/disease/avian_influenza/country/cases_table_2006_08_14/en/index.html, accessed 11/24/06
5. WHO Global Influenza Preparedness Plan. Geneva, Switzerland:
http://www.who.int/csr/resources/publications/influenza/WHO_CDS_CSR_GIP_2005_5/en, accessed 9/27/06
6. Department of Homeland Security (DHS) Home Preparedness Plan comprehensive checklists for home, hospital and business:
<http://www.ready.gov/america/index.html>.
7. National Disaster Medical System (NDMS) 2006 Conference Reno Nev. Sessions: http://www.ndms.chepinc.org/index.asp?content_id=741, accessed 8/19/06
8. National Disaster Life Support Courses (NDLSTM): <http://www.ama-assn.org/ama/pub/category/12606.html>, accessed 8/19/06
9. Gostin LO: Medical countermeasures for pandemic influenza: ethics and the law. *JAMA* 2006; 295: 554-6
10. Center for Infectious Disease Research and Policy (CIDRAP):
<http://www.cidrap.umn.edu/cidrap/content/influenza/avianflu> ;
<http://www.cidrap.umn.edu/cidrap/content/influenza/panflu/biofacts/panflu.html>,
accessed 9/27/06
11. Barry J: *The Great Influenza: The Epic Story of the Deadliest Plague in History*. New York, Penguin Group, 2004 (see also Barry, JM 1918 Revisited *Inst. of Medicine* Nov 16 2004)
12. Chan M, Cheung C, Chiu W, et. al.: Proinflammatory cytokine responses induced by influenza A(H5N1) viruses in primary human alveolar and bronchial epithelial cells. *Respir Res* 2005; 6 (1) abstract
13. Zhou J, Law HK, Cheung CY, et al.: Differential expression of chemokines and their receptors in adult and neonatal macrophages infected with human or avian influenza viruses. *J Infect Dis* 2006; 194: 61-70
14. de Jong MD, et al.: Oseltamivir resistance during treatment of influenza A (H5N1) infection. *N Engl J Med* 2005; 353: 2667-72
15. WHO Rapid Advice Guidelines on pharmacological management of humans infected with avian influenza A (H5N1) virus:
http://www.who.int/csr/disease/avian_influenza/guidelines/pharmamanagement/en/index.html, accessed 8/19/06

16. Prevention and Control of Influenza: Recommendations of the Advisory Committee on Immunization Practices (ACIP), CDC -MMWR, July 29, 2005/Vol. 54/ No. RR-8: <http://www.cdc.gov/mmwr/PDF/rr/rr5408.pdf>, accessed 9/27/06
17. Fedson DS: Pandemic influenza: a potential role for statins in treatment and prophylaxis. *Clin Infect Dis* 2006; 43: 199-205, <http://www.journals.uchicago.edu/CID/journal/issues/v43n2/38852/brief/38852.abstract.html?erFrom=-2311532022364203832Guest>, accessed 8/19/06
18. Hampton T: Blood transfusions for flu pandemic? *JAMA* 2006; 296: 1827
19. Henter JI, Chow CB, Leung CW, Lau YL: Cytotoxic therapy for severe avian influenza A (H5N1) infection. *Lancet* 2006; 367: 870-3
20. Kavanaugh B: Panel on "Responding to the Coming Plagues" October 2006 ASA Chicago, and personal communication. 10/06
21. Chee VW, Khoo ML, Lee SF, Lai YC, Chin NM: Infection control measures for operative procedures in severe acute respiratory syndrome-related patients. *Anesthesiology* 2004; 100: 1394-8
22. Garner JS: Guideline for isolation precautions in hospitals. Part I. Evolution of isolation practices, Hospital Infection Control Practices Advisory Committee. *Am J Infect Control* 1996; http://www.cdc.gov/ncidod/dhqp/gl_isolation.html accessed 9/27/06; 24: 24-31
23. Garner JS: Guideline for isolation precautions in hospitals. The Hospital Infection Control Practices Advisory Committee. *Infect Control Hosp Epidemiol* 1996; http://www.cdc.gov/ncidod/dhqp/gl_isolation.html accessed 9/27/06; 17: 53-80
24. Interim Recommendations for Infection Control in Health-Care Facilities Caring for Patients with Known or Suspected Avian Influenza: <http://www.cdc.gov/flu/avian/professional/infect-control.htm> . accessed 9/27/06
25. Interim Guidance on Planning for the Use of Surgical Masks and Respirators in Health Care Settings during and Influenza Pandemic, Oct 2006; <http://www.pandemicflu.gov/plan/maskguidancehc.html>. accessed 11/11/06
26. Interim Recommendations for Infection Control in Health-Care Facilities Caring for Patients with Known or Suspected Avian Influenza: <http://www.cdc.gov/flu/avian/professional/infect-control.htm>. accessed 9/27/06
27. OSHA (Occupational Safety and Health Administration) Respiratory Protection Program: <http://www.osha.gov/SLTC/etools/respiratory/>. accessed 9/27/06
28. Weiner-Kronish J: Infection Control for the Anesthesiologist: Is There More than Handwashing? 2006 ASA Refresher course #502 Chicago, and personal communication. 10/06
29. California Influenza Preparedness and Response Plan Sept 8 2006: <http://www.dhs.ca.gov/ps/dcdc/izgroup/pdf/pandemic.pdf>. accessed 10/22/06
30. Agency for Healthcare Research and Quality. Understanding needs for health system preparedness and capacity for bioterrorist attacks. <http://www.ahrq.gov/about/cpcr/bioterrtxt.htm>.
31. Barach P, Rivkind A, Israeli A, et al.: Emergency preparedness and response in Israel during the Gulf War. *Ann Emerg Med* 1998; 32: 224-33
32. Hendler I, Nahtomi O, Segal E, et al.: The effect of full protective gear on intubation performance by hospital medical personnel. *Mil Med* 2000; 165: 272-4

33. Conly JM: Personal protective equipment for preventing respiratory infections: What have we really learned? CMAJ • 2006;175 (3):263: <http://www.cmaj.ca/cgi/content/full/175/3/263>. accessed 9/27/06
34. Zamora JE, Murdoch J, Simchison B, Day AG: Contamination: a comparison of 2 personal protective systems. Cmaj 2006; 175: 249-54; <http://www.cmaj.ca/cgi/content/full/175/3/249#T116>. accessed 9/27/06
35. Guidelines for Preventing Transmission of M. tuberculosis in Health Care Facilities,1994: <http://www.cdc.gov/mmwr/preview/mmwrhtml/00035909.htm> accessed 9/1/06
36. World Health Organization. Hospital Infection Control Guidance for Severe Acute Respiratory Syndrome (SARS): <http://who.int/csr/sars/infectioncontrol/en>.