

Issues Relevant to the Adoption and Modification of Hospital Infection-Control Recommendations for Avian Influenza (H5N1 Infection) in Developing Countries

Anucha Apisarntharak,¹ David K. Warren,² and Victoria J. Fraser²

¹Division of Infectious Diseases, Faculty of Medicine, Thammasart University Hospital, Pratumthani, Thailand; and ²Division of Infectious Diseases, Washington University School of Medicine, St. Louis, Missouri

The reemergence of avian influenza (H5N1 infection) has heightened concern for a potential human influenza pandemic. Recommendations regarding preparation for a global avian influenza pandemic are available, and it is imperative that health care workers participate in preparedness planning and training. In developing countries, health care worker preparedness training should address the modes of avian influenza transmission and specify how to implement appropriate infection-control strategies to prevent and control the spread of avian influenza. We provide evidence for avian influenza transmission methods and identify prevention strategies relevant to infection control for hospitals in developing countries. Pandemic influenza preparedness plans must include health care administrative support, mechanisms to rapidly create temporary isolation facilities, systems to restrict access to exposed health care workers, and plans to involve specialists to screen and identify cases early, to provide for continuous monitoring to ensure adherence to optimal infection-control practices, and to provide regular feedback to health care workers.

It is estimated that the next influenza pandemic will infect ~20% of the world population. One in every 100 individuals with influenza is expected to be hospitalized, and 7 million people will potentially die within a few months [1–3]. The ongoing avian influenza (H5N1 infection) epidemic poses significant risks to both humans and animals [4–7]. The potential exists for cross-species transmission to humans and subsequent reassortment of avian and human influenza viruses in

coinfected individuals [8]. Pandemic influenza planning and worldwide surveillance are key factors in mounting an effective global preparedness strategy for avian influenza [9]. Although recommendations for hospital infection control for avian influenza are available [10], adopting these recommendations has been an issue in developing countries. Because infection-control resources, including infrastructure and personal protective equipment (PPE), may vary considerably in different settings, hospital policy-makers in developing countries need to make decisions regarding the use of infection-control resources on the basis of disease prevalence, local priorities, personnel availability, and financial constraints. It is, therefore, important for health care workers (HCWs), who in many cases serve as first responders (i.e., may triage and eval-

uate an index case), to understand the dynamics of avian influenza transmission and to recognize the appropriate infection-control strategies recommended for the prevention and control of avian influenza.

EVIDENCE OF AVIAN INFLUENZA TRANSMISSION

Current evidence suggests that H5N1 viral infection occurs via bird-to-human transmission, possibly via environment-to-human transmission, and via limited, non-sustained human-to-human transmission [11]. To date, animal-to-human transmission is thought to be the predominant mode of avian influenza acquisition in humans [12, 13]. Risk factors include plucking and preparing ill birds, handling cocks for fighting events and tourism, playing with poultry, consumption of duck blood

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Reprints or correspondence: Dr. Anucha Apisarntharak, Div. of Infectious Diseases, Faculty of Medicine, Thammasart University Hospital, Pathumthani 12120, Thailand (anapisarn@yahoo.com).

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or undercooked poultry, and exposure to live poultry within 1 week prior to the onset of illness [11, 12]. Interestingly, interspecies transmission of avian influenza viruses has occurred in experimental settings from chickens to tigers, chickens to leopards, and chickens to domestic cats [14–16]. Human-to-human transmission of avian influenza has occurred via intimate contact without the use of barrier precautions but has not occurred from casual, social contact [17]. Serological studies of avian influenza among exposed HCWs, household contacts, and poultry cullers suggest that human-to-human transmission to date has been inefficient and that antibodies may develop in asymptomatic, exposed persons [13, 17–21]. Albeit rare, probable human-to-human transmission of H5N1 virus has been reported in several household clusters [8, 22].

Although it is unclear what role aerosols play in the natural transmission of avian influenza, it is important to keep in mind that the main goal of infection control is to minimize the risk of transmission of avian influenza within health care facilities. The recommendation to routinely use N95 respirators during an influenza pandemic is complicated by several factors. First, N95 respirators require fit testing. Once tested, any individual must use only the brand and size of respirator for which they have been certified. During a pandemic, it is likely that supplies of respirators may be limited, and supply chains may become disrupted. Therefore, it will be difficult to provide the appropriate size of respirator for each HCW. Also, the large number of N95 respirators marketed will make the stockpiling of appropriate numbers and sizes of respirators logistically difficult. The reproducibility of fit testing over time has been questioned [23], and prolonged use of N95 respirators has been shown to cause headaches [24] and facial discomfort [25] and may result in hypoxemia [26]. Poor compliance or incorrect use of an N95 respirator may negate any

potential benefit that might be gained from their use. Therefore, pandemic influenza plans in developing countries might have to take these realities into consideration and use a more risk-based stratification approach to address droplet and contact precautions versus airborne and contact precautions.

HOSPITAL INFECTION CONTROL

The infection-control components of an avian influenza preparedness plan include: (1) basic infection-control measures, including hand hygiene; (2) use of PPE; (3) vaccination with seasonal influenza vaccines; (4) administration of prophylactic antiviral drugs; (5) surveillance and monitoring for HCW exposures; (6) evaluation of ill HCWs; (7) precautions for household and close contacts; and (8) limited visitation, if not quarantine, of ill patients. The rationale for most pandemic influenza preparedness plans are based on several assumptions: (1) it is unlikely that appropriate vaccines will be readily available in adequate supplies; (2) populations at high risk for complications may increase tremendously, given the high attack rate and mortality among adults aged 15–35 years seen in the 1918 pandemic [27]; and (3) containing illness among HCWs during an influenza pandemic will be challenging even if there is excellent compliance with infection-control practices.

In general, influenza attack rates during outbreaks among unvaccinated HCWs are reported to be as high as 59% [28]. Influenza attack rates often remain >10% among unvaccinated HCWs, even when there are excellent infection-control measures and behavioral compliance [29]. Viral shedding of influenza in adults can extend for 7 days after symptom onset and for weeks in infants and immunocompromised individuals. This makes environmental control of influenza even more difficult in health care facilities. Thus, the initial specific protection of HCWs will need to include available antiviral agents

(e.g., oseltamivir and zanamivir) for chemoprophylaxis and treatment. A recently proposed university hospital-based preparedness plan has recommended the stockpiling of oseltamivir [29]. There are 4 potential strategies for using antiviral agents during an influenza outbreak [30, 31]: chemoprophylaxis for the entire influenza outbreak and season, postexposure chemoprophylaxis, treatment of ill patients, and a combination of chemoprophylaxis and treatment. Several studies support the use of prophylactic viral agents [31–35]. Furthermore, a model of the 1957–1958 Asian influenza pandemic predicted that 8 weeks of antiviral prophylaxis for close contacts of index case patients would have reduced the attack rate from 33% to 2% [36]. Thus, targeted prophylaxis for HCWs and patients would likely mean administering 6–8 weeks of prophylaxis to all vulnerable groups. Although attractive, this strategy is prohibitively expensive for most hospitals and other health care facilities in both developed and developing countries. Furthermore, widespread, long-term use of antiviral prophylaxis could promote antiviral resistance. An alternative strategy that focuses on the treatment of ill HCWs, with some targeted prophylaxis of heavily exposed HCWs, would be more financially feasible. This strategy would provide for treatment of those HCWs directly caring for patients with influenza during a pandemic. Recent studies have reported that neuraminidase inhibitors administered within 48 h of symptom onset decrease the duration of illness and viral shedding, the incidence of hospitalization, antibiotic use, and mortality [35, 37, 38]. Health care workers should be tracked and monitored for influenza-like illness (e.g., myalgia and fever). It is likely that such monitoring would identify most of the ill HCWs and, thus, allow timely administration of antiviral therapy. Despite these recommendations, health care facilities in developing countries may find it difficult to imple-

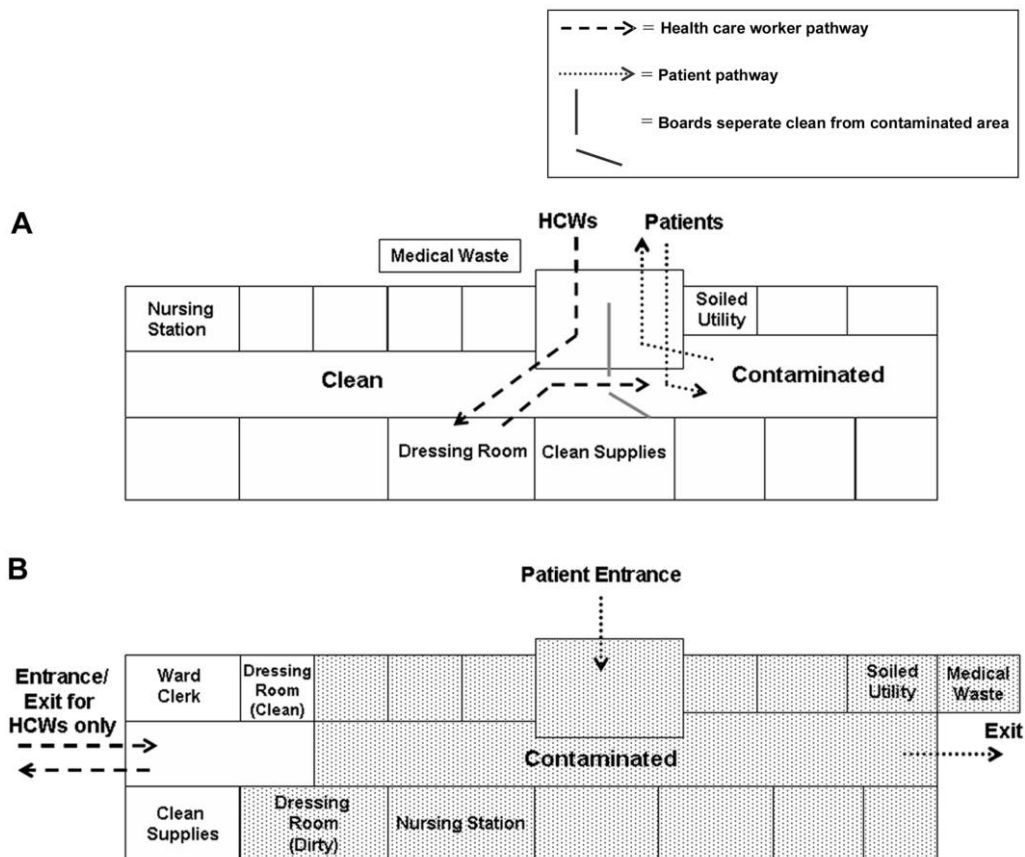


Figure 1. Potential cross-contamination of the isolation unit (A). This issue could be minimized by using separate entrance and exit pathways for health care workers (HCWs) and patients and by creating a one-way entrance and one-way exit for patients (B). Dressing room (clean), room where HCWs put on personal protective equipment; dressing room (dirty), room where HCWs remove contaminated personal protective equipment after leaving the contaminated zone.

ment antiviral therapy because of the associated high cost.

INFECTION CONTROL FOR HEALTH CARE FACILITIES IN DEVELOPING COUNTRIES

For preparedness planning in health care facilities in developing countries, some practical issues that are relevant to the adoption and modification of the above recommendations should be considered [39].

Health care administrative support.

The level of occupational protection of HCWs in developing countries has not met the minimal standards of the US Occupational Health and Safety Administration. Despite the logistical and economic challenges, efforts to promote implementation of effective infection control and

occupational health strategies are overdue, and a global need for such strategies is now recognized. Given the experience of severe acute respiratory syndrome (SARS) outbreaks, which occurred in both designated "SARS hospitals" and "non-SARS hospitals" [40–42], global preparedness plans should facilitate administrative, fiscal, and infrastructure support for routine occupational health and safety programs for HCWs, appropriate infection-control expertise, and infrastructure in health care settings, available PPE for HCWs, and epidemiological resources for the prevention and control of emerging infectious diseases. These expenditures should not be viewed as an increase in the cost of health care but as preventive health and safety measures that insure protection of HCWs and, ideally, provide an anticipated return

on investment to the health care institution.

Development of practical surveillance strategies.

Surveillance strategies should be developed in accordance with the current level of the influenza pandemic and the existing local infrastructure. Such strategies should be continuously monitored and modified. During the SARS outbreak in Hong Kong, there were very few private rooms in which to isolate patients. Some hospitals controlled the outbreak by having designated SARS teams and geographically separate wards for patient triage, patients with confirmed SARS cases, and patients without SARS [43]. During an avian influenza outbreak, some hospitals in Thailand performed surveillance for avian influenza among all patients who were admitted to the intensive care unit

with severe community-acquired pneumonia [44, 45]. The estimated annual cost for avian influenza screening in a Thai hospital was \$7375 [44]. These studies reported a low detection rate for avian influenza (3 cases among 5496 patients). Therefore, cost-effectiveness studies of screening programs, based on the level of local avian influenza activity, are warranted before this strategy can be adopted in areas where H5N1 infection is endemic.

Involvement of specialists. As in developed countries, health care providers with the least experience are often the first to evaluate patients with unrecognized emerging infectious diseases in developing countries [46, 47]. This may lead to delayed recognition of disease and missed opportunities to interrupt disease transmission [46, 47]. Several reports from developing countries emphasize the added value of specialists (e.g., infectious diseases, pulmonary, and emergency medicine specialists) in screening for suspected cases of emerging infectious diseases and early recognition of atypical cases in acute and ambulatory care settings [7, 21, 41, 48]. Given the difficulty of rapidly diagnosing avian influenza [49, 50], early involvement of specialists could promote the obtaining of adequate, lower respiratory tract specimens from an index patient before that patient receives antiviral medication. Although the value of infection control and health care epidemiology expertise has been formally recognized in North America and Europe [51–52], this is not the case in most acute-care facilities in developing countries.

Creation of a temporary isolation ward during an epidemic. Rapid creation of a temporary isolation ward using existing functional hospital units is readily applicable to clinical settings in developing countries. Such units should be divided into a clean zone, for changing into and out of street clothes and for recording the HCW's name and entry and exit times; an intermediate zone, for donning PPE that has been modified according to resource availability (e.g., scrubs and double-glov-

ing); and a contaminated zone, for entering isolation areas [53]. Exhaust fans could be installed above windows in each room if isolation rooms with negative pressure ventilation are unavailable. At least 1 m of distance should be placed between patients to reduce the risk of cross-transmission through respiratory droplets. Although creation of a temporary isolation ward seems to be attractive during an epidemic, it is important to realize that the ward designated for temporary isolation should have separate entrance and exit pathways for HCWs and patients, and a one-way entrance and one-way exit should be designated for patients, to minimize problems involving cross-contamination (figure 1).

Improvement of existing infection-control practices. As is the case with any set of practices, infection-control practices may be difficult to orchestrate without effective communication that clearly outlines the objectives for these practices. This point was emphasized in recent reports of increased rates of methicillin-resistant *Staphylococcus aureus* acquisition in Hong Kong and Singapore during the SARS outbreak [54, 55]. These studies suggested that rates of methicillin-resistant *S. aureus* transmission increased when HCWs adopted the nonstandard practice of wearing gloves and gowns all of the time. Several infection-control practices, such as proper hand hygiene and the correct use of PPE, may need to be highly monitored, with feedback provided to HCWs in a timely manner, to optimize appropriate infection-control practices and to reduce the risk of disease transmission.

CONCLUSIONS

Avian influenza is a likely candidate for the next influenza pandemic. Given the global experience from the SARS epidemics, it is reasonable to suspect that health care facilities may serve as the nidus for large-scale community outbreaks. Health care facilities in developing countries will benefit from adopting or modifying their strategic pandemic influenza plan and

identifying local expertise to optimize control of outbreaks at their earliest stages.

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