

Recommendations for Respiratory Personal Protective Equipment Use during an Avian Influenza Pandemic

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Summary

In order to further planning efforts at the University of Louisville for a potential avian influenza pandemic, Documents from the World Health Organization, the Centers for Disease Control and Prevention, Occupational Safety and Health Administration and other entities were reviewed.

After consideration of the information collected, the following recommendations are offered:

Respiratory Protection:

- When available, N95 masks should be utilized when in close contact with infected or suspected infected individuals. In the event N95 masks are not available, surgical/procedure masks should be used.
- When an individual wishes to protect themselves during incidental contact with other people, surgical/procedure masks should be utilized. In the event a surgical/procedure mask is unavailable, a makeshift cloth mask may be used.
- People using N95 or surgical/procedure masks should be trained in their use, fit tested as appropriate, trained to perform a user seal test (fit check), and trained in good hygiene practices when using them. If people have not been trained or fitted for using the N95, they should utilize the surgical/procedures mask.
- Emergency planning efforts should consider using the highest level of respiratory protection and fall back to lower levels only when resources have been expended or become unavailable.

- Both N95 Particulate Respirators and Surgical/Procedures Masks should be considered disposable items and no attempts should be made to disinfect them for reuse.
- Prior to any respiratory protective equipment use, a training program must be developed. This program should be provided to all essential employees and any other employees who might have close contact with an infected or potentially infected individual prior to any sustained human to human transmission of the Avian Influenza Virus.
- Hand hygiene must be an integral part of all training programs involving an infectious disease.

PPE Guidelines from Governmental Agencies

All three organizations currently recommend the following personal protective equipment when treating or transporting patients suspected or confirmed to have avian flu:

- Disposable gloves that fit snugly over the gown cuff
- Impervious (fluid resistant) gowns are recommended, but a disposable full body isolation suit is an acceptable alternative to a gown. WHO recommends an impervious apron if an impervious gown is unavailable.
- Eye protection should be worn. The CDC recommendations go further to state that goggles or a face shield should be utilized.
- N95, N99 or N100 respirator should be used in accordance to the standards set forth in 29 CFR 1910.134. If these types of masks are not successful in providing protection due to facial hair, a powered air purifying respirator (PAPR) may be utilized instead. The WHO recommends that if insufficient particulate respirators are available, workers should use surgical or procedure masks.

Additionally, the WHO and CDC recommend that the **patient** be supplied a surgical or procedure mask to wear during the period of contact as a means of source containment of infectious particles.

The WHO document is dated February 9, 2006.¹ The CDC refers the reader to their document that was published for SARS dated January 8, 2004.³ The OSHA Guidance reviewed is currently on their website, but the date of issuance is not found on the web page.⁴

The highest level of protection available should be utilized during the treatment and transportation of a patient suspected of having Avian Influenza. This does not include incidental contact between people who are not treating/transporting suspected or confirmed avian flu patients. People trying to prevent the spread of an infection spread through large droplet exposure should use a surgical or procedure masks to prevent infection.

Additionally, if a shortage of N95 respirators occurs during an influenza pandemic, people delivering health care or transporting patients should utilize procedure/surgical masks. The CDC has even gone so far as posting procedures, developed by staff at the University of Pittsburgh, on their website for using a Hanes T shirt as a makeshift respirator in the event that respirators become unavailable.

This hierarchy is outlined by the WHO, who recommends that people trying to prevent the spread of large droplet use respiratory protections down to the level of makeshift masks if commercially available N95 or procedure/surgical masks are unavailable.

While different research and regulatory groups are evaluating different options, protocols should require that anyone who comes into direct contact with a potential or confirmed patient infected with Avian Flu should follow the guidelines listed above. Additionally, these recommendations also apply to patients suspected or confirmed to be infected with SARS.

Researchers in Hong Kong surveyed over 250 hospital staff exposed to 11 SARS patients between 15 March and 24 March, 2003. Most of the 13 staff who became infected did wash their hands after patient care, and a handful also wore gloves or a paper mask, but none had used a surgical or N95 mask. Analysis of the data showed that the use of surgical or N95 masks was the only measure to give statistically significant protection. However, not one of the 69 staff who had used all four recommended protection measures - wearing a N95 or surgical mask, gloves, gowns and washing their hands - contracted the virus.⁴

Service Life

The service life of the N95 respirator is an issue that has been brought up in several settings. I have researched the NIOSH web pages for standards related to service life of N95 respirators. The recommended service life of an N95 respirator is typically 8 hours. A N95 could be used for a longer period if the user does not find the mask to cause poor hygiene or increased breathing resistance.⁵ The effect of wearing an N95 respirator for periods of up to 8 hours will cause the wearer to tire more rapidly, become overheated and in some cases become annoyed by the continued use. This will make the worker less effective and could cause behaviors that may circumvent the mask's efficiencies and may, in fact, result in decreased use of other items of PPE.

The use of a N95 respirator should immediately cease when the respirator is damaged, soiled, or causing noticeably increased breathing resistance (causing discomfort to the wearer). Additionally, research efforts have been unable to locate any documentation on the service life of a procedure/surgical mask except for manufacturer recommendations. Prolonged use of the procedure/surgical mask results in the material matrix becoming increasingly moist which reduces the effectiveness of the mask. The manufacturers have indicated that masks are best changed when they become moist and that may occur in as little as one hour after use.

Hygiene

Improper respirator use and poor hygiene is a potential problem that could impact respiratory protection. It is imperative to have effective procedures in place to protect mask wearers from avian influenza. Masks that do not fit properly, removal of the mask around potentially infected individuals and adjusting the mask with unwashed hands can all lead to potential infection. The best respirator or surgical/procedure mask will do little to protect the wearer who refuses or misunderstands how and when to use it correctly.

Adjusting a mask with hands that are contaminated with the influenza virus could allow the virus to enter the body by inhalation or via the mucous membranes of the eyes, nose or mouth.⁶ After adjusting a contaminated mask, the wearer could auto inoculate themselves when the mask is removed and they return to normal operations. It is imperative to assure that hands are clean and disinfected both prior to adjusting a mask and after the adjustments have been made. This can be performed through the performance of hand washing or use of hand sanitizers such as alcohol-based hand rubs. Hands should be washed when visibly soiled. For other times, hand sanitizers are appropriate.

Any effort to communicate PPE usage must provide information on the usefulness of the equipment, the limitations of the equipment, proper hygiene and must be delivered with candor, truthfulness and authority.

Decontamination/Reuse

The Institute of Medicine of the National Academies has reviewed information regarding the reuse of facemasks during an Influenza Pandemic. In their April, 2006 report they conclude that there is no method available to decontaminate a facemask and not compromise its effectiveness. Therefore, once a mask is suspected to be contaminated it should be discarded.⁷

Use of PPE in the Non-Occupational Setting

There has been very little research on the effectiveness of using N-95 respirators and/or surgical masks in the community setting as a tool to control the spread of a pandemic influenza. In the absence of research data, the Department of Human and Health Services has issued interim guidance on the use of respirators and surgical masks. This interim guidance considers the principles of traditional infection control and differences in the healthcare and community settings.

Individuals who might be exposed to a person who has a respiratory disease, or is required access areas of large public gatherings should consider the use of a mask or respirator. Individuals charged with the care of an infected individual in the home setting should also consider the use of a mask or respirator. Additionally, individuals who must interact with other members of the community (examples include attending religious services, shopping trips for food or other essential supplies) may consider mask or

respirators use to avoid unexpected exposure due to a sneeze or cough. Use of a mask or respirator should not supplant the other traditional methods of infection control, but should be a supplement.⁸

Individuals in the Non-Occupational setting should continue to avoid the situation that allows exposure to an infected individual regardless of the availability of masks or respirators. Good hand and cough hygiene needs be practiced constantly to prevent the spread of contamination.

Calculations for Determining Respiratory PPE

While there are few products that have been developed to assist entities in calculating the number of respirators needed during an Influenza Pandemic, the World Health Organization guidance⁸ is the most beneficial.

Individuals that arrive at a medical facility to be evaluated for treatment should immediately be provided with a surgical/procedure mask and instructed to wear the mask throughout their visit. Since it is expected that 35% of the population will become ill and exhibit symptoms, planners should expect 35% of the total population to present themselves for medical evaluation. In addition, some individuals may present themselves for evaluation due to being concerned or scared that they have contracted the influenza. The WHO has placed the percentage of these “worried well” at 15% of the total population. This number might be higher. A radiation accident in Goiania Brazil saw that the worried well was almost 100% of the population.

The number of surgical/treatment masks needed for initial visits to a medical facility should anticipate 50% of the total population. The surgical/procedure masks that will be needed for medical staff evaluating individuals that present themselves equals the amount of masks that will be needed for 50% of the population. In summary, during the initial medical screening visit both the patient and medical evaluator will need a surgical/procedures mask. This number will equal $2 \times 50\%$ of the population.

Essential staff that are not healthcare workers that may be potentially exposed through incidental contact, should be placed into a separate population group. This group would include police, security, food workers, service workers and other responders. The number of surgical/procedure masks should be calculated using the total number of individuals for this population group and multiplying by two. This is using the concept that these masks will have to be changed very four hours or twice during an eight-hour shift. If it is expected that their shift will exceed four hours, the multiplying factor must be the numbers of hours worked divided by 4.

The formula for essential personnel that may have incidental contact with potentially infected individuals is the number of essential staff multiplied by the number of hours they work divided by 4 and then multiplied by the number of days that they will work during the pandemic. WHO recommends planning for 90-180 days with an additional 50% buffer.

In the case where there is more than incidental contact with potentially infected individuals, a N95 mask be required instead of the surgical/procedures mask.

In the event that the University must care for sick individuals on an inpatient basis, additional masks will be required. This number is dependent on the number of healthcare workers. The total number of masks needed for healthcare workers should be calculated using the same formula as the essential workers formula above. Additionally, individuals being cared for as in patients would also need a daily change in mask, this would be calculated as the number of patients X 60 days to provide an adequate buffer.

When patient treatment requires attention to the respiratory tract of ill individuals, healthcare workers should discard the surgical/procedure mask in lieu of an N95 mask that offers greater protection. This would include medical procedures such as intubation, suction, and resuscitation efforts. This would also include situations where the infected individual does not have respiratory protection and the healthcare worker must deliver care with close patient contact. Plans should be made that at least 10% of the masks needed by healthcare workers be N95 masks.

Powered Air Purifying Respirators (PAPRs)

Powered Air Purifying Respirators (PAPR) was not considered in this evaluation and recommendation for respiratory protection due to their unavailability en masse and their cost. This equipment does provide valuable respiratory and contact protection, but requires additional considerations such as the ability to disinfect after use and prior to reuse, recharging of the power supply, care and maintenance of the filtration cartridge, and use of appropriate hoods. Therefore, it is suggested that PAPRs be used in special circumstances and with prior planning.

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