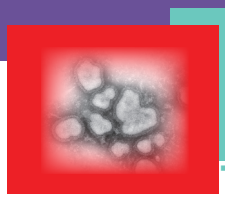

Pan American Health Organisation
Office of the Assistant Director
Health Systems and Services Area

Technical Document 4

HAND WASHING AND PERSONAL PROTECTIVE EQUIPMENT

INFORMATION for Health Care Managers

JUNE 29, 2009

This document provides technical information on hand washing and the use of personal protective equipment (PPE) during the influenza A (H1N1) outbreak, to mitigate the risk of transmission and accumulation of infected cases at national and community levels. It is intended for health care managers[1] in all countries in the Region of the Americas, which may or may not have probable or confirmed cases of infection. It will be revised as the situation evolves and additional information becomes available.

BACKGROUND

Current evidence suggests that the main route of human-to-human transmission of the new influenza A (H1N1) virus is via respiratory droplets, which are expelled by speaking, sneezing or coughing. Any person who is in close contact (approximately 1 metre/6 feet) with someone who has influenza-like symptoms (fever, sneezing, coughing, running nose, chills, muscle ache etc.) is at risk of being exposed to potentially infective respiratory droplets.

During the 2003 outbreak of severe acute respiratory syndrome (SARS), several surveys of the general public were conducted to gauge their response to the outbreak and adoption of transmission prevention measures. It was found that SARS-related perceptions and behaviours evolved rapidly during the epidemic. Most respondents in one study believed that the virus could be transmitted via direct body contact and droplets. About half of the respondents believed that SARS was curable; this perception increased in the initial phase and decreased in the second phase. Perceived chance of infection was low (9%) but fear of infection in public places was high (48%). Perceived efficacy of hygiene measures (wearing a mask: 82%, hand washing: 93%, and home disinfection: 75%) remained high in both phases and the perceived efficacy of avoiding crowded place, and using public transportation, etc, increased initially and decreased in the second phase of the epidemic.[2]

Examination of the public's knowledge and perception of SARS and the extent to which various precautionary measures had been adopted, found that 40% did not recognise fomites as a possible mode of transmission whereas 55.1% believed that the infection could be transmitted airborne. Thirty percent believed they were very or somewhat likely to contract SARS; 25% believed they were very likely to survive if they contracted the disease, benchmarked against an actual case fatality ratio of 2.8% at the time of the survey. Precautionary measures directed against person to person droplet spread were generally adopted by most while the prevention of transmission through fomites was not practised as frequently. Respondents with higher risk perceptions and a moderate level of anxiety were most likely to take comprehensive precautionary measures against the infection, as were older, female, more educated people as well as those with a positive contact history and SARS-like symptoms.[3]

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1 ***Health care managers***: are all persons who manage a health care setting be it a locality (country, region/district, village) or a facility (hospital, ambulatory care centre). This includes the person in charge of the national Health Authority (e.g. Minister of Health) and all other persons in the health system who manage a health care setting and the health of its resident population and in so doing are responsible for decision-making.

2 Lau JTFm Yang X, Tsui H, Kim JH. Monitoring community responses to the SARS epidemic in Hong Kong: from day 10 to day 62. Journal of Epidemiology and Community Health 2003;57:864-870.

3 Leung GM, Lam T-H, Ho S-Y, Chan BHY, Wong IOL, Hedley AJ. The impact of community psychological responses on outbreak control for

HAND WASHING AND MASKS

Appropriate hand hygiene and rational use of available personal protective equipment (PPE) are two of the fundamentals of infection control. Masks are designed with particular purposes in mind and using a mask incorrectly may actually increase the risk of transmission, rather than reduce it.

Hand Washing

Hand washing has been consistently shown by research and in practice to be the most effective method of preventing infection transmission. In comparison with other physical interventions to interrupt or reduce the spread of SARS, frequent hand washing, defined as at least 10 times per day (OR 0.45, 95% CI 0.36 to 0.57; number needed to treat=4, 95% CI 3.65 to 5.52), was most effective - compared to wearing (surgical) masks (0.32, 0.25 to 0.40; NNT=6, 4.54 to 8.03), wearing N95 masks (0.09, 0.03 to 0.30; NNT=3, 2.37 to 4.06), wearing gloves (0.43, 0.29 to 0.65; NNT=5, 4.15 to 15.41), and wearing gowns (0.23, 0.14 to 0.37; NNT=5, 3.37 to 7.12).[4]

Quantitative systematic review of research on hand washing and risk of respiratory infections has also concluded that hand washing is associated with lowered respiratory infection and can cut the risk of respiratory infection by 16%, particularly in developed countries.[5]

The incremental effect of adding virucidals or antiseptics to normal handwashing to decrease the spread of respiratory disease remains uncertain.[4] However, the use of alcohol-based hand rubs is encouraged when facilities or resources for hand washing are unavailable or time for handwashing is a limiting factor.

Masks

There are two basic types of masks:

- surgical masks (facemasks) - designed to protect the environment from the wearer and
- particulate respirators - designed to protect the wearer from the environment.[6]

Surgical Masks[7]

Surgical masks are used to protect other people against infection from the person wearing the surgical mask. Such masks trap large particles of body fluids that may contain bacteria or viruses expelled by the wearer. They are also used as a physical barrier to protect the user from hazards, such as splashes of large droplets of blood or body fluids.

Specific uses include:

- Placement on sick people to limit the spread of infectious respiratory secretions to others.
- Wear by healthcare providers to prevent accidental contamination of patients' wounds by the organisms normally present in mucus and saliva.
- Wear by health care workers to protect themselves from splashes or sprays of blood or bodily fluids; they may also keep contaminated fingers/hands away from the mouth and nose.

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severe acute respiratory syndrome in Hong Kong. Journal of Epidemiology and Community Health 2003;57:857-863.

4 Jefferson T, Foxlee R, Del Mar C et al. Physical interventions to interrupt or reduce the spread of respiratory viruses: systematic review. BMJ 2008; 336:77-80.

5 Rabie T, Curtis V. Handwashing and risk of respiratory infections: a quantitative systematic review. Tropical Medicine and International Health. 2006; 11:258-267.

6 Balzay A. Toivola M, Adhikari A, Sivasubramani SK, Riponen T, Grinshpun SA. **Do N95 respirators provide 95% protection level against air-borne viruses, and how adequate are surgical masks?** American Journal of Infection Control 2006;34:51-7.

7 Occupational Safety and Health Administration (OSHA). Respiratory Infection Control: Respirators Versus Surgical Masks. OSHA Fact Sheet.

Respirators[7]

Respirators offer the best protection for workers who must work closely (either in contact with or within 1 metre/6 feet) with people who have influenza-like symptoms or other infectious diseases.

- Particulate respirators, such as N95, are specifically designed to protect workers during procedures generating aerosols.
- All respirators come in various sizes and must be individually selected to fit the wearer's face and to provide a tight seal.
- A proper seal between the user's face and the respirator forces inhaled air to be pulled through the respirator's filter material and not through gaps between the face and respirator.

PREVENTING THE SPREAD OF PANDEMIC INFLUENZA IN COMMUNITY SETTINGS

Research has suggested that the spread of respiratory viruses in the community can be prevented by intervening with hygienic measures aimed at younger children. A yearlong randomised controlled trial in squatter settlements in Karachi, Pakistan assessed the effect of hand washing on child health, via comparison of hand washing promotion with use of antibacterial vs. plain soap on the incidence of three clinical syndromes that cause large numbers of childhood deaths globally, including acute respiratory infections. Children younger than 5 years in households that received plain soap and hand washing promotion had a 50% lower incidence of pneumonia than controls (95% CI –65% to –34%). Incidence of disease did not differ significantly between households given plain soap compared with those given antibacterial soap. The hand washing methodology included nursery rhymes and counting to 10 seconds when washing and rinsing.[8] Another study on hand washing reported a significant decrease in respiratory illness in children up to age 24 months (relative risk 0.90, 95% confidence interval 0.83 to 0.97).[4]

The benefits of wearing masks have not been established for community settings. This is especially true in open areas (e.g. while walking or driving), as opposed to enclosed spaces while in close contact with a person with influenza-like symptoms. Thus, the use of masks is **not** advised for individuals who are not directly involved in providing care to an ill person confined to home-care. **Ill persons** who are accompanied by a non-affected person **must wear a mask** to reduce the transmission risk. Using masks will enable ill persons to consistently cover their mouth and nose to help contain respiratory droplets, a measure that is part of *respiratory hygiene and cough etiquette*.[9]

Home disinfection should also be strongly promoted in the community, with particular attention paid to cleaning of contact surfaces and washing of all utensils used for food consumption in the home.

Timely dissemination of information to the general public is a key component of effective management of public health crises[2], which may arise from an influenza A H1N1 pandemic. Promotion of protective personal health practices to interrupt the self sustaining transmission of the H1N1 virus in the community must take into account background perceptions of risk and anxiety levels of the public at large. Continuing public education about preventive measures should be targeted at the identified groups with low current uptake of precautions[3], at various points during a pandemic.

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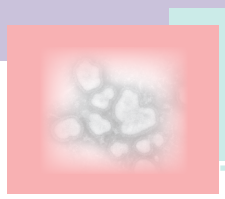
8 Luby SP, Agboatwalla M, Feikin DR, Painter J, Billhimer W, Altaf A, Hoekstra RM. Effect of handwashing on child health: a randomized controlled trial. Lancet 2005; 366:225-33.

9 ***Respiratory hygiene and cough etiquette***: Persons with respiratory symptoms should apply source control measures- cover their nose and mouth when coughing/sneezing with tissue or mask, dispose of used tissues and masks, and perform hand hygiene after contact with respiratory secretions. World Health Organisation. Standard precautions in health care. October 2007.



PREVENTING THE SPREAD OF PANDEMIC INFLUENZA IN HEALTH CARE SETTINGS

In health care settings, studies evaluating measures to reduce the spread of respiratory viruses have shown that hand washing and the use of masks can reduce the transmission of influenza. Investigation of a nosocomial outbreak of SARS in a Singapore hospital found that contact with respiratory secretions substantially and significantly increased the odds of SARS (OR 6.9, 95% CI 1.4–34.6, P=0.02). However, a very large reduction in odds was achieved by consistent hand washing after patient contact (OR 0.06, 95% CI 0.007–0.5, P=0.03). A large and highly significant reduction in odds was also achieved by wearing N95 masks when attending to SARS-infected patients (OR 0.1, 95% CI 0.03–0.4, P=0.001). Wearing latex gloves (OR 0.5, 95% CI 0.2–1.2, P=0.1) and gowns (OR 0.5, 95%CI 0.1–1.4, P=0.2) each halved the odds of infection.[10]

If masks are worn, proper use and disposal is essential to ensure they are potentially effective and to avoid any increase in risk of transmission associated with incorrect use. The following information on correct use of masks derives from the practices in health-care settings[11]:

- perform hand hygiene before putting on a mask
- place mask carefully to cover mouth and nose and secure as needed to minimise any gaps between the face and the mask
- while in use, avoid touching the mask
- replace masks with a new clean, dry mask as soon as they become damp/humid
- do not re-use single-use masks; discard single-use masks after each use and dispose of them immediately upon removing
- perform hand hygiene after removing a mask; clean hands by washing with soap and water or using an alcohol-based hand rub.

TYPES OF MASKS AND WHO SHOULD USE THEM

The type of mask to be used is determined by the setting and the persons involved.

TYPE OF MASK	LEVEL OF PROTECTION	WHO NEEDS IT	RATIONALE FOR USE
Non-Rigid Facemask	Confers second highest level of nose and mouth protection* for health care workers.	**All** health care workers** in settings where influenza-related care is not being provided (e.g. dental clinics, hospital surgeons and nurses).	Health workers providing non-influenza-related care are not at high risk of being in close contact with an influenza-infected person. Non-rigid structure is sufficient for these settings.

10 Teleman MD, Boudville IC, Heng BH, Zhu D, Leo YS. Factors associated with transmission of severe acute respiratory syndrome among health-care workers in Singapore. Epidemiology and Infection. 2004; 132: 797-803.

11 World Health Organisation. Infection prevention and control in health care in providing care for confirmed or suspected A(H1N1) swine influenza patients. Interim guidance. 29 April 2009. Available at http://www.who.int/csr/resources/publications/swineflu/en/index.html

Rigid Surgical Facemask	Confers second highest level of nose and mouth protection for health care workers. Rigid nose bridge provides better fit and greater potential for staying in place. Measurement of the level of nose and mouth protection conferred by two different types of surgical masks at 30L/min (light workload) and 85L/min (heavy workload) flow rates, and with 10-80nm MS2 virions, indicated that for one type, the highest level of virion penetration was 20.5%, and 84.5% for the other type.[6]	**All** workers in an entire health care facility or part of a facility that is providing care to potentially influenza A (H1N1) infected persons. Hospitalised patients, persons accompanying ill persons in the triage area. Family members and other visitors to hospitalised patients	Closed setting; exposure risk is high for all persons involved in the operation of the facility. Patient transport within health-care facilities: probable or confirmed influenza A (H1N1) patients should wear a medical/surgical mask. Family members/visitors should be limited to those essential for patient support and should use the same infection control precautions as health care workers.
Particulate Respirator	Confers maximum available nose and mouth protection for health care workers with **direct and continued exposure to particulate matter** in the care of patients with influenza. Measurement of the level of nose and mouth protection conferred by two different models of N95 particulate respirators at 30L/min (light workload) and 85L/min (heavy workload) flow rates, and with 10-80nm MS2 virions, indicated that for the **certified** N95 respirator all values of the virion penetration were below 5%, while for the other respirator, virion penetration exceeded the 5% threshold at the higher inhalation rate with a mean value of 5.6%.[6]	Health care workers involved in complex clinical care of hospitalised patients with probable or confirmed influenza A (H1N1) infection.	**Aerosol generating procedures** (e.g. aspiration of respiratory tract, intubation, resuscitation, bronchoscopy, autopsy) **are associated with increased risk of infection transmission, and the infection control precautions should include using:** - particulate respirator (e.g. EU FFP2, US NIOSH-certified N95); - eye protection (i.e. goggles); - a clean, non-sterile, long-sleeved gown; - gloves (some of these procedures require sterile gloves).[11]

* **Levels of protection:** Particulate respirators confer the highest available nose and mouth protection for health care workers exposed to close contact and/or aerosol-generating procedures with infectious disease patients. By default, surgical masks confer the next highest level of nose and mouth protection, particularly for health care workers who are not exposed to close contact and/or aerosol-generating procedures with infectious disease patients.

** **Health care workers in health care settings**: are comprised of health service providers and health management and support workers. World Health Organisation. The World Health Report 2006 - Working together for health.

STANDARD PRECAUTIONS AND USE OF PERSONAL PROTECTIVE EQUIPMENT[12]

Use of masks by health care facility workers should be performed as part of standard and droplet precautions, and in conjunction with use of other appropriate PPE. PPE should be utilised in health care facility working areas only.

12 World Health Organisation. Standard precautions in health care. October 2007.

Standard precautions are meant to reduce the risk of transmission of blood borne and other pathogens from both recognised and unrecognised sources. They are the basic level of infection control precautions which are to be used, as a minimum, in the care of all patients.
Hand hygiene is a major component of standard precautions and one of the most effective methods to prevent transmission of pathogens associated with health care. In addition to hand hygiene, the use of personal protective equipment should be guided by risk assessment and the extent of contact anticipated with blood and body fluids, or pathogens.

1. Hand hygiene

Summary technique:

- Hand washing (40–60 sec): wet hands and apply soap; rub all surfaces; rinse hands and dry thoroughly with a single use towel; use towel to turn off faucet.
- Hand rubbing (20–30 sec): apply enough product to cover all areas of the hands; rub hands until dry.

Summary indications:

- Before and after any direct patient contact and between patients, whether or not gloves are worn.
- Immediately after gloves are removed.
- Before handling an invasive device.
- After touching blood, body fluids, secretions, excretions, non-intact skin, and contaminated items, even if gloves are worn.
- During patient care, when moving from a contaminated to a clean body site of the patient.
- After contact with inanimate objects in the immediate vicinity of the patient.

2. Gloves

- Wear when touching blood, body fluids, secretions, excretions, mucous membranes, non-intact skin.
- Change between tasks and procedures on the same patient after contact with potentially infectious material.
- Remove after use, before touching non-contaminated items and surfaces, and before going to another patient.
- Perform hand hygiene **immediately** after removal.

3. Facial protection (eyes, nose, and mouth)

- Wear (1) a surgical or procedure mask and eye protection (eye visor, goggles) or (2) a face shield to protect mucous membranes of the eyes, nose, and mouth during activities that are likely to generate splashes or sprays of blood, body fluids, secretions, and excretions.
- Perform hand hygiene **immediately** after removal.

4. Gown

- Wear to protect skin and prevent soiling of clothing during activities that are likely to generate splashes or sprays of blood, body fluids, secretions, or excretions.
- Remove soiled gown as soon as possible, **and**
- Perform hand hygiene.

Additional considerations for health care settings[14]:

Respiratory hygiene

- Health care facilities should consider making hand hygiene resources, tissues and masks available in common areas and areas used for the evaluation of patients with respiratory illnesses.

Environmental cleaning

- Use adequate procedures for the routine cleaning and disinfection of environmental and other frequently touched surfaces.

Linens

- Handle, transport, and process used linen in a manner which:
  - Prevents skin and mucous membrane exposures and contamination of clothing.
  - Avoids transfer of pathogens to other patients and or the environment.

Waste disposal

- Ensure safe waste management.
- Treat waste contaminated with blood, body fluids, secretions and excretions as clinical waste, in accordance with local regulations.
- Human tissues and laboratory waste that is directly associated with specimen processing should also be treated as clinical waste.
- Discard single use items properly.

Patient care equipment

- Handle equipment soiled with blood, body fluids, secretions, and excretions in a manner that prevents skin and mucous membrane exposures, contamination of clothing, and transfer of pathogens to other patients or the environment.
- Clean, disinfect, and reprocess reusable equipment appropriately before use with another patient.

CONSIDERATIONS AND IMPLICATIONS FOR DECISION-MAKING

Costs and Implications

Supplies

- PPE supplies and other infection control materials will need to be kept constantly in stock during the pandemic. The table below presents **average costs** of some supplies from multiple vendors.
- Costs will vary by supplier and perhaps by overall supply, if shortages occur.
- It is important to keep these and other costs in mind when deciding on supplies needed for a influenza A (H1N1) pandemic. Sustainability of maintaining a supply of PPE and infection control materials is critical given that the duration of the pandemic is unknown. ***Who*** and ***how many use what type of supply*** are important criteria to consider.

Supply	Total Cost (USD)	Number	Unit Cost (USD)
Soap (liquid) - Dispenser	18.61 each	1	18.61
Soap (liquid) - Refill	53.00 per case	12	4.42
Alcohol-based hand rub - Dispenser	16.51 each	1	16.51
Alcohol-based hand rub (gel) - Refill	87.26 per case	8	10.91
Nitrile gloves (non-sterile)	80.64 per case	1000	0.08
Protective glasses	283.59 per case	30	9.45
Bouffant cap (21")	25.76 per case	500	0.05
Surgical mask (non-rigid facemask; tie-on)	182.27 per case	600	0.30
Surgical mask (non-rigid facemask; ear loop)	220.29 per case	600	0.37
Surgical mask (rigid)	13.99 per box	50	0.28
N95 Particulate respirator	181.46 per case	120	1.51
Gown (isolation-SML)	23.99 per case	50	0.48
Gown (isolation-XL)	25.94 per case	50	0.52
Gown (impervious – SML)	38.99 per case	50	0.78
PPE kit (one disposable gown, one pair of gloves, a face shield, hair and shoe covers, a red bag, and a copy of the PPE placement and removal posters.)	154.80 per case	20	7.74
Full Barrier Personal Protective Equipment (PPE kit) with N95 Respirator	154.80 per case	20	7.74
Personal Protective Equipment (PPE) in Healthcare Settings (training video) http://bookstore.phf.org/product_info.php?products_id=369	27.50 each	1	27.50

Source: The average price for each item was calculated based on a rapid survey of prices for medical supplies and equipment, which was conducted using multiple sources. PAHO-HSS.

Training

- Infection control:
  All health care workers will need to be trained in work practices such as hand hygiene, appropriate use of PPE, facility hygiene, and other infection control measures. These practices will need to be taught, monitored and continuously reinforced. How well these practices have been learned by workers will also need to be evaluated, and training redone or amended accordingly. Specific services include: housekeeping, food preparation (kitchen), patient escort, in addition to all clinical staff.

- Procedure performance and equipment use:
  All staff involved in the provision of complex care to infected patients must be appropriately and adequately trained to use all equipment they will be in charge of during a pandemia. This is particularly important for staff who will be reassigned from other facilities and services to perform functions they do not normally provide or have the training for. This includes infection control practices particular to procedures and types of equipment, such as invasive ventilation.

Maintenance

- Maintenance and repair of equipment will need to be increased and sustained during an outbreak. This will ensure that health care workers will have all equipment and devices they need to provide care to influenza A (H1N1)-infected patients, at their disposal.

Services

- Support services such as laundering and waste disposal, will have to be performed more regularly and will require increased funding.
- Health care facility workers will also need to be provided for as they may be working very long shifts during the course of an outbreak.
- Ensure the preservation of basic services by obtaining agreements with service providers in other sectors whose support to the facility on anticipated contingency measures for the pandemic are essential. These services include electricity, communications, water supply, collection of ordinary and pathogenic waste, funerary, and others.

ENSURING COMPLIANCE WITH HAND WASHING AND USE OF PERSONAL PROTECTIVE EQUIPMENT

- Simple public health measures can be highly effective at reducing the transmission of respiratory viruses, especially when they are part of a structured programme including instruction and education and when they are delivered together.[4]
- Lack of compliance with interventions, particularly educational programmes, has been shown to be problematic for implementation of the methodologies of several studies, especially over long term periods.[4]
- Health care facilities should strongly consider assembling small teams to ensure compliance with standard and droplet precautions during an outbreak.
- Routine long term implementation of interventions to maintain strict hygiene and barrier routines for a pandemic of potentially long duration would need to be coordinated and closely monitored by appropriately trained staff.