Healthcare Worker Protection in the Emergency Department During Pandemic Influenza

A Position Paper

Ratified by:

- Quebec Association of Emergency Physicians
- Quebec Association of Specialists in Emergency Medicine
- Quebec Association of Emergency Nurses

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Executive Summary

Introduction

In the 20th Century, we experienced 3 influenza pandemics. In 1918–1919, the Spanish Flu (A H1N1) killed approximately 30 million people in the world, in 1957–1958, the Asian Flu (A H2N2) was responsible for 1 million deaths, and in 1968–1969, the Hong Kong Flu (A H3N2) led to 800,000 deaths. It was well accepted that the next influenza pandemic would occur at the beginning of the 21st Century.

In 1997, an influenza A(H5N1) of avian origin emerged in Hong Kong, a virus characterised as having a high pathogenicity (60% mortality rate), with a low grade of human-to-human transmission. H5N1 still circulates, expanding its geographical range, and has been predicted to be the precursor for a 21st century influenza pandemic.[1-6] In April 2009, a novel virus influenza A(H1N1), a triple reassortant strain that contains genes from swine, avian, and human influenza A arising from Mexico, a circumstance not anticipated in pandemic planning.[7] On June 11th, 2009, the WHO raised the global pandemic alert level to phase 6, formally declaring an influenza pandemic. Although it is characterised as mild, it has been confirmed in over 90,000 individuals and resulted in at least 380 deaths in 3 months.[8] The Centre for Disease Control (CDC) has proposed a Pandemic Severity Index (PSI) using mortality as an indicator. The 2009 H1N1 pandemic is between severity categories 2 and 3 out of 5 possible categories. This is identified by a case fatality ratio ranging between 0.1% – < 1%. Categories 4 and 5 are indicative of a severe pandemic, characterised by case fatality ratios of 1.0% – < 2.0% and ≥ 2.0% respectively.[9]

During an influenza pandemic, healthcare workers (HCWs) are at high risk of being infected.[10] HCWs on the front-line, including emergency department (ED) personnel, are at higher risk since they will be among the first contacts. HCWs here will be important influencers on the progression of the pandemic through screening, facilitating treatment, and preventing further transmission of disease. Additionally, ED overcrowding and reduced staffing have been identified as factors that impair the safety of patients and staff, and lessen the quality of healthcare provided.[11] It is well recognised that the surge capacity required to cope with the increased workload of an influenza pandemic will be dramatically reduced if HCWs are themselves ill or if there is an increase in absenteeism due to concerns regarding personal protective equipment (PPE) and their own safety.[12] It has been estimated that absenteeism among HCWs would be increased during an influenza pandemic to levels ranging between 15% and 80%.[13,14] It has also been reported that a number of barriers amplified during a pandemic period may serve to discourage HCWs from working. Among these are the prioritisation of family member well-being and a lack of information regarding potential risks and what is expected from them.[15] Furthermore, HCW absenteeism may increase with elevated workplace stress and feelings of being unprotected or unsupported.[16] A comprehensive report on PPE for HCWs during an influenza pandemic by Goldfrank and Liverman states that efforts in protecting HCWs are impeded by uncertainty on transmission modes of influenza, challenges in training, and provision of PPE. It emphasised that a culture of safety must be promoted, in which the HCWs are certain that policies are dedicated to their protection, and that HCWs feel that the PPE used is reliable to reduce risk of infection.[12] HCW protection is essential in preventing transmission from HCWs to family members, colleagues, and patients—groups that, in turn, may potentially further transmit the virus, propagating its spread. It is therefore imperative that HCW safety is addressed in both pandemic preparedness and response.

In 2003, Severe Acute Respiratory Syndrome (SARS) emerged as a completely unprecedented, novel virus that achieved near pandemic status. It led to rapid outbreaks in 30 countries, infecting over 8000 people across the globe, and claiming 774 lives.[17] In Toronto, there were 375 probable and suspect cases; 50 % of them being HCWs. The death toll in Ontario was 44, and included 3 HCWs. The SARS outbreak has provided what has often been referred to as a "dress rehearsal" for pandemic influenza.[1,18] It played a pivotal role in highlighting the lack of preparation in dealing with infectious diseases and failing to protect HCWs due to limited resources.[19] In the wake of the SARS epidemic, a SARS commission headed by Justice Archie Campbell, analysed the events that led to that severe crisis. The hallmark of his report "Spring of Fear" was the Precautionary Principle, which has received increased attention following experiences recounted by the general public, policy makers, planners, and HCWs:

> *"Perhaps the most important lesson of SARS is the importance of the precautionary principle. SARS demonstrated over and over the importance of the principle that we cannot wait for scientific certainty before we take reasonable steps to reduce risk. This principle should be adopted as a guiding principle throughout Ontario's health, public health and workers' safety systems."*[20]

The SARS Commission further recommends in their report *"that in any future infectious disease crisis, the precautionary principle guide the development, implementation and monitoring of worker safety procedures, guidelines, processes and systems"*.[20] From this report, it was demonstrated that the precautionary principle has led to increased standards of occupational health and safety, along with a greater awareness of risk.[21] Consideration of the precautionary principle is vital in pandemic planning and response.

Most countries have worked extensively in pandemic preparedness and have issued elaborated pandemic plans. The recent events of the 2009 H1N1 pandemic, has led to a significant number of guideline changes and new guidelines. Two significant problems must be highlighted. Firstly, mainly because of the paucity of strong evidence- based scientific knowledge about influenza pandemic, many recommendations from the different national guidelines differ and sometimes in a significant way. Secondly, it is well known now, that there is a significant gap between guidelines recommendations and their applicability in real life practice. That is why, the domain of Knowledge Translation is so vital in this regard.

In this paper, we state our position regarding the roles of individual staff protection, administrative and engineering controls in protecting HCWs during an influenza pandemic. The positions in this paper are focused on HCWs on the front-line in EDs, namely physicians, nurses, respiratory therapists, pharmacists, social workers, and support staff (eg, clerical, orderlies, volunteers). In developing these positions we have considered a broad base of existing recommendations from the original pandemic plans of Western countries, as well as the new guidelines that have emerged from the 2009 H1N1 pandemic. We have also conducted comprehensive literature reviews and sought expert opinions. We have used consideration of the precautionary principle to guide our stance, as well as approaches from the field of Knowledge Translation to consider the feasibility and applicability of each position. These positions aim to outline the ideal response with maximal protection in the instance of a severe pandemic and should serve as a baseline that can then be adapted to the situation as it unfolds in terms of pandemic severity and resource limitations. We believe this will provide the best HCW protection as well as provide an optimal standard for planning and resource allocation.

Methods

This paper was prepared by a committee comprising representatives of HCW groups. We identified important existing pandemic influenza plans, as well as emerging H1N1 guidelines, and systematically reviewed these for recommendations directly relevant to HCW protection. We used a well-accepted "hierarchy of controls" to categorise these recommendations into 3 groups: individual staff protection (masks, personal protective equipment [PPE], antiviral prophylaxis, and vaccination), administrative controls (pre-triage and triage, patient flow, healthcare delivery area management, patient education and visitor policy, HCW education and safe work practices, personnel management, organisation and planning, ED crowding and surge capacity), and engineering controls (infrastuctural biocontainment).

Where there were conflicting recommendations, namely for the use of N95 respirators and antiviral prophylaxis, we performed a literature review to better inform our positions. The committee considered all information from the pandemic plans, H1N1 guidelines, and literature reviews in developing the position statements. We have used consideration of the precautionary principle to guide our stance, as well as approaches from the field of Knowledge Translation to consider the feasibility and applicability of each position. Our committee believed it important that position statements be modulated according to the CDC Pandemic Severity Index (mild to severe).

Position Statements

The position statements are presented below for each category within the hierarchy of control groups.

1. Individual Staff Protection

1.1 Masks, Respirators, and PAPR

There is agreement across the pandemic plans and H1N1 guidelines that a respirator of at least 95% efficiency (N95) is recommended for HCWs during aerosol-generating procedures.

The evidence, however, remains unclear whether influenza is generally transmitted by the airborne route, and if so, its contribution in comparison with contact or droplet modes of transmission. This possibility is gaining increased attention. Due to this uncertainty, there is a lack of consensus among recommendations for mask or N95 respirator use for close contact with pandemic influenza cases, with equal distribution of recommendations for each type of mask. Since aerosol transmission cannot be excluded, we support the recommendation of N95 respirators—the precautionary principle suggests we err on the side of greater protection.

Position 1.1.1 An N95 respirator must be used during aerosol-generating procedures, if the patient has a strong cough and is not wearing a mask, or if the patient is acutely ill. (page 29)

Position 1.1.2 In the instance of a severe pandemic, an N95 respirator should be used for all cases not included in Position 1.1.1. (page 29)

Position 1.1.3 In the instance of a mild pandemic, the use of an N95 respirator should ideally be used for all cases not included in Position 1.1.1. We recognise the possibility of limited supply of N95 respirators, and for this reason support a minimum standard of using a procedural mask in this situation. (page 29)

Position 1.1.4 All facilities must have a global fit testing plan, by which all HCWs must be fit tested. (page 29)

1.2 Gloves, Gowns, and Eye Protection

There is consensus across all pandemic plans and H1N1 guidelines that gloves, gowns, and eye protection are all required during aerosol-generating procedures and when there is a risk of exposure to blood, body fluids, secretions, or excretions.

Although all except one pandemic plan recommend that the use of gloves, gowns, or eye protection are not required for routine care, nearly all guidelines released during the H1N1 outbreak changed this recommendation. There is not, however, consistency among these recommendations, and they continued to change as the pandemic progressed. There is consensus on the recommendation for use of gloves for all patient contact, but not for the use of gowns or eye protection.

Position 1.2.1 Gloves, gown, and eye protection must be worn by all HCWs during aerosol-generating procedures, if the patient has a severe cough and is not wearing a mask, if the patient is severely ill, or if there is risk of exposure to bodily fluids or secretions. (page 31)

Position 1.2.2 Gloves should be always be used for any contact with a case. Gloves should be changed between each patient contact. Hand hygiene should be performed after removing gloves and between all patient contacts. (page 31)

Position 1.2.3 Gowns and eye protection should be worn for any contact with a case during a severe pandemic. (page 31)

Position 1.2.4 In the instance of a mild pandemic, gowns and eye protection may not be required for contact where there is no risk of exposure to bodily fluids or secretions. (page 31)

1.3 Antiviral Prophylaxis

There is consensus among nearly all major pandemic plans recommending the use of prophylaxis for HCWs—the exception to this is the Canadian Pandemic Influenza Plan. Antiviral prophylaxis has been shown, however, to reduce the rate of infection during seasonal flu, and models of pandemic situations indicate that prophylaxis can reduce early transmission to contain outbreaks or slow progression and severity. Adverse effects and the development of resistance are commonly cited objections to the use of prophylaxis, but evidence from prophylaxis trials indicate no significant adverse effects, nor development of resistance.

There is disagreement among the pandemic plans, however, with equal distribution of recommendations for either pre-exposure or postexposure prophylaxis. Our literature review indicated similar efficacies for both pre- and postexposure prophylaxis. A postexposure strategy would have the advantage of requiring fewer antivirals, thereby improving use of antiviral stockpiles, with lower overall and opportunity costs than a pre-exposure approach.

In the instance of a severe pandemic causing significant case load and virulence (morbidity and mortality), implementation of a postexposure strategy will be hampered by the vast numbers of cases being attended to, ED crowding, and difficulties in contact tracing. In addition, although PPE confers a substantial degree of protection, the number of encounters over the course of a working day would probably still result in attack rates of greater than 10% among HCWs in the absence of vaccination. In this setting, pre-exposure prophylaxis for HCW groups who are at high risk of exposure (for example, those constantly exposed to the pandemic strain or performing multiple aerosol-generating procedures on pandemic cases) would be required to provide adequate protection. This recommendation should be modulated according to severity of disease and attack rate, as evidenced during the initial phase of the 2009 H1N1 pandemic. Both the USA and Australian plans recommended pre-exposure prophylaxis for these groups, but with the development of only mild illness with H1N1, both countries no longer recommended this.

Position 1.3.1 We support postexposure prophylaxis for all HCWs following unprotected exposure with a case. (page 37)

Position 1.3.2 In the instance of a severe pandemic, the use of pre-exposure prophylaxis should be considered for the duration of the pandemic for HCWs on the front-line at high risk of exposure (eg, HCWs constantly exposed to the pandemic strain or performing multiple aerosol-generating procedures on pandemic cases). (page 37)

Position 1.3.3 If a HCW had a confirmed infection due to the pandemic strain, or has received effective vaccination, then AV (antiviral) prophylaxis is not required. (page 37)

Position 1.3.4 HCWs at high risk of complications should be assigned duties where they will not be exposed. If this is not possible, pre-exposure prophylaxis should be offered. (page 37)

Position 1.3.5 Prophylaxis should be offered to HCWs during outbreaks in closed settings (confirmation of at least 2 nosocomial infections in a 10-day period) according to standard practices. (page 38)

1.4 Vaccination

Ten pandemic plans contained recommendations and information regarding the use of vaccination for HCWs during pandemic influenza. Given the likely delay before a pandemic-specific vaccine becomes available, and even then initially in limited supply, the guidelines agree that HCWs should be among the highest priority to be vaccinated when it becomes available.

As of July 2009, a vaccine was not publicly available for this strain. When it becomes available, it is still recommended that HCWs be among the first priority to be vaccinated.

Position 1.4.1 When a pandemic-specific vaccine becomes available, front-line HCWs should be among the highest priority groups. Distribution and administration plans should be in place to facilitate timely availability. (page 39)

Position 1.4.2 HCWs should be encouraged to receive the annual seasonal influenza vaccine. (page 39)

2. Administrative Controls

2.1 Pre-Triage Screening, Triage, and Testing

Position 2.1.1 A pre-triage screening assessment at the ED entrance should be performed using a screening tool to identify the care required and allow separation of suspect cases with possible influenza from other patients. Informational signage is important in keeping patients informed about this process. HCWs performing screening should wear appropriate PPE. (page 40)

Position 2.1.2 Rapid, reliable diagnostic testing must be readily available 7 days a week in the ED and for hospitalised patients. Obtaining rapid test results within a few hours will have a significant positive impact on ED crowding. (page 41)

2.2 Patient Pathways

Position 2.2.1 Protocols should be established in the Emergency Department, Intensive Care Unit and general hospital wards regarding patient flow and rapid admission pathways. (page 42)

Position 2.2.2 A dedicated coordination role to manage patient flow and resources should be implemented during surge periods in both the Emergency Department and the hospital. (page 42)

Position 2.2.3 Where possible, cases should be assigned single rooms. In pandemic situations, patients may be cohorted according to clinical status. (page 43)

2.3 Healthcare Delivery Area

Position 2.3.1 Patient care equipment should be cleaned according to routine infection control procedures and manufacturers' instructions. Disposable equipment could be used where appropriate. (page 44)

Position 2.3.2 Potentially contaminated surfaces and environments (eg, patient rooms) should be cleaned using detergent and disinfectant, in line with routine infection control procedures. HCWs performing this should wear appropriate PPE. Dedicated staff for cleaning influenza patient rooms and areas should be considered. (page 44)

Position 2.3.3 Housekeeping (eg, dishes and cutlery), laundry, and waste management (both medical and non-medical) should be handled according to standard precautions. (page 44)

2.4 Patient Education and Visitor Policy

Position 2.4.1 Patients, family, and visitors should be educated on the different modes of influenza transmission and how to reduce the risk. All education should be multilingual and cross-cultural. Education can be in the form of signs, pamphlets, Internet-based, or multimedia presentations. (page 45)

Position 2.4.2 Patients and visitors should be educated on the importance of respiratory etiquette. In addition, the resources to practice these measures should be easily available in patient areas. (page 45)

Position 2.4.3 Symptomatic cases with influenza-like illness should wear a properly fitting procedural mask if able to tolerate. Patients will need instruction on donning and removing the mask. (page 46)

Position 2.4.4 Visitors should be restricted to reduce risk of transmission. For mild cases likely to be discharged, no visitors should be allowed unless a companion is required for other reasons (eg, paediatric). For other cases, only 1 visitor should be allowed at a time, with strict adherence to hand hygiene and respiratory etiquette. (page 46)

2.5 Healthcare Worker Education and Safe Work Practices

Position 2.5.1 Routine practices should be followed, such as appropriate hand hygiene, and respiratory etiquette. In all cases where exposure to influenza is likely, especially in certain procedures, PPE should be utilised. (page 47)

Position 2.5.2 Hand hygiene is paramount in preventing the spread of influenza virus. It should be practiced immediately after contact with a patient, and after removing PPE. Visibly soiled hands should be washed with antimicrobial soap and water. Hands that are not visibly soiled should be cleansed with alcohol-based gels/hand washes. The healthcare setting should be readily equipped with the resources necessary to facilitate this. (page 47)

Position 2.5.3 Staff should be well informed through a variety of means of the implications of the pandemic, methods of prevention and treatment, and should be educated in the use of PPE. (page 47)

Position 2.5.4 Dedicated training and education time should be made available to all HCWs on a regular basis. (page 47)

Position 2.5.5 Specimens are to be handled under biocontainment settings, ideally by individuals that are vaccinated against or immune to the virus; if this is not possible they should wear appropriate PPE. Specimens are to be stored appropriately and shipped immediately following federal dangerous goods shipping regulations. (page 48)

Position 2.5.6 Individuals that are transporting body bags should wear PPE in order to prevent transmission from bodily fluids. A procedural mask should be placed on the deceased in the initial hours post-mortem. (page 48)

2.6 Personnel Management

Position 2.6.1 Staff can be considered fit to work if they are asymptomatic, vaccinated against the pandemic strain, recovered from the pandemic strain, or receiving antiviral prophylaxis. (page 49)

Position 2.6.2 Staff are unfit to work if they have influenza-like illness. In some circumstances staff may be required to continue working if they are well enough; these personnel should be restricted to caring for patients with influenza-like illness. HCWs should be offered early treatment if they have a confirmed case of pandemic influenza. (page 49)

Position 2.6.3 HCWs who are at a high risk of complications due to influenza (including pregnant staff), should be assigned to low-risk duties (no direct care of influenza patients). (page 49)

Position 2.6.4 It is important to monitor and screen staff for influenza-like illness. Ill staff should be given early antiviral treatment (within 48 hours), and be restricted from the workplace to reduce transmission and time-off work. (page 50)

Position 2.6.5 Emotional support techniques should be practiced and services should be provided for HCWs and their families throughout the pandemic. Reward programs and penalizations should be avoided. (page 50)

Position 2.6.6 HCWs may require scheduled breaks from wearing PPE to reduce burden and increase safety. (page 50)

2.7 Planning, Organisation, Communication, and Security

Position 2.7.1 Each acute healthcare facility should have a detailed influenza pandemic plan, as well as an identified responsible person to lead an executive pandemic committee. Each major department, especially the ED, ICU, anaesthesia, and medicine, should have a clear pandemic influenza plan. (page 51)

Position 2.7.2 Each department should prepare a prioritised and detailed list of activities that they can progressively reduce or cease, in order to provide extra resources (staff and beds) to critical hospital functions (eg, ED, ICU, operating theatres, and other critical departments) in the instance of overwhelming case loads or severe pandemic. (page 51)

Position 2.7.3 Healthcare facilities should ensure that HCWs are informed of progress regarding the pandemic by a variety of means. HCWs should be informed of work-related issues, family issues, and healthcare issues. (page 52)

Position 2.7.4 Healthcare facilities should define clear communication channels for rapid dissemination of information, policies, and procedures that will be updated throughout the pandemic. (page 52)

Position 2.7.5 Security personnel should be strategically placed in areas of the hospital that have significant patient and visitor traffic, and high potential influenza exposure. All security personnel should be trained in, and apply all protective measures as HCWs. (page 52)

2.8 Emergency Department Crowding and Surge Capacity

Position 2.8.1 It is of high priority for governments, public health agencies, and hospitals to ensure that influenza pandemic guidelines are applicable in the event of ED crowding. For this, barriers and facilitators impacting ED crowding should be clearly addressed. Particular attention should be given to accessibility to appropriate ED treatment areas, ensuring adequate staffing, rapid testing, and implementing rapid admission pathways from the ED. (page 54)

Position 2.8.2 Healthcare facilities should designate alternative care areas to expand the ED in the case of overwhelming patient load or ED crowding. (page 54)

3. Engineering Controls

3.1 Infrastructure

Position 3.1.1 Emergency departments should use physical barriers where possible, such as at triage and reception. (page 55)

Position 3.1.2 Emergency departments should use airborne infection isolation rooms (AIIR) or negative-pressure rooms for aerosol-generating procedures. (page 55)

Position 3.1.3 Emergency departments should have at least 2 airborne infection isolation rooms (AIIR) or negative-pressure rooms, so that at least such 1 room is always available for use. Alternatively, a designated negative pressure area may be developed for cohorting patients with confirmed or suspected influenza.(page 55)

Position 3.1.4 Emergency departments should have sufficient isolation rooms for the expected case load, and ensure at least 1 such room is always available to accept new cases. (page 55)

Discussion

We consider these positions to be “safe” recommendations based on the consensus of existing pandemic plans and guidance arising from H1N1. Where there are conflicting recommendations, we have also considered information from the literature. When there remained insufficient evidence, we have taken into consideration the precautionary principle to guide us toward greater staff protection in the face of the unknown. We believe these positions should act as a baseline for staff protection and be adapted to the specific pandemic situation. For example, the 2009 H1N1 pandemic is proving to cause mainly mild illness, and not all of the more cautious protective measures may be required. This was evidenced by the changes in recommendations for PPE—for example, Australia's recommendations evolved from full PPE and N95 respirator use in their pandemic plan to recommendations including situations where neither PPE nor a mask are required—and antiviral prophylaxis. Both the USA and Australian plans initially recommended pre-exposure prophylaxis for HCWs, but with the development of only mild illness with H1N1, both countries no longer recommended this.

There is however a significant danger to become complacent as the actual 2009 pandemic is causing mainly mild illness. Over the past few months, influenza caused by novel H1N1 has been reported as comparable to seasonal influenza. This may be misleading and hinders the evolution of planning and preparedness. It is important to note that characteristics of 2009(H1N1) are being identified as the pandemic progresses suggesting that the probable impact H1N1 can no longer be compared to seasonal influenza. The annual mortality rate of circulating seasonal influenza in the United States is approximately 0.06–0.24%, whereas to date, that of pandemic H1N1 is approximately 0.57%.[22,23] The secondary attack rate for the pandemic H1N1 strain is approximately 22–33%, whereas that for seasonal H1N1 is approximately 5–15%.[24,25] This is suggestive that pandemic H1N1 is a highly contagious virus. The population affected by pandemic H1N1 and seasonal H1N1 have significant differences that may cause additional concern and impact. Groups infected by seasonal H1N1 are mostly paediatric and elderly populations.[26] The current pandemic strain however, has shown a higher propensity to infect older children, adolescents, and young adults.[27,28] Furthermore, novel H1N1 is affecting otherwise healthy individuals, presenting with no other comorbidities.[28,29] In addition, the virulence of pandemic H1N1 has been suggested to be greater than that of seasonal H1N1. In humans, this influenza virus has been shown to manifest with influenza-like symptoms, as well as gastrointestinal symptoms such as vomiting and diarrhoea. It has also been reported to result in rapid inflammation of the lungs, and eventual loss of lung function.[30] Recent animal studies of pandemic H1N1 strains isolated from humans have revealed that this strain replicates efficiently in the trachea and deep lung tissue, and has a wider distribution of viral replication within the body.[29,30] Additional animal studies on transmission of the current H1N1 pandemic strains have indicated that H1N1 may be transmitted by the airborne route. An increase in viral shedding has also been detected, suggesting that novel H1N1 is more infectious than the seasonal strain.[31] Furthermore, earlier epidemiological analysis indicates higher transmissibility.[32] The increased transmissibility of H1N1 (including the potential airborne route), increased virulence, as well as the potential mutation of this virus, suggest that H1N1 may result in a more severe pandemic.

Although vaccination is the most effective means by which HCWs can be protected, the development of a vaccine for the 2009 H1N1 pandemic is proving difficult.[33] As of July 2009, a vaccine remains in development and early, rushed, clinical trials.[34] These rushed clinical trials may result in uncertain knowledge regarding efficacy and safety, and recommendations regarding vaccination may change as these become clear and as the pandemic resurges.[35]

These positions are based on recommendations from municipal, provincial, national, international, and global bodies. They are not specific to any healthcare system or geographic region, and should be applicable to other provinces and countries. The application of some of these positions may require localisation to consider local guidelines and definitions, but most should be directly applicable in other healthcare settings. Communication, training, availability of resources, psychosocial support, and infrastructural preparations are key themes that were identified in the aftermath of SARS as important lessons for pandemic influenza planning.

One of the main limitations of our positions, and most pandemic plans and guidance, is the lack of direct evidence regarding HCW protection during pandemic influenza. Evidence is generally extrapolated from data collected during seasonal and avian influenza outbreaks. We have used existing plans and guidelines as the primary evidence base for our positions. These documents seldom explicitly state their methodology or evidence base.

Given this lack of evidence and the uncertainty still surrounding pandemic influenza, we found that the precautionary principle was often referred to when discussing recommendations and in the development of these positions. This lends itself to positions that are most beneficial, or protective, from the HCW perspective.

This, however, is not a perfect or unbiased approach. We believe that these positions, especially for the controversial topics of antiviral prophylaxis and N95 respirator use, would benefit from a systematic approach that considers the many perspectives found in the healthcare environment. Although it is out of the scope of this paper, we are investigating the possibility of formulating recommendations based on the well-validated Grading of Recommendations Assessment, Development and Evaluation (GRADE) system.[36] The GRADE system provides a system for rating quality of evidence and strength of recommendations with consideration of varying outcomes and perspectives that is explicit, comprehensive, transparent, and pragmatic and is increasingly being adopted by organisations worldwide.[37]

Conclusion

The recommendations provided by pandemic plans demonstrated significant variation, especially regarding N95 or surgical mask use, PPE, and antiviral prophylaxis. The guidelines released during the H1N1 pandemic updated these recommendations, and evolved as more became known about the course of the pandemic, but remained variable across countries. This may reflect the findings that there is little direct evidence in the literature regarding pandemic influenza.

These position statements represent the committee's belief of what is best practice to protect HCWs during pandemic influenza. The positions are founded upon a wide base of recommendations from provincial, national, and international bodies, and reflect the synthesis of a large amount of information. We considered the precautionary principle as a deciding factor in the face of incomplete knowledge and conflicting recommendations, and also, as well as approaches from the field of Knowledge Translation to consider the feasibility and applicability of each position.

The current 2009 H1N1 pandemic has highlighted the need for greater guidance in HCW protection and the lack of this in existing pandemic plans. This is currently being treated as a “mild” pandemic with low severity. There is growing concern among infectious disease experts and policy makers that the potential impact of H1N1 is being underestimated as comparable to seasonal influenza. There are data to suggest that H1N1 is associated with higher attack rates, mortality, and transmission, as well as affecting a higher proportion of healthy, young adults than seasonal influenza. It is acknowledged that we cannot accurately predict the progress of this pandemic and the potential increase in pathogenicity. Ongoing pandemic planning, therefore, must aim at being prepared for the worst possible outcome—we must plan for maximal HCW protection.

This is well translated in the recent paper by Lipsitch et al noting:

> *“Moreover, several other factors suggest that it is premature to dismiss concerns about severity.”*[28]

And in the address of the US HHS, Secretary of the HHS Kathleen Sebelius stated at a recent US pandemic summit that:

> *"The virus hasn't gone away, and we have not let up, this summit is not about stoking fears. It is about being prepared. We have to avoid complacency, and we have to be prepared for what the fall brings.... The overwhelming take home message of the day was that everyone should work now as though the situation this fall will be a worse case scenario. If we learned the flu is not as severe as feared, we can step back from our plan. What we can't do is wait until October and suddenly decide we have a crisis on our hands."*[38]

This has been echoed by expert opinions in Canada, stating *"We should prepare for the worst and hope for the best."*[39]

The committee believes that application of these safe positions would contribute to improving HCW protection during even severe influenza pandemic by addressing all levels of the hierarchy of controls, with an emphasis of individual staff protection at the front-line. This would have many beneficial effects, not least ensuring HCWs are available to meet the anticipated increase in workload.

Introduction

In the 20th Century, we experienced 3 influenza pandemics. In 1918–1919, the Spanish Flu (A H1N1) killed about 30 million people in the world, in 1957–1958, the Asian Flu (A H2N2) was responsible of 1 million deaths, and in 1968–1969, the Hong Kong Flu (A H3N2) led to 800,000 deaths. It was well accepted that the next influenza pandemic would occur at the beginning of the 21st Century.

In 1997, an influenza A(H5N1) of avian origin emerged in Hong Kong, a virus characterised as having a high pathogenicity (60% mortality rate), with a low grade of human-to-human transmission. H5N1 still circulates, expanding its geographical range, and has been predicted to be the precursor for a 21st century influenza pandemic.[1-6] In April 2009, a novel virus influenza A(H1N1), a triple reassortant strain that contains genes from swine, avian, and human influenza A arising from Mexico, a circumstance not anticipated in pandemic planning.[40] On June 11th, 2009, the WHO raised the global pandemic alert level to phase 6, formally declaring an influenza pandemic. Although it is characterised as mild, it has been confirmed in over 90,000 individuals and resulted in at least 380 deaths within 3 months.[8] The Centre for Disease Control (CDC) has proposed a Pandemic Severity Index (PSI) using mortality as an indicator. The 2009 H1N1 pandemic is between severity categories 2 and 3 out of 5 possible categories. This is identified by a case fatality ratio ranging between 0.1 – < 1%. Categories 4 and 5 are indicative of a severe pandemic, characterised by case fatality ratios of 1.0 – < 2.0% and ≥ 2.0% respectively.[9]

During an influenza pandemic, healthcare workers (HCWs) are at high risk of being infected.[10] HCWs on the front-line, including emergency department (ED) personnel, are at higher risk since they will be among the first contacts. HCWs here will be important influencers on the progression of the pandemic through screening, facilitating treatment, and preventing further transmission of disease. Additionally, ED overcrowding and reduced staffing have been identified as factors that impair the safety of patients and staff, and lessen the quality of healthcare provided.[11] It is well recognised that the surge capacity required to cope with the increased workload of an influenza pandemic will be dramatically reduced if HCWs are themselves ill or if there is an increase in absenteeism due to concerns regarding personal protective equipment (PPE) and their own safety.[12] It has been estimated that absenteeism among HCWs would be increased during an influenza pandemic to levels ranging between 15% and 80%.[13,41] It has also been reported that a number of barriers amplified during a pandemic period may serve to discourage HCWs from working. Among these are the prioritisation of family member well-being and a lack of information regarding potential risks and what is expected from them.[15] Furthermore, HCW absenteeism may increase with elevated workplace stress and feelings of being unprotected or unsupported.[16] A comprehensive report on PPE for HCWs during an influenza pandemic by Goldfrank and Liverman states that efforts in protecting HCWs are impeded by uncertainty on transmission modes of influenza, challenges in training, and provision of PPE. It emphasised that a culture of safety must be promoted, in which the HCWs are certain that policies are dedicated to their protection, and that HCWs feel that the PPE being used is reliable in reducing risk of infection.[12] HCW protection is essential in preventing transmission from HCWs to family members, colleagues, and patients—groups that, in turn, may potentially further transmit the virus, propagating its spread. It is therefore imperative that HCW safety is addressed in both pandemic preparedness and response.

In 2003, Severe Acute Respiratory Syndrome (SARS) emerged as a completely unprecedented, novel virus that achieved near pandemic status. It led to rapid outbreaks in 30 countries, infecting over 8000

people across the globe, and claiming 774 lives.[17] In Toronto, there were 375 probable and suspect cases; 50 % of them being HCWs. The death toll in Ontario was 44, and included 3 HCWs. The SARS outbreak has provided what has often been referred to as a "dress rehearsal" for pandemic influenza.[3,18] It played a pivotal role in highlighting the lack of preparation in dealing with infectious diseases and failing to protect HCWs due to limited resources.[19] In the wake of the SARS epidemic, a SARS commission headed by Justice Archie Campbell, analysed the events that led to that severe crisis. The hallmark of his report "Spring of Fear" was the Precautionary Principle, which has received increased attention following experiences recounted by the general public, policy makers, planners, and HCWs:

> *"Perhaps the most important lesson of SARS is the importance of the precautionary principle. SARS demonstrated over and over the importance of the principle that we cannot wait for scientific certainty before we take reasonable steps to reduce risk. This principle should be adopted as a guiding principle throughout Ontario's health, public health and workers' safety systems*."[20]

The SARS Commission further recommends in their report "*that in any future infectious disease crisis, the precautionary principle guide the development, implementation and monitoring of worker safety procedures, guidelines, processes and systems*".[20] From this report, it was demonstrated that the precautionary principle has led to increased standards of occupational health and safety, along with a greater awareness of risk.[21] Consideration of the precautionary principle is vital in pandemic planning and response.

Most countries have worked extensively in pandemic preparedness and have issued elaborated pandemic plans. The recent events of the 2009 H1N1 pandemic has led to a significant number of guideline changes and new guidelines. Two significant problems must be highlighted. Firstly, mainly because of the paucity of strong evidence-based scientific knowledge about influenza pandemic, many recommendations from the different national guidelines differ and sometimes in a significant way. Secondly, it is well known now, that there is a significant gap between guidelines recommendations and their applicability in real life practice. That is why, the domain of Knowledge Translation is so vital in this regard.

In this paper, we state our position regarding the roles of individual staff protection, administrative and engineering controls in protecting HCWs during an influenza pandemic. The positions in this paper are focused on HCWs on the front-line in EDs, namely physicians, nurses, respiratory therapists, pharmacists, social workers, and support staff (eg, clerical, orderlies, volunteers). In developing these positions we have considered a broad base of existing recommendations from the original pandemic plans of Western countries, as well as the new guidelines that have emerged from the 2009 H1N1 pandemic. We have also conducted comprehensive literature reviews and have sought expert opinions. We have used consideration of the precautionary principle to guide our stance, as well as approaches from the field of Knowledge Translation to consider the feasibility and applicability of each position. These positions aim to outline the ideal response with maximal protection in the instance of a severe pandemic and should serve as a baseline that can then be adapted to the situation as it unfolds in terms of pandemic severity and resource limitations. We believe this will provide the best HCW protection as well as provide an optimal standard for planning and resource allocation

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Methods

Committee

In order to objectively address the current state of the art and define methods used to develop further recommendations, a diverse committee consisting of individuals involved in healthcare, with a focus on the emergency setting, was formed. The committee consists of experts representing important groups of HCWs, including emergency department physicians, nurses, respiratory therapists, pharmacists, infectious disease specialists, and emergency medicine researchers. The committee convened to systematically review recommendations specific for HCWs in an influenza pandemic. A subsequent review of original research in the absence of guideline consensus was also conducted.

Definition of Recommendation Categories and Guideline Review

Identification of Guidelines Chosen for Review

The most recent, publicly available, existing pandemic plans (along with their supplements and any relevant updates) for pandemic influenza preparedness and response were reviewed. Pandemic plans were selected according to relevance to our target setting in Quebec and Canada. Criteria included close geographic proximity and relatively similar healthcare systems. Other plans reviewed included those of globally validated bodies. Specific provincial and municipal plans were also selected due to their development after the 2003 SARS epidemic and their emphasis on application of the precautionary principle. Position papers, reviews, and other documents released by eminent groups specifically covering HCW protection were also selected for review.

Hierarchy of Controls for HCW Protection

We adopted the hierarchy of controls as the framework for our review, which serves to categorise overarching methods by which healthcare workplace hazards can be prevented and controlled. This hierarchy is defined by 3 primary groups: Individual Staff Protection, Administrative Work Practices, and Engineering Controls.[42] All pandemic planning and response guideline recommendations were analysed using the structure of the hierarchy of controls for categorisation. Individual Staff Protection encompasses the category of PPE, as well as vaccination and antiviral prophylaxis. Both vaccination and antiviral prophylaxis were included within this group definition due to their significance and immediacy to staff protection in a front-line setting. After iterative review and expert discussion, specific categories within each group were finalised, and topics within each category were defined. Recommendations pertaining to HCW safety were classified into the following system:

- **Individual Staff Protection:**
  - — Masks and respirators
  - — Gloves
  - — Eye-protection and face shields
  - — Gowns
  - — Powered air purifying respirators (PAPR)
  - — Antiviral prophylaxis

— Vaccination

- **Administrative controls:**
  — Pre-triage and triage
  — Patient flow
  — Healthcare delivery area
  — Patient education and visitor policy
  — HCW education and safe work practices
  — Personnel management
  — Organisation, planning, communication, and security
  — ED crowding and surge capacity
- **Engineering Controls:**
  — Infrastructural biocontainment

Review of Guidelines

Each pandemic plan (and its supplements) was reviewed using a standardised approach to identify recommendations that were considered relevant to HCW safety in the event of an influenza pandemic. All recommendations were classified and assigned to their relevant groups, categories, and topics within the hierarchy of controls. A web-based, front-end, "grid-like", user interface was developed by which guidelines (listed chronologically by country/organisation name) were displayed as row labels, and category names (within the hierarchy of controls) as column labels. Relevant topic headings served as clickable text at respective intersections within the grid, by which the user was directed to a separate page consisting of multiple fields in which detailed topic information (for the respective guideline) was reported and stored. Recommendations for all categories from the guidelines reviewed were stored in a SQLite database. All recommendations were entered into the database with brief synopses, detailed references, and citations to the respective guideline.

Identification of the evidence base for each recommendation from all guidelines was then carried out. In doing this, summaries for each individual topic were composed, relating all cited evidence, and any given rationales presented within the guidelines to their respective recommendations. In the process, all recommendations for each topic were thoroughly crosschecked by multiple reviewers for accuracy within our database. Furthermore, the methodologies by which the guidelines were developed were identified. When the guideline methodology or evidence base was unavailable, contact persons, overseeing bodies, and committees involved in developing the guidelines reviewed were contacted via email and website enquiry forms requesting further information. All responses and extracted evidence for each recommendation in all guidelines were included in final summaries.

Airborne Transmission Literature Review

Uncertainty about airborne transmission of influenza prompted a review of relevant literature and studies. A literature search was conducted using Medline and PubMed with specific consideration for articles addressing influenza virus and aerosol transmission, contribution of the airborne route to overall transmission, and the infectious capacity of influenza in aerosolised particles. Studies and

reviews in English were then reviewed for information relevant to airborne transmission within a healthcare setting. Further information regarding this review is presented in Section 1.1 .

Antiviral Prophylaxis Literature Review

We identified the question of antiviral prophylaxis as having variable and disparate recommendations in the guidelines. We sought to explore this topic further, and bridge the apparent contrast in recommendations through literature review. A literature search was conducted using PubMed and Medline for literature on influenza antivirals with specific consideration for articles addressing influenza virus and the following outcomes: rate of infection, time-off work, adverse events, mortality, transmission, viral resistance, cost, and opportunity cost. Studies and reviews in English addressing human populations were then reviewed for information regarding postexposure or pre-exposure antiviral prophylaxis in a healthcare setting. Further information regarding this literature review is presented in Appendix IV.

Emerging Influenza A (H1N1) Interim Guidance

During our review process, the emergence of novel influenza virus A(H1N1) prompted the release of multiple interim guidances from many public health bodies. All publicly available guidance documents and statements from the Public Health Agency of Canada (PHAC), Quebec, Ontario, CDC, WHO, UK, and Australia were retrieved as they became available in the public domain. Really Simple Syndication (RSS) feeds were utilised for notification of all new information with reference to interim H1N1 guidelines from each organisation. Furthermore, an ongoing analysis of literature pertaining to H1N1 is being performed as the current pandemic continues.

Development of Positions

Following pandemic plan, H1N1 guidelines, and literature reviews, the expert committee developed a position paper based on the information available at the time. Positions were drawn after thorough analysis of all guideline information (from pandemic plans as well as H1N1 guidelines), consideration of unified recommendations, contrasting recommendations, and any further evidence presented as rationale to support each recommendation. Positions with respect to antiviral prophylaxis and airborne transmission also considered information gathered from literature review. Where important topics were identified that were insufficiently or not covered in the pandemic plans and guidelines—especially in the group of administrative controls and logistical management during a pandemic—the committee discussed and formulated positions based on their expert opinion and experience gained through the H1N1 pandemic.

Healthcare Worker Survey

We performed a preliminary survey using a basic questionnaire to outline HCWs' opinions and perceptions relating to HCW safety and protection during an influenza pandemic. A literature review was conducted to identify studies on HCWs' perceptions on a potential pandemic and outbreak of contagious diseases such as SARS or smallpox. A combination of different keywords, including “SARS”, “avian flu”, “influenza pandemic”, and “outbreak” were used on Medline to identify 137 potentially relevant studies published predominantly from 2006–2008. From these studies, questionnaires were identified addressing specific topics, such as SARS, avian influenza, influenza

pandemics, absenteeism in the event of a pandemic, mass casualty involving an unknown virus, and emergency medical services (EMS) attitudes during a pandemic. Individual questions from 5 of these surveys were adapted in the development of an online questionnaire (developed in English and translated to French). Emergency physicians and residents, nurses, pharmacists, and respiratory therapists from 3 regions within the province of Quebec (Montreal, Quebec City, Laval) were contacted and invited to complete the questionnaire on HCW concerns regarding an influenza pandemic (hosted by www.surveygizmo.com). Detailed methods and results are provided in Appendix I.

Pandemic Plans Reviewed

We reviewed a total of 25 pre-existing pandemic plans and documents from 5 countries and the World Health Organization (WHO). These included national and provincial pandemic influenza plans, infection control and clinical guidelines, and reviews of the evidence for certain topics:

- Canada
  - The Canadian Pandemic Influenza Plan for the Health Sector, 2006[3]
  - Plan Québécois de Lutte à une Pandémie d'Influenza - Mission Santé, 2006[43]
  - Toronto Academic Health Services Network (TAHSN): Pandemic Influenza Planning Guidelines, 2006[44]
  - Pan-Canadian Public Health Network Council (PHNC) Report And Policy Recommendations on the Use of Antivirals for Prophylaxis During an Influenza Pandemic, 2007[45]
  - Influenza Transmission and the Role of Personal Protective Respiratory Equipment: An Assessment of the Evidence, 2007[46]
  - Ontario Health Plan for an Influenza Pandemic (OHPIP), 2008[47]
  - The Canadian Pandemic Influenza Plan for the Health Sector: Annex E The Use of Antiviral Drugs During a Pandemic, 2009[48]
- United States of America (USA)
  - U.S. Department of Health and Human Services. HHS Pandemic Influenza Plan, 2005[49]
  - American College of Physicians: The Health Care Response to Pandemic Influenza: Position Paper, 2006[50]
  - Centers for Disease Control and Prevention (CDC) Interim Guidance on Planning for the Use of Surgical Masks and Respirators in Health Care Settings during an Influenza Pandemic, 2006[51]
  - CDC Prevention and Control of Influenza: Recommendations of the Advisory Committee on Immunization Practices (ACIP), 2008[52]
  - Goldfrank and Liverman: Preparing for an Influenza Pandemic: Personal Protective Equipment for Healthcare Workers, 2008[12]
  - HHS Guidance on Antiviral Drug Use during an Influenza Pandemic, 2008[53]
- World Health Organization (WHO)
  - WHO Global Influenza Preparedness Plan: The Role of WHO and Recommendations for National Measures Before and During Pandemics, 2005[54]
  - WHO Checklist for Influenza Pandemic Preparedness Planning, 2005[55]
  - Clarification: Use of Masks by Health-care Workers in Pandemic Settings, 2005[56]

  - Health Evidence Network (HEN): How effective would antiviral vaccination and antiviral drug prevention and treatment strategies be for reducing the impact of the next influenza pandemic?, 2006[57]
  - Pandemic Influenza Preparedness and Response, 2009[58]
- United Kingdom (UK)
  - Pandemic Flu: A National Framework for Responding to an Influenza Pandemic, 2007[59]
  - Pandemic Influenza: Guidance for Infection Control in Hospitals and Primary Care Settings, 2007[60]
- Australia
  - Interim Infection Control Guidelines for Pandemic Influenza in Healthcare and Community Settings, 2006[61]
  - Interim National Pandemic Influenza Clinical Guidelines: Annex to Australian Health Management Plan for Pandemic Influenza, 2006[62]
  - Australian Health Management Plan for Pandemic Influenza (AHMPPI): Important Information for All Australians, 2008[63]
- France
  - Plan National de Prévention et de Lutte Pandémie Grippale, 2007[64]
  - Plan National de Prévention et de Lutte Pandémie Grippale, 2009[65]

Most of the pandemic plans did not specify the methodologies or evidence base used to arrive at the recommendations. We had received further detail about the methodology of 1 plan from 1 group (AHMPPI) at the time this paper was prepared. A summary of the pandemic plans and documents and their methodologies can be found in Appendix II.

Relevant results from our preliminary survey regarding HCW concerns during pandemic influenza are outlined below. The methods and full results are available in Appendix I.

Recommendations

A full review of the recommendations and information presented for each category in each of the reviewed pre-existing plans is available in Appendix III. Below we offer our position on each of the categories with a summarised rationale based on the findings of our review.

Definitions Used

Case definitions for pandemic influenza are specifically defined and updated as information becomes available during an outbreak. These definitions are generally split into 3 categories:

- Suspect/possible: Positive on pre-screening tool. This typically includes presence of influenza-like illness (ILI) and an epidemiological link to the pandemic strain.
- Probable: A suspect/possible case that tests positive on rapid testing.
- Confirmed: A case confirmed as the pandemic strain through reverse transcriptase polymerase chain reaction (RT-PCR), viral culture, or an increase in pandemic strain–specific antibodies.

We use the general term “case” to refer to a suspected, probable, or confirmed case of the pandemic strain. Influenza-like illness is defined as fever (temperature of 37.8°C [100°F] or greater) and a cough and/or a sore throat in the absence of a known cause other than influenza.[66]

We have adopted the following definitions for contact with cases:

- Close contact – Prolonged or repeated contact within 2 metres of a case during the case's contagious period
- Unprotected exposure – Close contact where the HCW was not wearing appropriate PPE, or where the PPE failed

We are using the pandemic severity index (PSI) developed by the CDC. Categories are defined by the case fatality ratio, increasing with higher case fatality ratios. Categories 4 and 5 are used to define a severe pandemic (Table 1).[9]

Table 1: CDC Pandemic Severity Index

Characteristics	Category 1	Category 2	Category 3	Category 4 (Severe)	Category 5 (Severe)
Case fatality ratio (%)	< 0.1	0.1 – < 0.5	0.5 – < 1.0	1.0 – < 2.0	≥ 2.0
Potential number of deaths in USA (based on 2006 population)	< 90,000	< 90,000 – < 450,000	450,000 – < 900,000	900,000 – < 1.8 million	≥ 1.8 million
20th Century experience	Seasonal Influenza (illness rate 5%–20%)	1957,1968 Pandemic	H1N1 2009 (estimate as of July 2009)	None	1918 Pandemic

Position Statements

1. Individual Staff Protection

1.1 Masks, Respirators, and PAPR

Review of Guidelines

There is limited evidence on the efficacy of mask and respirator use, and guideline recommendations are predominantly based upon the expected modes of transmission of pandemic influenza drawn from what is known about seasonal and avian strains. Influenza can be transmitted by inhalation of viral particles—either airborne or within droplets—or through contamination of mucous membranes via contact. Short-range inhalation transmission—within 1 to 2 metres of the patient—is the predominant mode of transmission. Although the influenza virus can survive in ambient air, there is little evidence of the contribution of this to transmission.[46]

There are 2 types of mask in common use for droplet precautions: surgical and procedural. These both offer protection against liquids and droplets and are both are manufactured to similar standards.[67] The 2 masks are discussed almost interchangeably in the guidelines. We will use procedural masks in our discussions. Both procedural masks and N95 respirators offer a physical barrier to contact with contaminated hands and ballistic trajectory particles.[46] Procedural masks protect the wearer from pathogens that are transmitted by contact or droplet contamination of the nasal or oral mucosa, but not those transmitted by the airborne route.[61] Procedural masks are not certified to serve as respiratory tract protection for their wearer.[46]

For protection from airborne pathogens, a particulate-filtering respirator is required. Protection with these masks require that they are properly fit tested, the wearer is trained on their use, removal, and disposal, and that a fit check is carried out each time it is worn.[61]

Twelve pandemic plans had information regarding mask, respirator, and powered air-purifying respirator (PAPR) use.[3,12,46,47,49,51,56,59-61,64,65] There is agreement across the plans that a respirator of at least 95% efficiency (N95) be recommended for HCWs during aerosol-generating procedures. Individuals carrying out aerosol-generating procedures are considered to be at an elevated risk of infection by any potential aerosol transmission. Aerosol-generating procedures include cardiopulmonary resuscitation, intubation, suction, bronchoscopy, and nebulisation.[51,68] Where an appropriate N95 respirator is not available, or a good fit cannot be achieved, the use of a PAPR is recommended.[51,60,62]

There is equal distribution of recommendations for the type of mask for close contact with patients with confirmed or suspected pandemic influenza. Canada, the WHO, and the UK recommend the use of a standard procedural mask, whereas Ontario, the USA, Australia, and France recommend the use of an N95 respirator.

Where there is a shortage of N95 respirators, the pandemic plans agree that their use be prioritised for aerosol-generating procedures. In this circumstance, procedural masks may be worn for close contact.

Table 2: Pandemic plan recommendations for mask and respirator use from 9 current plans

Recommended mask use	General care / close contact	Aerosol-generating
Standard mask	5 (Canada, Quebec, WHO, UK [2 guidelines])	
N95 respirator or better (eg, N99, PAPR)	4 (Ontario, USA, Australia, France)	8 (Canada, Quebec, Ontario, USA, WHO, Australia, UK)
No recommendation		1 (France)

Interim guidance for facemask and respirator use released in response to the H1N1 pandemic for the routine care of H1N1 cases all agree with the respective pandemic influenza plans (Table 3). There remains agreement that N95 respirators are always required for aerosol-generating procedures. The CDC[69] and Ontario[70] continue to recommend the use of an N95 respirator for routine care, whereas most other guidance recommend that both the HCW and patient wear procedural masks.[71,72] If the patient has a strong cough and is not wearing a mask, then Canada[73] and Quebec[74] recommend the use of an N95 respirator. Quebec otherwise recommends a procedural mask for routine care.[68] Australia has moved into a "protect" strategy, and recommend that no mask is required if the patient is wearing a procedural mask, or there is to be no close contact. A procedural mask is recommended where the HCW may stimulate coughing, or the patient is not wearing a mask.[75] After ongoing data analysis of the H1N1 pandemic, consideration of limited resources in this time of need, and clinical experience with both H1N1 and SARS, The Society for Healthcare Epidemiology of America (SHEA) suggested a revision of the CDC guideline. It has been recommended that N95 respirators be worn only for aerosol-generating procedures. SHEA has also classified only select procedures as "aerosol-generating."[76]

Table 3: H1N1 guideline recommendations for mask and respirator use for suspect/possible, probable, and confirmed cases (as of 14 July 2009)

Case situation	CDC	Canada	Québec	Ontario	UK	WHO	Australia
No, or weak, cough	N95	Mask	Mask	N95*	Mask	Mask	None†
Strong cough, patient wearing mask		Mask	Mask				None
Strong cough, patient not wearing mask		N95	N95				Mask
Aerosol-generating procedure	N95	N95	N95	N95	N95	N95	N95

* The Ontario plan recommends procedural mask for influenza-like illness (ILI) unlikely to be H1N1 and N95 respirators for H1N1 cases.

† Only if the patient is wearing a procedural mask, otherwise a procedural mask is recommended.

Review of the Literature

A review of the recent literature revealed ongoing uncertainty whether influenza is a potentially airborne pathogen. In a 2006 review, it was suggested that the airborne route may be an important mode of influenza A transmission.[77]

There remain arguments that influenza is unlikely to be transmitted by the airborne route, and even if this does occur, its contribution to transmission is thought to be insignificant. Studies have demonstrated transmission using artificially generated aerosols, but these data have been described as insufficient to conclude that aerosol transmission results in natural human infection.[78] One systematic review concluded that transmission of influenza A occurs at close range, as opposed to long range, suggesting the airborne route is unlikely to be significant in most clinical environments.[79]

More recent studies, however, have detected influenza virus in aerosolised particles generated directly from humans in a natural setting. A study published by Fabian et al demonstrated that influenza RNA was detectable in aerosolised particles from the breath of influenza infected patients.[80] It has also been shown that influenza could be detected in aerosolised particles found in ambient air in an emergency department.[81]

Although the above studies are suggestive of airborne transmission, a definite role has not been substantiated. A recent study, utilising a guinea pig model, has revealed efficient transmission of human influenza viruses.[82] Results from this study indicate that influenza viruses can persist in infectious aerosols and can infect a susceptible mammalian host via the airborne route.

Data indicating transmissibility of influenza between humans via the airborne route are scarce. The suggestion of aerosol transmission is based on indirect evidence from an animal model, findings of influenza virus detected in bioaerosols, and in ambient air of a clinical setting.[80,81] The finding that human influenza virus can be transmitted among guinea pigs via the airborne route suggests that if aerosol transmission of influenza does occur among humans, then the influenza virus may still be infectious within bioaerosols.[82]

Early studies of transmission modes of the 2009 H1N1 pandemic strains using ferret models have demonstrated transmission via direct contact similar to the seasonal strain.[83] Although one study demonstrated evidence of aerosol and respiratory droplet transmission,[31] another did not.[83]

Rationale of Position

There is agreement across the pandemic plans and H1N1 guidelines that a respirator of at least 95% efficiency (N95) is recommended for HCWs during aerosol-generating procedures. We consider acutely ill patients—for instance, with severe respiratory infection (SRI), acute respiratory distress syndrome (ARDS), respiratory failure, haemodynamic instability, or altered mental status—to be in the same group, as they will potentially require care including aerosol-generating procedures, possibly on an urgent basis.

The evidence, however, remains unclear whether influenza is generally transmitted by the airborne route, and if so, its contribution in comparison with contact or droplet modes of transmission. This possibility is gaining increased attention. Due to this uncertainty, there is a lack of consensus among recommendations for procedural mask use or N95 respirators for close contact with pandemic influenza cases, with equal distribution of recommendations for each type of mask. Since aerosol transmission cannot be excluded, we support the recommendation of N95 respirators—the precautionary principle suggests we lean toward greater protection.

We understand that a number of factors may make N95 usage in routine care unfeasible, such as discomfort with prolonged use, increased cost, limited resources, fit testing, and education (application, removal, and disposal).[84] In addition, for N95 respirators to be effective they must be properly fitted, including regular fit testing to ensure a good fit. HCWs need to be trained on the correct procedures for putting on, removing, and disposal to minimise risk of contact transmission. If N95 respirators are unavailable, then procedural masks provide the minimum necessary protection for the wearer from large droplet exposure and prevent indirect contact transmission by discouraging the wearer from touching their face.[51] Our preliminary survey indicated that 97% of HCWs believe that the N95 respirator will offer good protection. Less than half of the physicians believed a procedural mask will offer protection (46%), whereas 81% of nurses felt they would be protected by a procedural mask.

Position Statements

Position 1.1.1: *An N95 respirator must be used during aerosol-generating procedures, if the patient has a strong cough and is not wearing a mask, or if the patient is acutely ill.*

Position 1.1.2: *In the instance of a severe pandemic, an N95 respirator should be used for all cases not included in Position 1.1.1.*

Position 1.1.3: *In the instance of a mild pandemic, the use of an N95 respirator should ideally be used for all cases not included in Position 1.1.1. We recognise the possibility of limited supply of N95 respirators, and for this reason support a minimum standard of using a procedural mask in this situation.*

Position 1.1.4: *All facilities must have a global fit testing plan, by which all HCWs must be fit tested.*

1.2 Gloves, Gowns, and Eye Protection

Review of Guidelines

There were 7 pandemic plans that included recommendations on the use of gloves, gowns, and eye protection for PPE.[3,12,47,49,59-61] With the exception of the Australian plan, there was consensus that gloves, gowns, and eye protection (using goggles or a face shield) are not required for routine care of influenza cases. The Australian guideline recommends the use of all 3 whenever there is close contact.[61]

There is consensus across all pandemic plans and H1N1 guidelines that gloves, gowns, and eye protection are all required when there is a risk of exposure to blood, body fluids, secretions, or excretions, and during aerosol-generating procedures.

H1N1 guidelines from the CDC,[85] Canada,[73] and the UK[71], however, all recommend the use of gloves, as well as aprons or gowns, for routine care of H1N1 cases (Table 4). Quebec[68] and Ontario[70] recommend the routine use of gloves. The WHO[72] recommends gloves and gowns only where there is a risk of exposure to bodily fluids. The Australian recommendations have not been changed.

In addition, H1N1 guidelines from the CDC,[85] Canada,[73] and Ontario[70] recommend the use of eye protection for routine care, whereas Quebec,[68] the UK[71] and WHO[72] recommend their use only where there is a risk of exposure to blood, respiratory secretions, or bodily fluids to the face. The recommendations from Australia remain from their pandemic plan. All guidances recommend the use of eye protection for aerosol-generating procedures.

Table 4: H1N1 guideline recommendations for gloves, gown, and eye protection (as of 14 July 2009)

Recommendation		CDC	Canada	Quebec	Ontario	UK	WHO	Australia
Recommended for routine care of all cases	Gloves	✓	✓	✓	✓	✓		✓**
	Gowns	✓	✓			✓*		
	Eye protection	✓	✓†		✓			✓**
Recommended where there is risk of exposure to bodily fluids and for aerosol-generating procedures	Gloves	✓	✓	✓	✓	✓	✓	✓
	Gowns	✓	✓	✓	✓	✓*	✓	✓
	Eye Protection	✓	✓	✓	✓	✓	✓	✓

* The UK guidance recommends the use of an apron for routine care, and of a gown for aerosol-generating procedure.

† Eye protection is recommended whenever a facemask or respirator is required.

** No PPE is recommended where there is no close contact or the patient is wearing a mask. If the HCW is likely to stimulate a cough or the patient is not wearing a mask, then gloves and eye protection are recommended.

Rationale of Position

There is consensus across all pandemic plans and H1N1 guidelines that gloves, gowns, and eye protection are all required during aerosol-generating procedures and when there is a risk of exposure to blood, body fluids, secretions, or excretions.

Although all except 1 pandemic plan recommend that the use of gloves, gowns, or eye protection are not required for routine care, nearly all guidelines released during the H1N1 outbreak changed this recommendation. There is not, however, consistency among these recommendations, and they continued to change as the pandemic progressed. There is consensus on the recommendation for use of gloves for all patient contact, but not for the use of gowns or eye protection. Our preliminary survey indicated that nearly all HCWs who responded believe that gloves, gowns, and eye protection will be useful for protection during pandemic influenza.

Our positions are consistent with the precautionary principle, suggesting full PPE use for aerosol-generating procedures, when contact where exposure to bodily fluids is expected, and in the setting of a severe pandemic causing a significant case load or with high virulence.

Position Statements

Position 1.2.1: *Gloves, gown, and eye protection must be worn by all HCWs during aerosol-generating procedures, if the patient has a severe cough and is not wearing a mask, if the patient is severely ill, or if there is risk of exposure to bodily fluids or secretions.*

Position 1.2.2: *Gloves should be always be used for any contact with a case. Gloves should be changed between each patient contact. Hand hygiene should be performed after removing gloves and between all patient contacts.*

Position 1.2.3: *Gowns and eye protection should be worn for any contact with a case during a severe pandemic.*

Position 1.2.4: *In the instance of a mild pandemic, gowns and eye protection may not be required for contact where there is no risk of exposure to bodily fluids or secretions.*

1.3 Antiviral Prophylaxis

During an influenza pandemic, HCWs are at far greater risk of infection than the general population, even with appropriate use of PPE. While the use of such equipment may decrease the risk of transmission for an individual encounter with an infectious patient, the number of encounters over the course of a working day would probably still result in disease transmission. Even with excellent infection control practices, attack rates of greater than 10% are likely to occur among HCWs in the absence of vaccination.[86,87]

Since a sizeable proportion of HCWs may become infected early due to increased exposure, there will likely be reduced capacity of the healthcare system at a time where there will be a surge in demand.[86,88] It should be emphasised that keeping the HCW workforce in place is critical not just to respond to the needed care of pandemic influenza patients, but also to prevent deaths from all other causes.[86]

As a pandemic would not be limited to hospitals but would also involve the community, the best protection for HCWs would be one that provides constant protection both inside and outside the hospital.[89] It is suggested, therefore, that antiviral agents are an important control strategy through both treatment and prophylaxis during a pandemic, including either pre-exposure or postexposure prophylaxis strategies, especially HCWs who are unvaccinated or only recently vaccinated.[86,90]

Modelling of pandemic influenza situations suggest that apart from directly protecting the staff and subsequent absenteeism, antiviral prophylaxis may have indirect benefits as well, such as reducing transmission and reducing the size of a pandemic and delaying its onset—in fact, a combination of prophylaxis with early treatment may result in the optimal outcome.[91,92] Data from a postexposure prophylaxis study provides evidence that control of an influenza outbreak (epidemic or pandemic) is not solely based on treatment of developing cases, but on a strategy involving prophylaxis.[93] It is likely that the optimal strategy combines treatment and prophylaxis strategies.[92]

Neuraminidase inhibitors (NIs) oseltamivir and zanimivir are suggested as the drugs of choice—compared to the alternative of M2 inhibitors amantidine and rimantidine—due to a greater breadth of spectrum (both influenza A and B), modest side-effect profiles, and less clinical drug resistance development, although there are no head-to-head trials between the 2 groups.[94]

There remain concerns regarding the development of antiviral resistance with use as prophylaxis. The 2008–2009 seasonal influenza A(H1N1) demonstrated significant resistance to oseltamivir (99.5%).[95] The first reported case of oseltamivir resistance in the H1N1 pandemic was reported in a patient receiving treatment with the drug in Denmark (June 29, 2009),[96] a country that uses only low levels of oseltamivir.[97] Further cases have been reported in Japan, Hong Kong, and Quebec.[98,99] Notably, no significant clinical impact has been identified as a result of such resistance.

Review of Guidelines

We identified recommendations and information on antiviral prophylaxis in 14 of the pandemic plans reviewed. There remains disagreement regarding the role of antivirals for prophylaxis of HCWs (Table 5). Long-term, pre-exposure antiviral prophylaxis for HCWs during outbreaks of pandemic influenza is recommended by 5 plans (TAHSN,[44] USA HHS,[53] WHO,[57] Australia,[62], and France[100]). Three plans currently recommend a strategy of postexposure prophylaxis (Quebec,[43] PHNC,[45] and UK[59]) and 1 a strategy of treatment only and use for outbreak control during phase 6 pandemic (Canada[48]).[48] The Canadian Plan cites that a focus on early treatment rather than prophylaxis is the most efficient use of

antiviral drugs, and likely to be cost-saving. In addition, the limited use of prophylaxis in this plan can be supported by the National Antiviral Stockpile, whereas prophylaxis beyond these recommendations will require additional supplies.[48]

Table 5: Pandemic plan recommendations for antiviral prophylaxis for HCWs

Antiviral strategy for HCWs	Plans
Pre-exposure prophylaxis for duration of outbreak	TAHSN, HHS, WHO, Australia, France*
Postexposure prophylaxis	Quebec, PHNC, UK
No prophylaxis; early treatment only	Canada†
Not clearly stated	OHPIP, CCA Expert Panel

* Pre-exposure prophylaxis would be considered for HCWs in phase 5B if approved by the Ministère de la Santé once significant circulation of the novel virus is detected.

† The updated Canadian Pandemic Plan recommends the use of antivirals for postexposure prophylaxis during phases 4 and 5, and a strategy of treatment and outbreak control during phase 6.

In response to the 2009 H1N1 outbreak, specific guidelines on the use of antivirals prophylaxis for HCWs were identified from 5 bodies (Canada,[101] Quebec,[102-104] USA,[105] UK,[106,107] and Australia[108-110]). These guidance documents evolved rapidly with the progression of the outbreak, and generally remained in line with the respective pandemic plans (Table 5). These guidelines also included special consideration for persons at high risk of complications from influenza:[105]

- Children younger than 5 years old. The risk for severe complications from seasonal influenza is highest among children younger than 2 years old.
- Adults 65 years of age and older
- Persons with the following conditions:
  - — Chronic pulmonary (including asthma), cardiovascular (except hypertension), renal, hepatic, hematological (including sickle cell disease), neurologic, neuromuscular, or metabolic disorders (including diabetes mellitus)
  - — Immunosuppression, including that caused by medications or by human immunodeficiency virus (HIV)
  - — Pregnant women
  - — Persons younger than 19 years of age who are receiving long-term aspirin therapy
- Persons who are morbidly obese were also identified to be at high risk of complications during the H1N1 pandemic.[111]

Table 6: Antiviral prophylaxis recommendations from H1N1 guidelines (as of 3 July 2009)

Source	Strategy in pandemic plan	H1N1 guideline
Canada	– **Pre-exposure prophylaxis:** Not recommended – **Postexposure prophylaxis:** – Phase 4 & 5: For close contacts – Phase 6: Not recommended – In Phase 6, antivirals use for treatment only and outbreak control in closed settings.	– **Recommendations unchanged**
Quebec	– **Pre-exposure prophylaxis:** No recommendation for HCWs – **Postexposure prophylaxis:** For exposed HCWs	– **Pre-exposure prophylaxis:** No recommendation – **Postexposure prophylaxis:** Recommended for HCWs with unprotected exposure to an isolated probable or confirmed case (including colleagues). – In the case of an outbreak in a healthcare setting, postexposure prophylaxis is recommended for all HCWs in the affected unit according to their exposure.
USA	– **Pre-exposure prophylaxis:** HCWs with frequent, direct, high-risk exposure for the duration of community outbreaks – **Postexposure prophylaxis:** For HCWs with no regular exposure.	– **Pre-exposure prophylaxis:** Consider for HCWs at high risk for complications of influenza who are working in a facility with patients with H1N1 or caring for patient with acute respiratory illness. – **Postexposure prophylaxis:** HCWs not using appropriate PPE during close contact with confirmed, probable, or suspected case.
UK	– **Pre-exposure prophylaxis:** No recommendation for HCWs. – **Postexposure prophylaxis:** Limited use for close household contacts; no recommendation for HCWs.	– **Pre-exposure prophylaxis:** No recommendation – **Postexposure prophylaxis:** HCWs who provided direct clinical or personal care to a symptomatic case without wearing a facemask, or conducted an aerosol-generating procedure, or cared for a case with serious respiratory illness without an FFP3 mask.
Australia	– **Pre-exposure prophylaxis:** For persons exposed to aerosol-generating procedure on cases or with ongoing re-exposure to cases. – **Postexposure prophylaxis:** For persons with unprotected close contact with an infectious case, including in healthcare settings.	– **Pre-exposure prophylaxis:** Not recommended – **Postexposure prophylaxis:** Not recommended – Given the mild nature of H1N1 infection, prophylaxis for HCWs is not recommended. Infection should be handled as with seasonal influenza.

Review of Literature

Given the lack of consensus in this area, we performed a review of the literature of the evidence for antiviral prophylaxis in pandemic influenza. Direct evidence for the effectiveness of antiviral prevention and treatment strategies—or even vaccine prevention strategies—for reducing the health impacts of a pandemic is extremely limited. Whilst there are some data for M2 inhibitors from previous pandemics, there are none for NIs.[112,113] The evidence, therefore, for the effectiveness of antiviral prophylaxis arises from clinical trials in seasonal flu and mathematical modelling using pandemic influenza scenarios. Since M2 inhibitors are not recommended for prophylaxis,[113,114] this review focuses only on NIs. Both long-term, seasonal pre-exposure and targeted postexposure prophylaxis strategies are considered.

The full results of this literature review are shown in Appendix IV. The main results for each of the outcomes considered in this review are shown in Table 7. Both pre-exposure and postexposure prophylaxis strategies have similar efficacy in preventing infection during seasonal influenza.[115] There is one study that modelled the effect of pre-exposure prophylaxis on absenteeism, concluding that this strategy may reduce absenteeism, especially if the pandemic is severe.[88] Significant concerns about prophylaxis, such as adverse events and the development of resistance, do not appear supported by the literature.[93,116] Although resistance has not been reported in clinical trials, it is difficult to predict the risk of emerging resistance following use at the pandemic scale. Cost and availability of antivirals remain limiting factors in the applicability of prophylaxis strategies.

Table 7: Main findings of literature review on antiviral prophylaxis (see Appendix IV. for full review and references)

Outcome	Pre-exposure prophylaxis	Postexposure prophylaxis	Comments
Rate of infection	• Evidence from seasonal flu indicates efficacy against confirmed influenza (oseltamivir 64%, zanamavir 43%).	• Evidence from seasonal flu indicates efficacy against confirmed influenza (oseltamivir 68%–89%, zanamavir 79%–81%).	• Similar efficacy for preventing infection for both pre- and postexposure prophylaxis.
Time-off work (absenteeism)	• May reduce absenteeism (from models) • Greater benefit in more severe pandemic • Benefit lost if prophylaxis begun too early	• No articles identified	• The only study of absenteeism and prophylaxis in HCWs supports the use of pre-exposure prophylaxis.
Mortality	• Population-based strategy may increase the number of lives saved compared to a treatment-based strategy (from model)	• No articles identified	• Population-based pre-exposure prophylaxis may increase the number of lives saved. • There were no data on the effect of prophylaxis for HCWs on their mortality.

Outcome	Pre-exposure prophylaxis	Postexposure prophylaxis	Comments
Transmission and population rates	• Substantially reduce transmission, especially early in an outbreak, by up to 72% (from models) • May delay progression and reduce magnitude	• Population-based strategies can contain outbreaks and reduce population attack rates (from models) • May select resistant strain and thereby increase attack rate	• Modelling of pre-exposure prophylaxis in HCWs suggests it may have population benefits. • Postexposure prophylaxis can contain outbreaks when implemented on a population level.
Safety	• No significant adverse reactions • Oseltamivir induces nausea	• No significant adverse reactions	• Both oseltamivir and zanamavir safe and well tolerated as prophylaxis
Viral resistance	• No reports of resistance development • Widespread use may select for a resistant strain to become dominant (population-based model)	• No reports of resistance development • Excessive use may select resistant strain and lead to poorer population outcomes (population-based model)	• No reports of resistance development with use of pre- and postexposure prophylaxis • Models of both pre- and postexposure prophylaxis in a population setting suggest that excessive use may contribute to the dominance of a resistant strain
Cost	• High economic costs • Requires more stockpiling • Economically beneficial in high-risk groups (from model; did not consider health outcomes) • Lost treatment opportunity	• Favourable cost-benefit ratio similar to treatment	• Pre-exposure prophylaxis incurs greater economic and opportunity costs and requires more stockpiling, but is economically beneficial in high-risk groups

Rationale of Position

There is consensus among nearly all major pandemic plans recommending the use of prophylaxis for HCWs.[43-45,53,57,59,62,64] The exception to this is the Canadian Pandemic Influenza Plan, which allows for postexposure prophylaxis during phases 4 and 5, but adopts a treatment-only strategy in phase 6, with prophylaxis only indicated for outbreak control in closed settings.[48] Antiviral prophylaxis has been shown, however, to reduce the rate of infection during seasonal flu,[113,115] and models of pandemic situations indicate that prophylaxis can reduce early transmission to contain outbreaks or slow progression and severity.[86,87,93,117-119] Our preliminary survey indicated that offering prophylaxis may reduce absenteeism in a pandemic influenza setting (only 61.9% of physicians and 65.6% of nurses indicated they would remain at work without prophylaxis, whereas 87.3% of physicians and 78.1% of nurses would remain with prophylaxis). This is supported by similar findings from a model of the effect of pre-exposure prophylaxis on HCW absenteeism.[88] Adverse effects and the development of resistance

are commonly cited objections to the use of prophylaxis, but evidence from prophylaxis trials indicate no significant adverse effects,[116] nor development of resistance.[93]

There is disagreement among the pandemic plans, however, with recommendations for either pre-exposure or postexposure prophylaxis. Our literature review indicated similar efficacies for both pre- and postexposure prophylaxis.[115] A postexposure strategy would have the advantage of requiring fewer antivirals, thereby improving use of antiviral stockpiles, with lower overall and opportunity costs than a pre-exposure approach.

In the instance of a severe pandemic with a significant case load, implementation of a postexposure strategy will be hampered by the vast numbers of cases being attended to, ED crowding, and difficulties in contact tracing. In addition, although PPE confers a substantial degree of protection, the number of encounters over the course of a working day would probably still result in attack rates of greater than 10% among HCWs in the absence of vaccination.[86,87] In this setting, pre-exposure prophylaxis for HCW groups who are at high risk of exposure (for example, those constantly exposed to the pandemic strain or performing multiple aerosol-generating procedures on pandemic cases[62]) would be required to provide adequate protection. This would not be required in a mild pandemic, as evidenced during the initial phase of the 2009 H1N1 pandemic: both the USA and Australian plans recommended pre-exposure prophylaxis for these groups, but with the development of only mild illness with H1N1, both countries no longer recommended this.[105,108]

There is consensus across guidelines that HCWs at high risk of complications of influenza should be allocated tasks where there is no risk of exposure or be offered pre-exposure prophylaxis.

The use of antiviral prophylaxis for outbreak control in closed settings is standard practice in Canada and the USA,[48,53] and recommended in Canada during phase 6 pandemic.[48] There is substantial evidence that antiviral prophylaxis is effective in terminating outbreaks of seasonal influenza in closed institutions.[46,120] An outbreak is suggested to be defined as the incidence of 3 unrelated nosocomial respiratory infections within a 72-hour period in any one unit.[120] We have adopted the cautious definition for an outbreak as used in Quebec: the confirmation of 2 or more nosocomial infections among residents/patients within a 10-day period.[104]

Position Statements

Position 1.3.1: *We support postexposure prophylaxis for all HCWs following unprotected exposure with a case.*

Position 1.3.2: *In the instance of a severe pandemic, the use of pre-exposure prophylaxis should be considered for the duration of the pandemic for HCWs on the front-line at high risk of exposure (eg, HCWs constantly exposed to the pandemic strain or performing multiple aerosol-generating procedures on pandemic cases).*

Position 1.3.3: *If a HCW had a confirmed infection due to the pandemic strain, or has received effective vaccination, then AV (antiviral) prophylaxis is not required.*

Position 1.3.4: *HCWs at high risk of complications should be assigned duties where they will not be exposed. If this is not possible, pre-exposure prophylaxis should be offered.*

Position 1.3.5: *Prophylaxis should be offered to HCWs during outbreaks in closed settings (confirmation of at least 2 nosocomial infections in a 10-day period) according to standard practices.*

1.4 Vaccination

Rationale of Position

Vaccination is the most effective means of preventing influenza. Vaccine development against a particular influenza strain, however, can only start once a pandemic begins and the strain is identified. Then it can take another 6 months or more for mass production of the vaccine using current technology. Therefore, virus-specific vaccines are unlikely to be available during the initial wave of a pandemic.[57] The use of other protective measures, such as PPE and antiviral prophylaxis, will be required in the period until a vaccine becomes available.[46]

Ten pandemic plans contained recommendations and information regarding the use of vaccination for HCWs during pandemic influenza.[3,44-47,49,59,60,62,64] Given the likely delay before a pandemic-specific vaccine becomes available, and even then initially in limited supply,[57] the guidelines agree that HCWs should be among the highest priority to be vaccinated when it becomes available.[3,44,57,64]

As of July 2009, a vaccine was not publicly available for this strain. When it becomes available, it is still recommended that HCWs be among the first priority to be vaccinated.[121,122] Development of this vaccine is, however, proving difficult,[33] and it remains uncertain when a vaccine will be available. To facilitate its availability, this vaccine will be rushed through clinical trials, which will result in uncertainty over optimal dosage, efficacy for developing immunity, and the duration of immunity.[123] There remain concerns regarding vaccine safety, as previous vaccines rushed through trials for the 1976 swine flu resulted in reported cases of Guillain-Barré Syndrome.[124] Recommendations regarding vaccination may evolve as these factors become clear and as the pandemic progresses. When a pandemic vaccine becomes available, a system and resources, especially human resources, will be required to rapidly achieve mass vaccination—most pandemic plans include recommendations regarding development of such a system.

Although it is recognised that the annual, seasonal influenza vaccine is unlikely to have any protective benefits against a pandemic strain,[62,64] its increased uptake among HCWs in encouraged.[57] Our preliminary survey revealed that although nearly all workplaces recommend annual influenza vaccination (98%), only 80.9% of physicians and 40.6% of nurses always get vaccinated, with a similar rate of uptake for the 2008–2009 annual vaccination.

Position Statement

> ***Position 1.4.1:*** *When a pandemic-specific vaccine becomes available, front-line HCWs should be among the highest priority groups. Distribution and administration plans should be in place to facilitate timely availability.*
>
> ***Position 1.4.2:*** *HCWs should be encouraged to receive the annual seasonal influenza vaccine.*

2. Administrative Controls

2.1 Pre-Triage Screening, Triage, and Testing

Pre-Triage Screening and Triage

Rationale of Position

The early identification of potential pandemic influenza cases remains vitally important in preventing exposure of HCWs without adequate protection. Early data from the H1N1 pandemic indicate that a lack of early identification was one of the major factors in HCW infection.[125] In addition, most pandemic plans recommend early identification of potential cases to allow for segregation of influenza and non-influenza patients. Our preliminary questionnaire indicated that nearly all HCWs agree that pre-triage will be useful in staff protection during pandemic influenza.

Six of the pandemic plans we reviewed had recommendations relevant to the role of emergency department pre-triage screening, and triage.[3,44,49,59-61] Four of these plans recommend the implementation of pre-triage screening and assessment, with suggestions it be situated near the entrance to the emergency department so as to allow for controlled entry.[44,59-61] A rapid screening tool enquiring about symptoms and history will be vital to identify suspect patients with influenza-like illness. This would also allow the early identification of the type of care required as well as for the separation of symptomatic influenza-like illness and other patients, and the provision of a mask for suspected cases. This process could be equally performed for walk-in and ambulance patients.

Clear informational signs to inform patients of the process, symptoms of influenza, and respiratory etiquette may contribute to the process.[44] HCWs performing screening and triage should wear appropriate PPE.

Position Statement

> ***Position 2.1.1:*** *A pre-triage screening assessment at the ED entrance should be performed using a screening tool to identify the care required and allow separation of suspect cases with possible influenza from other patients. Informational signage is important in keeping patients informed about this process. HCWs performing screening should wear appropriate PPE.*

Rapid Diagnostic Testing

Rationale of Position

The ready availability of rapid and accurate diagnostic testing for pandemic influenza strains was identified by the committee as a crucial component of suspected influenza patient care. Accurate diagnosis of pandemic influenza will define the pathway a patient will follow and greatly impact the usage of isolation rooms, PPE use, and even admission versus discharge. Prolonged delay before diagnosis could contribute to increased length of stay in the ED and consequent crowding, increased risk of exposure, and excessive use of PPE unnecessarily. A readily available test with rapid, accurate results is therefore essential in ensuring appropriate patient flow in the ED.

Rapid tests (non–PCR-based), although commonly used, have a low sensitivity for detection of seasonal influenza, as well as for the swine-origin strains.[7,126,127] Based on initial data during the 2009

H1N1 pandemic, the CDC reported that there are insufficient data available to recommend these rapid tests with novel H1N1.[128] Rapid testing can be useful under certain circumstances in the absence of circulating flu and a positive test result. However, a negative test result does not rule out influenza A(H1N1), and thus should be used with caution.[129] Reverse-transcriptase polymerase chain reaction (RT-PCR) and viral culture are the only available methods that can accurately confirm 2009 H1N1—RT-PCR is the only method with potential for rapidly available results.

Position Statement

> ***Position 2.1.2:*** *Rapid, reliable diagnostic testing must be readily available 7 days a week in the ED and for hospitalised patients. Obtaining rapid test results within a few hours will have a significant positive impact on ED crowding.*

2.2 Patient Pathways

Emergency Department, Intensive Care Unit, and Hospital Wards

Rationale for Position

The committee identified that managing patient pathways in the ED and subsequent admission to the intensive care unit (ICU) or hospital wards as an important consideration during an influenza pandemic. We did not identify any recommendations in the guidelines regarding these topics. The committee believes that clear protocols should be clearly established to define patient flow along potential pathways in each area.

In the ED, we foresee 3 possible scenarios after triage:

- The case is mild and can be seen in the fast-track area: a segregated area should be present in the waiting room for these cases.
- The case is severe and should be directed in the resuscitation area in a negative-pressure isolation room.
- Other cases need to be put on stretchers and assessed in isolation rooms. The patient should be directed to a negative-pressure room if procedures are contemplated.

For patients requiring ICU admission, a protocol should be elaborated to include strict criteria for rapid admission from the ED. Isolation rooms and negative-pressure rooms in general hospital wards should be pre-identified and a protocol established that clearly states rapid admission criteria and pathways from the ED.

Position Statement

> ***Position 2.2.1:*** *Protocols should be established in the Emergency Department, Intensive Care Unit and general hospital wards regarding patient flow and rapid admission pathways.*

Patient Flow Coordination

Rationale of Position

The implementation of a dedicated coordinator to manage patient flow is recommended by 3 pandemic plans.[44,49,60]

Position Statement

> ***Position 2.2.2:*** *A dedicated coordination role to manage patient flow and resources should be implemented during surge periods in both the Emergency Department and the hospital.*

Patient Isolation and Cohorting

Rationale of Position

The isolation of suspect, probable, and confirmed pandemic influenza cases into single rooms, where available, was recommended by the Canadian and UK infection control plans.[3,60] The Canadian plan adds that in a pandemic situation, where single rooms will be overwhelmed, influenza patients may be cohorted according to their clinical status.[3]

Position Statement

Position 2.2.3: *Where possible, cases should be assigned single rooms. In pandemic situations, patients may be cohorted according to clinical status.*

2.3 Healthcare Delivery Area

Patient Care Equipment

Rationale of Position

Five pandemic plans included recommendations on the cleaning, disinfection, and sterilisation of patient care equipment.[3,47,49,60,61] There was consensus among them that patient care equipment should be cleaned according to routine infection control procedures and the manufacturers' instructions. Two plans recommend the use of disposable equipment where possible.[60,61] We support these recommendations.

Position Statement

> ***Position 2.3.1:*** *Patient care equipment should be cleaned according to routine infection control procedures and manufacturers' instructions. Disposable equipment could be used where appropriate.*

Surfaces and Environment

Rationale of Position

Four pandemic plans included recommendations on the cleaning and disinfection of surfaces and environments, for instance, influenza patient rooms.[47,49,60,61] There was consensus that cleaning should be done using a detergent and a disinfectant in line with routine infection control procedures. Three plans reinforced that HCWs performing cleaning should wear appropriate PPE,[47,60,61] and 2 suggested having a dedicated cleaning staff for influenza patient rooms and areas.[60,61]

Position Statement

> ***Position 2.3.2:*** *Potentially contaminated surfaces and environments (eg, patient rooms) should be cleaned using detergent and disinfectant, in line with routine infection control procedures. HCWs performing this should wear appropriate PPE. Dedicated staff for cleaning influenza patient rooms and areas should be considered.*

Housekeeping, Laundry, and Waste Management

Rationale of Position

There were 5 pandemic plans with recommendations on housekeeping (eg, dishes and cutlery), laundry and linen, and both medical and non-medical waste management.[3,47,49,60,61] There was consensus that these can be handled according to standard precautions, with no special process required for potential influenza contamination. The use of disposable materials is not required. The Canadian Pandemic Influenza Plan cites level AIII evidence for this recommendation.[3]

Position Statement

> ***Position 2.3.3:*** *Housekeeping (eg, dishes and cutlery), laundry, and waste management (both medical and non-medical) should be handled according to standard precautions.*

2.4 Patient Education and Visitor Policy

Patient Education

Rationale of Position

We support the recommendation of the HHS that patients should be educated about disease transmission and reducing risk, so they know what they can do to prevent disease transmission in the hospital, as well as at home, and in community settings.[49] Education materials should be multilingual and cross-cultural. Reliable sources, such as the PHAC, CDC, and WHO will be good sources for these materials, but the information may need to be tailored to local settings.

Position Statement

> ***Position 2.4.1:*** *Patients, family, and visitors should be educated on the different modes of influenza transmission and how to reduce the risk. All education should be multilingual and cross-cultural. Education can be in the form of signs, pamphlets, Internet-based, or multimedia presentations.*

Respiratory Etiquette

Rationale of Position

Although the impact of covering sneezes and coughs on the containment of respiratory secretions or on the transmission of respiratory infections has not been systematically studied,[49] the implementation and patient education of proper respiratory hygiene/cough etiquette was strongly recommended across 4 pandemic plans,[47,49,61,63] and we support this strategy. This measure includes educating patients and visitors on the importance of containing respiratory secretions (through signs and other educational material) as well as enforcing various control measures (eg, proper hand hygiene, covering sneezes and coughs). To be successful, the resources required must be easily available in patient areas.

Position Statements

> ***Position 2.4.2:*** *Patients and visitors should be educated on the importance of respiratory etiquette. In addition, the resources to practice these measures should be easily available in patient areas.*

Patient Mask Use

Rationale of Position

We identified 5 pandemic plans that strongly recommend that symptomatic, potentially infected patients should be properly instructed and encouraged to wear a mask to reduce transmission.[47,49,61,63,64] We support this recommendation.

In addition, interim guidance during the H1N1 outbreak from Canada,[73] Quebec,[74] the CDC,[85] and Australia[130] all recommend patient use of a mask as part of respiratory etiquette. The adherence of the patient to this recommendation has an impact on the type of facemask or respirator recommended for the treating HCW—these guidances recommend the HCW wear an N95 respirator unless the patient is wearing a procedural mask, in which case a procedural mask is deemed to provide adequate protection.

Position Statement

> ***Position 2.4.3:*** *Symptomatic cases with influenza-like illness should wear a properly fitting procedural mask if able to tolerate. Patients will need instruction on donning and removing the mask.*

Visitor Policy

Rationale of Position

We did not identify any recommendations from pandemic plans or H1N1 guidelines regarding hospital visitor policies. The committee identified this as an important practical consideration, especially in the ED. The volume of visitors may contribute to a risk of transmission among patients, visitors, and HCWs, especially if strict hand hygiene and respiratory etiquette are not complied with. It is advisable to restrict visitors to the minimum number possible, and to ensure all visitors are educated on hygiene practices. Adequate supplies must be present for these to be adhered to.

Position Statement

> ***Position 2.4.4:*** *Visitors should be restricted to reduce risk of transmission. For mild cases likely to be discharged, no visitors should be allowed unless a companion is required for other reasons (eg, paediatric). For other cases, only 1 visitor should be allowed at a time, with strict adherence to hand hygiene and respiratory etiquette.*

2.5 Healthcare Worker Education and Safe Work Practices

Hand Hygiene

Rationale of Position

The importance of routine infection control practices, most notably hand hygiene, respiratory etiquette, and use of PPE, is highlighted by recommendations in 8 pandemic plans.[44,46,47,59-63] There is agreement that hygiene should be performed after each encounter with a patient and after removal of PPE, and regarding the use of soap and water or alcohol-based gels or hand washes. For this strategy to be successful, the healthcare setting must be equipped with the necessary resources. Our preliminary survey indicates that nearly all physicians and nurses (98% and 100%) believe that hand washing will help protect them during pandemic influenza.

Position Statements

Position 2.5.1: *Routine practices should be followed, such as appropriate hand hygiene, and respiratory etiquette. In all cases where exposure to influenza is likely, especially in certain procedures, PPE should be utilised.*

Position 2.5.2: *Hand hygiene is paramount in preventing the spread of influenza virus. It should be practiced immediately after contact with a patient, and after removing PPE. Visibly soiled hands should be washed with antimicrobial soap and water. Hands that are not visibly soiled should be cleansed with alcohol-based gels/hand washes. The healthcare setting should be readily equipped with the resources necessary to facilitate this.*

Staff Education and Training

Rationale of Position

Six pandemic plans recommended that staff should receive comprehensive education regarding infection control (including proper use of PPE) and pandemic influenza.[3,12,44,47,49,60] Important topics regarding the pandemic influenza identified included in-advance details about planning, procedures, and policies, as well as up-to-date information regarding progress, status, implications, prevention, and treatment. Information and communication can be passed through a number of channels and media.

Our preliminary questionnaire indicated that, although 100% of nurses reported adequate training on the use of PPE, 14.1% of physicians reported inadequate or no training. This disparity was also seen regarding special training regarding pandemic influenza: 79.2% of nurses reported receiving such training, compared to 54.7% of physicians.

Position Statement

Position 2.5.3: *Staff should be well informed through a variety of means of the implications of the pandemic, methods of prevention and treatment, and should be educated in the use of PPE.*

Position 2.5.4: *Dedicated training and education time should be made available to all HCWs on a regular basis.*

Safe Handling of Specimens and Post-Mortem Care

Rationale of Position

Standards for safe handling of laboratory specimens are cited in the OHPIP and HHS plans.[47,49] The Australian infection control guideline includes these recommendations for post-mortem care.[61]

Position Statements

Position 2.5.5: *Specimens are to be handled under biocontainment settings, ideally by individuals that are vaccinated against or immune to the virus; if this is not possible they should wear appropriate PPE. Specimens are to be stored appropriately and shipped immediately following federal dangerous goods shipping regulations.*

Position 2.5.6: *Individuals that are transporting body bags should wear PPE in order to prevent transmission from bodily fluids. A procedural mask should be placed on the deceased in the initial hours post-mortem.*

2.6 Personnel Management

The primary goals of personnel management will be to protect staff and to ensure optimal staffing levels are maintained. This will be achieved by keeping personnel healthy, providing training and education, reallocating personnel to meet needs (this may involve just-in-time training for critical tasks), and planning resource management and time-off policies to ensure staffing levels.

Deployment and fitness to work

Rationale of Position

Six pandemic plans had recommendations on the deployment of staff, with consideration of well, at-risk, and ill personnel.[3,44,47,49,59-61] There was general agreement on when HCWs are deemed to be fit for work, unfit for work, or fit for work with restrictions. Staff who have recovered from the pandemic strain are assumed to be immune to subsequent infection by the same strain, and are therefore preferred for duties with influenza patients, due to being protected, or for patients at high-risk of complications from infections, due to low rate of transmission.[49,60,61] Two plans suggest that HCWs at high risk of complications (eg, pregnancy) should be assigned to low-risk duties, or taken off active duty.[49,64] The ideal deployment of staff may not be possible if there are insufficient staff to meet the need. This absenteeism may arise from illness and being unfit to work, as well as from refusal to work where the staff do not feel safe. Our preliminary survey indicated that only 9% of HCWs believe there will be sufficient staff to handle the increased demand during pandemic influenza. This response was slightly improved assuming the availability of antiviral prophylaxis for HCWs—15% of HCWs believed there would be enough staff if this were available.

Position Statements

Position 2.6.1: *Staff can be considered fit to work if they are asymptomatic, vaccinated against the pandemic strain, recovered from the pandemic strain, or receiving antiviral prophylaxis.*

Position 2.6.2: *Staff are unfit to work if they have influenza-like illness. In some circumstances staff may be required to continue working if they are well enough; these personnel should be restricted to caring for patients with influenza-like illness. HCWs should be offered early treatment if they have a confirmed case of pandemic influenza.*

Position 2.6.3: *HCWs who are at a high risk of complications due to influenza (including pregnant staff), should be assigned to low-risk duties (no direct care of influenza patients).*

Staff Health and Psychosocial Support

Rationale of Position

The importance of supporting personnel in terms of health and psychosocial factors is stressed in 6 pandemic plans,[44,49,60-63] with the issues of monitoring staff health, providing psychosocial supports to staff and their families, and ensuring ongoing communication with all HCWs suggested across multiple plans. The importance of psychosocial support was highlighted by our preliminary questionnaire results. The majority of respondents agreed that, during an influenza pandemic, people may avoid them due to their profession, that they would feel more stressed at work, and that they expect more conflict between colleagues at work.

The psychosocial support of HCWs and their families will need to be easily accessible and staff well informed of the availability and services offered. Staff should be encouraged to seek this help. Resources and staff availability to provide this support may be a limiting factor to the scope that can be addressed.

Consideration of the work environment is also of importance, especially in view of the extra precautions required during pandemic influenza. Lessons of this were learnt during the SARS outbreak in 2003, with the CDC subsequently recommending:[131]

> "*Wearing PPE for extended periods is burdensome and can lead to lapses in PPE protocol and opportunities for exposure. Healthcare workers may need scheduled breaks from wearing PPE to reduce this burden and provide greater safety."*

Position Statements

Position 2.6.4: *It is important to monitor and screen staff for influenza-like illness. Ill staff should be given early antiviral treatment (within 48 hours), and be restricted from the workplace to reduce transmission and time-off work.*

Position 2.6.5: *Emotional support techniques should be practiced and services should be provided for HCWs and their families throughout the pandemic. Reward programs and penalizations should be avoided.*

Position 2.6.6: *HCWs may require scheduled breaks from wearing PPE to reduce burden and increase safety.*

2.7 Planning, Organisation, Communication, and Security

Planning and Organisation

Rationale of Position

Preparedness is of vital importance when a pandemic ensues. Adequate preparedness includes a detailed influenza pandemic plan that clearly outlines the procedures, policies, and protocols to be followed and applied in the institution or department during the pandemic. Also of significant importance are the issues of coordination and organisation within the institution and, as for disaster planning, the identification of a designated leader is key.

Another prerequisite for adequate planning and organisation of proven value in disaster planning is the formation of an executive committee. In the case of influenza pandemic, it should be comprised of infection control experts and major stakeholders.

Position Statements

> ***Position 2.7.1:*** *Each acute healthcare facility should have a detailed influenza pandemic plan, as well as an identified responsible person to lead an executive pandemic committee. Each major department, especially the ED, ICU, anaesthesia, and medicine, should have a clear pandemic influenza plan.*

Contingency Planning for Resource Reallocation

Rationale of Position

In the instance of a severe pandemic or one causing overwhelming case loads it may be necessary to adjust the normal functioning of hospital departments to allow for reallocation of resources. Important hospital sectors such as ED, ICU, operating theatres, and other critical departments may be especially affected by increased case load in combination with staff shortages, and this may impact quality of care as well as HCW safety. In this instance, some hospital activities may have to be reduced or ceased to make staff and beds available for care of pandemic patients. This will most likely be best achieved on a departmental level, with each department planning how they can reduce activities and contribute staff and beds to the hospital.

Position Statement

> ***Position 2.7.2:*** *Each department should prepare a prioritised and detailed list of activities that they can progressively reduce or cease, in order to provide extra resources (staff and beds) to critical hospital functions (eg, ED, ICU, operating theatres, and other critical departments) in the instance of overwhelming case loads or severe pandemic.*

Communication

Rationale of Position

Part of ensuring ongoing HCW education and psychosocial support during a pandemic is through open and comprehensive communication.[49,62,44,63] Healthcare facilities should ensure that employees have ongoing access to information regarding progress of the pandemic, work-related issues, family issues, and healthcare issues.[49] Communication is vital—reliable and efficient channels need to be defined so HCWs have constant access to news and information. The content of the communications will likely need to be centralised to ensure accurate and consistent information is being presented.

Position Statement

Position 2.7.3: *Healthcare facilities should ensure that HCWs are informed of progress regarding the pandemic by a variety of means. HCWs should be informed of work-related issues, family issues, and healthcare issues.*

Position 2.7.4: *Healthcare facilities should define clear communication channels for rapid dissemination of information, policies, and procedures that will be updated throughout the pandemic.*

Security

Rationale of Position

Through experience during the H1N1 pandemic, the committee identified the important role of security personnel in a pandemic setting. Security personnel will be required to ensure safe flow of patients and visitors, as well as to enforce visiting policies. Security officers must be supported similarly to other HCWs in terms of education, training, and PPE use.

Position Statement

Position 2.7.5: *Security personnel should be strategically placed in areas of the hospital that have significant patient and visitor traffic, and high potential influenza exposure. All security personnel should be trained in, and apply all protective measures as HCWs.*

2.8 Emergency Department Crowding and Surge Capacity

ED Crowding and Surge Capacity

Rationale of Position

The pandemic plans and guidelines that have been established across many levels (government, public health agencies, and hospitals) may be significantly hindered by ED crowding, a factor that is often not taken into account. Indeed, further increases in ED crowding (eg, number of admitted patients in the ED) may constitute a key indicator of pandemic activity in a community, as well as an additional risk factor for transmission within a facility. It is widely recognised that ED crowding is a complex and multifactorial healthcare issue, and providing comprehensive solutions is beyond the scope of this report.

Main contributors to crowding in the ED during a pandemic are likely to be increased patient numbers, staff shortages, limited availability of hospital and ICU beds, limited availability of rapid diagnostic testing, and a lack of alternative care areas. The anticipated increase in case load will greatly exacerbate this situation, and will necessitate the ability to rapidly move patients along the various pathways of discharge and admission.

In terms of knowledge translation, the committee identified 6 major barriers to efficient guideline applicability that must be addressed at government and local levels:

1. Accessibility to ED treatment areas: There should be designated treatment areas to accommodate the suspected influenza cases. At least 2 treatment areas should always be unoccupied and ready to receive new patients.
2. Appropriate ED treatment areas: Suspected influenza cases should be managed in isolation rooms or in negative-pressure rooms when a procedure is being carried out. There should be enough of these 2 types of treatment areas to meet the demand in each institution.
3. Adequate staffing: The presence of adequate staffing, mainly in terms of physicians, nurses and respiratory therapists, is a key element. Contingency staffing may include increased use of volunteers, retired HCWs, and medical and nursing students.
4. Rapid Testing: This is crucial to maximize efficient flow through the ED, as well as to optimize the use of isolation rooms and admission pathways. This would also facilitate the infection control protocols.
5. Rapid admission from the ED to the wards or ICU: The delays encountered in EDs (bed block) are seen as the most important cause of ED crowding. In a pandemic setting, this issue must be addressed specifically with clear protocols for rapid admission pathways from the ED.
6. Surge capacity: In the event of a significant increase in volume of influenza cases, there will be increased demand on personnel, resources, and treatment areas. The hospital should establish clear policies coordinating the ED, the ICU and the wards to cope with surges in demand during a pandemic.

Position Statement

> ***Position 2.8.1:*** *It is of high priority for governments, public health agencies, and hospitals to ensure that influenza pandemic guidelines are applicable in the event of ED crowding. For this, barriers and facilitators impacting ED crowding should be clearly addressed. Particular attention should be given to accessibility to appropriate ED treatment areas, ensuring adequate staffing, rapid testing, and implementing rapid admission pathways from the ED.*

Alternative Care Areas

Rationale of Position

Increased patient load and ED crowding may become so severe that they overwhelm the ED's capacity to provide care to influenza and non-influenza patients alike. In this instance, the use of alternative care areas for pre-triage screening and triage,[26] to provide extra isolation rooms, or as segregated care areas for excess influenza patients may be required. Healthcare facilities should plan for this by designating potential areas that could be adapted for these purposes, in coordination with reducing non-urgent activities of other departments. Areas which could potentially be used would include ED garages or ambulance bays, cafeterias, and outpatient clinics. These areas would require adequate staffing and resources to operate as ED areas.

Position Statement

> ***Position 2.8.2:*** *Healthcare facilities should designate alternative care areas to expand the ED in the case of overwhelming patient load or ED crowding.*

3. Engineering Controls

3.1 Infrastructure

Rationale of Position

Although engineering controls are the first level of protection in the hierarchy of controls, there were few recommendations regarding these in the pandemic plans. We identified 5 pandemic plans,[46,47,49,51,61] although 1 of these only had recommendations for laboratory-based infrastructure.[49] The recommendations of using barriers for basic staff protection were supported by 3 plans,[3,47,51] and for using airborne infection isolation rooms (AIIR) for performing aerosol-generating procedures by 2 plans.[47,51] Our preliminary survey reported that nearly all workplaces have designated areas for isolating patients in case of pandemic influenza, and nearly all HCWs who responded felt that use of these areas would be useful for protecting staff.

It is widely recognised that preparation for the next pandemic requires that infrastructure be in place during the interpandemic period.[3] Many of these measures are most effectively implemented during the original design and planning stages for new buildings; however, the SARS outbreak in Toronto demonstrated that many can also be retro-fitted in emergency situations.[132]

Although there are recommendations for the use of AIIR and negative-pressure rooms, there is little guidance from the pandemic plans regarding the availability of such rooms. This was identified as an important practical consideration by the committee through early experience during the H1N1 pandemic. The committee believes that at least 2 such rooms are required in each ED, so that at least 1 room is always available to be used. Similarly, there is little guidance on the number of isolation rooms required. This number will depend on the size of the ED, and the anticipated case load that the ED will see. In planning for an adequate number of rooms, the committee believes that allowance for at least 1 such room being always available to accept new cases is vital.

During a pandemic, temporary structures could be used to increase the number of isolation rooms, and existing rooms retrofitted to meet negative-pressure standards.

Position Statements

Position 3.1.1: *Emergency departments should use physical barriers where possible, such as at triage and reception.*

Position 3.1.2: *Emergency departments should use airborne infection isolation rooms (AIIR) or negative-pressure rooms for aerosol-generating procedures.*

Position 3.1.3: *Emergency departments should have at least 2 airborne infection isolation rooms (AIIR) or negative-pressure rooms, so that at least such 1 room is always available for use. Alternatively, a designated negative pressure area may be developed for cohorting patients with confirmed or suspected influenza.*

Position 3.1.4: *Emergency departments should have sufficient isolation rooms for the expected case load, and ensure at least 1 such room is always available to accept new cases.*

Discussion

We consider these positions to be “safe” recommendations based on the consensus of existing pandemic plans and guidance arising from H1N1. Where there are conflicting recommendations, we have also considered information from the literature. When there remained insufficient evidence, we have taken into consideration the precautionary principle to guide us toward greater staff protection in the face of the unknown. We believe these positions should act as a baseline for staff protection and be adapted to the specific pandemic situation. For example, the 2009 H1N1 pandemic is proving to cause mainly mild illness, and not all of the more cautious protective measures may be required. This was evidenced by the changes in recommendations for PPE—for example, Australia's recommendations evolved from full PPE and N95 respirator use in their pandemic plan to recommendations including situations where neither PPE nor a mask are required—and antiviral prophylaxis. Both the USA and Australian plans initially recommended pre-exposure prophylaxis for HCWs, but with the development of only mild illness with H1N1, both countries no longer recommended this.

There is however a significant danger to become complacent as the actual 2009 pandemic is causing mainly mild illness. Over the past few months, influenza caused by novel H1N1 has been reported as comparable to seasonal influenza. This may be misleading and hinders the evolution of planning and preparedness. It is important to note that characteristics of 2009(H1N1) are being identified as the pandemic progresses suggesting that the probable impact H1N1 can no longer be compared to seasonal influenza. The annual mortality rate of circulating seasonal influenza in the United States is approximately 0.06–0.24%, whereas to date, that of pandemic H1N1 is approximately 0.57%.[22,23] The secondary attack rate for the pandemic H1N1 strain is approximately 22–33%, whereas that for seasonal H1N1 is approximately 5–15%.[24,25] This is suggestive that pandemic H1N1 is a highly contagious virus. The population affected by pandemic H1N1 and seasonal H1N1 have significant differences that may cause additional concern and impact. Groups infected by seasonal H1N1 are mostly paediatric and elderly populations.[26] The current pandemic strain however, has shown a higher propensity to infect older children, adolescents, and young adults.[27,28] Furthermore, novel H1N1 is affecting otherwise healthy individuals, presenting with no other comorbidities.[28,29] In addition, the virulence of pandemic H1N1 has been suggested to be greater than that of seasonal H1N1. In humans, this influenza virus has been shown to manifest with influenza-like symptoms, as well as gastrointestinal symptoms such as vomiting and diarrhoea. It has also been reported to result in rapid inflammation of the lungs, and eventual loss of lung function.[30] Recent animal studies of pandemic H1N1 strains isolated from humans have revealed that this strain replicates efficiently in the trachea and deep lung tissue, and has a wider distribution of viral replication within the body.[29,30] Additional animal studies on transmission of the current H1N1 pandemic strains have indicated that H1N1 may be transmitted by the airborne route. An increase in viral shedding has also been detected, suggesting that novel H1N1 is more infectious than the seasonal strain.[31] Furthermore, earlier epidemiological analysis indicates higher transmissibility.[32] The increased transmissibility of H1N1 (including the potential airborne route), increased virulence, as well as the potential mutation of this virus, suggest that H1N1 may result in a more severe pandemic.

Although vaccination is the most effective means by which HCWs can be protected, the development of a vaccine for the 2009 H1N1 pandemic is proving difficult.[33] As of July 2009, a vaccine remains in development and early, rushed, clinical trials.[34] These rushed clinical trials may result in uncertain

knowledge regarding efficacy and safety, and recommendations regarding vaccination may change as these become clear and as the pandemic resurges.[35]

These positions are based on recommendations from municipal, provincial, national, international, and global bodies. They are not specific to any healthcare system or geographic region, and should be applicable to other provinces and countries. The application of some of these positions may require localisation to consider local guidelines and definitions, but most should be directly applicable in other healthcare settings. Communication, training, availability of resources, psychosocial support, and infrastructural preparations are key themes that were identified in the aftermath of SARS as important lessons for pandemic influenza planning.

One of the main limitations of our positions, and most pandemic plans and guidance, is the lack of direct evidence regarding HCW protection during pandemic influenza. Evidence is generally extrapolated from data collected during seasonal and avian influenza outbreaks. We have used existing plans and guidelines as the primary evidence base for our positions. These documents seldom explicitly state their methodology or evidence base.

Given this lack of evidence and the uncertainty still surrounding pandemic influenza, we found that the precautionary principle was often referred to when discussing recommendations and in the development of these positions. This lends itself to positions that are most beneficial, or protective, from the HCW perspective.

This, however, is not a perfect or unbiased approach. We believe that these positions, especially for the controversial topics of antiviral prophylaxis and N95 respirator use, would benefit from a systematic approach that considers the many perspectives found in the healthcare environment. Although it is out of the scope of this paper, we are investigating the possibility of formulating recommendations based on the well-validated Grading of Recommendations Assessment, Development and Evaluation (GRADE) system.[36] The GRADE system provides a system for rating quality of evidence and strength of recommendations with consideration of varying outcomes and perspectives that is explicit, comprehensive, transparent, and pragmatic and is increasingly being adopted by organisations worldwide.[37]

Conclusion

The recommendations provided by pandemic plans demonstrated significant variation, especially regarding N95 or surgical mask use, PPE, and antiviral prophylaxis. The guidelines released during the H1N1 pandemic updated these recommendations, and evolved as more became known about the course of the pandemic, but remained variable across countries. This may reflect the findings that there is little direct evidence in the literature regarding pandemic influenza.

These position statements represent the committee's belief of what is best practice to protect HCWs during pandemic influenza. The positions are founded upon a wide base of recommendations from provincial, national, and international bodies, and reflect the synthesis of a large amount of information. We considered the precautionary principle as a deciding factor in the face of incomplete knowledge and conflicting recommendations, as well as approaches from the field of Knowledge Translation to consider the feasibility and applicability of each position.

The current 2009 H1N1 pandemic has highlighted the need for greater guidance in HCW protection and the lack of this in existing pandemic plans. This is currently being treated as a “mild” pandemic with low severity. There is growing concern among infectious disease experts and policy makers that the potential impact of H1N1 is being underestimated as comparable to seasonal influenza. There are data to suggest that H1N1 is associated with higher attack rates, mortality, and transmission, as well as affecting a higher proportion of healthy, young adults than seasonal influenza. It is acknowledged that we cannot accurately predict the progress of this pandemic and the potential increase in pathogenicity. Ongoing pandemic planning, therefore, must aim at being prepared for the worst possible outcome—we must plan for maximal HCW protection.

This is well translated in the recent paper by Lipsitch et al noting:

> *“Moreover, several other factors suggest that it is premature to dismiss concerns about severity.”*[28]

And in the address of the US HHS, Secretary of the HHS Kathleen Sebelius stated at a recent US pandemic summit that:

> *“The virus hasn't gone away, and we have not let up, this summit is not about stoking fears. It is about being prepared. We have to avoid complacency, and we have to be prepared for what the fall brings.... The overwhelming take home message of the day was that everyone should work now as though the situation this fall will be a worse case scenario. If we learned the flu is not as severe as feared, we can step back from our plan. What we can't do is wait until October and suddenly decide we have a crisis on our hands.”*[38]

This has been echoed by expert opinions in Canada, stating *“We should prepare for the worst and hope for the best.”*[39]

The committee believes that application of these safe positions would contribute to improving HCW protection during even severe influenza pandemic by addressing all levels of the hierarchy of controls, with an emphasis of individual staff protection at the front-line. This would have many beneficial effects, not least ensuring HCWs are available to meet the anticipated increase in workload.

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Glossary of Terms

Term	Definition
Aerosol-generating procedure	Procedure that is likely to generate aerosolised particles, including cardiopulmonary resuscitation, intubation, suction, bronchoscopy, and nebulisation
Case	A suspected, probable, or confirmed case of the pandemic strain
Close contact	Prolonged or repeated contact within 2 metres of a case during the case's contagious period
High risk of complications	Individuals in the following groups: • Children younger than 5 years old. The risk for severe complications from seasonal influenza is highest among children younger than 2 years old • Adults 65 years of age and older • Persons with the following conditions: — Chronic pulmonary (including asthma), cardiovascular (except hypertension), renal, hepatic, hematological (including sickle cell disease), neurologic, neuromuscular, or metabolic disorders (including diabetes mellitus) — Immunosuppression, including that caused by medications or by HIV — Pregnant women — Persons younger than 19 years of age who are receiving long-term aspirin therapy — Morbid obesity
High risk of exposure	Individuals constantly exposed to the pandemic strain or performing multiple aerosol-generating procedures on pandemic cases
Influenza-like illness (ILI)	Defined as a fever (temperature of 37.8°C [100°F] or greater) and a cough and/or a sore throat in the absence of a known cause other than influenza
Outbreak	The confirmation of 2 or more nosocomial infections among residents/patients within a 10-day period
Unprotected exposure	Close contact where the HCW was not wearing appropriate personal protective equipment (PPE), or where the PPE failed

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Appendix I. Healthcare Worker Concerns Survey

Introduction

In the instance of an influenza pandemic, a substantial increase in demand for healthcare services is anticipated. To meet this demand all healthcare workers (HCWs) and resources will be required to be available in full force. It is also recognised that HCWs caring for ill patients on the front-line will be particularly at risk. Their presence, however, is essential to maintain an adequate level of services not only for influenza patients, but for all other patients as well. It is crucial, therefore, to assess HCWs' concerns that might have an impact their likelihood to work during an influenza pandemic so that strategies can be developed to mitigate these risks and optimise our workforce in the instance of pandemic influenza.

Methods

Selection of studies

A literature review was conducted to identify studies on HCWs' perceptions on potential pandemic situations and outbreaks of contagious diseases, like sudden acute respiratory syndrome (SARS) or smallpox. A combination of different keywords (including very specific keywords such as SARS and avian flu, and broader keywords including influenza, pandemic, and outbreak) was used to identify 137 recently published potentially relevant studies (2008 (n = 42), in 2007 (n = 35) and 2006 (n = 19)). Further review of these studies identified 57 studies focusing specifically on our subject of interest.

Selection of questionnaires

From these 57 studies, 10 actual questionnaires were available in 11 studies: 3 were on SARS,[1-4] 2 on avian influenza,[5,6] 1 on influenza pandemic,[7] 1 on absenteeism during a pandemic,[8] 1 on vaccination against influenza,[9] 1 on mass casualty incidents involving an unknown virus,[10] and 1 on EMS providers' attitude during a pandemic.[11]

Selection of questions

The selection of questions relevant to HCW protection in pandemic influenza was made from 5 of the 10 questionnaires:

- 17 questions from a survey regarding pandemic influenza[7]
- 7 questions from a self-administrated questionnaire on avian influenza[5]
- 2 questions from a survey on absenteeism in HCWs during a pandemic[8]
- 1 question from a questionnaire on risk perception and vaccination[9]
- 1 question from a questionnaire on EMS providers' attitude during a pandemic[11]

Questions were written in English and translated to French.

Study population

During the week of May 18th 2009, a convenience sample of 123 emergency physicians and 32 emergency medicine residents from 3 regions within the province of Quebec (Montreal, Quebec City, Laval) were contacted through electronic emergency departments' listserv services or via direct email (when available) and invited to complete a web version of a questionnaire on HCW concerns in case of an influenza pandemic (hosted by www.surveygizmo.com) before June 5th 2009. The same exercise was conducted with a convenient sample of nurses, respiratory therapists, and pharmacists during the week of June 15th 2009. These participants were invited to complete the online questionnaire before June 26th 2009.

Results

Questionnaire Content

Twenty-eight questions from 5 different questionnaires were retained for the final version of the survey. These were grouped into 4 categories that correspond to the hierarchy of controls:

1. Individual Staff Protection
    1. Personal Protective Equipment
    2. Antiviral Prophylaxis
    3. Vaccination
2. Administrative Controls
    1. Early Identification and Assessment
    2. Patient Education
    3. Health Care Provider Education and Safe Work Practices
    4. Personnel Management
3. Engineering Controls – Infrastructural Biocontainment
4. Other
    1. Attitude toward coping with risk
    2. Work-related and not work-related concerns
    3. Willingness to come to work

Responses

Overall, 46% of responses came from emergency physicians (n = 56), 26% from nurses (n = 32), 11% from pharmacists (n = 14), 10% from respiratory therapists (n = 12), and 7% from emergency medicine residents (n = 8). Respondents were mainly from Montreal (83%), 62% were female, and they were mainly aged between 30 to 49 years old (68%) (Table 1).

Table 1: Sociodemographic variables of questionnaire responders

Variable	Physicians/ residents	Nurses	Pharmacists	Respiratory therapists	Total (%)
Sample size	64	32	14	12	122
Region					
Montreal	48	28	13	11	**100** (83%)
Quebec City	11	2	—	—	**13** (11%)
Laval	4	1	—	—	**5** (4%)
Montérégie	—	1	—	1	**2** (2%)
Gender					
Male	35	4	5	2	**46** (38%)
Female	28	28	8	10	**74** (62%)
Age					
< 25 years	1	3	1	1	**6** (5%)
25–29 years	7	8	7	2	**24** (20%)
30–39 years	30	13	4	5	**52** (43%)
40–49 years	19	7	1	4	**31** (25%)
50–59 years	7	1	1	—	**9** (7%)
≥ 60 years	—	—	—	—	**0** (0%)

1. Individual Staff Protection

Three categories of individual staff protection were targeted in the survey: antiviral prophylaxis, vaccination, and personal protective equipment (PPE).

1.1 Masks, Respirators, and Personal Protective Equipment (PPE)

Questions regarding 5 different modes of PPE were included in our questionnaire: N95 respirator, surgical mask, gloves, eye protection and face shield, and gowns. While almost all of the respondents (98%) agree that N95 respirator will be useful in protecting them in case of influenza pandemic, only 59% believe that surgical mask will protect them. Almost all of the respondents agree that gloves, goggles, and gowns will be useful in protecting them in case of influenza pandemic (gloves = 96%; goggles = 95%; gowns = 92%).

		Strongly agree	**Agree**	**Disagree**	**Strongly disagree**
Do you believe that **N95 mask** will be useful in protecting you in case of an influenza pandemic?	MD/Res.	44	19	1	—
	Nurse	23	7	1	1
	Pharmacist	9	5	—	—
	Respiratory therapist	10	2	—	—
	Total (%)	**86** (71%)	**33** (27%)	**2** (2%)	**1** (1%)
Do you believe that **surgical mask** will be useful in protecting you in case of an influenza pandemic?	MD/Res.	5	24	22	12
	Nurse	13	13	3	3
	Pharmacist	6	3	3	2
	Respiratory therapist	2	5	3	1
	Total (%)	**26** (21%)	**45** (38%)	**31** (26%)	**18** (15%)
Do you believe that **gloves** will be useful in protecting you in case of an influenza pandemic?	MD/Res.	35	27	2	—
	Nurse	25	6	—	1
	Pharmacist	10	3	1	—
	Respiratory therapist	11	—	1	—

	Total (%)	**81** (66%)	**36** (30%)	**4** (3%)	**1** (1%)
Do you believe that **goggles** will be useful in protecting you in case of an influenza pandemic?	MD/Res.	33	29	2	—
	Nurse	18	12	—	2
	Pharmacist	9	4	1	—
	Respiratory therapist	10	1	1	—
	Total (%)	**70** (57%)	**46** (38%)	**4** (3%)	**2** (2%)
Do you believe that **gowns** will be useful in protecting you in case of an influenza pandemic?	MD/Res.	28	30	5	—
	Nurse	21	9	—	2
	Pharmacist	9	2	2	—
	Respiratory therapist	9	2	1	—
	Total (%)	**67** (56%)	**43** (36%)	**8** (7%)	**2** (2%)

1.2 Antiviral Prophylaxis

Two questions were on antiviral prophylaxis. Less than 59%of the respondents agree that antiviral drugs given pre-exposure will be useful in protecting them in case of influenza pandemic, while 89% agree that antiviral drugs given postexposure will be protective.

		Strongly agree	**Agree**	**Disagree**	**Strongly disagree**
Do you believe that antiviral drugs – **pre-exposure** will be useful in protecting you in case of an influenza pandemic?	MD/Res.	9	25	28	2
	Nurse	5	16	10	1
	Pharmacist	56	4	4	—
	Respiratory therapist	5	2	4	1
	Total (%)	**25** (20%)	**47** (39%)	**46** (38%)	**4** (3%)

Do you believe that antiviral drugs – **post-exposure** will be useful in protecting you in case of an influenza pandemic?	MD/Res.	20	36	7	—
	Nurse	12	14	4	2
	Pharmacist	11	2	1	—
	Respiratory therapist	10	2	—	—
	Total (%)	**53** (44%)	**54** (45%)	**12** (10%)	**2** (2%)

1.3 Vaccination

Three questions were on the topic of vaccination. Almost all workplaces recommend annual vaccination to their staff (98%), 60% of the respondents mentioned that they always get vaccinated against seasonal influenza and 61% were vaccinated this year.

		Yes	**No**	**Don't know**
Does your workplace recommend annual vaccination for staff?	MD/Res.	64	—	—
	Nurse	31	1	—
	Pharmacist	13	—	1
	Respiratory therapist	12	—	—
	Total (%)	**120** (98%)	**1** (1%)	**1** (1%)
		Always	**Sometimes**	**Never**
Do you generally get vaccinated against seasonal influenza?	MD/Res.	51	10	3
	Nurse	13	10	9
	Pharmacist	6	5	3
	Respiratory therapist	3	4	5
	Total (%)	**73** (60%)	**29** (23%)	**20** (17%)

		Yes	No
Have you received a seasonal influenza vaccination this year?	MD/Res.	51	13
	Nurse	14	18
	Pharmacist	7	7
	Respiratory therapist	3	9
	Total (%)	**75** (61%)	**47** (39%)

2. Administrative Controls

Three types of administrative controls were investigated in the survey: early identification and assessment, patient education, and healthcare provider education and safe work practices.

2.1 Early Identification and Assessment

Ninety four percent of respondents agreed that pre-triage will be useful in protecting them in case of an influenza pandemic.

		Strongly agree	Agree	Disagree	Strongly disagree
Do you believe that **pre-triage** will be useful in protecting you in case of an influenza pandemic?	MD/Res.	31	29	2	—
	Nurse	16	12	2	2
	Pharmacist	n/a	n/a	n/a	n/a
	Respiratory therapist	8	4	—	—
	Total (%)	**55** (52%)	**45** (42%)	**4** (4%)	**2** (2%)

2.2 Patient Education

Two questions focused on patient education. Almost all of the respondents agree that limiting visitors (95%) and hand washing (98%) will protect them in case of an influenza pandemic.

		Strongly agree	Agree	Disagree	Strongly disagree
Do you believe that **limiting visitors** will be useful in protecting you in case of an influenza pandemic?	MD/Res.	39	23	1	1
	Nurse	20	7	2	2
	Pharmacist	n/a	n/a	n/a	n/a
	Respiratory therapist	9	3	—	—
	Total (%)	**68** (64%)	**33** (31%)	**3** (3%)	**3** (3%)
Do you believe that **hand washing** will be useful in protecting you in case of an influenza pandemic?	MD/Res.	55	8	1	—
	Nurse	25	5	—	1
	Pharmacist	11	3	—	—
	Respiratory therapist	11	1	—	—
	Total (%)	**102** (84%)	**17** (14%)	**1** (1%)	**1** (1%)

2.3 HCW Education and Safe Work Practices

Three questions explore HCW education and safe work practices. Seventy-six percent (76%) of respondents evaluate the training they received for using PPE (in case of a pandemic) as very adequate or adequate, and 68% reported that their workplace provides special training in case of an influenza pandemic. However 5% of the respondents never received training for using PPE. Finally, 71% of the respondents have someone to turn to if they have problem in using PPE.

	Very adequate	Adequate	Somewhat adequate	Not adequate	No training provided

Has adequate training been provided to you in the use of personal protective equipment (PPE) (eg, N95 mask, goggles, gloves, etc.) in case of an influenza pandemic?	MD/Res.	13	31	11	4	5
	Nurse	9	19	3	1	—
	Pharmacist	3	7	4	—	—
	Respiratory therapist	3	8	—	—	1
	Total (%)	**28** (23%)	**65** (53%)	**18** (15%)	**5** (4%)	**6** (5%)

		Yes	**No**	**Don't know**
Does your workplace provide special training in case of an influenza pandemic?	MD/Res.	35	18	11
	Nurse	26	5	1
	Pharmacist	11	1	2
	Respiratory therapist	11	1	—
	Total (%)	**83** (68%)	**25** (21%)	**14** (12%)
In case of an influenza pandemic, would you have someone to turn to if you have a problem in using PPE?	MD/Res.	39	4	21
	Nurse	27	2	3
	Pharmacist	10	—	4
	Respiratory therapist	11	1	—
	Total (%)	**87** (71%)	**7** (6%)	**28** (23%)

2.4 Personnel Management

In terms of personnel management, 86% of the respondents reported that their workplace has a preparedness plan in case of an influenza pandemic and 83% responded that their emergency department has a preparedness plan for such an event. Finally, the majority of respondents believe there would not be enough staff to handle an increase of demand due to an influenza pandemic if antiviral drugs were not available as prophylaxis (65%) as well as if antiviral prophylaxis were available (56%).

		Yes	**No**	**Don't know / Not applicable**
Does your workplace (eg, hospital, clinic) have a preparedness plan in case of an influenza pandemic?	MD/Res.	54	1	8
	Nurse	28	1	3
	Pharmacist	12	1	1
	Respiratory therapist	10	1	1
	Total (%)	**104** (86%)	**4** (3%)	**13** (11%)
Does your emergency department have a preparedness plan in case of an influenza pandemic?	MD/Res.	49	2	13
	Nurse	30	—	1
	Pharmacist	n/a	n/a	n/a
	Respiratory therapist	n/a	n/a	n/a
	Total (%)	**79** (83%)	**2** (2%)	**14** (15%)
In case of an influenza pandemic, there would be enough staff at my workplace to handle the increased of demand.				
Without taking antiviral drugs as prophylaxis	MD/Res.	9	44	11
	Nurse	1	23	8

	Pharmacist	2	4	8
	Respiratory therapist	—	8	4
	Total (%)	**12** (10%)	**79** (65%)	**31** (25%)
After taking antiviral drugs as prophylaxis	MD/Res.	10	37	16
	Nurse	3	21	8
	Pharmacist	4	3	7
	Respiratory therapist	2	7	3
	Total (%)	**19** (16%)	**68** (56%)	**34** (28%)

3. Engineering Controls – Infrastructural Biocontainment

Two questions were about isolation areas. Overall, almost all emergency departments represented in our survey (93%) have designated areas for isolating patients in case of an influenza pandemic, and respondents agree that these areas are useful in protect them in case of a influenza pandemic (99%).

		Strongly agree	**Agree**	**Disagree**	**Strongly disagree**
Do you believe that **isolation areas** will be useful in protecting you in case of an influenza pandemic?	MD/Res.	35	28	1	—
	Nurse	17	14	—	1
	Pharmacist	11	3	—	—
	Respiratory therapist	9	3	—	—
	Total (%)	**72** (59%)	**48** (40%)	**1** (1%)	**1** (1%)

		Yes	**No**	**Don't know**
Does your workplace have	MD/Res.	59	4	1

designated areas for isolating patients in case of an influenza pandemic?	Nurse	32	—	—
	Pharmacist	11	1	2
	Respiratory therapist	12	—	—
	Total (%)	**114** (93%)	**5** (3%)	**3** (3%)

Other

Three others areas were also covered in the survey: attitude toward coping with risk, work-related and non–work-related concerns, and willingness to come to work

Attitude toward coping with risk

When asked about work attendance if there was a greater risk than usual of infecting their family, 67% of the respondents reported they would likely continue working without taking antiviral drugs as prophylaxis. This rose to 88% if prophylaxis were available. When asked if they would work if there was a greater risk than usual of becoming sick themselves, 60% of the respondents reported they were likely to work without antiviral prophylaxis. With antiviral prophylaxis, 83% reported they were likely to work.

		Very likely	**Likely**	**Unlikely**	**Very unlikely**
In case of an influenza pandemic, how likely is it that you would work if there was a greater risk than usual of infecting your family?					
Without taking antiviral drugs as prophylaxis	MD/Res.	17	31	12	4
	Nurse	6	15	5	6
	Pharmacist	1	7	2	4
	Respiratory therapist	1	4	3	4
	Total (%)	**25** (20%)	**57** (47%)	**22** (18%)	**18** (15%)
After taking antiviral drugs as prophylaxis	MD/Res.	30	29	3	1
	Nurse	11	15	2	4

	Pharmacist	5	6	3	—
	Respiratory therapist	4	7	1	—
	Total (%)	**50** (41%)	**57** (47%)	**9** (7%)	**5** (4%)
		Very likely	**Likely**	**Unlikely**	**Very unlikely**
In case of an influenza pandemic, how likely is it that you would work if there was a greater risk than usual of becoming infected at work and falling ill yourself?					
Without taking antiviral drugs as prophylaxis	MD/Res.	18	29	13	4
	Nurse	3	15	7	7
	Pharmacist	2	2	8	2
	Respiratory therapist	—	4	4	4
	Total (%)	**23** (19%)	**50** (41%)	**32** (26%)	**17** (14%)
After taking antiviral drugs as prophylaxis	MD/Res.	26	35	2	1
	Nurse	8	13	7	4
	Pharmacist	1	10	2	1
	Respiratory therapist	2	7	3	—
	Total (%)	**37** (31%)	**65** (53%)	**14** (12%)	**6** (5%)

Work-related and non–work-related concerns

In the instance of an influenza pandemic, respondents believe the general public may avoid them because of their work if they were taking antivirals as prophylaxis (49%) or not taking antiviral prophylaxis (63%). Respondents expect higher levels of stress during a pandemic with (67%) or without prophylaxis (73%). Finally, respondents believed there would be more conflict amongst colleagues during a pandemic. This was similar if antiviral prophylaxis were available (46%) or not (52%).

		Strongly agree	Agree	Disagree	Strongly disagree
In case of an influenza pandemic, people may avoid me because of the nature of my work.					
Without taking antiviral drugs as prophylaxis	MD/Res.	16	28	18	2
	Nurse	2	12	14	4
	Pharmacist	4	5	5	—
	Respiratory therapist	7	2	2	1
	Total (%)	**29** (24%)	**47** (39%)	**39** (32%)	**7** (6%)
After taking antiviral drugs as prophylaxis	MD/Res.	13	24	24	3
	Nurse	—	9	18	5
	Pharmacist	1	6	6	1
	Respiratory therapist	1	6	4	1
	Total (%)	**15** (12%)	**45** (37%)	**52** (43%)	**10** (8%)
In case of an influenza pandemic, I would feel more stressed at work.					
Without taking antiviral drugs as prophylaxis	MD/Res.	25	31	8	—
	Nurse	9	7	12	4
	Pharmacist	5	4	5	—
	Respiratory therapist	6	2	3	1
	Total (%)	**45** (37%)	**44** (36%)	**28** (23%)	**5** (4%)
After taking antiviral drugs as prophylaxis	MD/Res.	14	37	13	—
	Nurse	7	9	11	5
	Pharmacist	—	8	5	1

	Respiratory therapist	1	5	5	1
	Total (%)	**22** (18%)	**59** (49%)	**34** (28%)	**7** (6%)
In case of an influenza pandemic, there would be more conflict amongst colleagues at work.					
Without taking antiviral drugs as prophylaxis	MD/Res.	16	26	21	1
	Nurse	2	8	18	4
	Pharmacist	3	5	4	2
	Respiratory therapist	1	3	7	1
	Total (%)	**22** (18%)	**42** (34%)	**50** (41%)	**8** (7%)
After taking antiviral drugs as prophylaxis	MD/Res.	10	30	23	1
	Nurse	—	7	20	5
	Pharmacist	2	5	6	1
	Respiratory therapist	—	3	7	2
	Total (%)	**12** (10%)	**45** (37%)	**56** (46%)	**9** (7%)

Willingness to come to work

In regards to remaining on duty to treat/care for patients infected with the virus, during an influenza pandemic, 11% of the respondents would refuse without taking antiviral prophylaxis but only 2% would refuse after taking prophylaxis. Finally, respondents agreed to accept additional duties or work more hours more after taking antiviral prophylaxis (62%) than without taking prophylaxis (44%).

		Yes	**Maybe**	**No**
In case of an influenza pandemic, would you remain on duty to treat/care for patients infected with the virus?				
Without taking antiviral drugs as prophylaxis	MD/Res.	39	19	6
	Nurse	21	6	5

	Pharmacist	3	8	3
	Respiratory therapist	4	7	1
	Total (%)	**67** (56%)	**40** (34%)	**13** (11%)
After taking antiviral drugs as prophylaxis	MD/Res.	55	7	—
	Nurse	25	5	2
	Pharmacist	7	7	—
	Respiratory therapist	10	2	—
	Total (%)	**97** (81%)	**21** (18%)	**2** (2%)

		Very likely	**Likely**	**Unlikely**	**Very unlikely**
In case of an influenza pandemic, how likely is it that you would work if you were asked to take on additional work/duties or work more hours?					
Without taking antiviral drugs as prophylaxis	MD/Res.	10	25	18	11
	Nurse	3	9	12	8
	Pharmacist	1	3	8	2
	Respiratory therapist	—	3	3	6
	Total (%)	**14** (11%)	**40** (33%)	**41** (34%)	**27** (22%)
After taking antiviral drugs as prophylaxis	MD/Res.	16	32	11	5
	Nurse	3	11	11	7
	Pharmacist	1	7	5	1
	Respiratory therapist	1	4	5	2
	Total (%)	**21** (18%)	**54** (45%)	**32** (27%)	**14** (12%)

Conclusion

The objective of this exercise was to survey 4 groups of HCWs about their main concerns in case of an influenza pandemic with regard to their personal safety. Topics explored were grouped into 4 categories: individual staff protection, administrative controls, engineering controls, and other factors.

- **Individual staff protection:** In general, HCWs believe that postexposure antiviral prophylaxis, more so than pre-exposure, will be useful in protecting them. Physicians tend to get vaccinated annually more than other groups of HCWs, but only 61% of HCWs reported being vaccinated for the current year. Finally, HCWs agreed that PPE will be useful in protecting them in case of an influenza pandemic. The exception to this is the surgical mask, which more respondents, especially physicians, did not believe would provide adequate protection.
- **Administrative controls:** Respondents were almost unanimous on the fact that pre-triage, limiting visitors, and hand washing will be useful in protecting them during an influenza pandemic. In terms of training, a majority of respondents agreed that they received adequate training for using PPE, that they have someone to turn to if they have problem in using PPE, and that special training in case of an influenza pandemic was provided. Finally, although most workplaces were reported to have a preparedness plan, respondents believed there would not be enough staff in case of an influenza pandemic.
- **Engineering controls:** Almost all emergency departments represented in our survey have designated areas for isolating patients in case of an influenza pandemic and respondents agree that these areas will be useful in protecting them.
- **Other:** In general, respondents reported that they expect to feel more stressed at work during an influenza pandemic, as well as social avoidance because of their work. The majority of respondents, however, still reported they would continue working even if there was a greater risk than usual of infecting their family or becoming sick themselves. They reported that they would remain on duty to treat/care for patients infected with pandemic influenza with or without taking antiviral prophylaxis.

This preliminary survey was planned prior to the onset of the 2009 influenza A(H1N1) pandemic, but was distributed during the initial stages. The outbreak was at pandemic phase 5 (pre-pandemic) when physicians and residents were invited to respond. By the time nurses, respiratory therapists, and pharmacists were invited to respond, phase 6 pandemic had been declared. Although we believe this would heighten awareness and consideration of these issues among HCWs, we do not expect this environment would lead to misleading results.

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Appendix II. Guidelines Reviewed

We reviewed a total of 24 pandemic planning guidelines and documents from 5 countries and the World Health Organization (WHO). These included national and provincial pandemic influenza plans, infection control and clinical guidelines, and reviews of the evidence for certain topics (Table 8). These documents were developed prior to the outbreak of the H1N1 pandemic.

Table 8: Guidelines and documents reviewed

Year	Document type	Document
Canada		
2006	National plan	Centre for Infectious Diseases Prevention and Control (CIDPC). The Canadian Pandemic Influenza Plan for the Health Sector. Ottawa, Canada; 2006.
2006	Provincial plan	Santé et Services Sociaux Québec. Plan Québécois de lutte à une Pandémie d'Influenza - Mission Santé. Québec, Canada; 2006.
2006	Hospital network plan	Toronto Academic Health Services Network (TAHSN). Toronto Academic Health Services Network: Pandemic Influenza Planning Guidelines.; 2006.
2007	Evidence review	Pan-Canadian Public Health Network. Pan-Canadian Public Health Network Council Report And Policy Recommendations on the Use of Antivirals for Prophylaxis During an Influenza Pandemic. Canada; 2007.
2007	Evidence review	The Expert Panel on Influenza and Personal Protective Respiratory Equipment. Influenza Transmission and the Role of Personal Protective Respiratory Equipment: An Assessment of the Evidence. Ottawa, Canada: Council of Canadian Academies; 2007.
2008	Provincial plan	Ministry of Health and Long Term Care. Ontario Health Plan for an Influenza Pandemic. Toronto, Canada; 2008.
2009	National plan update	Centre for Infectious Diseases Prevention and Control (CIDPC). The Canadian Pandemic Influenza Plan for the Health Sector: Annex E The Use of Antiviral Drugs During a Pandemic. Ottawa, Canada; 2009.
USA		
2005	National plan	U.S. Department of Health and Human Services. HHS Pandemic Influenza Plan.; 2005.
2006	Position paper	American College of Physicians. The Health Care Response to Pandemic Influenza: Position Paper. Philadelphia, PA: (Available from American College of Physicians, 190 N. Independence Mall West, Philadelphia, PA 19106.); 2006.
2006	National guidelines	Centers for Disease Control and Prevention. Interim Guidance on Planning for the Use of Surgical Masks and Respirators in Health Care Settings during an Influenza Pandemic.; 2006.

Year	Document type	Document
2008	National plan (seasonal flu)	U.S. Department of Health and Human Services Centres for Disease Control and Prevention. Prevention and Control of Influenza: Recommendations of the Advisory Committee on Immunization Practices (ACIP).; 2008.
2008	Evidence review	Goldfrank L, Liverman C. Preparing for an Influenza Pandemic: Personal Protective Equipment for Healthcare Workers.; 2008.
2009	National plan	U.S. Department of Health and Human Services. Guidance on Antiviral Drug Use during an Influenza Pandemic.; 2009.
WHO		
2005	Global plan	World Health Organization. WHO Global Influenza Preparedness Plan: The role of WHO and recommendations for national measures before and during pandemics.; 2005.
2005	Global plan	World Health Organization. WHO Checklist for Influenza Pandemic Preparedness Planning.; 2005.
2005	Global plan	World Health Organization. Clarification: Use of masks by health-care workers in pandemic settings.; 2005.
2006	Evidence review	World Health Organization: Health Evidence Network. How effective would antiviral vaccination and antiviral drug prevention and treatment strategies be for reducing the impact of the next influenza pandemic?; 2006.
2009	Global plan update	World Health Organization. Pandemic Influenza Preparedness and Response. Geneva, Switzerland: World Health Organization; 2009
UK		
2007	National plan	Department of Health. Pandemic Flu: A National Framework for Responding to an Influenza Pandemic. London, UK; 2007.
2007	National guidelines	Department of Health. Pandemic Influenza: Guidance for Infection Control in Hospitals and Primary Care Settings.; 2007.
Australia		
2006	National guidelines	Australia: Department of Health and Ageing. Interim Infection Control Guidelines for Pandemic Influenza in Healthcare and Community Settings.; 2006.
2006	National guidelines	Australia: Department of Health and Ageing. Interim National Pandemic Influenza Clinical Guidelines: Annex to Australian Health Management Plan for Pandemic Influenza. Canberra, Australia; 2006.
2008	National plan	Australia: Department of Health and Ageing. Australian Health Management Plan for Pandemic Influenza: Important Information for All Australians. Canberra, Australia; 2008.

Year	Document type	Document
France		
2007	National plan	Secréteriat General de la Défense Nationale. Plan National de Prévention et de Lutte Pandémie Grippale. France; 2007.

Canada

The Canadian Pandemic Influenza Plan for the Health Sector (2006)

The Canadian Pandemic Influenza Plan for the Health Sector maps out how the health sector can prepare for and respond to pandemic influenza in Canada.[3]

Methodology

The Canadian Pandemic Influenza Plan for the Health Sector is the product of extensive dialogue and collaboration within the Pandemic Influenza Committee (PIC). Created in 2001, PIC consists of 15 voting members, including representatives from all provinces and territories. Expertise within PIC includes Chief Medical Officers of Health, epidemiologists, virologists, communicable disease specialists, clinical, public health, and laboratory specialists, and an ethicist. Committee members, in turn, have been greatly assisted through a process of consultation with a wider group of stakeholders, including the health non-government organisation community, local governments, emergency planners, and bioethicists.[3]

This guideline categorises the evidence, and quality of the evidence to support provided recommendations (Table 9), but does not cite specific references.

Table 9: Level of evidence categorisation used in the Canadian Pandemic Plan[3]

Categories evaluating the strength of each recommendation:	
A:	Good evidence to support a recommendation for or against use
B:	Moderate evidence to support a recommendation for or against use
C:	Insufficient evidence to support a recommendation for or against use
Categories evaluating the quality of the evidence:	
I:	Evidence from at least 1 properly randomized, controlled trial.
II:	Evidence from at least 1 well-designed clinical trial without randomization; from cohort or case-controlled analytic studies, preferably from more than one centre, from multiple time series; or from dramatic results in uncontrolled experiments.
III:	Evidence from opinions of respected authorities on the basis of clinical experience, descriptive studies, or reports of expert committees.

Plan Québécois de Lutte à une Pandémie d'Influenza - Mission Santé (2006)

The Plan Québécois de Lutte à une Pandémie d'Influenza describes the problem of an influenza pandemic and its potential impacts on the health and social services and society. It provides the broad

pathways for healthcare planning, and establishes the basic principles of assistance, through a series of strategies and activities at the provincial level. It is expected that regional and institutional bodies can use this framework to produce specific pandemic plans. The plan will guide health and social services in the implementation of pandemic plans based on the roles and responsibilities that they perform, and act as a reference guide to affiliated organisations.[43]

This plan does not contain specific recommendations, but lays out a framework of collaboration and communication and defines responsibilities for specific planning activities.[43]

Methodology

The methodology used to develop this plan is not clearly stated.

Toronto Academic Health Services Network: Pandemic Influenza Planning Guidelines (2006)

Toronto Academic Health Sciences Network: Pandemic Influenza Planning Guidelines is a planning guideline that has been drafted as a collaborative effort to promote greater coordination among the hospitals in Toronto in the event of a pandemic.[44]

Methodology

These guidelines were developed by the TAHSN Pandemic Taskforce. The TAHSN comprises the University of Toronto (health faculties and schools), and 9 fully-affiliated teaching hospitals and their research units. Its steering committee consists of 30 members, as well as a number of sub-committee members with diverse roles (HCW and administration) from each hospital. This project stemmed from the 2003 Toronto SARS outbreak.[44]

Pan-Canadian Public Health Network Council Report And Policy Recommendations on the Use of Antivirals for Prophylaxis During an Influenza Pandemic (2007)

The Pan-Canadian Public Health Network Council (PHNC) Report and Policy Recommendations on the Use of Antivirals for Prophylaxis During an Influenza Pandemic outlines Canada's population-based, multi-faceted strategy for health sector preparation and response to an influenza pandemic. It has several components, such as surveillance, public health measures, immunisation with a pandemic vaccine, public communications, care of the sick, and the use of antivirals for treatment.[45]

Methodology

The Task Group on Antivirals for Prophylaxis (TGAP) was established by the PHNC to create a national policy recommendation on the provision of prophylactic antivirals for use during an influenza pandemic.[45] Members of TGAP represent public health, emergency management, aboriginal health, communications, policy, legal services, and ethics viewpoints. TGAP was mandated to:[45]

1. Review scientific evidence and other key considerations related to antivirals and their use for prophylaxis

2. Carry out public consultation by examining the views and priorities of Canadian, including target groups and stakeholders
3. Carry out a review of groups for whom antivirals might be considered for prophylaxis
4. From this, draw recommendations for use of antivirals during an influenza pandemic

Influenza Transmission and the Role of Personal Protective Respiratory Equipment: An Assessment of the Evidence (2007)

This guideline was requested as input to the working group Annex F of the Canadian Pandemic Influenza Plan.[46]

Methodology

This report was prepared for the Government of Canada in response to a request from the Public Health Agency of Canada (PHAC). PHAC charged 2 questions to be addressed by the Council of Canadian Academies (CCA). They were 1) how and where are seasonal and pandemic influenza transmitted based on reviews and original literature, and 2) based on the conclusion, what is the assessment of the contribution of N95 respirators or surgical masks in the prevention of transmission. The expert panel consisting of 13 members compiled relevant reviews and combined bibliographies in order to establish a pool for evaluation. This pool was then refined throughout the assessment process as information was obtained from expert witnesses, conference proceedings, and individual interviews. The panel also canvassed the views of several experts. The panel drew conclusions from the evidence as to the potential contribution of surgical masks and N95 respirators to the prevention of influenza transmission.[46]

Ontario Health Plan for an Influenza Pandemic (2008)

The Ontario Health Pandemic Influenza Plan is a document designed to guide planning at both the provincial and local levels across the province of Ontario, Canada. It describes the response of the healthcare system to a pandemic, and provides information to guide local pandemic planning groups.[47]

Methodology

The development of this guideline was managed and coordinated by the Emergency Management Unit of the Ontario Ministry of Health and Long-Term Care. The steering committee established to oversee health planning for an influenza pandemic includes representatives from emergency management, public health, laboratories, the healthcare delivery system, labour associations, and regulatory colleges.[47]

The Canadian Pandemic Influenza Plan for the Health Sector: Annex E The Use of Antiviral Drugs During a Pandemic (2009)

This document serves as an update to Annex E of the Canadian Pandemic Influenza Plan for the Health Sector on the use of antiviral drugs during a pandemic. It was developed to provide information and further recommendations for pandemic planners regarding development and implementation of antiviral strategies. The recommendations provided were developed to facilitate execution of the

national antiviral strategy, with an emphasis on integrating emerging epidemiology and other data. This update contains specific, notable changes to the previous version.[48]

Methodology

These recommendations were developed by the Antiviral Working Group of the Pandemic Influenza Committee (PIC).[48] It is presumed that the methodology utilised for this annex is similar, if not identical, to that followed in development of The Canadian Plan for the Health Sector (2006).

United States of America

HHS Pandemic Influenza Plan (2005)

The U.S. Department of Health and Human Service (HHS) Pandemic Influenza Plan serves as a blueprint for all HHS pandemic influenza preparedness and response planning. This document consists of Part 1: The Strategic Plan, and Part 2: Public Health Guidance for State and Local Partners.[49]

Methodology

The methodology used to develop this plan is not clearly stated.

The Health Care Response to Pandemic Influenza: Position Paper (2006)

The American College of Physicians (ACP) published this position paper based on issues raised in the HHS plan that explicitly or implicitly call for the involvement of physicians.[50]

Methodology

This paper was developed for the Health and Public Policy Committee of the American College of Physicians.[50] The methodology is not clearly stated.

Interim Guidance on Planning for the Use of Surgical Masks and Respirators in Health Care Settings during an Influenza Pandemic (2006)

This document is an adjunct to the HHS plan, and synthesises traditional infection control and industrial hygiene approaches to enhancing protection of healthcare personnel during an influenza pandemic.[51]

Methodology

The methodology for the development of this guidance is not clearly stated.

Prevention and Control of Influenza: Recommendations of the Advisory Committee on Immunization Practices (ACIP) (2008)

This report updates the 2007 recommendations by CDC Advisory Committee on Immunization Practices (ACIP) regarding the use of influenza vaccine and antiviral agents for seasonal influenza.[52]

Methodology

This guideline was developed by the CDC's Advisory Committee on Immunization Practices (ACIP). Members of the group meet monthly, and bring experience from a number backgrounds regarding influenza. Published, peer-reviewed studies are the primary source of data used by ACIP in making recommendations for the prevention and control of influenza, but unpublished data may also be considered.[52]

Preparing for an Influenza Pandemic: Personal Protective Equipment for Healthcare Workers (2008)

This textbook was developed in order to address very specific concerns and questions relating to PPE for healthcare workers in the event of pandemic influenza. It offers several suggestions throughout and potential future considerations.[12]

Methodology

The methodology for the development of this textbook is not clearly stated.

Guidance on Antiviral Drug Use during an Influenza Pandemic (2009)

The guidance in this document replaces the recommendations developed in 2005 which are published as part of the HHS pandemic influenza plan. Increased antiviral drug production capacity and evidence of potential benefits with prophylactic antiviral use have resulted in changes in antiviral strategy to embrace greater use of prophylaxis.[53]

Methodology

HHS convened a federal interagency group that included representatives from federal agencies and obtained input from state and local public health experts. In its deliberations, the working group considered the national goals of a pandemic response, results of scientific studies on the effectiveness of antiviral treatment and prophylaxis for seasonal influenza infections, treatment for H5N1 avian influenza infections, surveillance data and studies of antiviral resistance, results of mathematical modelling of antiviral drug and non-pharmaceutical interventions, perspectives of state, local, and tribal health officials, and public values and ethical principles. The potential impacts of antiviral treatment and postexposure prophylaxis in households of persons with pandemic influenza disease were estimated using a mathematical model.[53]

World Health Organization

WHO Global Influenza Preparedness Plan: The Role of WHO and Recommendations for National Measures Before and During Pandemics (2005)

This guideline provides no direct recommendations for the healthcare setting, and is primarily focused on actions taken by the WHO and national governments.

Methodology

The methodology for the development of this guidance is not clearly stated.

WHO Checklist for Influenza Pandemic Preparedness Planning (2005)

This is a checklist for the WHO guidelines.

Methodology

The methodology for the development of this guidance is not clearly stated.

Clarification: Use of Masks by Healthcare Workers in Pandemic Settings (2005)

This addendum was developed to clarify mask usage by healthcare workers exposed to potentially infected individuals.[56]

Methodology

The methodology for the development of this addendum is not stated.

How effective would antiviral vaccination and antiviral drug prevention and treatment strategies be for reducing the impact of the next influenza pandemic? (2006)

This is a synthesis report on the potential effectiveness of antiviral vaccination and antiviral drug use for prevention and treatment for reducing the impact of an influenza pandemic. It serves as a summary of existing information and evidence related to influenza pandemics that may be of use to policy makers.[57]

Methodology

This report is a commissioned work, written by 3 members of The Lewin Group (a healthcare policy research and management consulting firm), initiated and coordinated by the WHO Regional Office for Europe. It has been reviewed by the Health Evidence Network (HEN) Team. It is based on evidence from systematic review, narrative reviews, epidemiological and other observational studies, modelling and related analyses (based in part on clinical or epidemiological evidence), practice guidelines, other guidance and policy documents from national and international health agencies, and recent news reports.[57]

Pandemic Influenza Preparedness and Response (2009)

This guideline serves as an update to WHO Global Influenza Preparedness Plan: The role of WHO and recommendations for national measures before and during pandemics (2005). Recommendations in this guideline are focused on actions taken by federal bodies, and by the WHO. This guideline contains changes that embody overall pandemic planning, phase regrouping, and assumptions made.[58]

Methodology

The information and recommendations contained in this guidance is the product of expert opinion, derived from several international consultations which included examination of available information and modelling studies, input from public health experts on lessons learned from SARS, and both animal and human influenza responses, and consolidation of recommendations in existing WHO guidance.[58]

United Kingdom

Pandemic Flu: A National Framework for Responding to an Influenza Pandemic (2007)

This document sets out the UK Government's strategic aims for responding to an influenza pandemic and provides background information and guidance to public and private organisations developing response plans.[59]

Methodology

This framework is supported by an evidence base that undergoes continual review and update. This evidence base is obtained from the Pandemic Influenza Scientific Advisory Group, the Joint Committee on Vaccination and Immunisation, the Advisory Committee on Dangerous Pathogens, the Government's Chief Scientific Adviser, and the Government Office for Science.[59]

Pandemic Influenza: Guidance for Infection Control in Hospitals and Primary Care Settings (2007)

This document was developed to facilitate planning by UK National Health Service (NHS) trusts and provides guidance on infection control and tools for local public health and healthcare officials who are at the frontline in managing and containing an influenza pandemic. It includes detailed sections on preparedness planning, occupational health, infection control precautions and environmental infection control. Additional sections focus separately on issues specific to hospitals and primary care.[60]

Methodology

Several references are provided and specifically cited within this document. However, no clear methodology on the development of the recommendations is stated.

Australia

Interim Infection Control Guidelines for Pandemic Influenza in Healthcare and Community Settings (2006)

This is a set of guidelines that is an annex for the Australian Health Management Plan for Pandemic Influenza (AHMPPI). Its focus is on infection control and public health management principles applicable to the care of patients with suspected or confirmed pandemic influenza and their contacts.[61]

Methodology

These guidelines were developed by experts from an infection control working group of the National Influenza Pandemic Action Committee.[61]

Interim National Pandemic Influenza Clinical Guidelines: Annex to Australian Health Management Plan for Pandemic Influenza (2006)

The Interim National Pandemic Influenza Clinical Guidelines were developed in 2006 as an annex to the main Australian pandemic influenza plan (AHMPPI).[62,63]

Methodology

These clinical guidelines were developed by a 13 member working group representing government, public health, physician (intensive care, internal medicine, infectious disease, respiratory medicine, general practitioners, and emergency medicine), and nursing bodies. The information forming the basis of the guidelines was obtained from the Canadian Pandemic Influenza Plan and the New South Wales Draft Pandemic Influenza Clinical Guidelines.[62]

Australian Health Management Plan for Pandemic Influenza: Important Information for All Australians (2008)

Methodology

The AHMPPI was developed by the Office of Health Protection in the Department of Health and Ageing following extensive consultation and feedback from peak bodies, advisory groups, and eminent experts in pandemic influenza.[63]

France

Plan National de Prévention et de Lutte Pandémie Grippale (2007)

This document summarises the plans, principles, and provisions of the French pandemic influenza plan, and is an update of the previous plan from 2006.[64] This plan is primarily a planning document, outlining provisions and responsibilities for pandemic preparation.

Methodology

The methodology used to develop this plan is not clearly stated. Pandemic influenza modelling was performed by the Institut de Veille Sanitaire, based on historic pandemic data.[64]

Appendix III. Guideline Recommendations

This appendix contains a comprehensive review of the recommendations from the reviewed pandemic plan guidelines for each category. This does not include guidance arising from the H1N1 pandemic.

1. Individual Staff Protection

1.1 Masks, Respirators, and PAPR

Of the guidelines reviewed, 11 had information relevant to the use of masks, respirators, or PAPRs for healthcare workers (HCWs). Of these, 8 had current recommendations.

Canada

Canadian Pandemic Influenza Plan (2006)

An N95 respirator is recommended for all HCWs in the room during aerosol-generating procedures.[3] No level of evidence or reference is cited for this recommendation.

A surgical mask is recommended when face-to-face with coughing individuals. It is suggested that this is useful during the early phases of the pandemic but not practical or helpful when influenza transmission has entered the community (level of evidence BIII[a]).[3]

Masks should continue to be worn to prevent transmission of other organisms and to protect HCWs from exposure to sprays of blood, body secretion, or excretions (level of evidence BIII).[3]

Expert Panel on Influenza and PPRE (2007)

This document does not include recommendations, but presents a review of the evidence.[46]

Ontario Health Pandemic Influenza Plan (2008)

HCWs should wear an N95 respirator when entering a room with patients with confirmed or suspected influenza during a pandemic and for aerosol-generating procedures. Although N95 respirators are not routinely required for seasonal influenza, this recommendation is in keeping with the precautionary principle. The use of surgical masks is not recommended for HCWs.[47] This recommendation is based upon the evidence presented by the Council of Canadian Academies.[46]

A surgical mask is recommended for use on the patient while in common areas (at triage, outside patient room).[47]

USA

CDC Interim Guidance on Mask and Respirator Use in Pandemic Influenza (2006)

The recommendations of this guidance document supersede those relating to mask and respirator use in the HHS Pandemic Influenza Plan.

N95 or better respirators are recommended for use during aerosol-generating procedures, resuscitation, and care for patients with pandemic influenza-associated pneumonia. Other equivalent protection (eg, PAPR) should be used if N95 respirators are not available.[51]

a Levels of evidence used in the Canadian Pandemic Influenza Plan are outlined in Appendix II.

It is considered prudent to wear an N95 respirator for other direct-care activities for patients with confirmed or suspected pandemic influenza. If N95 respirators are not available, a surgical mask should be used.[51]

It is likely that during a pandemic, there will be a shortage of masks. Mask usage should be prioritised to high-risk people and procedures, whilst not denying usage for important tasks. Alternative methods (eg, barriers/enclosures) should be considered where possible.[51]

These recommendations are based on a review of the existing evidence, but no levels of evidence or references are directly cited to support these recommendations.

HHS Pandemic Influenza Plan (2005)

An N95 respirator should be worn by HCWs during aerosol-generating procedures. Single-use disposable surgical masks should be worn when entering a patient room and for close contact with infectious patients.[49]

An N95 respirator may also be indicated for strains of influenza exhibiting increased transmissibility during the initial stages of an outbreak.[49]

No levels of evidence or references are cited for these recommendations.

Goldfrank et al PPRE Review (2008)

According to the CDC 2006 interim guidelines for an influenza pandemic,[51] N95 respirators are recommended for HCWs caring for patients with confirmed or suspected influenza or in situations, such as bronchoscopy or resuscitation, that are likely to generate infectious respiratory aerosols.[12]

WHO

WHO Clarification: Use of Masks by HCWS in Pandemic Settings (2005)

The use of an N95 respirator is recommended for HCWs when a patient is undergoing an aerosol-generating procedure. A surgical or procedural mask is recommended for close contact and when entering the room of an infectious patient.[56]

These recommendations are cited to be based on evidence of transmission modes, but no levels of evidence or references are cited.

UK

National Framework for Responding to an Influenza Pandemic (2007)

The use of an FFP3 (N99) respirator is recommended when carrying out clinical procedures likely to generate aerosols of respiratory secretions from infected patients. Ideally these procedures would be avoided where possible.[59]

Fluid-repellent surgical masks should be worn by HCWs who may be in close and/or frequent contact with symptomatic patients.[59]

No levels of evidence or references are directly cited for these recommendations.

Guidance for Infection Control (2007)

The highest level of protection—an FFP3 (N99) respirator or, if unavailable, an FFP2 (N95) respirator—should be worn by HCWs when performing aerosol-generating procedures. Other types of respiratory protective equipment (eg, PAPR) should be considered if available and a good fit cannot be achieved with a disposable respirator.[60]

A fluid-repellent surgical mask should be worn by HCWs for any close contact with patients.[60]

No levels of evidence or references are directly cited for these recommendations.

Australia

Infection Control Guidelines (2006)

The use of an N95 (P2) mask is recommended for close contact with patients and for aerosol-generating procedures. If there is a shortage of N95 respirators, or an N95 respirator is not available, a surgical mask should be used for close contact and N95 respirator use prioritised for aerosol-generating procedures. If a good seal cannot be achieved with an N95 respirator, PAPR should be used after adequate training.[61]

Surgical masks are recommended when entering patient rooms where there is no close contact.[61]

The use of a surgical mask for symptomatic persons in common areas (eg, in waiting rooms) or when being transported (eg, by ambulance) should be promoted.[61]

No levels of evidence or references are directly cited for these recommendations.

France

National Pandemic Influenza Plan (2007)

The use of N95 respirators is prioritised for people, notably HCWs, in close and repetitive contact with infected patients or their biological samples.[64] No specific recommendations are made for aerosol-generating procedures.

Infected patients should wear a mask while in public areas.[64]

No levels of evidence or references are cited for these recommendations.

National Pandemic Influenza Plan (2009)

This update of the 2007 plan contains the same recommendation for use of N95 respirators by HCWs.[65,133]

No levels of evidence or references are cited for these recommendations.

Summary of Recommendations

There is agreement across the guidelines that a respirator of at least 95% efficiency (N95) is recommended for HCWs during aerosol-generating procedures. Guidelines from the UK go further and recommend N99 standard respirators for these situations. Where an appropriate respirator (N95 or N99) is not available, or a good fit cannot be achieved, the use of a PAPR is recommended.

There is equal distribution between recommendations for N95 respirators and surgical masks for close contact with patients with confirmed or suspected pandemic influenza. Canada, the WHO, and the UK recommend the use of a standard surgical or procedural mask, whereas Ontario, the USA, Australia, and France recommend the use of an N95 respirator.

Where there is a shortage of N95 respirators, the guidelines agree that their use should be prioritised to aerosol-generating procedures. In this circumstance, surgical masks may be worn for close contact.

There is limited evidence on the efficacy of mask and respirator use, and these recommendations are predominantly based upon the expected modes of transmission of pandemic influenza given what is known about seasonal and avian strains.

Recommended mask use	General care / close contact	Aerosol-generating
Standard surgical or procedural mask	4 (Canada, WHO, UK)	
N95 respirator	4 (Ontario, USA, Australia, France)	5 (Canada, Ontario, USA, WHO, Australia)
N99 respirator		2 (UK)
No recommendation		1 (France)

Country	Guideline	General care /close contact	Aerosol-generating	Evidence
Canada	Canadian Pandemic Influenza Plan (2006)	– Surgical mask should be used when face-to-face with a coughing patient	– An N95 respirator is recommended for all HCWs in the room	Level BIII (surgical mask use)
	Expert Panel on Influenza and PPRE (2007)	– No recommendations; review of the evidence	– No recommendations; review of the evidence	
	Ontario Health Plan for Influenza Pandemic (2008)	– HCWs should wear an N95 respirator when entering a room with patients with confirmed or suspected influenza during a pandemic	– HCWs should wear an N95 respirator for aerosol-generating procedures on patients with confirmed or suspected influenza during a pandemic	CCA review cited
USA	Interim Guidance on Mask and Respirator Use in Pandemic Influenza (2006)	– It is prudent to wear an N95 respirator – Surgical mask may be worn if N95 unavailable	– N95 respirator required – Equivalent protection (eg, PAPR) if N95 unavailable	None cited

Country	Guideline	General care /close contact	Aerosol-generating	Evidence
	HHS Pandemic Influenza Plan (2005) *Superseded by Interim Guidance*	– A surgical mask should be worn when entering patients' rooms and for close contact – An N95 respirator may be considered for influenza strains exhibiting increased transmissibility	– An N95 respirator should be worn for aerosol-generating procedures	None cited
	Goldfrank PPRE Review (2008) *Recommendations from Interim Guidance*	– N95 respirators are recommended for healthcare workers in caring for patients with confirmed or suspected influenza	– N95 respirators are recommended for healthcare workers performing aerosol-generating procedures	Interim Guidance document
WHO	Clarification on Mask Use (2005)	– Surgical or procedural mask should be worn for close contact and when entering a patient room	– N95 respirator or equivalent should be considered	None cited
UK	Pandemic Influenza Plan (2007)	– Fluid-repellent surgical masks should be worn by HCWs	– A FFP3 (N99) mask should be worn	None cited
	Infection Control Guidance (2007)	– Fluid-repellent surgical masks should be worn by HCWs	– A FFP3 (N99) mask should be worn – FFP2 (N95) should be used if FFP3 unavailable – PAPR should be considered if adequate fit not achieved with respirator	None cited
Australia	Interim National Pandemic Influenza Clinical Guidelines (2006)	– N95 (P2) mask or PAPR is recommended – If not available, a surgical mask should be used	– N95 (P2) mask or PAPR is recommended	None cited
France	Pandemic Influenza Plan (2007)	– N95 respirators are prioritised for use by HCWs in close, repeated contact with infected patients	– No recommendations are made	None cited
	Pandemic Influenza Plan (2007)	– N95s are recommended for HCWs for all contact with sick patients	– No recommendations are made	None cited

1.2 Gloves, Gowns, and Eye Protection

Seven guidelines had recommendations on the use of gloves, gowns, and eye protection.

Canada

Canadian Pandemic Influenza Plan (2006)

Gloves. Gloves are not required for routine care of suspected or confirmed influenza patients (AIII[a]). They should be worn to provide an additional protective barrier to reduce the potential transfer of microorganisms from infected patients to HCWs and vice-versa (AII). Gloves are necessary for HCWs with open lesions on their hands when providing direct patient care (AII). They should not be used as a substitute for hand hygiene (BII), and are not be reused or washed (AII). Recommendations are supported mainly by good evidence.[3]

Gowns. Gowns are not required for routine care of patients suspected or confirmed to have influenza (AI). Long-sleeved gowns should only be used to protect uncovered skin and prevent soiling of clothes during procedures (BIII). HCWs should ensure any open skin areas/lesions are covered with a dry dressing and intact skin contaminated should be washed immediately (BIII). Recommendations are supported by good or moderate evidence.[3]

Eyewear. Eye protection or face shields should be worn to prevent HCW exposure to sprays of blood, body secretions or excretions (BIII). Recommendations are supported by moderate evidence.[3]

Ontario Health Pandemic Influenza Plan (2008)

Gloves. Gloves are to be worn when there is a risk of hand contact with blood, body fluids, secretions, excretions, non-intact skin, mucous membranes or contaminated surfaces or objects. Wearing gloves is not a substitute for hand hygiene. Hand hygiene should be performed after removing gloves.[47,134]

Gowns. Wear a long-sleeved gown if contamination of uniform or clothing is anticipated.[47,134]

Eyewear. Protect eyes during procedures and care activities likely to generate splashes or sprays of blood, body fluids, secretions or excretions, or during aerosol-generating procedures.[47,134]

USA

HHS Pandemic Influenza Plan (2005)

Gloves. A single pair of patient-care gloves should be worn for contact with blood and body fluids, including during hand contact with respiratory secretions. Gloves are single-use only. In times of short supply, glove use may need to be prioritised. Hand hygiene remains important.[49]

Gowns. Wear an isolation gown, if soiling of personal clothes or uniform with a patient's blood or body fluids, including respiratory secretions, is anticipated, or during procedures that involving holding the patient closely.[49]

Eyewear. In general, wearing goggles or a face shield for routine contact with patients with pandemic influenza is not necessary. If sprays or splatter of infectious material is likely, goggles or a face shield should be worn as recommended for standard precautions.[49]

a Levels of evidence used in the Canadian Pandemic Influenza Plan are outlined in Appendix II.

Goldfrank PPE for Healthcare workers (2008)

Gloves. Use for contact with blood, body fluids, secretions, excretions, and contaminated items and for touching mucous membranes and non-intact skin; perform hand hygiene after removing gloves and between patient contacts. This document cites evidence for efficacy in prevention of bloodborne illness, but does not cite evidence for efficacy in influenza.[12]

Gowns. Use during procedures and patient care activities when contact of clothing or exposed skin with blood or body fluids, secretions, or excretions is anticipated. No references are presented regarding the efficacy of gowns in preventing influenza transmission.[12]

Eyewear. Use during procedures and patient care activities likely to generate splash or spray of blood, body fluids, secretions, or excretions. This paper notes that there is no data regarding influenza transmission via contact with conjunctiva. This recommendation is made in line with standard practices.[12]

UK

National Framework for Responding to an Influenza Pandemic (2007)

Gloves. If close contact with an influenza-infected patient is considered inevitable or highly likely, health workers should adopt sensible barrier precautions in addition to face masks. Disposable protective equipment, such as aprons and gloves, provide a physical barrier and help avoid spreading contamination.[59]

Gowns. If close contact with an influenza-infected patient is considered inevitable or highly likely, health workers should adopt sensible barrier precautions in addition to face masks. Disposable protective equipment, such as aprons and gloves, provide a physical barrier and help avoid spreading contamination.[59]

Eyewear. Eye protection (preferably disposable) may be necessary when carrying out aerosol-generating procedures or if risk assessment indicates that it is necessary.[59]

Infection control in hospitals & primary care (2007)

Gloves. Gloves are not required for the routine care of patients with pandemic influenza. Gloves are to be worn for invasive procedures, when in contact with sterile sites, non-intact skin and mucous membranes is expected, for all activities that carry a risk of exposure to blood, body fluids, secretions (including respiratory secretions), and excretions, and when handling sharp or contaminated instruments.[60]

Gowns. Disposable plastic aprons should be worn whenever there is a risk of personal clothes or a uniform coming into contact with a patient's blood, body fluids, secretions or excretions, or during activities that involve close contact with the patient. HCW should wear gowns if they anticipate extensive soiling of their personal clothing or uniform with respiratory secretions, or if there is risk of extensive splashing of blood, body fluids, secretions or excretions onto their skin.[60]

Eyewear. Eye protection should always be worn during aerosol-generating procedures. Eye protection should be considered when there is a risk of contamination of the eyes by splashes and droplets, including blood, body fluids, secretions or excretions.[60]

This document lists references, but does not directly cite them to support the recommendations.

Australia

AHMPPI Infection Control Guidelines (2006)

Gloves. Gloves are to be worn when in close patient contact (< 1 metre), and during any aerosol-generating procedures. They should always be replaced between different patient contacts, and never replace the need for hand hygiene.[61]

Gowns. Gowns are to be worn when in close patient contact (<1 metre), and also when aerosol-generating procedures are being performed. During procedures that may generate aerosols, the use of a disposable fluid-repellent, long-sleeved gown is necessary. Gowns are essential when soiling of clothes is anticipated. Gowns should be worn only once, hand hygiene remains important. Any cleaners who have to enter the room of an infectious patient should wear a gown.[61]

Eyewear. In general, wearing goggles or a face shield for routine contact with patients with pandemic influenza is not necessary. Eyewear is to be worn if there is close patient contact (< 1 metre), and body fluid exposure is anticipated, and during aerosol-generating procedures. These items should be removed and decontaminated between patient uses.[61]

This document lists references, but does not directly cite them to support the recommendations.

Summary of Recommendations

Country	Guideline	Recommendation		Evidence
Canada	Canadian Pandemic Influenza Plan (2006)	Gloves	Gloves are not required for routine care of suspected/confirmed influenza patients. They should be worn to provide an additional protective barrier to reduce the potential transfer of microorganisms from infected patients to HCWs and vice versa.	Supported by AIII & AII evidence
		Gowns	Gowns are not required for routine care of suspected/confirmed influenza patients. Long sleeved gowns should only be used to protect uncovered skin and prevent soiling of clothes during procedures.	Supported by AI & BII evidence
		Eyewear	Eye protection, or face shields should be worn to prevent HCW exposure to sprays of blood, body secretions, or excretions.	Supported by BIII evidence
	Ontario Health Plan for Influenza Pandemic (2008)	Gloves	Gloves are to be worn when there is a risk of hand contact with blood, body fluids, secretions, excretions, non-intact skin, mucous membranes, or contaminated surfaces or objects.	None cited
		Gowns	Wear a long-sleeved gown if contamination of uniform or clothing is anticipated.	
		Eyewear	Protect eyes during procedures and care activities likely to generate splashes or sprays of blood, body fluids, secretions or excretions, or during aerosol-generating procedures.	

Country	Guideline	Recommendation		Evidence
USA	HHS Pandemic Influenza Plan (2005)	Gloves	A single pair of patient care gloves should be worn for contact with blood and body fluids, including during hand contact with respiratory secretions.	None cited
		Gowns	Wear an isolation gown if soiling of personal clothes or uniform with a patient's blood or body fluids, including respiratory secretions, is anticipated, or during procedures that involving holding the patient closely.	
		Eyewear	In general, wearing goggles or a face shield for routine contact with patients with pandemic influenza is not necessary. If sprays or splatter of infectious material is likely, goggles or a face shield should be worn as recommended for standard precautions.	
	Goldfrank PPE for Healthcare workers (2008)	Gloves	Use for contact with blood, body fluids, secretions, excretions, and contaminated items and for touching mucous membranes and non-intact skin.	Evidence from Siegel et al., 2007
		Gowns	Use during procedures and patient care activities when contact of clothing or exposed skin with blood or body fluids, secretions, or excretions is anticipated.	
		Eyewear	Use during procedures and patient care activities likely to generate splash or spray of blood, body fluids, secretions, or excretions.	
UK	National Framework for Responding to an Influenza Pandemic (2007)	Gloves	Disposable protective equipment, such as aprons and gloves, provide a physical barrier and help avoid spreading contamination.	None cited
		Gowns	Disposable protective equipment, such as aprons and gloves, provide a physical barrier and help avoid spreading contamination.	
		Eyewear	Eye protection may be necessary when carrying out aerosol-generating procedures or if risk assessment indicates that it is necessary.	
	UK infection control in hospitals & PCS (2007)	Gloves	Gloves are not required for the routine care of patients with pandemic influenza. Gloves are to be worn for invasive procedures, when in contact with sterile sites, non-intact skin and mucous membranes, for all activities that carry a risk of exposure to blood, body fluids, secretions (including respiratory secretions), and excretions, and when handling sharp or contaminated instruments.	Reference list, not specifically cited

Country	Guideline	Recommendation		Evidence
		Gowns	Disposable plastic aprons should be worn whenever there is a risk of personal clothes or a uniform coming into contact with a patient's blood, body fluids, secretions or excretions or during activities that involve close contact with the patient.	
		Eyewear	Eye protection should always be worn during aerosol-generating procedures. Eye protection should be considered when there is a risk of contamination of the eyes by splashes and droplets.	
Australia	AHMPPI, Infection Control Guidelines (2006)	Gloves	Gloves are to be worn when in close patient contact (< 1 metre), and during any aerosol-generating procedures.	Reference list, not specifically cited
		Gowns	Gowns are to be worn when in close patient contact (< 1 metre), and during aerosol-generating procedures, when soiling of clothes is anticipated.	
		Eyewear	Eyewear is to be worn if there is close patient contact (< 1 metre), and body fluid exposure is anticipated, and during aerosol-generating procedures.	

1.3 Antiviral Prophylaxis

Fourteen of the guidelines reviewed had recommendations relevant to the use of antiviral prophylaxis for healthcare workers (HCWs). Two of these are updates of previous guidelines also included, and replace the recommendations from these.

Canada

Canadian Pandemic Influenza Plan (2006)

These recommendations have been replaced by the 2009 update of Annex E of the Canadian Pandemic Influenza Plan, described on the next page.

Although recognised as a potential contributor to minimising the impact of pandemic influenza, there is no clear recommendation on the use of antivirals for long-term prophylaxis.

This guideline recognises that antiviral prophylaxis for HCWs and some other groups could help minimise serious illness and death, as well as societal disruption, during pandemic flu. Prophylaxis of HCWs could help keep the healthcare workforce in place at a time of greatly increased need and help maintain an effective early treatment strategy for the general public. Although the use of infection control precautions and PPE may result in no increased risk for HCWs at work, they remain at risk in the community. An infected HCW has the potential to transmit the virus to vulnerable patients.[3]

Conversely, prophylaxis requires far greater amounts of antivirals than a strategy centred on treatment, and the recommended use of the National Antiviral Stockpile is for treatment only. Implementation of a prophylaxis strategy has several challenges, including identification of eligible personnel, the need to adjust timing to local epidemiology, compliance, potential for drug diversion (eg, to family members), and the requirement for off-label use of the drug (in the case of zanamivir).[3]

This document specifies that a national process is underway to inform prophylaxis policy recommendations.[3] This process resulted in the May 12 update of Annex E shown below.

No evidence or references are cited for these recommendations.

Canadian Pandemic Influenza Plan for the Health Sector; Annex E Update (2009)

This update of Annex E of the Canadian Pandemic Plan includes recommendations of antiviral prophylaxis based on the PHNC and Task Group on Antiviral Prophylaxis (TGAP) report on recommendations for antiviral prophylaxis. There are no recommendations specific for the use of antivirals for prophylaxis in HCWs. This update recommends:[48,45]

- During phases 4 & 5 (pandemic alert):
  - — Postexposure prophylaxis of close contacts of persons with novel virus infection, and for early treatment of cases with novel virus infection
- During phase 6 (pandemic period):
  - — Focus on early treatment of cases with no postexposure prophylaxis of close contacts
  - — Provide rapid access to antivirals and early treatment to critical infrastructure workers (includes HCWs[48]) to minimise societal disruption
  - — Use antivirals for outbreak control, including treatment of cases and postexposure prophylaxis of close contacts of cases (residents, staff, volunteers and others who provide services in these

facilities) in closed healthcare facilities (long-term care facilities and hospitals) and other closed facilities where high-risk people reside[48,45]

— No use of antivirals from government stockpiles for pre-exposure prophylaxis

PHNC Report and Recommendations on Antiviral Prophylaxis (2007)

This guideline recommends the use of antivirals from the National Antiviral Stockpile for early treatment and postexposure prophylaxis (pandemic phases 4 and 5), and for early treatment when the pandemic becomes widespread (phase 6). In phase 6, antivirals may also be used for prophylaxis for outbreak control in closed facilities in which people at high risk of poor outcomes reside.[45] These recommendations are population-based and not specific to HCWs.

The rationale for cessation of postexposure prophylaxis in phase 6 is the likely widespread distribution of disease and contacts, and limited benefits to the population.[45] Treatment of cases and postexposure prophylaxis of contacts in closed healthcare facilities and other closed facilities in which high-risk persons reside should, however, be continued.[45]

Although there is no clear recommendation for HCWs, this guideline recognises that antiviral prophylaxis may encourage continued work in a high-exposure setting and help reduce the risk of HCWs transmitting influenza to other patients and to their families. There is no clear evidence to indicate that HCWs following appropriate infection control precautions will be at higher risk for illness. It is recognised, however, that the trust of HCWs may be severely compromised if they are *not* provided with prophylactic antivirals, as some existing pandemic plans state or imply that antivirals will be available for prophylaxis.[45] In addition, citizen dialogues performed for this report identified front-line HCWs as the highest priority group to receive antiviral prophylaxis should they be available.[45]

The review infers from adequate, good quality randomized controlled trials (RCT) evidence to support the efficacy of oseltamivir used either as pre- or postexposure prophylaxis against pandemic influenza.[45]

This guideline recommends that governments create an additional national stockpile of antivirals for specific and limited prophylactic use, and that the use of prophylactic antivirals be limited to as few people as necessary to obtain results,[45] but this should not extend to stockpiling for population-based pre-exposure prophylaxis. The rationale for this is inadequate evidence to support efficacy, and a lack of approved drug indication for this use.[45]

This guideline clearly states the rationale for each recommendation. A comprehensive literature review is presented in Annex 3.1.[45] In addition, this document contains a brief review of 8 pandemic influenza guidelines from different countries, including the strategies of each for antiviral use.[45]

Quebec Pandemic Plan (2006)

This plan suggests that the use of postexposure prophylaxis for exposed HCWs should be considered.[43] The plan otherwise states to apply the Canadian recommendations using priority lists maintained by the Public Health Agency of Canada.[43]Antiviral prophylaxis is stated as the only available strategy in the absence of a vaccine, and may be useful to reduce morbidity and maintain services by reducing absenteeism. In the pandemic alert period and at the start of the pandemic, the use of antivirals can contribute to slowing the propagation of isolated cases, reduce the risk of genetic exchange between human and avian strains, and possibly slow the progression or aggressiveness of a pandemic. Antivirals

will not stop transmission and circulation once the virus is in the community. Their use remains limited by a lack of effectiveness evidence in pandemic, the potential development of resistance, adverse reactions, and limited availability. Priority groups for prophylaxis will be determined with regard to recommendations from international, Canadian, and Quebec experts, and based on epidemiological data collection during the pandemic phase.[43]

TAHSN Pandemic Influenza Planning Guidelines (2006)

The TAHSN recommends antiviral prophylaxis for up to 8 weeks for predetermined recipients using oseltamivir as the primary drug of choice, and zanamivir as the secondary choice.[44] It may be possible to continue prophylaxis for up to 12 weeks.[44] The guideline emphasises that controlling the spread of influenza cannot be done only by treating symptomatic cases upon emergence.

Stockpiling sufficient oseltamivir for mass chemoprophylaxis of predetermined recipients for 8 weeks, and the purchase of zanamivir for those unable to tolerate/take oseltamivir is recommended. The TAHSN recommends that M2 inhibitors not be used for pandemic influenza prophylaxis or treatment.[44]

TAHSN cites data from registration studies that indicate benefits of chemoprophylaxis.[44] These benefits include:

- Reduction in the incidence of laboratory-confirmed clinical influenza by 92%
- Reduction in the influence of influenza A and B virus infection
- Reduction in the proportion of subjects shedding the influenza virus
- Reduction in the incidence of clinically diagnosed complications of influenza
- No prevention of the formation of a specific antibody response to influenza infection
- No development of resistance in comparison to old-generation antiviral agents

Expert Panel on Influenza and PPRE (2007)

This guideline does not clearly state any direct recommendation regarding the use of antiviral prophylaxis in HCWs, but assumes that antiviral prophylaxis will form part of pandemic influenza mitigation. Due to the possibility of antiviral resistance, limitations in the size of antiviral stockpiles, and the fact that the prophylactic efficacy of antivirals is less than 100%, other measures need to be considered—this is the focus of this report.[46]

It is stated that the only interventions that have been tried and shown unequivocally to reduce the spread and mitigate the impact of influenza in populations are vaccines and antivirals. Antiviral prophylaxis is an important adjunct to vaccination in the control of seasonal outbreaks of influenza in institutions,[a] and is likely to be used during a pandemic for both treatment and prophylaxis.[46]

Ontario Health Pandemic Influenza Plan (2008)

Antiviral prophylaxis may have a role in maintaining critical services by preventing infection in workers until a vaccine becomes available. This guideline does not include a specific recommendation for HCWs. Oseltamivir is the drug of choice for most people during a pandemic.[47]

a Hota, S., McGeer, A., (2007) "Antivirals and the Control of Influenza Outbreaks". *Clin Infect Dis.*, 45, 1362-1368. Monto, A.S., Rotthoff, J., Teich, E., Herlocher, M.L., Truscon, R., Yen, H.L., Elias, S., Ohmit, S.E., (2004) "Detection and Control of Influenza Outbreaks in Well-vaccinated Nursing Home Populations". *Clinl Infect Dis.*, 39, 459-64.

There is otherwise no evidence that putting large groups of otherwise healthy Canadians on antiviral prophylaxis will slow or stop the spread of a pandemic.[47]

This plan states that Ontario will develop a provincial policy on the use of antivirals for prophylaxis after consideration of the national policy (released as the 2009 Annex E update described above).[47]

No levels of evidence or references are cited.

USA

HHS Pandemic Influenza Plan (2005)

These recommendations have been replaced by the HHS Guidance on Antiviral Drug Use during Influenza Pandemic recommendations shown below.

The HHS Pandemic Influenza Plan recommends the priority use of antivirals for early treatment. Limited use for prophylaxis at peak periods of viral circulation may be considered to preserve the delivery of healthcare and essential services if there is sufficient supply.[49] Healthcare workers in emergency, intensive care units, emergency medical services, and dialysis are prioritised to receive prophylaxis to minimise absenteeism and maintain effective functioning of these units.[49] Antiviral agents should be stockpiled—oseltamivir should be the primary drug (90%) as well as zanamavir in case of resistance (10%).[49]

No level of evidence or references are cited for these recommendations.

ACP Position Paper: The Health Care Response to Pandemic Influenza (2006)

This position paper reflects the recommendations made in the HHS Pandemic Influenza Plan above: treatment, rather than prophylaxis, is the preferred strategy of administering antiviral drugs for all groups except for HCWs in emergency departments, intensive care units, dialysis centres, and emergency medical service providers. The ACP further recommends that all healthcare providers in direct contact with patients be given antiviral medications from the Strategic National Stockpile in amounts sufficient to provide prophylaxis.[50]

HHS Guidance on Antiviral Drug Use During Influenza Pandemic (2009)

These recommendations replace those of the HHS Pandemic Plan and ACP position paper above.

This guidance document recommends the use of a mixed strategy: HCWs and front-line emergency services who have direct high-risk exposures to pandemic influenza patients should receive (pre-exposure) prophylaxis for the duration of community outbreaks, whereas HCWs who do not have regular exposure would be eligible for postexposure prophylaxis.[53]

The recommended strategy is expected to have the benefits of:[53]

- Reduced absenteeism due to illness or fear of becoming infected
- Protects those at highest occupational risk
- Reduces chances of transmitting infection to high-risk patients

If there are limited resources, however, treatment is the priority, as other measures (eg, PPE) can be implemented to protect staff. In this situation, targeted postexposure prophylaxis (eg, following unprotected exposure) should be implemented.[53]

Implementing prophylaxis for HCWs will depend on private sector stockpiling of antiviral drugs. Healthcare organisations should purchase and stockpile sufficient antiviral drug supply to support

recommended antiviral drug use strategies and to plan for effective implementation at the time of a pandemic as part of comprehensive pandemic planning and preparedness. Oseltamivir and zanamavir are recommended for stockpiling (80%:20%).[53]

Some barriers to stockpiling include cost, shelf-life of the drugs, potential for seizure of private sector stockpiles by state health departments, and liability concerns.[53]

This guideline cites references to support the increased exposure of HCWs to influenza,[a] probable reduction in absenteeism with prophylaxis,[b] the effectiveness of prophylaxis,[c] and reduced transmission to patients with staff influenza vaccination.[d]

WHO

Vaccination and Antiviral Prevention and Treatment Strategies (2006)

This report recommends the use of antiviral drugs for prevention in priority groups and initial cases of infected individuals, and continued use of antiviral drugs for prevention and treatment as available, as part of a targeted strategy until a strain-specific vaccine becomes available.[57]

Antiviral stockpiles of neuraminidase inhibitors are likely required to ensure feasibility for a targeted strategy. Despite very limited experience or evidence pertaining to the effectiveness of such a strategy in pandemics, stockpiling of antivirals that remain active against known prevailing influenza viruses is warranted, recognising that emerging viral resistance could render these products ineffective.[57]

The report acknowledges, however, that there is no direct evidence of the effectiveness of antiviral drug prevention and treatment strategies for lowering mortality and morbidity, or for containing or delaying the spread of an influenza pandemic.[57] This report cites indirect data regarding the use of antivirals for influenza treatment and prevention to support this recommendation.[57]

UK

National Framework for Responding to an Influenza Pandemic (2007)

The UK framework recommends that antivirals be used for early treatment of confirmed cases, with only limited use for prophylaxis to contain initial outbreaks. As a pandemic develops, this strategy should move toward a treatment-only approach.[59] No specific recommendation regarding the provision of antiviral prophylaxis to HCWs is included.

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a Elder AG, O'Donnell B, McCruden EAB, et al. Incidence and recall of influenza in a cohort of Glasgow healthcare workers during the 1993-4 epidemic: results of serum testing and questionnaire. *BMJ* 1996;313:1241-2.
Kawana A, Teruya K, Kirikae T, et al. Syndromic surveillance within a hospital for the early detection of a nosocomial outbreak of acute respiratory illness. *Jpn J Infect Dis* 2006;59:377-9

b Balicer RD, Omer SB, Varnett DJ, Everly GS Jr. Local public health workers' perceptions toward responding to an influenza pandemic. *BMC Public Health* 2006;6:99. www.biomedcentral.com/14712458/6/99

c LaForce C, Man CY, Henderson FW, et al. Efficacy and safety of inhaled zanamivir in the prevention of influenza in community-dwelling high-risk adult and adolescent subjects: a 28-day, multicenter, randomized, double-blind, placebo-controlled trial. *Clin Therapeutics* 2007;29:1579-90.
Monto AS, Robinson DP, Herlocher ML, Hinson JM Jr, Elliott MJ, Crisp A. Zanamivir in the prevention of influenza among healthy adults: a randomized controlled trial. *JAMA* 1999;281:31-35.

d Salgado CD, Giannetta ET, Hayden FG, Farr BM. Preventing nosocomial influenza by improving the vaccine acceptance rate of clinicians. *Inf Cont Hosp Epidemiol* 2004;25:923-8.
Carman WF, Elder AG, Wallace LA, et al. Effects of influenza vaccination of healthcare workers on mortality of elderly people in long-term care: a randomized controlled trial. *Lancet* 2000;355:93-7.

The rationale for this approach is that a prophylaxis strategy would consume large numbers of treatment courses and still leave those treated susceptible to infection as soon as they stopped taking the medicine. Therefore, apart from attempts to contain initial spread, general prophylaxis is not currently regarded as an effective or practical response strategy. Targeted postexposure prophylaxis is suggested to also mitigate and delay the progress of a pandemic, but would also consume large amounts of antivirals.[59]

This framework cites theoretical modelling that supports the use of widespread prophylaxis to contain initial outbreaks.[59] No other levels of evidence or references are cited.

Australia

Interim National Pandemic Influenza Clinical Guidelines (2006)

This guideline suggests that during a pandemic, it may be necessary to provide long-term prophylaxis to those at frequent high risk of exposure or in particular occupations.[62] No further definition of this group is offered. It notes that long-term prophylaxis for seasonal influenza (eg, for occupational exposure or high risk) has been used for 4–6 weeks; the safety, tolerability, and efficacy of longer term prophylaxis is unknown.

In addition, the guideline recommends the use of postexposure antiviral prophylaxis for contacts of an index case, ideally after laboratory confirmation. Prophylaxis may be commenced prior to confirmation if the public health authorities suggest an aggressive approach to contain the virus.[62]

This guideline recommends the use of neuraminidase inhibitors for postexposure prophylaxis, unless susceptibility to M2 inhibitors has been demonstrated. Prophylaxis should begin within the incubation period (7 days), and continue for 10 days.[62]

No level of evidence or references are cited for these recommendations.

France

National Pandemic Influenza Plan (2007)

These recommendations have been replaced by the 2009 update of this document.

This plan's antiviral strategy is for early treatment, but postexposure prophylaxis could be offered to HCWs. Antiviral prophylaxis is considered if there is sufficient supply and it is indicated by the Ministère de la Santé. These situations include control of an affected area, protection of household members, or HCWs exposed without adequate protection.[64]

No level of evidence or references are cited.

National Pandemic Influenza Plan (2009)

These recommendations replace those of the 2007 plan.

This plan recommends the use of antiviral medications for treatment, but foresee the possibility of using prophylaxis for containment of early outbreaks and for HCWs who had unprotected exposure.[65] Pre-exposure prophylaxis of HCWs in addition to PPE would be considered in phase 5B—pandemic alert with initial outbreaks equivalent to the start of phase 6 pandemic within France[65]—if approved on a region-by-region basis by the Ministère de la Santé, once significant circulation of the novel virus is detected in the community.[100]

No level of evidence or references are cited.

Discussion

Long-term, pre-exposure antiviral prophylaxis for HCWs during outbreaks of pandemic influenza is recommended by 4 of the 14 guidelines that contain relevant recommendations (Toronto, USA, WHO, and Australia). Four of these guidelines currently recommend a strategy of postexposure prophylaxis (PHNC, Quebec, UK, and France) and 1 a strategy of early treatment (Canada, for phase 6). Two guidelines which recommended a postexposure prophylaxis strategy[49,50] have now been replaced by the most recent guideline advocating pre-exposure prophylaxis.[53] Two guidelines do not clearly state a recommendation on this topic, although 1 of these works on the assumption antiviral prophylaxis will form part of the pandemic influenza strategy,[46] and the other could be interpreted as recommending a potential role for antiviral prophylaxis for HCWs to maintain critical services.[47]

Neuraminidase inhibitors—specifically oseltamivir, unless resistance is demonstrated—are the preferred agents for prophylaxis. Development of virus resistance has rendered M2 inhibitors ineffective as prophylaxis.

Guidelines that recommend a strategy of postexposure prophylaxis and early treatment cite the limited supply of antiviral agents as one of the major determinants.

The evidence base of these guidelines is sparse since there is a lack of direct evidence for antiviral prophylaxis in pandemic influenza. Indirect data on efficacy and benefits from seasonal influenza and theoretical modelling are provided as supporting data in some guidelines, although many are not explicit with supporting evidence, nor even the methodology used to arrive at the recommendations.

Summary of Recommendations

Primary antiviral strategy for HCWs	Number of guidelines
Pre-exposure prophylaxis for duration of outbreak*	TAHSN, HHS, WHO, Australia, France**
Postexposure prophylaxis	Quebec, PHNC, UK
No prophylaxis; early treatment only	Canada†
Not clearly stated	OHPIP, CCA Expert Panel

*Assuming HCWs are high priority to receive prophylaxis.

** Pre-exposure prophylaxis would be considered for HCWs in phase 5B if approved by the Ministère de la Santé once significant circulation of the novel virus is detected.

† The updated Canadian Pandemic Plan recommends the use of antivirals for postexposure prophylaxis during phases 4 and 5, and a strategy of treatment and outbreak control during phase 6.

Country	Strategy	Guideline	Recommendation	Evidence
Canada	No prophylaxis (replaced)	Canadian Pandemic Influenza Plan (2006)	Although recognised as a potential contributor to minimising the impact of pandemic influenza, the use of antivirals for long-term prophylaxis is not clearly recommended due to limited resources.	None cited
	No prophylaxis (in phase 6 pandemic)	Canadian Pandemic Influenza Plan: Annex E Update (2009)	Antivirals are recommended for postexposure prophylaxis only in phases 4 and 5 of a pandemic. During phase 6 antivirals are for treatment only. The National Antiviral Stockpile should not be utilized for the purpose of pre-exposure prophylaxis.	Evidence review from PHNC and TGAP report
	Postexposure	PHNC Report and Recommendations on Antiviral Prophylaxis (2007)	Antivirals from the National Antiviral Stockpile should be used for early treatment and postexposure prophylaxis, and for early treatment when the pandemic becomes widespread. These recommendations are population-based and not specific to HCWs.	Comprehensive review of indirect evidence (seasonal flu)
	Postexposure	Plan Québécois de lutte à une Pandémie d'Influenza - Mission Santé (2006)	Overall, postexposure prophylaxis of HCWs would be considered. This guideline recommends following those of the Public Health Agency of Canada and the Canadian Pandemic Influenza Plan.	None cited
	Pre-exposure	TAHSN Pandemic Influenza Planning Guidelines (2006)	Antiviral prophylaxis for up to 8 weeks for predetermined recipients using oseltamivir or zanamavir.	Reference list, not specifically cited
	Not clearly stated	Expert Panel on Influenza and PPRE (2007)	This guideline does not clearly state any direct recommendation regarding the use of antiviral prophylaxis in HCWs, but assumes that antiviral prophylaxis will form part of pandemic influenza mitigation.	Studies of antiviral prophylaxis in seasonal outbreaks in closed settings

Country	Strategy	Guideline	Recommendation	Evidence
	Not clearly stated	Ontario Health Plan for Influenza Pandemic (2008)	Antiviral prophylaxis may have a role in maintaining critical services by preventing infection in workers in these areas until a vaccine becomes available. This guideline does not include a specific recommendation for HCWs.	None cited
USA	Postexposure (replaced)	HHS Pandemic Influenza Plan (2005)	Priority use of antivirals for early treatment. Limited use for prophylaxis at peak periods of viral circulation may be considered.	None cited
	Postexposure (replaced)	ACP Healthcare Response to HHS Pandemic Influenza Plan (2006)	Reflects HHS recommendation for limited prophylaxis. HCWs should be provided antivirals for prophylaxis from the Strategic National Stockpile.	None cited
	Pre-exposure	HHS Guidance on Antiviral Use (2009)	HCWs who have direct high-risk exposures to pandemic influenza patients should receive prophylaxis for the duration of community outbreaks, whereas HCWs who do not have regular exposure would be eligible for postexposure prophylaxis.	Evidence for effectiveness and indirect evidence for benefits cited
WHO	Pre-exposure	Vaccination and Antiviral Guidelines (2006)	Antiviral drugs for prevention in priority groups and initial cases of infected individuals as part of a targeted strategy until a strain-specific vaccine becomes available.	Indirect data from seasonal and outbreaks of influenza
UK	Postexposure	Pandemic Influenza Plan (2007)	Antivirals use for early treatment of confirmed cases, with only limited use for prophylaxis to contain initial outbreaks.	Theoretical modelling
Australia	Pre-exposure	Interim National Pandemic Influenza Clinical Guidelines (2006)	During a pandemic, it may be necessary to provide long-term prophylaxis to those at frequent high risk of exposure or in particular occupations.	None cited; based on Canadian plan and NSW guidelines
France	Postexposure	Pandemic Influenza Plan (2007)	Early treatment of symptomatic cases, with postexposure prophylaxis for HCWs exposed without adequate protection.	None cited

Country	Strategy	Guideline	Recommendation	Evidence
	Pre-exposure	Pandemic Influenza Plan (2009)	Postexposure prophylaxis for HCWs exposed without adequate protection, with consideration of pre-exposure prophylaxis in phase 5B if approved by the Ministère de la Santé once significant circulation of the novel virus is detected.	None cited

1.4 Vaccination

Ten guidelines had recommendations and information about vaccination of HCWs for pandemic influenza.

Canada

Canadian Pandemic Influenza Plan (2006)

Pandemic vaccine. During the early phases of a pandemic, vaccine will be limited and provided to priority groups. HCWs, and those trainees, volunteers, and others who are recruited to perform the duties of a HCW, are to be one of the priority groups.[3]

PHNC Report and Recommendations on Antiviral Prophylaxis (2007)

Pandemic vaccine. Immunisation with a vaccine is considered to be the most effective public health measure during a pandemic. However, development of a vaccine against a novel influenza virus may take at least 6 months once the virus is identified.[45]

TAHSN Pandemic Influenza Planning Guidelines (2006)

Pandemic vaccine. Hospitals should publicise internally a clear rationale (consistent with government guidelines) for giving priority access to healthcare services, including antiviral and vaccines, to particular groups, such as front-line healthcare workers and those in emergency services. It is likely that the supply of vaccine will be limited during a pandemic and so its distribution will be controlled.[44]

Expert Panel on Influenza and PPRE (2007)

Pandemic vaccine. It is recognised that the most important line of defence against influenza is vaccination, but that other interventions are needed because vaccination will not be 100% effective, and because a vaccine is not likely to be available during the first wave of a pandemic.[46]

Ontario Health Pandemic Influenza Plan (2008)

Pandemic vaccine. During a pandemic, Ontario will use primarily a "pull" strategy to ensure best use of available resources: influenza vaccine will be sent only to public health units, which will organise mass immunisation clinics in various locations in their communities. Other vaccines (eg, essential immunisations) will continue to be administered through current channels.[47]

USA

HHS Pandemic Influenza Plan (2005)

Pandemic vaccine. Medical workers are included in Tier 1A (highest) vaccine priority subgroup. Healthcare workers are required for quality medical care (studies show outcome is associated with staff-to-patient ratios). Facilities should develop a stratification scheme for prioritising vaccination of healthcare personnel who are most critical for patient care and essential personnel to maintain the day-to-day operation of the healthcare facility.[49]

Pre-pandemic vaccine. Healthcare workers should be encouraged to have the seasonal flu vaccine. If stockpiled vaccine of the pandemic subtype is available, work with healthcare partners and other stakeholders to distribute, deliver, and administer vaccines to designated groups.[49]

WHO

Vaccination and Antiviral Prevention and Treatment Strategies (2006)

Pandemic vaccine. Targeted treatment strategies to reduce symptoms and transmission by vaccinating those infected are considered ineffective in comparison to antiviral administration. It takes 2–3 weeks to develop post-vaccination immunity, which is considered too late to reduce the mortality and morbidity of influenza. Although vaccination is the most effective means of preventing influenza, a strain-specific vaccine is unlikely to be available during the initial wave of a pandemic.[57]

As pandemic vaccine becomes available, the literature recommends vaccination with strain-specific vaccine according to priority. This usually starts with essential services workers, including HCWs who treat patients and others in close contact with infected or high-risk groups.[57]

Pre-pandemic vaccine. In the absence of a strain-specific pandemic vaccine, WHO has recommended developing and stockpiling the current H5N1 vaccine along with increased use of the annual inter-pandemic vaccine.[57]

This document mainly comprises a review of the evidence and cites multiple references to support these recommendations.

UK

National Framework for Responding to an Influenza Pandemic (2007)

Pandemic vaccine. The Government is trying to make sufficient supplies of a matching vaccine as soon as it is developed. However, it may take 4–6 months before a matching vaccine is available and evaluated for safety.[59]

Pre-pandemic vaccine. The UK has very limited stocks of an A/H5N1 vaccine purchased specifically for the protection of HCWs. Pre-pandemic vaccination would be initiated based on national and international expert advice and delivery would primarily be the responsibility of employers.[59]

Australia

Interim National Pandemic Influenza Clinical Guidelines (2006)

Pre-pandemic vaccine. It is unknown, but unlikely, that prior human influenza vaccine offers any protection against a pandemic influenza strain.[62]

France

National Pandemic Influenza Plan (2007)

Pre-pandemic vaccine. Seasonal vaccines will likely be ineffective against the pandemic strain. The efficacy of pre-pandemic vaccine should be verified at the beginning of sustained transmission.[64]

Pandemic vaccine. Pandemic vaccine can be developed only after pandemic strain isolation which may take many months. Priority is given to HCWs, those prone to complications because of co-morbidities, and those susceptible to diffuse epidemic.[64]

Summary of Recommendations

Country	Guideline	Recommendation		Evidence
Canada	Canadian Pandemic Influenza Plan (2006)	Pandemic vaccine	HCWs, and those trainees, volunteers, etc. who are recruited to perform the duties of a HCW, are to be one of the priority groups.	Reference list, not specifically cited
	PHNC Report and Recommendations on Antiviral Prophylaxis (2007)	Pandemic vaccine	Immunisation with a vaccine is considered to be the most effective public health measure during a pandemic. However, development of a vaccine against a novel influenza virus may take at least 6 months once the virus is identified.	None cited
	TAHSN Pandemic Influenza Planning Guidelines (2006)	Pandemic vaccine	Hospitals should publicise internally a clear rationale for giving priority access to healthcare services, including antiviral and vaccines, to particular groups, such as front-line health workers and those in emergency services.	None cited
	Expert Panel on Influenza and PPRE (2007)	Pandemic vaccine	It is recognised that the most important line of defence against influenza is vaccination, but that other interventions are needed because vaccination will not be 100% effective, and because a vaccine is not likely to be available during the first wave of a pandemic.	Reference list, not specifically cited
	Ontario Health Plan for Pandemic Influenza (2008)	Pandemic vaccine	Influenza vaccine will be sent only to public health units, which will organize mass immunisation clinics in various locations in their communities.	None cited
USA	HHS Pandemic Influenza Plan (2005)	Pandemic vaccine	Medical workers are included in Tier 1A (highest) vaccine priority subgroup. If stockpiled vaccine of the pandemic subtype is available, work with healthcare partners and other stakeholders to distribute, deliver, and administer vaccines to designated groups.	None cited
WHO	Vaccination and Antiviral Prevention and Treatment Strategies (2006)	Pandemic vaccine	Priority starts with essential services workers, including HCWs who treat patients and others in close contact with infected or high-risk groups. However, a strain-specific vaccine is unlikely to be available during the initial wave of a pandemic.	Supported by evidence

Country	Guideline	Recommendation		Evidence
		Pre-pandemic vaccine	In the absence of a strain-specific pandemic vaccine, WHO has recommended developing and stockpiling the current H5N1 vaccine along with increased use of the annual inter-pandemic vaccine.	
UK	National Framework for Responding to an Influenza Pandemic (2007)	Pandemic vaccine	The UK is trying to make sufficient supplies of a matching vaccine as soon as it is developed. However, it may take 4–6 months before a matching vaccine is available and evaluated for safety.	None cited
		Pre-pandemic vaccine	The UK has very limited stocks of an A/H5N1 vaccine purchased specifically for the protection of HCWs. Pre-pandemic vaccination would be initiated based on expert advice and delivery would primarily be the responsibility of employers.	
Australia	Interim National Pandemic Influenza Clinical Guidelines (2006)	Pre-pandemic vaccine	It is unknown, but unlikely, that prior human influenza vaccine offers any protection against a pandemic influenza strain.	None cited
France	National Pandemic Influenza Plan (2007)	Pandemic vaccine	Pandemic vaccine can be developed only after pandemic strain isolation which may take many months. HCWs are one of the priority groups to have access.	None cited
		Pre-pandemic vaccine	The efficacy of pre-pandemic vaccine should be verified at the beginning of sustained transmission.	

2. Administrative Controls

2.1 Early Identification and Assessment

There were 6 guidelines with recommendations regarding the early identification and assessment of potential cases.

Canada

Canadian Pandemic Influenza Plan (2006)

Triage Settings. The Canadian Pandemic Influenza plan recommends that when Pandemic Phase 2 is declared, triage settings in acute care hospitals are opened.[3] Patients with influenza-like illness (ILI) are to be triaged promptly to a separate designated influenza assessment area onsite, to minimise transmission to others in the waiting room.[3] Non-ILI patients (but requiring acute care assessment) are to be triaged promptly to specific non-ILI waiting and examining areas physically separate from the ILI assessment area to prevent their exposure to ILI.[3]

Prehospital Care. During a pandemic, emergency service workers should adhere to routine infection control practices. PPE and barrier techniques should be used accordingly.[3]

TAHSN Pandemic Influenza Planning Guidelines (2006)

Triage Processes. The TAHSN recommends that both influenza and non-influenza patients are triaged following screening, and that separate areas be designated for triage of each group of patients. TAHSN recommends adopting The Canadian Triage and Acuity Scale (CTAS) to prioritize patients. Infection control and prevention should be applied for patients initially screened to the non-influenza area now being redirected to the influenza area. The TAHSN defines 2 categories of assessment: primary and secondary:

- Primary assessment – may occur outside the hospital setting. It will be performed by an individual with clinical experience. ED should conduct triage and primary assessment using forms and systems in place that capture the necessary information required in a primary influenza assessment. In hospitals, if it is determined that the patient is well enough to be discharged without any further assessment, the patient must still be assessed by a physician prior to discharge. Provide all patients who are sent home with an information package that contains influenza facts, self-care and what to do/who to contact should influenza symptoms develop or worsen.
- Secondary assessment – hospitals should consider maintaining existing assessment forms for secondary assessment or adopt generic patient assessment forms as provided. Investigations not routinely ordered by non-physicians (chest radiographs and nasopharyngeal swabs) may be allowed. If staffing levels and supplies permit, consider establishing alternate locations within the hospital for admitting patients (eg, meeting rooms) if the inpatient units are full.

Hospitals may wish to designate an individual to be responsible for patient flow to the appropriate units. TAHSN further mentions that early in the pandemic, patients with influenza that do or do not meet the MOHLTC case definitions should be admitted to the influenza unit. Non-influenza patients are to be admitted to the non-influenza unit.[44]

Initial Identification and Screening. TAHSN recommends that hospitals consider closing emergency departments (EDs) to direct visits from patients who would otherwise walk in from the street. If this is

done, hospitals should communicate this decision through the media and advise patients that unless medical attention is immediately warranted they should first call TeleHealth (a phone service) for advice. Patients will undergo screening and triage to ensure proper and timely assessment. Screening is to be done rapidly, and is suggested to be done inside or just outside the doors of the hospital. Signage directing patients to influenza and non-influenza lines is to be displayed. Patients who need urgent medical assessment are to go directly into the emergency department or other designated areas for assessment and management. Infection prevention and control protocols should be implemented for both healthcare workers and patients waiting in line.[44]

Triage settings. TAHSN recommends separate entrances for patients coming to hospital for clinic appointments. To alleviate high patient numbers in the ED, primary assessment can be performed by clinic personnel. Hospitals and clinics should determine where to direct patients should secondary assessment be required. In most instances, this would be the ED.[44]

USA

HHS Pandemic Influenza Plan (2005)

Triage Process. HHS identifies the purpose of triage as: 1) identifying persons who might have pandemic influenza, 2) separating them from others to reduce the risk of disease transmission, and 3) identifying the type of care they require. HHS also mentions using phone triage to identify patients who need emergency care and those who can be referred to a medical office or other non-urgent facility. Separate waiting areas and triage evaluation areas for persons with respiratory symptoms are to be assigned.[49]

To facilitate the process, the following are recommended:

- Visual alerts should be posted at the entrance to hospital outpatient facilities instructing persons with respiratory symptoms to inform reception and healthcare personnel when they first register for care, and practice respiratory hygiene/cough etiquette.
- Patients calling for medical appointments should be screened for influenza symptoms. Discourage unnecessary visits to medical facilities.
- Set up a separate triage area for persons presenting with symptoms of respiratory infection. Because not every patient presenting with symptoms will have pandemic influenza, infection control measures will be important in preventing further spread.
- A “triage officer” may be useful for managing patient flow, including deferral of patients who do not require emergency care.[49]

Prehospital Care. HHS recommends that EMS personnel screen patients requiring emergency transport for symptoms of influenza, while following standard and droplet precautions during transport of symptomatic patients. They should consider routine use of surgical or procedure masks for all patient transport when pandemic influenza is in the community. Further, it is recommended to place a procedure or surgical mask on the patient to contain droplets expelled during coughing. Aerosol-generating procedures should be avoided unless necessary to support life in prehospital care. Oxygen delivery with a non-rebreather facemask can be used to provide oxygen support during transport. The emergency vehicle's ventilation should be optimised to increase the volume of air exchange during transport. When possible, use vehicles that have separate driver and patient compartments that can provide separate ventilation to each area.[49]

UK

National Framework for Responding to an Influenza Pandemic (2007)

Initial Identification and Screening. This guideline states that if the virus does originate in the UK, internal containment efforts are unlikely to succeed due to large numbers of initial contacts.[59] Therefore, hospital pandemic plans should ensure that measures are in place to: control entry, immediately identify, assess, and separate symptomatic patients prior to and during assessment and treatment, protect staff and control contamination of emergency facilities, provide appropriate treatment and/or self-management advice, and manage patients according to agreed protocols.[59]

UK Infection control in Hospitals and PCS (2007)

Triage Process. These infection control guidelines recommend that rapid screening be carried out upon patient arrival, and that symptomatic patients are separated. The type of care a patient requires is to be determined as early as possible. Signs should be posted en route, and at the entrance. A triage practitioner is to be based in reception for managing patient flow.[60]

Australia

Interim Infection Control Guidelines for Pandemic Influenza in Healthcare and Community Settings (2006)

Prehospital Care. When a GP considers that a patient needs immediate hospitalisation, the GP should telephone the ambulance service and advise the ambulance officer that the patient is a potentially infectious case. The attending ambulance officer should wear the recommended PPE and inform the receiving hospital ED or clinic prior to the patient's arrival.[61]

Initial Identification and Screening. A number of recommendations are made to allow early identification of potential cases:[61]

- Post visual alerts at the entrance to the facility instructing persons with respiratory symptoms to: inform reception and other healthcare personnel when they first register for care, practice respiratory hygiene/cough etiquette, request and wear a surgical mask.
- Patients calling for medical appointments should be triaged for influenza symptoms. Symptomatic patients calling should be instructed on infection control measures to limit transmission in the home and when traveling to necessary medical appointments.
- Unnecessary visits to medical facilities are to be discouraged.
- Prior to clinical assessment, any patient who telephones or presents for an appointment should immediately be questioned to determine if he or she could be an infectious case. The suspected case should be provided with a surgical mask upon entering the facility and separated from other patients and staff, prior to assessment by a doctor or nurse.[61]

Summary of Recommendations

Recommendations	Guideline					
	Canadian Pandemic Influenza Plan (2006)	**TAHSN (2006)**	**HHS Pandemic Influenza Plan (2005)**	**UK National Framework (2007)**	**UK Infection Control (2007)**	**Australian Infection Control (2006)**
Triage Process						
Implementation of pre-triage screening and assessment		✓		✓	✓	✓
Identifying type of care required		✓	✓		✓	
Assigning a "Coordination Officer" to manage flow		✓	✓		✓	
Separate influenza (or symptomatic) and non-influenza patients	✓	✓	✓		✓	
Phone service triaging, discouraging unnecessary visits			✓			
Signage to direct patients			✓		✓	
HCWs to wear PPE						✓
Initial Identification and Screening						
Develop a method of controlled entry into the hospital.		✓		✓		
Adopt a telephone service for patients, addressing concerns, instructing, and questioning.		✓				
Rapid screening should be directly at entrance.		✓		✓		
Adopt signage to direct patients, and apply cough etiquette.		✓				

Recommendations	Guideline					
	Canadian Pandemic Influenza Plan (2006)	**TAHSN (2006)**	**HHS Pandemic Influenza Plan (2005)**	**UK National Framework (2007)**	**UK Infection Control (2007)**	**Australian Infection Control (2006)**
Prehospital Care						
Emergency service workers should adhere to routine infection control practices. PPE and barrier techniques should be used accordingly.	✓		✓			

2.2 Patient Education

This category encompasses various aspects that deal with patient education about disease transmission and risk reduction, plans for disseminating educational information to persons entering hospitals, infection control principles for reducing environmental contamination and minimising droplet spread, patient education and resources for proper hand hygiene and respiratory etiquette, and lastly, instructions for effective patient mask use. We identified 5 guidelines with recommendations in these areas.

Canada

Ontario Health Pandemic Influenza Plan (2008)

Respiratory etiquette. Patients who have influenza symptoms (ie, fever, cough) who come to a health setting for care should be asked to:[47]

- Practise hand hygiene: clean their hands using alcohol-based hand rub;
- Wear a surgical or procedure mask and either wait in a separate area or keep at least 2 metres away from other patients and staff. If the patient cannot tolerate a mask (eg, children, people with chronic breathing problems, people with dementia), she/he should wait in a separate area or keep at least 2 metres distance from other patients and be provided with tissues to contain coughs. Each health setting's capacity to separate patients with symptoms of ILI will depend on space. In crowded waiting areas, precautions like hand hygiene and masks become even more important. If masks are not available, patients should be encouraged to use another method to cover their mouth and nose when coughing or sneezing (eg, tissue, coughing into sleeve).

Patient mask use. Instruct patients with influenza-like illness (ILI) symptoms (coughing, sneezing) to perform proper hand hygiene and wear surgical/procedure masks (if their condition allows) when in common areas, such as waiting rooms, triage areas, and emergency vehicles, or when being transported within or between facilities.[47]

USA

HHS Pandemic Influenza Plan (2005)

Patient Education. Patients should be educated about disease transmission and reducing risk. Education should be multilingual and cross-cultural. Patients and others should know what they can do to prevent disease transmission in the hospital, as well as at home and in community settings. Identify language-specific and reading-level appropriate materials for educating patients, family members, and hospital visitors during an influenza pandemic. If language-specific materials are not available for the population(s) being served, arrange for translations. Develop a plan for distributing information to all persons who enter the hospital. Identify staff to answer questions about procedures for preventing influenza transmission.[49]

Respiratory etiquette. Instruct persons who have "flu-like" symptoms to use respiratory hygiene/cough etiquette. The elements of respiratory hygiene/cough etiquette include:[49]

- Education of healthcare facility staff, patients, and visitors on the importance of containing respiratory secretions to help prevent the transmission of influenza and other respiratory viruses;

- Posted signs in languages appropriate to the populations served with instructions to patients and accompanying family members or friends to immediately report symptoms of a respiratory infection as directed;
- Source control measures (eg, covering the mouth/nose with a tissue when coughing and disposing of used tissues; using masks on the coughing person when they can be tolerated and are appropriate)
- Hand hygiene after contact with respiratory secretions, spatial separation (ideally > 3 feet) of persons with respiratory infections in common waiting areas when possible.

Patient mask use. Promote use of masks by symptomatic persons in common areas (eg, waiting rooms in physician offices or emergency departments) or when being transported (eg, in emergency vehicles).[49]

UK

Infection Control in Hospitals & PCS (2007)

Patient area environment. Standard infection control principles must be strictly applied in conjunction with droplet precautions. For bays with 4–6 beds, an equipment station should be set up outside the entrance to the bay to hold PPE. In accordance with droplet precautions, the distance between beds should be at least 1 metre. A physical barrier, such as curtains, will help reduce environmental contamination and droplet spread between patients, but their use must be balanced against other aspects of patient safety, and they must be cleaned in line with local policy.[60] Cohorted areas should be scrupulously cleaned at least 1 a day, with a focus on frequently touched surfaces such as bed rails, over bed tables, door handles and bathroom fixtures. Cleaning after patient discharge should be carried out as normal.[60]

Australia

AHMPPI (2008)

Respiratory etiquette. Standard respiratory (cough and sneeze) etiquette should be practiced. If you cough or sneeze, you should:[63]

- Cover your nose and mouth with a disposable tissue rather than your hands;
- If there are no tissues available, cover your nose and mouth with your upper arm rather than your hands. Wash your upper arm (or sleeve) as soon as practical if you have sneezed or coughed into it;
- Dispose of used tissues in the nearest bin;
- Wash your hands afterwards or after touching used tissues.

Simple things everyone can do to help control the spread of the influenza virus during a pandemic include:[63]

- Washing and drying your hands regularly and properly;
- Covering your mouth and nose when you cough or sneeze;
- Wearing basic PPE;
- Standing or sitting back from other people.

Patient mask use. It is particularly important for people who are coughing or sneezing to wear a mask to prevent the spread of infection to others. It’s important to ensure that surgical masks are worn (fitted)

and disposed of correctly. Make sure the mask is correctly fitted by ensuring that it covers your nose and mouth, and that it is secured at the back of your head. Avoid touching your face while wearing the mask. Replace the mask whenever it's moist. A mask that has been removed (for example, when eating) should not be reused. Remove the mask by only touching the straps and put the used mask in a bin. Wash your hands straight away.[63]

AHMPPI, Infection Control Guidelines (HCCS) (2006)

Patient area environment. Where possible, designate separate waiting areas or rooms for patients with symptoms of pandemic influenza. Place signs indicating the separate waiting areas. If this is not feasible, a waiting area should be set up to enable patients with respiratory symptoms to sit as far away as possible (at least 1 metre) from other patients. Place symptomatic patients in an evaluation room as soon as possible to limit their time in common waiting areas.[61]

Respiratory etiquette. To contain respiratory secretions, all persons exhibiting signs and symptoms of a respiratory infection, regardless of presumed cause, should be instructed to follow respiratory hygiene/cough etiquette which includes the following:[61]

- Cover the nose/mouth when coughing or sneezing;
- Use tissues to contain respiratory secretions;
- Dispose of tissues in nearest waste receptacle after use;
- Perform hand hygiene after contact with respiratory secretions and contaminated objects/materials.

Source control measures for containing respiratory secretions include the following:[61]

- Posting signs that promote and instruct hygiene/cough etiquette (including wearing of surgical masks if people exhibit respiratory symptoms) in common areas (eg, waiting areas, toilets) where they serve as reminders to all persons in the healthcare facility.
- All healthcare facilities should facilitate the adherence to respiratory hygiene/cough etiquette by ensuring the availability of materials in waiting areas for patients and visitors. Steps include:
  - — Provide tissues and no-touch receptacles (eg, waste containers with pedal-operated lid or uncovered waste container) for used tissue disposal;
  - — Provide conveniently located dispensers of alcohol-based hand wash product;
  - — Provide soap and disposable towels for hand washing where sinks are available;
  - — Provide surgical masks for use by those with respiratory symptoms;
  - — Promote the use of surgical masks and spatial separation for persons with symptoms of influenza;
  - — Offer and encourage the use of surgical masks by symptomatic persons to limit the dispersal of respiratory droplets;
  - — Encourage coughing persons to sit at least 1 metre from other persons in common waiting areas;
  - — Wearing surgical masks and separation of symptomatic persons.

During periods of increased respiratory infection in the community, persons who are coughing should be offered a surgical mask to contain respiratory secretions. Coughing persons should be encouraged to

sit as far away as possible (at least 1 metre) from others in common waiting areas. Some facilities may wish to institute this recommendation year-round.[61]

France

Pandemic Flu Plan (2007)

Patient mask use. The French pandemic plan includes a recommendation that patients should wear a surgical mask.[64]

Summary of Recommendations

The goals of patient education, including respiratory etiquette and patient mask use, are to inform and sensitise patients to the modes of influenza transmission and how they can act to reduce the risk of transmission. The key findings of the guideline recommendations pertaining to patient education can be summarised as follows:

- Patients (caregivers, visitors) should be educated on the different modes of influenza transmission and how to reduce the risk. As a result of this education, patients would be familiar with what they can do to prevent influenza transmission in hospital, in their community at large, as well as in their homes. All education must be multilingual and cross-cultural.
- Although the impact of covering sneezes and coughs and/or placing a mask on a coughing patient on the containment of respiratory secretions or on the transmission of respiratory infections has not been systematically studied,[49] the implementation and patient education of proper respiratory hygiene/cough etiquette remains universally recommended. This measure includes educating patients and visitors on the importance of containing respiratory secretions (with signs and other educational material) as well as enforcing various control measures (eg, proper hand hygiene, covering sneezes and coughs).
- Symptomatic potentially-infected patients should be properly instructed and encouraged to wear a mask (standard surgical) to reduce transmission.

Recommendation	Canada OHPIP	HHS	AHMPPI	Australian Infection Control	France
Educate patients on influenza disease and transmission		✓			
Educate and encourage patient respiratory etiquette	✓	✓	✓	✓	
Educate and encourage patient mask use (surgical)	✓	✓	✓	✓	✓

2.3 Healthcare Delivery Area Management

We identified 5 guidelines with recommendations relevant to healthcare delivery area management relevant to protection of healthcare workers (HCWs).

Canada

Canadian Pandemic Influenza Plan (2006)

Patient care equipment. Patient care equipment contaminated with secretions from patients with confirmed or suspected influenza should be cleaned prior to use with another patient. Cleaning should be performed in accordance with routine infection control procedures (level of evidence AIII).[3]

Patient segregation and cohorting. Single rooms should be allocated for patients with suspected or confirmed airborne infections—for example, tuberculosis, measles, varicella, or disseminated zoster—or for patients who visibly soil the environment and for whom appropriate hygiene cannot be maintained (level of evidence AII). In phase 2 pandemic, patients may be cohorted together, according to status, including influenza-like illness or confirmed pandemic influenza (level of evidence AIII). Patients who have recovered from influenza can be moved into the "non-influenza" cohort areas. As the pandemic progresses, the suspected/exposed cohort and the confirmed influenza cohorts may be merged (level of evidence AIII).[3]

In the ambulatory care setting, patients with influenza-like illness should be separated from well patients (level of evidence AIII).[3]

Housekeeping, laundry, and waste management. Management of housekeeping, laundry, and waste are recommended to follow routine infection control procedures (level of evidence AIII). Special handling of contaminated linen or waste is not required (level of evidence AII).[3]

Ontario Health Pandemic Influenza Plan (2008)

This plan recommends processes for handling and cleaning equipment and clothing that reduce possible exposure, including the use of appropriate PPE. Cleaning and disinfection should be done according to routine best practice.[47]

USA

HHS Pandemic Influenza Plan

Surfaces and environment. Cleaning and disinfection should follow the same general principles of routine infection control. HCWs should be vigilant to avoid contaminating environmental surfaces that are not directly related to patient care (eg, door knobs, switches).[49]

Housekeeping, laundry, and waste management. Standard precautions are recommended for disposal of solid waste (medical and non-medical), linen and laundry, and dishes and eating utensils that might be contaminated with pandemic influenza virus.[49]

Patient care equipment. Follow standard practices for handling and reprocessing used patient-care equipment, including medical devices.[49]

Patient segregation. Limit contact between infected and non-infected persons—during the early stages of a pandemic, infection with influenza should be laboratory-confirmed, if possible. Isolate infected persons (ie, confine patients to a defined area as appropriate for the healthcare setting). Limit contact between non-essential personnel and other persons (eg, social visitors) and patients who are ill with

pandemic influenza. Promote spatial separation in common areas (ie, sit or stand as far away as possible—at least 3 feet—from potentially infectious persons) to limit contact between symptomatic and non-symptomatic persons.[49]

Designate separate waiting areas for patients with influenza-like symptoms. If this is not feasible, the waiting area should be set up to enable patients with respiratory symptoms to sit as far away as possible (at least 3 feet) from other patients.[49]

Place patients with influenza in a private room or cohort with other patients with influenza. Keep door closed or slightly ajar; maintain room assignments of patients in nursing homes and other residential settings; and apply droplet precautions to all persons in the room.[49]

No levels of evidence or references are cited for these recommendations.

UK

Infection Control Guidance (2007)

Patient segregation. Patients with symptoms of influenza should be triaged to a segregated waiting and assessment area immediately.[60]

Surfaces and environment. Freshly prepared neutral detergent and warm water should be used for cleaning the hospital or other healthcare environment. There should be a dedicated staff for cleaning influenza rooms. Staff must wear appropriate PPE. Dedicated or single-use disposable equipment should be used when possible.[60]

Patient care equipment. Patient care equipment should be cleaned according to standard practices. Where possible, non-critical patient equipment should be dedicated to patients with influenza.[60]

Housekeeping, laundry, and waste management. No special precautions are required for handling clinical and non-clinical waste. Linen should be handled in a manner to prevent exposure to the skin, mucous membranes, clothing, and environment. Gloves and aprons should be worn when handling contaminated linen. Hot water and detergent in a dishwasher is sufficient to decontaminate dishes and eating utensils. There is no need to use disposable equipment.[60]

Australia

Interim Infection Control Guidelines for Pandemic Influenza (2006)

Patient care equipment. Disposable equipment should be used wherever possible during the treatment and care of patients, and should be disposed of appropriately in the general waste. If equipment is to be reused, then it should be disinfected in accordance with the manufacturers' instructions. Follow standard precautions for handling and reprocessing used patient-care equipment, including medical devices.[61]

Surfaces and environment. Cleaning of environmental surfaces with a neutral detergent followed by a disinfectant solution is recommended. “Wet” dusting rather than “dry” dusting should be used to prevent generation of dust particles, and vacuum cleaners should be fitted with HEPA filters. Dedicated or single-use/disposable cleaning equipment should be used wherever possible. Non-disposable equipment, including mop-heads, should be laundered after use. If the patient is in the room, appropriate PPE should be worn.[61]

Housekeeping, laundry, waste management. Standard precautions are recommended for: 1) handling dishes and eating utensils used by a patient with known or possible pandemic influenza, 2) the disposal

of solid waste (clinical and non-clinical) that might be contaminated with pandemic influenza, and 3) linen and laundry that might be contaminated with respiratory secretions from patients with pandemic influenza.[61]

No levels of evidence or references are cited for these recommendations.

Summary of Recommendations

In general, standard procedures and precautions are recommended for cleaning, housekeeping, laundry, and waste management. Where possible, disposable patient-care and cleaning equipment should be considered. Rooms and surfaces should be cleaned between patients as per standard recommendations. Cleaning staff should be trained on the appropriate use of PPE.

As the pandemic progresses, separate waiting rooms, common patient areas, and care facilities (including cohort areas and alternative locations) should be considered for influenza patients. Cleaning and other staff should be allocated only this area. Social distancing by either designating separate areas (spatial separation) or limiting contact between potentially infected symptomatic and non-symptomatic, non-infected persons. Limiting contact is described as maintaining a distance of ≥ 3 feet (≈ 1 metre) between persons.

This table shows which guidelines support a set of generic recommendations.

Recommendation	Canadian plan	Ontario	USA HHS plan	UK Infection Control	Australia
Patient care equipment					
Use disposable equipment				✓	✓
Clean according to routine infection control and manufacturer's instructions	✓*	✓	✓	✓	✓
Surfaces and environment					
Clean using detergent and disinfectant and routine procedures		✓	✓	✓	✓
Wet dusting, HEPA vacuum					✓
HCW cleaning influenza patient rooms use appropriate PPE		✓		✓	✓
Dedicated staff for cleaning influenza patient rooms				✓	✓
Housekeeping, laundry, waste management					
Standard precautions	✓*	✓	✓	✓	✓

Recommendation	Canadian plan	Ontario	USA HHS plan	UK Infection Control	Australia
Patient segregation and cohorting					
Suspected or confirmed cases should be assigned single rooms, where available	✓[†]		✓	✓	
In pandemic situation, patients may be cohorted according to clinical status	✓[*]		✓		

Unless specifically noted, these recommendations did not have any levels of evidence or references cited;

[*]Level of evidence AIII (see Appendix II. for definition)

[†]Level of evidence AII (see Appendix II. for definition)

2.4 Healthcare Worker Education and Safe Work Practices

There is no clear evidence to indicate that HCWs following appropriate infection control precautions will be at higher risk for illness during the pandemic.[45]

Canada

Canadian Pandemic Influenza Plan (2006)

Staff Education and Training. This guideline states that information for HCWs should be provided as soon as WHO Pandemic Phase 0 Level 1 is declared and repeated at frequent intervals to all staff levels and during all shifts. The pandemic influenza information should be appropriate to HCWs and be provided using a variety of methods (eg, postings in elevators, at facility entrances, brochures, newsletters, and websites). This plan explicitly states the information that should be covered in the educational material.[3]

Hand Hygiene. This guideline identifies hand hygiene as the cornerstone of infection prevention and states that it may be the only preventative measure available during a pandemic. It recommends that hand hygiene procedures be reinforced. Hands should be washed or hand antisepsis performed after direct contact with patients or HCWs with ILI, and after contact with their personal articles or their immediate environment.[3]

TAHSN Pandemic Influenza Planning Guidelines (2006)

Infection Control Precautions. TAHSN recommends infection prevention and control screening be performed at clinic entrances for presence of influenza symptoms. It is recommended that HCWs don PPE when within 1 metre of patients. When possible it is recommended to separate patients with influenza-like symptoms from those with no symptoms (eg, separate waiting area).[44]

TAHSN indicates that it supports specific recommendations stated in the National (see above) and Ontario (see below) pandemic influenza plans for infection prevention and control practices.[44]

Staff Education and Training. TAHSN recommends that training be provided as required and/or up-to-date reference materials covering information related to the pandemic be made available. It is recommended that the focus be on reinforcing personal practices such as: hand hygiene, not coming to work when ill, appropriate cleaning and disinfection of equipment, appropriate use of PPE, and basic infection prevention and control practices. It is also emphasises that staff and volunteers be made aware of the importance of antiviral prophylaxis and immunisation, including side effects and benefits.[44]

Expert Panel on Influenza and PPRE (2007)

Infection Control Precautions. The primary elements of protection against influenza transmission are engineering and administrative controls.[46]

The panel identifies administrative controls to be procedural and behavioural measures such as hand hygiene, respiratory etiquette, and other basic practices to prevent the transmission of organisms (called Routine Practices in Canadian Healthcare Facilities) (PHAC, 1999; CDC, 2007). These also include measures to identify individuals who are likely infected and who require separation from others; personal protective measures for caregivers; and education and training for all persons who must implement these measures. Effective implementation of such administrative controls has been shown to be effective in preventing disease and controlling outbreaks due to many pathogens, in both healthcare and non-healthcare settings.[46]

Ontario Health Pandemic Influenza Plan (2008)

Infection Control Precautions. OHPIP recommends precautions routinely used with influenza, including hand hygiene, routine practices, droplet and contact precautions for routine care, and airborne precautions when performing aerosol-generating procedures. In addition to droplet precautions, OHPIP recommends the use of N95 respirators when in an area with influenza patients. This recommendation is based on the precautionary principle and is designed to protect workers from the risk of fine droplet spread.[47]

Safe Handling of Laboratory Specimens. OHPIP recommends that specimens be collected and transported in the appropriate viral transport medium and shipped to the laboratory immediately following collection (on ice). Transportation in a pneumatic tube should be avoided. Specimens that cannot be processed within 48 to 72 hours should be frozen at –70°C. Packaging, shipping and transport of specimens must comply with the national requirements of the Canadian Transportation of Dangerous Goods Regulations.[47]

Staff Education and Training. The OHPIP emphasises that employers provide appropriate ongoing education and training to HCWs. OHPIP states that the education and training emphasis be on the principles and procedures of infection prevention and control, as well as the hierarchy of controls used to reduce the spread of influenza. Furthermore, instruction in the correct use and donning of personal protective equipment is recommended.[47]

Reducing contact with infected persons. OHPIP advocates patient flow management in order to reduce contact with infected persons by keeping individuals with influenza symptoms separate from people without ILI symptoms. This can be initiated by directing people with symptoms of ILI to certain entrances and exits, and limiting access to certain parts of the health setting.[47] OHPIP recommends social distancing procedures that minimise face-to-face contact between HCWs in situations where they are not wearing PPE.[47]

USA

HHS Pandemic Influenza Plan (2005)

Safe Handling of Laboratory Specimens. HHS recommends that specimen handling should be done under appropriate biocontainment conditions, and that eligible laboratory personnel exposed to patient specimens are vaccinated.[49]

Staff Education and Training. HHS recommends that each hospital develop an education and training plan that addresses the needs of staff. This can be done by a variety of means, in different languages if necessary. A number of topics to address are specifically included in the HHS guideline, inclusive of, but not limited to: implications of the pandemic, benefits of vaccination, role of antivirals, infection control strategies, policies, contingency plans, and cross-training.[49]

Hand Hygiene. HHS recommends that hand hygiene be performed after contact with infectious patients.[49] The term “hand hygiene” includes hand washing with either plain or antimicrobial soap and water, and use of alcohol-based products containing an emollient that do not require water. If hands are visibly soiled or contaminated with respiratory secretions, wash hands with soap (either non-antimicrobial or antimicrobial) and water. HHS recommends always performing hand hygiene between patient contacts and after removing PPE. Resources to facilitate hand washing (ie, sinks with warm and

cold running water, plain or antimicrobial soap, disposable paper towels) and hand disinfection (ie, alcohol-based products) should be readily accessible in areas in which patient care is provided.[49]

Goldfrank PPE for Healthcare Workers (2008)

Staff Education and Training. This report mentions that equal access and culturally competent training are needed for all workers at healthcare facilities who will be expected to come to work and keep the facility running smoothly during a pandemic.[12] Emphasis on PPE for HCW training is considered essential to promote a culture of safety within healthcare facilities.[12]

Hand Hygiene. Hand hygiene practices appropriate for pandemic influenza are the same as those recommended for seasonal influenza. In a pandemic influenza situation, strict adherence to hand hygiene protocols would be of great importance.[12]

WHO

Mask Clarification (2005)

Hand Hygiene. The mask clarification states that HCWs should disinfect hands with an alcohol-based preparation or should wash with soap and water immediately after each encounter with a patient and before seeing another patient. Hand hygiene should be performed immediately after removing PPE. [56]

UK

National Framework for Responding to an Influenza Pandemic (2007)

Infection Control Precautions. This UK national guideline recommends that standard basic infection control measures are to be followed, inclusive of routine practices and utilisation of PPE. Administrative measures, such as HCW education are also included under infection control precautions.[59]

UK Infection control in Hospitals and PCS (2007)

Infection Control Precautions. This infection control guideline recommends that standard infection control principles and droplet precautions be followed while in contact with confirmed or suspected influenza patients. Furthermore, PPE usage should be proportionate to the risk of contact with respiratory secretions and other body fluids.[60]

Staff Education and Training. The UK infection control guidelines recommend that senior medical and nursing staff be briefed on procedures of infection control. Training and fit-testing for respirators is recommended. General training for all staff on infection control and implications of the pandemic is also recommended.[60]

Australia

Interim Infection Control Guidelines for Pandemic Influenza in Healthcare and Community Settings (2006)

Infection Control Precautions. This guideline recommends routine practices be followed, such as hand hygiene and respiratory etiquette. PPE use is also advocated. Measures that can be taken within the community and at homes of infected HCWs are extensively described. [61]

Hand Hygiene. These infection control guidelines state that "hand hygiene" includes both hand washing with either plain or antimicrobial soap and water, and use of alcohol-based products containing an emollient that do not require the use of water. It is stated that if hands are visibly soiled or contaminated with respiratory secretions, they should be washed with soap and water. It is

recommended to always perform hand hygiene between patient contacts and after removing PPE. Resources to facilitate hand washing and hand disinfection should be readily accessible in areas in which patient care is provided.[61]

Reducing contact with infected persons. This guideline recommends generally limiting contact between infected and non-infected persons. A number of methods are suggested, such as isolating infected persons, promoting overall spatial separation, and limiting contact to a small number of HCWs, family, and friends.[61]

Post-mortem care. The Australian Interim infection control guidelines recommend that a surgical mask or cloth should be placed on the body in the initial hours after death, and that the body should be transferred to the mortuary as soon as possible. Those transporting the body should wear a gown, gloves, and a surgical mask. Body bags are indicated only when leakage of body fluids or substances is likely and cannot be contained by a standard linen shroud. Provided the HCW is not transporting the body, standard precautions are sufficient for contact with the deceased. Therefore, gloves and gowns are not necessary unless contact with respiratory secretions or other body fluids is anticipated. Surgical masks are not necessary, although they may be used to prevent the HCW from touching his/her mouth and/or nose, and to protect against contact with droplets that may occur if fluids are splashed.[61]

Australian Health Management Plan for Pandemic Influenza: Important Information for All Australians (2008)

Infection Control Precautions. The Interim Pandemic Influenza Infection Control Guidelines provide detailed instructions on infection control during a pandemic. These include hand hygiene, respiratory etiquette, wearing PPE, and social distancing.[63]

Hand Hygiene. The AHMPPI states that hand hygiene includes washing hands with soap and water, or cleaning hands with alcohol-based products that can be used without water. If hands are visibly dirty with respiratory secretions it is recommended to wash with soap and water. If there is no visible dirt, alcohol-based products with an emollient may be used. It is recommended to wash and dry hands after contact with other people, before and after removing a mask or gloves, and before touching one's face.[63]

Summary of Recommendations

	Can. Pan. Flu Plan (2006)	TAHSN (2006)	CCA on PPRE (2007)	OHPIP (2008)	HHS Pan. Flu Plan (2005)	WHO Mask Clarification (2005)	UK National Framework (2007)	UK Infection Control (2007)	Aust. Clin. Guidelines (2006)	Aust. Inf. Cont. (2006)	AHMPPI (2008)	Goldfrank PPE (2008)
Infection Control Precautions and Hand Hygiene												
Follow routine practices (hand hygiene and respiratory etiquette)		✓	✓	✓			✓	✓	✓	✓	✓	

	Can. Pan. Flu Plan (2006)	TAHSN (2006)	CCA on PPRE (2007)	OHPIP (2008)	HHS Pan. Flu Plan (2005)	WHO Mask Clarification (2005)	UK National Framework (2007)	UK Infection Control (2007)	Aust. Clin. Guidelines (2006)	Aust. Inf. Cont. (2006)	AHMPPI (2008)	Goldfrank PPE (2008)
Don PPE		✓	✓	✓			✓	✓	✓	✓		
Practice hand hygiene (usually after encounter with patient)	✓				✓	✓				✓	✓	✓
Wash visibly soiled hands with soap and water					✓					✓	✓	
Utilize alcohol-based hand washes in the absence of soiled hands					✓					✓	✓	
Wash hands after PPE use					✓	✓				✓	✓	
Make hand hygiene resources available in the healthcare setting					✓					✓		
Staff Education and Training												
General education on infection control, implications of the pandemic, planning, procedures	✓	✓		✓	✓			✓				✓
PPE education/fit testing		✓		✓				✓				✓
Reducing contact with infected persons												
Apply social distancing methods and reduce contact between ILI and non-ILI patients.				✓						✓		
Separate potential cases from non-potential cases.		✓	✓				✓					
Safe handling of laboratory specimens												
Specimens should be shipped immediately, in compliance with national standards.				✓								
Handling should be done under biocontainment conditions.					✓							

	Can. Pan. Flu Plan (2006)	TAHSN (2006)	CCA on PPRE (2007)	OHPIP (2008)	HHS Pan. Flu Plan (2005)	WHO Mask Clarification (2005)	UK National Framework (2007)	UK Infection Control (2007)	Aust. Clin. Guidelines (2006)	Aust. Inf. Cont. (2006)	AHMPPI (2008)	Goldfrank PPE (2008)
Post-mortem care												
Those transporting body bags should wear a gown, gloves and surgical mask.										✓		
Surgical mask should be put on the body in initial hours after death.										✓		

2.5 Personnel Management

We identified 12 guidelines with recommendations regarding HCW personnel management. These included recommendations regarding:

- Deployment and consideration of ill, at-risk, and recovered staff
- Availability of resources
- Personnel health monitoring
- Provision of psychosocial support
- Communication with HCWs
- Time-off and resource management

Canada

Canadian Pandemic Influenza Plan (2006)

Availability of Resources. During a pandemic, it is recommended that the needs for child care, emotional support, and grief counselling are addressed to help maintain adequate staffing levels. During the pandemic, it will be imperative to keep HCWs as healthy as possible. Occupational health issues that need to be considered include vaccination of HCWs, and use of PPE.[3]

Deployment (ill, at-risk, recovered staff). The Canadian Pandemic Flu plan defines “fitness to work” by 3 categories:

1. HCWs are “fit to work” when 1 of the following conditions apply: a) they have recovered from ILI during earlier phases of the pandemic, b) they have been immunised against the pandemic strain of influenza, or c) they are on appropriate antivirals. “Fit to work” HCWs may work with all patients and may be selected to work in units where there are patients who, if infected with influenza, would be at high risk for complications. Whenever possible, well, unexposed HCWs should work in non-influenza areas. Asymptomatic HCWs may work even if influenza vaccine and antivirals are unavailable.[3]
2. Staff with ILI should be considered "unfit for work" and should not work. Nevertheless, due to limited resources, these HCWs may be asked to work if they are well enough to do so.[3]
3. Symptomatic HCWs who are considered "fit to work with restrictions" should only work with patients with ILI. HCWs who must work with non-exposed patients (non-influenza areas) should be required to wear a mask if they are coughing and must pay meticulous attention to hand hygiene. Symptomatic HCWs who are well enough to work should not be redeployed to intensive care areas, nurseries or units with severely immunocompromised patients.[3]

The Canadian Pandemic Influenza Plan does not provide any levels of evidence or references for these recommendations.

PHNC Report and Recommendations on Antiviral Prophylaxis (2007)

Ill Personnel. The PHNC states that early treatment of critical workers can be expected to shorten the duration of their illness, and restricting them from the workplace at the first indication of illness may reduce the likelihood of infection spreading to colleagues or clients.[45]

The PHNC Report does not provide any levels of evidence or references for these recommendations.

TAHSN Pandemic Influenza Planning Guidelines (2006)

Availability of Resources. During a pandemic period, there should be periodic assessment of overall capacity (beds, ICU beds, staffing, supplies, ventilators, deaths), coordination of patient transport, and tracking/managing of beds.[44]

Time-off and Resource Management. TAHSN recommends that the government and healthcare sector should ensure that care providers' safety is protected at all times, and providers are able to discharge duties and receive sufficient support throughout a period of extraordinary demands. They should also ensure that there are provisions in place to provide support to staff and families adversely affected while performing their duties.[3]

Psychosocial Support. TAHSN recommends that emotional support services be made available from multiple sources and that staff be informed of these choices and allowed to choose the source they prefer. Staff should be informed of normal responses to extraordinary stress, warning signs of depression or anxiety disorders, and provided information about coping and self-care. Critical incident debriefing should be avoided.[44] Effective communication is stated as being interactive, responsive, and provided by trusted, respected, and knowledgeable opinion leaders.[44]

Deployment (ill, at-risk, recovered staff). The TAHSN adopts the same categorising scheme in defining fitness-to-work as the Canadian Pandemic Influenza Plan.[44]

Personnel Health Monitoring. TAHSN recommends that managers advise Occupational Health if a cluster of illness in staff is observed. Staff members who begin to experience signs and symptoms of influenza-like illness when working should be assessed immediately, and the following steps taken: consider laboratory testing for influenza, initiate treatment with oseltamivir, and determine whether or not the staff member should be sent home. Active screening is recommended during Phases 5 and 6.[44]

The TAHSN Report does not provide any levels of evidence or references for these recommendations.

Ontario Health Pandemic Influenza Plan (2008)

Time-off and Resource Management. OHPIP recommends human resources (HR) policies that encourage ill employees to stay home. All employers should establish a clear expectation that staff do not come into work when they have ILI symptoms For example, employers should: provide sick leave benefits for all workers (either in the form of paid sick days for full-time staff or in compensatory wage rates in lieu of benefits to part-time staff); avoid reward programs for workers who have no sick days; avoid penalizing workers for taking sick days; and actively exclude workers who are ill (ie, send workers home who arrive at work ill).[47]

Deployment (ill, at-risk, recovered staff). The OHPIP adopts the same categorising scheme in defining “fitness-to-work” as the Canadian Pandemic Influenza Plan.[47]

The OHPIP does not provide any levels of evidence or references for these recommendations.

USA

HHS Pandemic Influenza Plan (2005)

Availability of Resources. HHS recommends that systems developed for tracking consumption of medical supplies be equipped to track rapid consumption, including PPE. Anticipated needs for consumable and durable resources, as well as any equipment should be assessed. Stockpiling of consumable resources is recommended for the first pandemic wave (6–8 weeks).[49] Healthcare facilities

should develop a plan to address emergency staffing needs, as well as increased demand for isolation wards, ICUs, and assisted ventilation services.[49]

Time-off and Resource Management. HHS recommends that time-off policies and procedures consider staffing needs during periods of clinical crisis.[49]

At-Risk Personnel. HHS recommends plans to protect personnel at high risk for complications of influenza (eg, pregnant women, immunocompromised persons). These plans may consists of either reassigning them to low-risk duties or placing them on leave of absence.[49]

Ill Personnel. HHS recommends a plan for detecting signs and symptoms of influenza in healthcare personnel before they report for duty. Policies developed for managing HCWs with respiratory symptoms should take into account HHS recommendations for HCWs with influenza. Symptomatic personnel should be sent home until they are physically ready to return to duty.[49] Further, assigning staff recovering from influenza to care for influenza patients should be considered.[49]

Psychosocial Support. HHS recommends that healthcare facilities and public health agencies should make full use of public health techniques and communication tools that can help response workers manage emotional stress and family issues, and build coping skills and resilience.[49] Counselling should include measures to maximise professional performance and personal resilience by addressing management of grief, exhaustion, anger, and fear; physical and mental healthcare for oneself and one's loved ones; and resolution of ethical dilemmas.[49]

HHS recommends the institutionalisation of psychosocial support services that will help HCWs manage emotional stress during the response to an influenza pandemic and resolve related personal, professional, and family issues.[49]

HHS provides an exhaustive list of psychosocial issues (and how they can be exacerbated) that response workers might need to address.[49]

Communication with HCWs. HHS states that HCWs will have special needs for open lines of communication with employers and access to up-to-date information. It is recommended that healthcare facilities should ensure that employees have ongoing access to information on the following:

1. International, national, and local progress of the pandemic
2. Work issues related to illness, sick pay, staff rotation, shift coverage, overtime pay, use of benefit time, transportation, and use of cellphones
3. Family issues, especially availability of child care
4. Healthcare issues such as: availability of vaccines, antiviral drugs, and PPE; actions to address understaffing or depletion of PPE and medical supplies; infection control practices as conditions change; approaches to ensure patients' adherence to medical and public health measures without causing undue anxiety or alarm; management of agitated or desperate persons; guidance on distinguishing between psychiatric disorders and common reactions to stress and trauma; management of those who fear they may be infected, but are not (the so-called "worried well"); guidance and psychosocial support for persons exposed to large numbers of influenza cases and deaths and to persons with unusual or disturbing disease symptoms.[49]

Deployment (ill, at-risk, recovered staff). HHS states that healthcare personnel who have recovered from pandemic influenza should have antibodies against future infection with the same virus, and therefore should be prioritized for the care of patients with active pandemic influenza and its complications. Such workers would also be well-suited to care for patients who are at risk for serious complications from influenza.[49]

HHS does not provide any levels of evidence or references for these recommendations.

Goldfrank PPE for Healthcare Workers (2008)

Availability of resources. This document indicates that the benefits of PPE use may include decreases in healthcare-acquired infections and associated gains in patients' well-being, as well as reductions in medical leave and associated overtime costs.[12]

UK

UK Infection control in Hospitals and PCS (2007)

Deployment (ill, at-risk, recovered staff). This guideline recommends that HCWs with influenza should not come to work. HCWs at high risk of complications from influenza should not provide direct patient care. HCWs that provide care in areas with pandemic influenza patients should not care for other patients, although exceptions may be necessary. HCWs who have recovered from influenza, or who have received a full course of vaccination against the pandemic strain and are considered unlikely to develop or transmit influenza, should be prioritised for the care of patients with influenza. In exceptional circumstances these workers may be moved within a period of duty, but this is not desirable.[60]

Personnel Health Monitoring. It is recommended that occupational health departments or providers should lead the implementation of systems to monitor staff illness and absence. Antiviral treatment should be accessible to staff where necessary and vaccination should be implemented when required. As part of their employer's duty of care, occupational health departments or providers have a role to play in ensuring fit-testing programmes are in place for staff who may need to wear FFP3 respirators.[60]

This UK guideline does not provide any levels of evidence or references for these recommendations.

Australia

Interim National Pandemic Influenza Clinical Guidelines (2006)

Psychosocial Support. The Interim Clinical Guidelines suggest that it is helpful to acknowledge concerns, highlight information available, and answer queries honestly, while offering supportive advice if required. It provides a number of strategies that can be implemented in order to provide information, answer any queries, and provide emotional support. It further recommends that post-influenza syndromes, such as depression, fatigue, and even organic conditions may need to be monitored in the aftermath. These conditions should be considered in determining whether a person is fit to return to work.[62]

This interim clinical guideline does not provide any rationale for the recommendations provided.

Interim Infection Control Guidelines for Pandemic Influenza in Healthcare and Community Settings (2006)

Deployment (ill, at-risk, recovered staff). These interim infection guidelines recommend that HCWs assigned to care for patients with pandemic influenza or who work in areas designated for patients with

pandemic influenza not be assigned to care for non-influenza patients or work in non-influenza areas. Exceptions to this include:

- In hospitals, occupations with a limited number of staff, although segregation of staff should be maintained as much as practically possible.
- In primary care settings this may not be feasible. However, comparable options such as arranging for 1 general practitioner or nurse to see all patients with symptoms of influenza during a session, or referral to a fever clinic, should be explored.
- Situations where the care and management of the patient would be compromised.
- Staff who are vaccinated or have developed immunity after infection.

It is further stated that HCWs who have recovered from pandemic influenza are expected to develop antibodies against future infection with the same virus. Workers who have protective immunity should be prioritised for care of patients with active pandemic influenza and its complications. Such workers would also be well-suited to care for patients on units where the introduction of influenza would have serious consequences for patients.

Personnel who are at high risk for complications of pandemic influenza should be informed about their medical risk and offered an alternative work assignment away from influenza patient care until pandemic influenza has abated in the community.

High-risk individuals should not provide care to patients known to have influenza nor enter parts of the hospital segregated for the treatment of patients with influenza. Implementation of this recommendation should not interfere with staff privacy and confidentiality.[61]

Personnel Health Monitoring. This interim guideline recommends that all personnel be screened for influenza-like symptoms before commencing work. Symptomatic people should be sent home and advised not to return for the duration of the infectious period.[61]

This Interim Infection Control guideline does not provide any levels of evidence or references for these recommendations.

Australian Health Management Plan for Pandemic Influenza: Important Information for All Australians (2008)

Psychosocial Support. AHMPPI briefly recommends, in parallel to the Interim Clinical guidelines, that concerns be acknowledged, and suggests the same strategies.[61] The AHMPPI does not provide levels of evidence or references for this recommendation.

France

National Pandemic Influenza Plan (2007)

At-risk personnel. This guideline recommends that at-risk HCWs stay at home.[64]

Summary of Recommendations

	Can. Pan. Flu Plan (2006)	PHNC Report (2007)	TAHSN (2006)	OHPIP (2008)	HHS Flu Plan (2005)	UK National Framework (2007)	UK Infection Control (2007)	Aust. Nat.Clin. Guidelines (2006)	Aust.Int. Inf. Cont. (2006)	AHMPPI (2008)	France (2007)	Goldfrank PPE (2008)
Availability of Resources												
Availability, assessment, and stockpiling of vaccines, antivirals, or PPEs and other equipment to maintain HCW safety	✓		✓		✓							✓
Availability of services to maintain staffing needs (emotional support, child care)	✓											
Time-off and Resource Management												
HCWs should be supported when not working due to illness or increased demand (ie, sick leave benefits, time-off policies)			✓	✓	✓							
At-risk personnel												
Assign HCWs at high risk for complications of influenza to low-risk duties, or place them on furlough					✓						✓	
Ill personnel												
Early treatment of HCWs		✓										
Restrict ill HCWs from workplace		✓			✓							
Psychosocial support												
Address concerns and apply coping strategies. Provide specific emotional support services, and utilize various communication			✓		✓			✓		✓		

	Can. Pan. Flu Plan (2006)	PHNC Report (2007)	TAHSN (2006)	OHPIP (2008)	HHS Flu Plan (2005)	UK National Framework (2007)	UK Infection Control (2007)	Aust. Nat.Clin. Guidelines (2006)	Aust.Int. Inf. Cont. (2006)	AHMPPI (2008)	France (2007)	Goldfrank PPE (2008)
means.												
Post-influenza syndrome assessment to determine "return to work" status								✓				
Communication with HCWs												
Healthcare facilities should ensure that employees have ongoing access to information regarding progress of the pandemic, work-related issues, family issues, and healthcare issues.					✓							
Deployment (ill, at-risk, recovered staff)												
HCWs are considered "fit to work" when they have recovered from ILI, have been immunised, or are on appropriate antivirals.	✓		✓	✓	✓		✓		✓			
Symptomatic HCWs are considered "unfit to work with restrictions."	✓		✓	✓								
HCWs with ILI are considered "unfit to work."	✓		✓	✓			✓					
Personnel Health Monitoring												
Assessment/screening of staff with signs and symptoms of ILI			✓				✓		✓			
Access to antiviral treatment			✓				✓					

3. Engineering Controls

3.1 Infrastructure

It is widely recognised that preparation for the next pandemic requires that infrastructure be in place during the interpandemic period.[3] Many of these measures are most effectively implemented during the original design and planning stages for new buildings; however, the SARS outbreak in Toronto demonstrated that many can be retro-fitted in emergency situations.[a]

The transmission of influenza virus is affected by the relative humidity of the room and by diminished ventilation (which enhances transmissions).[b] Ultraviolet irradiation has been indirectly shown to potentially reduce airborne transmission of influenza.[c] There is no scientific evidence that influenza can be spread through ventilation systems or through prolonged residence in air.[49]

Despite the importance of engineering controls as the first level of protection in the hierarchy of controls, there were few recommendations in the guidelines reviewed, with only 5 having specific recommendations.

Canada

Influenza Transmission and the Role of Personal Protection Respiratory Equipment: An Assessment of the Evidence (2007)

Engineering controls include physical controls such as ventilation requirements, relative humidity and temperature controls.[d] In healthcare facilities, ultraviolet lighting and negative pressure rooms may be used to interrupt long distance transmission. Engineering controls also include measures to increase the space between people (eg, how far apart desks are placed in schools[e] or chairs in medical clinic waiting rooms); to prevent splashing from persons coughing or sneezing (eg, glass enclosures in the triage area of emergency departments, or at cashiers' cubicles); and to facilitate hand hygiene (eg, the placement of sinks outside patient rooms in hospitals). Engineering controls will minimise exposure to any infectious agent and are an important component of infection prevention programs in institutions. The biggest benefit of engineering controls is the fact that their effectiveness is not dependent on individual practice.[46]

Ontario Health Plan for an Influenza Pandemic. 2008.

Protection of HCWs from infectious diseases may be best achieved using a hierarchy of controls (ie, at the source, along the path, and with the HCW). Reducing the risk of influenza transmission in the workplace requires a comprehensive strategy, inclusive of engineering controls that make the work environment or setting safer. Engineering controls are the first and most effective line of defence against short-range inhalation transmission because they involve permanent changes in the healthcare

a Loutfy MR, Wallington T, Rutledge T, Mederski B, Rose K, Kwolek, S. (2004) "Hospital Preparedness and SARS", *Emerg Infect Dis*, 10, 771-776.

b Schulman J, Kilbourne, ED. (1962). Airborne transmission of influenza virus infection in mice. *Nature* 195: 1129–130.

c McLearn R. (1991). American Review of Respiratory diseases. 83 Part 2:36.

d American Industrial Hygiene Association - AIHA (2003) "The Occupational Environment: Its Evaluation, Control and Management" 2nd Edition. DiNardi SR, Ed. AIHA Press: Arlington.

e Feigin RD, Baker CJ, Herwaldt LA, Lampe RM, Mason EO, Whitney SE. (1982) "Epidemic Meningococcal Disease in an Elementary-School Classroom". *N Engl J Med*, 20, 1255-1257.

setting that reduce exposure to influenza, and eliminate the risk of human error or non-compliance with recommended practices. Developing physical environments that can reduce the spread of the disease is also cost-effective, and should be a priority when building or renovating facilities. Existing facilities should review their capital plans to assess the impact of the physical environment on health and safety, and make improvements (eg, traffic flow, barriers, positioning of chairs in waiting areas) wherever possible.[47] The following are examples of engineering controls:[47]

- Physical barriers, including acrylic partitions (sneeze guards) in triage, waiting areas or other high risk zones;
- Space/design plans for wards and waiting areas that keep sneezing and coughing patients at least 2 metres away from other patients if possible, or have separate areas for people with ILI;
- Equipment such as sinks, tissues, and disposable towels in every patient's room as well as alcohol-based hand rub and no-touch trash cans in key locations throughout the healthcare setting;
- Surfaces in patient-care areas easy to clean, combined with appropriate cleaning procedures (administrative and work practice);
- Ventilation systems that are designed and maintained in accordance with CSA Standards and Special Requirements for Heating, Ventilation and Air Conditioning (HVAC) Systems in Health Facilities and the American Society of Heating, Refrigeration, Air Conditioning Engineers (ASHRAE) Standards;
- Airborne infection isolation rooms (AIIR) or negative-pressure rooms for aerosol-generating procedures, monitored for compliance with CSA standards prior to use.

USA

HHS Pandemic Influenza Plan. 2005.

The HHS plan only includes recommendations for infrastructure in the laboratory and refers to H5N1 in particular.[49] Laboratory specimens should be handled under BSL-2 standards at all times. BSL-3 standards should be used where a specimen is positive for H5N1.[a]

BSL-3 with enhancements and Animal Biosafety Level 3 include: all BSL-3 practices, procedures, and facilities, plus the use of negative-pressure, HEPA-filtered respirators or positive air-purifying respirators, and clothing change and personal showering protocols. Additional practices and/or restrictions may be added as conditions of USDA-APHIS permits. Registration of personnel and facilities with the Select Agent Program is required for work with highly pathogenic avian influenza (HPAI) viruses, which are classified as agricultural select agents.

Commercial antigen detection testing for influenza may be conducted under BSL-2 containment conditions if a Class II biological safety cabinet is used. Clinical specimens from suspected novel influenza cases may be tested by RT-PCR using standard BSL-2 work practices in a Class II biological safety cabinet for initial processing. If a specimen is confirmed positive for influenza A (H5N1) by RT-PCR, additional testing should be performed only under BSL-3 conditions with enhancements.

a http://www.cdc.gov/od/ohs/biosfty/bmbl4/bmbl4toc.htm

Interim Guidance on Planning for the Use of Surgical Masks and Respirators in Health Care Settings during an Influenza Pandemic. 2006.

Work activities such as those performed by a receptionist at the entrance of a hospital should be designed to prevent exposure of the worker to large numbers of potentially infected patients. In such situations, the use of transparent barriers or enclosures is preferable to the use of respirators.[51]

If possible, airborne infection isolation rooms should be used when performing high-risk aerosol-generating procedures. If workflow, timing, resources, availability, or other factors prevent the use of airborne infection isolation rooms, it is prudent to conduct these activities in a private room (with the door closed) or other enclosed area, if possible, and to limit personnel in the room to the minimum number necessary to perform the procedure properly.[51]

Negative-pressure isolation is not required for routine patient care of individuals with pandemic influenza.[51]

Australia

Interim Infection Control Guidelines for Pandemic Influenza in Healthcare and Community Settings. 2006.

Proper ventilation can be expected to reduce the concentration of airborne organisms in enclosed spaces.[61] The order of priority for patient room placement is:[61]

1. Negative pressure isolation room
2. Single room (ideally with hand-washing facilities, toilet-bathroom facilities and an anteroom to support the use of PPE)
3. Area designated for cohorting of pandemic influenza patients

In a pandemic situation, it would not be possible to provide special air-handling facilities for every influenza patient (ie, independent air supply and exhaust system or negative pressure rooms). This would particularly be the case in “fever clinics” which might be in buildings not originally designed for this purpose. Part of the process of planning for these clinics should include an assessment of existing mechanical (or natural) ventilation and adjustments necessary to increase outdoor air ventilation rates and reduce the proportion of recirculated air where appropriate, and without necessarily rebuilding the systems.[61]

Summary of Recommendations

Engineering controls comprise a vital component of infection prevention programs in institutions. Engineering controls are the first and most effective line of defence against short-range inhalation transmission because they involve permanent changes in the healthcare setting that reduce exposure to influenza, and they eliminate the risk of human error or non-compliance with recommended practices or use of PPE. The biggest benefit of engineering controls is that their effectiveness is not dependent on individual practice. Their largest drawback is that engineering controls are most effectively implemented during the original design and planning stages of new buildings.

Evidence-based knowledge relating to engineering controls gleaned after reviewing the various guideline recommendations is minimal with limited references supporting the aforementioned engineering control recommendations.

Recommendation	Canada CCA on PPRE	OHPIP	CDC Mask use	Australia
Use barriers at triage and reception	✓	✓	✓	
Negative-pressure rooms required for routine use			Against	✓
AIIR for aerosol-generating procedures		✓	✓	

Appendix IV. Antiviral Prophylaxis Literature Review Results

Purpose

To identify recommendations from literature review to answer the population, intervention, comparison, outcome (PICO) question:

Should otherwise healthy healthcare workers in first-line settings during pandemic flu (population) *receive antiviral prophylaxis* (intervention) *compared to no intervention* (comparison)*?*

P	Otherwise healthy HCW in first-line setting during pandemic flu period
I	Antiviral prophylaxis
C	No intervention
O	• Rate of infection • Time-off work • Adverse events • Mortality • Transmission (to patients/family/other staff) • Viral resistance • Cost • Opportunity cost

Summary of Findings

Outcome	Pre-exposure prophylaxis	Postexposure prophylaxis	Comments
Rate of infection	• Evidence from seasonal flu indicates efficacy against confirmed influenza (oseltamivir 64%, zanamavir 43%)	• Evidence from seasonal flu indicates efficacy against confirmed influenza (oseltamivir 68%–89%, zanamavir 79%–81%)	• Similar efficacy for preventing infection for both pre- and postexposure prophylaxis
Time-off work (absenteeism)	• May reduce absenteeism (from models) • Greater benefit in more severe pandemic • Benefit lost if prophylaxis begun too early	• No articles identified	• The only study of absenteeism and prophylaxis in HCWs supports the use of pre-exposure prophylaxis
Mortality	• Population-based strategy may increase the number of lives saved compared to a treatment-based strategy (from model)	• No articles identified	• Population-based pre-exposure prophylaxis may increase the number of lives saved • There were no data on the effect of prophylaxis for HCWs on mortality
Transmission and population rates	• Substantially reduce transmission, especially early in an outbreak, by up to 72% (from models) • May delay progression and reduce magnitude	• Population-based strategies can contain outbreaks and reduce population attack rates (from models) • May select resistant strain and thereby increase attack rate	• Modelling of pre-exposure prophylaxis in HCWs suggests it may have population benefits • Postexposure prophylaxis can contain outbreaks when implemented on a population level
Safety	• No significant adverse reactions • Oseltamivir induces nausea	• No significant adverse reactions	• Both oseltamivir and zanamavir safe and well tolerated as prophylaxis

Viral resistance	• No reports of resistance • Widespread use may select for a resistant strain to become dominant (population-based model)	• No reports of resistance • Excessive use may select resistant strain and lead to poorer population outcomes (population-based model)	• Models of both pre- and postexposure prophylaxis in a population setting suggest that excessive use may contribute to the dominance of a resistant strain.
Cost	• High economic costs • Requires more stockpiling • Economically beneficial in high-risk groups (from model; did not consider health outcomes) • Lost treatment opportunity	• Favourable cost-benefit ratio similar to treatment	• Pre-exposure prophylaxis incurs greater economic and opportunity costs and requires more stockpiling, but is economically beneficial in high-risk groups

Introduction

During an influenza pandemic, healthcare workers (HCWs) are at far greater risk of infection than the general population, despite the appropriate use of personal protective equipment (PPE). While the use of such equipment may decrease the risk of transmission for an individual encounter with an infectious patient, the sheer number of encounters over the course of a working day would probably still result in disease transmission. Even with excellent infection control practices, attack rates of greater than 10% are likely to occur among HCWs in the absence of vaccination.[1,2]

Since a sizeable proportion of HCWs may become infected early due to increased exposure, there will likely be reduced capacity of the healthcare system at a time where there will be a surge in demand.[1,3] It should be emphasized that keeping HCWs in place is critical not just to respond to the needed care of pandemic influenza patients, but also to prevent deaths from all other causes.[1]

As a pandemic would not be limited to hospitals but would also involve the community, the best protection for HCWs would be one that provides constant protection both inside and outside the hospital.[4] It is suggested, therefore, that antiviral agents are an important control strategy for both treatment and prophylaxis during a pandemic, including either pre-exposure ("seasonal") or postexposure prophylaxis strategies for HCWs, especially those who are unvaccinated or only recently vaccinated.[1,5]

Modelling of pandemic influenza situations suggest that apart from directly protecting the staff and subsequent absenteeism, this may have indirect benefits as well, such as reducing transmission and reducing the size of a pandemic and delaying its onset—in fact, a combination of prophylaxis with early treatment may result in the optimal outcome.[6,7] Data from a postexposure prophylaxis study provides evidence that control of an influenza outbreak (epidemic or pandemic) is not solely based on

treatment of developing cases, but on a strategy involving prophylaxis.[8] It is likely that the optimal strategy combines treatment and prophylaxis strategies.[7]

Neuraminidase inhibitors (NIs) oseltamivir and zanimivir are suggested as the drugs of choice—compared to the alternative of M2 inhibitors amantidine and rimantidine—due to a greater breadth of spectrum (both influenza A and B), modest side-effect profiles, and a lack of clinical drug resistance development, although there are no head-to-head trials between the 2 groups.[9]

In fact, direct evidence for the effectiveness of antiviral prevention and treatment strategies—or even vaccine prevention strategies—for reducing the health impacts of a pandemic is extremely limited. Whilst there are some data for M2 inhibitors from previous pandemics, there are none for NIs.[10,11] The evidence, therefore, for the effectiveness of antiviral prophylaxis arises from clinical trials in seasonal flu and mathematical modelling using pandemic influenza scenarios. Since M2 inhibitors are not recommended for prophylaxis, [11,12] this review focuses only on NIs. Both long-term, seasonal pre-exposure and targeted postexposure prophylaxis strategies are considered.

Efficacy of Prophylaxis

The main measures of efficacy of antiviral prophylaxis in HCWs were defined as:

- Rate of infection
- Absenteeism
- Mortality
- Transmission and effect on pandemic

Rate of infection

The efficacy of NIs in pandemic influenza has not been established,[13] but it has been suggested that, in the absence of drug resistance, prophylaxis is likely to be as effective against pandemic influenza as it is against current seasonal influenza.[14]

Both oseltamivir and zanamavir have been demonstrated as effective in preventing laboratory-confirmed clinical influenza in healthy adults when used as either postexposure prophylaxis for close and household contacts, or as seasonal prophylaxis in the wider community.[9] There is a limited set of controlled trials for antiviral prophylaxis with oseltamivir[15-17] or zanamavir[18,19] that form the basis for much of this evidence. These trials are population-based—for example, using household contacts and closed-care settings—and are not specific to HCWs.

In their Cochrane review, Jefferson et al demonstrated that, for seasonal influenza, compared to placebo, pre-exposure prophylaxis with oseltamivir confers 64% protection against symptomatic and asymptomatic influenza (RR 0.46, 95% CI 0.31 to 0.68) at a dose of 75 mg daily. An increase to 150 mg daily does not appear to enhance its activity (RR 0.48, 95% CI 0.29 to 0.80) although this observation is based on a single study. Similarly, zanamivir has a 43% protective effect (RR 0.67, 95% CI 0.50 to 0.91) and based on a single study the addition of intranasal dose does not appear to enhance its activity (RR 0.77, 95% CI 0.38 to 1.56). This effect is significant in symptomatic influenza, but no significant effect was seen for the outcome of asymptomatic influenza. In addition, there was no effect against influenza-like illness (Table 10).[20]

In the same review, Jefferson et al reported that the efficacy of postexposure prophylaxis with oseltamivir was 68%–89%. Zanamavir was reported to have an efficacy of 79%–82%.[20]

These results are supported by a number of other reviews and analyses.[5,8-11,21-29]

Table 10: Efficacy of neuraminidase inhibitor prophylaxis[20]

Outcome	Pre-Exposure		Postexposure	
	Oseltamivir 75mg Efficacy (RR, 95% CI)	**Zanamavir 10mg Efficacy (RR, 95% CI)**	**Oseltamivir 75mg Efficacy for individuals**	**Zanamavir 10mg Efficacy for individuals**
Influenza-like illness	NS (RR 1.28, 0.45–3.66)	NS (RR 1.51, 0.77–2.95)		
Confirmed influenza (symptomatic or asymptomatic)	64% (RR 0.46, 0.31–0.68)	43% (RR 0.67, 0.50–0.91)	68%–89%	79-81%
Symptomatic influenza	61% (RR 0.39, 0.18–0.85)	62% (RR 0.38, 0.17–0.85)		72%–82%
Asymptomatic influenza	NS (RR 0.73, 0.43–1.26)	NS (RR 1.63, 0.99–2.67)		

NS = not significant

The only evidence for antiviral prophylaxis during a pandemic influenza comes from prospective, controlled trials on the seasonal use of adamantanes for prophylaxis undertaken during the 1968 Hong Kong influenza pandemic and the 1977 Russian pandemic-like event. These trials estimated efficacy against confirmed cases of influenza A illness as 59%–100% during the 1968 pandemic and 31%–71% during the reemergence of H1N1 in 1977. The estimated overall efficacy rate was 60%–70%, which is somewhat lower than the rates noted in similar studies during interpandemic years, but it is still clinically useful. Of interest, the efficacy against seroconversion, irrespective of symptoms, was lower, averaging 30%. This observation suggests that individuals receiving prophylaxis experienced subclinical or immunising infections. Similar rates of efficacy have been included in modelling the use of NIs for prophylaxis in potential pandemics.[21,30]

Absenteeism

One would expect that prophylaxis of HCWs may alleviate absenteeism by reducing the risk of infection well as concerns over exposure to infection in the workplace.[1]

In a model of HCW absenteeism during pandemic flu (modelled as $R_0 = 2.5$, duration of 12 weeks), Lee and Chen demonstrated that, when no action is taken, HCW absenteeism peaks at approximately 10%, although they admit absenteeism levels will likely be elevated. A strategy of treatment with antivirals reduced this peak to 8%, whereas providing 8 weeks of pre-exposure prophylaxis achieved peak absenteeism of approximately 2%. Prophylaxis for only 4 weeks resulted in greater peak

absenteeism compared to treatment only. Further analysis showed 6 weeks of prophylaxis was sufficient to have a benefit over treatment only.[3]

Across all R_0, insufficient duration of prophylaxis increased peak absenteeism compared with results for treatment only.[3] For prophylaxis strategies to accrue more benefits than treatment only, the prophylaxis duration must be sufficient to cover the pandemic peak. Eight weeks of prophylaxis, the maximum safe duration previously studied, was sufficient to provide a substantial reduction in peak absenteeism under a broad range of assumptions for more severe pandemics where peak absenteeism exceeded 10%.[3]

Improved surveillance, critical for early detection, paradoxically increases the likelihood of initiating prophylaxis too early, causing predetermined stockpile durations to be inadequate. If prophylaxis is started prematurely, stockpiles will be exhausted before the delayed waves of the pandemic occur and thus will not reduce absenteeism more than would treatment only.[3]

Pandemics of lesser severity place fewer requirements on essential services. Such pandemics also result in lower staff absenteeism rates; treatment and prophylaxis may thus be less critical to service continuity. On the contrary, severe pandemics increase strain because of the increased number of patients, hospitalisations, and deaths, as well as the reduced response capacity of healthcare services. For pandemics with high mortality rates, high growth rates, or high R_0, prophylaxis provides greater benefits than it does for pandemics with lower mortality rates, low growth rates, or low R_0; and the required duration of prophylaxis is shorter.[3]

In a model of population-based, pre-exposure prophylaxis, Eichner et al showed that if only a few people receive prophylaxis, their work loss can be less than half of the value without prophylaxis, especially if the fitness of the resistant strain is low. For strains with a fitness of less than 92%, up to 20% may benefit from prophylaxis. For strains with higher fitness, the expected work loss can be worse than without prophylaxis, if 10% or more of the population receive prophylaxis.[31] This may mean that limiting prophylaxis to essential services increases the probability of its effectiveness.

Mortality

One model reported that a population-based, pre-exposure prophylaxis strategy resulted in more lives saved than a treatment-based strategy, with longer prophylaxis achieving greater results.[32] No literature was identified on the impact of antiviral prophylaxis on mortality among HCWs.

Transmission and Population Rates

Antiviral prophylaxis with oseltamivir has been shown to reduce viral shedding, and may therefore have an impact on transmission and pandemic or epidemic progression.[8] Combined treatment and prophylaxis is likely to represent optimal use of antiviral agents to control transmission.[33]

Antiviral prophylaxis of HCWs has not been demonstrated to have any significant effect on the averaged control reproduction number (R). Despite this, a pre-exposure prophylaxis strategy for HCWs has been demonstrated to have a substantial impact on the transmission of infection, especially in the early stages of an outbreak. The mean proportion of infections that can be directly attributable to HCWs in the early stages of an epidemic is disproportionately large. Protection with PPE and pre-exposure prophylaxis for HCWs can reduce the probability of a minor outbreak through limiting the

spread of infection (number of general population cases reduced by 72%) and reducing disease-related mortality (reduced by 73%).[1,2] This approach, in turn, protects healthcare workers' families and is likely to enable the healthcare system to continue to function.[2]

For population demographics similar to those of Ontario, Canada, the findings suggest that with the full prophylaxis coverage of HCWs, a 45% reduction in population morbidity is achievable. The overall healthcare benefit of prophylaxis strategy may be much greater than other protective measures, and may contribute to a significant delay in the progression of the epidemic and substantially reduce the magnitude of the disease outbreak.[1]

Antiviral prophylaxis of HCWs, however, may not be considered as a disease control measure if the treatment of clinical infections fails to prevent the occurrence of an outbreak.[1]

The benefits of prophylaxis on epidemic or pandemic spread have also been demonstrated in models of population-based prophylaxis. Population-based studies have shown that postexposure prophylaxis of close contacts or "ring prophylaxis" can contain an epidemic at the source.[34,35] Models of targeted prophylaxis for close contacts have demonstrated greatly reduced population attack rates, as well as a delay in the epidemic peak, which may allow time for development of a vaccine.[8,36]

In another study of population-based prophylaxis, however, Eichner et al demonstrated that pre-exposure antiviral prophylaxis may lead to increased treatment failure through preferential transmission of a drug-resistant strain. If the fitness of the resistant virus is between 90% and 100%, prophylaxis increases the total number of cases and hospitalisations.[31] It is suggested that prophylactic use of NIs in a serious epidemic or a pandemic could enhance vulnerability to infection by preventing seroconversion and facilitating the selection of resistant viral strains.[11]

Safety

Oseltamivir and zanamivir are generally safe for prophylaxis or treatment of influenza A and influenza B.[22]

Data from treatment trials indicate that nausea, vomiting, and headache are the most common adverse effects of oseltamivir and can be reduced by taking the medication with food. Zanamivir is relatively free of adverse events in treatment trials, but can cause cough, nasal and throat discomfort, and rarely bronchospasm or decreased lung function.[22,23]

Significant adverse reactions are absent with the administration of oseltamivir prophylaxis at 75 mg daily per day for up to 8 weeks,8 although it induces nausea (RR 1.79, 95% CI 1.10–2.93).[20] Oseltamivir is generally well-tolerated. The most common adverse events are transient upper gastrointestinal complaints which resolved within 1–2 days, and headache. Patients who experience nausea, vomiting, and other complaints of the stomach may tolerate zanamivir better than oseltamivir.[5]

Viral Resistance

One of the reasons that M2 inhibitors are not recommended are their association with the emergence and transmission of resistant strains.[5,9,12,14,37]

NIs appear to be associated with a lower frequency of resistance emergence and transmission than M2 inhibitors.[30] Viral resistance can occur in vitro to either oseltamivir or zanamivir, but so far it has been

uncommon in immunocompetent adults treated for acute influenza. Person-to-person transmission of virus resistant to oseltamivir or zanamivir has not been documented to date. Influenza A viral strains resistant to amantadine and rimantadine generally remain susceptible to NIs. Zanamivir has been active against oseltamivir-resistant strains.22 Prophylaxis studies have not reported any development of resistance.[8]

Population-based models, often assume the development of resistance to NIs with antiviral drug use. Eichner et al demonstrated that population-based, pre-exposure prophylaxis increases the pressure on the drug-sensitive strain and favours the transmission of the resistant strain. This effect is increased with a greater percentage of the population receiving antiviral prophylaxis, as well as with increased viral fitness.[31] This is supported by the model of Lipsitch et al, who suggest that excessive use of antivirals for treatment or postexposure prophylaxis will lead to a worse epidemic outcome than moderate use.[6] Modelling results of a pandemic outbreak in the United States suggest that the best control strategy to prevent resistance emergence and reduce the total number of infections is early intervention heavily-based on prophylaxis, either pre- or postexposure, at a level that leads to outbreak containment.[38]

Cost

One calculation has estimated the cost of a 12-week prophylaxis course of oseltamivir at nearly $550 per person.[13] This is a significant amount when considering the size of the population that is eligible for prophylaxis. In addition, providing enough antivirals to HCWs for the duration of the pandemic will require stockpiling massive quantities.[1] Current stockpiles are not sufficient to allow for both adequate treatment of expected case loads and prophylaxis. Acquisition methods impact the cost of antivirals. Antivirals purchased from community pharmacies may have a much higher cost per prophylaxis course; however, when bought in bulk quantities for healthcare institutional purposes, there may be a significant reduction in the cost per unit.

Antiviral stockpiling has been calculated to have a favourable cost-benefit ratio if the supplies are used in pandemic for treatment or for short-term, postexposure prophylaxis.[39] In one simulation, pre-exposure prophylaxis resulted in more lives saved than treatment, although stockpiling costs for treatment was elevated. Prophylaxis was only economically beneficial compared with no action in subpopulations at high risk. In low-risk groups with low death and hospitalisation rates, increasing prophylaxis duration decreased economic benefit and increased cost per life saved. These analyses did not take into account the value of health, but are purely economic.[32]

Opportunity cost

Apart from the diversion of health budget into stockpiling in the interpandemic period, the main opportunity cost of a prophylaxis strategy is the ability to provide antiviral treatment during a pandemic. Each 1000 persons receiving antiviral prophylaxis for 8 weeks would require approximately 56,000 doses. In contrast, for a clinical attack rate of 35%, 3500 doses would be needed for treatment at currently recommended doses—a 16-fold difference.[21]

It is suggested that countries with limited supply should utilise antivirals strictly as therapy and not prophylaxis.[7]

Prophylaxis Priority

It is realistic to assume that available antiviral supplies would be insufficient to cover all groups identified in the healthcare setting during the immediate period following a pandemic outbreak.[13] Prophylaxis of a fraction of the total population will likely require many more doses of antivirals and is more problematic logistically compared with the treatment of infections. This could be prevented by using targeted prophylaxis.[38]

HCWs in close (< 1 metre), prolonged, and repeated contact, and those with close, but not prolonged or repeated, contact with high-risk patients in high-risk units (eg, intensive care units and emergency departments) are identified as the highest priorities for antiviral prophylaxis within the hospital system.[13]

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