Pandemic infection control for critical care

JE Enstone, BL Taylor, P Acheson, JS Nguyen-Van-Tam

Pandemic context

Internationally, it is recognised that an influenza pandemic is inevitable and, some would argue, overdue. Although it is impossible to predict the timing of such an event, if the next pandemic starts in South East Asia as is often predicted, because of international travel it is estimated that it will reach the UK within two to four weeks,[1] perhaps sooner. An influenza pandemic will occur when a novel influenza virus emerges to which all or most of the population have no immunity and which spreads efficiently from person to person. This may originate from an avian influenza virus eg A/H5N1, which adapts to the human host, as was probably the case in 1918. Alternatively, it may emerge through genetic recombination of an avian and a human influenza virus, as probably happened in the pandemics of 1957 and 1968.

Given the likelihood of an influenza pandemic, and its colossal impact, governments across the world and international bodies are developing plans to minimise the health, economic and social impact of such an event. The UK is ahead of many countries in this respect. A host of documents are available to the health and other services essential to national infrastructure, including a national framework for responding to an influenza pandemic, clinical management guidelines, planning guidance for acute hospitals and other sectors, and infection control guidance. All these and many other documents are available via the websites of the UK Departments of Health, the Cabinet Office (Civil Contingencies Secretariat) and the Health Protection Agency.

Predictions based on previous pandemics indicate that clinical attack rates will be high (up to 50%) and almost all the population will potentially be at risk. However, case fatality rates are likely to be much lower than those currently described for avian influenza A/H5N1 (60%), with even the worst pandemic of the twentieth century (1918) producing a case-fatality rate of roughly 2.5%. The Department of Health (UK) is planning to increase the stock of antiviral drugs to cover treatment for all symptomatic people at a clinical attack rate of up to 50%. It also plans to procure almost 15 million treatment courses of antibiotics to manage the bacterial complications arising from pandemic influenza.

The ubiquitous nature of a pandemic virus means that critical care staff, as with other healthcare staff, are just as likely to encounter pandemic influenza in settings associated with normal daily living, e.g. in the family home, as they are in the workplace. This is a crucially important contextual difference from the situation currently seen with human cases of avian influenza and the previous situation observed during the SARS epidemic. In addition, although influenza virus may be recovered experimentally from infected people before they show symptoms, there is little published evidence to support person to person transmission of influenza from an infected but pre-symptomatic individual to a non-infected but susceptible person.

Infection control guidance

Infection control guidance in the event of a pandemic is required for the general public, occupational and care settings and across a wide range of healthcare settings from dental practices to critical care units. Such guidance has been developed by the Department of Health and the Health Protection Agency working with relevant cross-government groups. Although the available guidance for hospitals and primary care settings[2] is comprehensive, it is also lengthy. Given the clinical pressures on staff working in critical care and high dependency areas, and the particular requirements in these areas, infection control guidance which focuses in more detail on issues relevant to such areas has also been made available and has just been published on the Department of Health website.

Current infection control advice has been developed on the assumption that pandemic influenza will have similar transmission, communicability and inactivation properties as seasonal influenza. In the event of a pandemic, if this proves not to be the case the advice will be updated and quickly disseminated. So although the spectrum of illness with pandemic influenza cannot be predicted, given the nature of seasonal influenza and the likelihood of respiratory complications, there are likely to be extreme pressures on critical care and high dependency facilities.

Whilst recognising the particular respiratory issues more relevant to critical care and high dependency settings, the importance of standard and basic infection control procedures cannot be overstated. Transmission almost certainly occurs through multiple routes.[3] The balance of evidence (admittedly limited and much of it based on old studies) currently points to transmission of influenza mainly by droplets or through direct and indirect contact as the most important modes of transmission. Aerosol transmission may also occur in certain situations[4] but is hotly debated.[5] However, the relative benefits of precautions for short range (droplet), aerosol/airborne and contact transmission are under debate and there is insufficient evidence to establish a clear hierarchy for transmission modes. New studies are urgently required to investigate and address these issues.

Administrative (e.g. signage and the control of healthcare worker deployment) and environmental (e.g. enhanced cleaning and segregation) controls play an important role in minimising the transmission of infection. Plans for such controls should be made well in advance. Cohorting (grouping patients together who have the same infection and no other infection) in segregated areas should be carried out from the outset of the pandemic to help contain influenza and reduce the risk to other patients. In addition to patient segregation it is desirable wherever possible to have different staff caring for 'flu' and 'non-flu' patients.

The practicalities of working within cohorted areas need to be considered. For example, measures should be taken to ensure borders to cohorted areas are clearly and sensibly defined so staff do not have to pass through them on their way to other areas, and arrangements should be made for changing facilities and refreshments within these areas. Appropriate entry/exit arrangements should be in place to ensure staff/visitors can exercise required infection control procedures, including donning and removing of personal protective equipment (PPE), with the minimum risk of contaminating themselves, others and the surrounding area.

In addition to the controls already detailed, personal behaviour to reduce transmission is also important – good hand and respiratory hygiene are particularly vital. Other precautions such as wearing a fluid-repellent surgical mask will minimise contamination of the nose and mouth by droplets from infected patients, and gloves and a plastic apron (or gowns when appropriate) should be worn when in close contact with a patient. In a recent systematic review, a meta-analysis of six case-control studies assessed the impact of several measures taken to reduce the spread of SARS. Frequent handwashing, wearing masks, wearing gloves and gowns were amongst the measures found to be effective.[6]

Epidemiological evidence has defined the area of risk around the patient as being a distance of less than one metre[7] although recent US guidance suggests that this should be used as an approximation rather than an absolute distance.[8] Nonetheless, using one metre for donning surgical masks has been considered effective in the past in preventing transmission of infectious agents via the droplet route. On occasion, respiratory protection in the form of FFP3 respirators will be required, for example during aerosol-generating procedures. The level of PPE and respiratory protection required will vary according to the procedure being carried out, and the critical care guidance provides this.

Aerosol-generating procedures

Some procedures with potential to generate aerosols have been associated with an increased risk of disease transmission. However, the risk associated with many aerosol-generating procedures is not yet well defined, and the understanding of the aero-biology involved in such procedures may change as further studies in this area are carried out.

In a recent publication, WHO list some procedures associated with a documented increase in risk of pathogen transmission in patients with acute respiratory disease.[9] Those specified are intubation and related procedures, e.g. manual ventilation and suctioning; cardiopulmonary resuscitation; bronchoscopy; and surgical procedures (and post-mortems) in which high-speed devices are used. Other procedures are also detailed in the same publication as ones which may be associated with an increased risk of pathogen transmission. These are termed procedures with a 'controversial/possible' increase in risk of pathogen transmission and include non-invasive positive pressure ventilation (NIV), high-frequency oscillating ventilation and nebulisation. However some of the studies by which they were identified as procedures carrying such a risk have methodological flaws that preclude using the study conclusions to make recommendations. Overall the risk associated with various aerosol-generating procedures is still unclear and under debate. For this reason, for procedures with a 'controversial/possible' increase in risk of pathogen transmission, current advice in the document is that use of an FFP3 respirator instead of a surgical mask may be considered prudent until data are available that allow better assessment of the risk associated with different procedures.

Almost all aerosol-generating procedures will also generate copious splashes and droplets, so it is important that standard infection control principles and droplet precautions remain critical at all times for all close patient contact. Although the preferred option would be to perform any potential aerosol-generating procedures in side-rooms or other closed single-patient areas it is acknowledged that, owing to urgency or limitation of such areas, this will generally not be achievable during a pandemic. It is therefore recommended that strict compliance to other components of infection control are adhered to in order to reduce the risk of disease transmission.

Case-mix issues make it inevitable that some aerosol-generating procedures are more likely to be carried out on critical care units than in many other areas of a healthcare setting. It is therefore important that particular preparation is carried out in such units. Assessment of stocks of PPE, bacterial/viral filters and other consumables/essential equipment should be carried out prior to the onset of a pandemic. When considering FFP3 respirators, attention should be paid not only to the likely quantity required but also to the fact that one make/brand of respirator is unlikely to fit all staff members and a range of models may be required.

Some units have conducted simulation studies over a 24-48 hour period by 'pretending' that the critical care unit is operating during the height of a pandemic period, and by adopting PPE and other administrative and environmental controls in accordance with national guidance. Although such exercises have resource implications, invaluable practical lessons have always been learned.

Other respiratory issues

The critical care setting can present some situations which may pose an increased risk for potential exposure to respiratory secretions. In patients receiving mechanical ventilatory support, pressures within the breathing circuits of ventilated patients are higher than those used for spontaneously breathing patients; high oxygen flow rates may also be required for spontaneously breathing patients who are in a precarious

condition and there exists the possibility that such severely ill patients will have higher viral loads and hence a greater risk of disease transmission.

The use of NIV and the risks it may pose to healthcare workers was debated during the SARS outbreaks in Canada and Hong Kong.[10,11] However, this was complicated by other factors including a lack of use of PPE, and other studies have shown NIV can be used effectively and safely in such situations if infection control procedures are strictly followed and guidance on NIV is provided. This is an area of current uncertainty which would benefit from further research.

In conclusion, it is important to be aware of the differences between the three separate contexts of avian influenza, the situation that occurred during the SARS epidemic, and pandemic influenza. Avian influenza is a disease of birds which has on occasion caused illness in humans and has to date demonstrated a high case fatality rate. However human cases of this disease are rare, limited spread between humans has only been documented on a few occasions and the risk of human-to-human transmission remains very low in the current WHO Pandemic Alert Phase 3. Avian influenza is therefore a high-mortality disease in humans but is low risk in terms of numbers and risk of transmission. Pandemic influenza will be ubiquitous and critical care staff are likely to encounter pandemic influenza away from the hospital eg at home where PPE will be unavailable and impractical, as well as during the course of their work.

Many factors were considered in developing the guidance. Scientific evidence, Health & Safety and patient and staff protection were key issues, as were practicality and delivering confidence to staff during a pandemic. Although the clinical severity of the next influenza pandemic cannot be reliably predicted, it is almost certain that there will be enormous pressures on the health service in every respect. Demand will exceed supply, especially in areas such as critical care, and difficult choices will have to be made. Planning for enhanced infection control now will maximise the chances of a successful pandemic response in the NHS.

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Joanne E Enstone Research Co-ordinator, Influenza Transmission and Infection Control Measures, University of Nottingham
joanne.enstone@nottingham.ac.uk

Bruce L Taylor ICS Representative for Pandemic Planning, Consultant in Critical Care Medicine, Portsmouth Hospitals NHS Trust

Peter Acheson Consultant in Health Protection, North East Health Protection Unit (formerly Health Protection Agency, Pandemic Influenza Office)

Jonathan S Nguyen-Van-Tam Professor of Health Protection, University of Nottingham (formerly Head of Pandemic Influenza Office, Health Protection Agency)