How pandemic H1N1 influenza is controlled in Indian hospitals

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Abstract

Influenza has been recognized as a respiratory disease in swine since its first appearance concurrent with the Swine Influenza is a respiratory disease of pig caused by Type A influenza viruses. Influenza A causes moderate to severe illness and affects all age groups. The virus infects humans and other animals. The WHO declared the H1N1 pandemic on June 11, 2009, after more than 70 countries reported 30000 cases of H1N1 infection. In 2015 the instances of Swine Flu substantially increased to five year highs with over 12963 cases reported and 774 deaths in India. Swine flu with high mortality and transfer rates is a worldwide health problem. Because of limited treatment regimen, the risk of secondary infection and high need to intensive care in H1N1 pneumonia, environmental control, including vaccination of high risk people and public announcement, make determining role in controlling of this disease. The CDC recommends real time PCR as the method of choice for diagnosing H1N1. Prevention of swine influenza has three components: prevention in swine, prevention of transmission to humans, and prevention of its spread among humans. If a person becomes sick with swine flu, antiviral drugs can make the illness milder and make the patient feel better faster. Antiviral drugs are most effective if they are started within the first 48 hours after the clinical signs begin, although they may also be used in severe or high risk cases first seen after this time. The CDC recommends the use of Oseltamivir (Tamiflu) or Zanamivir (Relenza) for the treatment.

Keywords: H1N1 Influenza, Clinical Features, Epidemiology, Diagnosis, Treatment.

INTRODUCTION

A pandemic occurs when a new viral strain appears, against which the human population has no immunity, resulting in epidemics worldwide with high mortality and morbidity (Ghosh et al., 2010). The influenza A virus has been responsible for three global pandemics in the last century: the Spanish Flu in 1918, Asian Flu in 1957 and the Hong Kong Flu in 1968 (Lim, 2009). Influenza virus outbreaks occur with regularity, but the severity of outbreaks differs. A prime example is the recent emergence of swine-origin influenza viruses A/H1N1 (SOIVs) that have transmitted to and spread among humans, resulting in outbreaks (Schnitzler and Schnitzler, 2009). India reported its first case on 13th May, 2008. Most of the cases reported subsequently were travel related cases among those traveling to India from affected countries. As on 20th August, 12,604 persons have been tested so far out of which 2401 are positive for Influenza A H1N1 [Swine]. Substantial number of cases now being reported from Maharashtra (Mumbai and Pune), Karnataka (Bangalore) and Tamil Nadu (Chennai)
are indigenous cases. Thirty six laboratory confirmed cases have died. Majority of those who died had some underlying diseases and have reported late to the identified health care facility (Pandemic Influenza A H1N1, 2015). The types of influenza virus found in pigs are known as swine influenza generally called swine flu or swine-origin influenza virus (S-OIV) (Smith et al., 2009). Swine Influenza is a respiratory disease of pig caused by Type A influenza viruses that causes regular outbreak in pigs (Schnitzler and Schnitzler, 2009; Ohwada et al., 1987). Influenza virus belongs to the genus Orthomyxovirus in the family Orthomyxoviridae which consists of influenza A, B and C viruses (Van Reeth, 2007) and has an envelope, single-stranded, negatively sensed RNA, eight separate segments and pleomorphic appearance with an average diameter of 120nm (Van Reeth, 2007; Das et al., 2011; Steel and Lowen, 2014; Pascua and Choi, 2014). Figure 1.

Epidemiology

The novel H1N1 strain which is responsible for the current outbreak of swine origin influenza was first recognized at the border between Mexico and United States in April 2009 and during a short span of two months became the first pandemic of the 21st century (Chang et al., 2009). Prior to this the same triple reassorted virus has been isolated in swine as early as 1998 with sporadic infections in humans as well (Olsen, 2002; Myers et al., 2007). The pandemic influenza A H1N1 2009 virus (A/2009/H1N1) finally arrived, causing the first pandemic influenza of the new millennium, which has affected over 214 countries and caused over 18,449 deaths (Vincent, 2012). It is estimated that the influenza pandemic that started with the 1918 Spanish flu killed 20 to 50 million people worldwide, followed by epidemics of Asian flu in 1957, Hong Kong flu in 1968 and Russian flu in 1977, each with random severe attacks on human populations (Ghosh et al., 2010). The H1N1 form of swine flu is one of the descendants of the strain that caused the 1918 flu pandemic. As well as persisting in pigs, the descendants of the 1918 virus have also circulated in humans through the 20th century, contributing to the normal seasonal epidemics of influenza (Taubenberger and Morens, 2006). The first identification of an influenza virus as a cause of disease in pigs occurred about ten years later, in 1930. For the following 60 years, swine influenza strains were almost exclusively H1N1. Then, between 1997 and 2002, new strains of three different subtypes and five different genotypes emerged as causes of influenza among pigs in North America (Olsen, 2002). As on 13th August 2009 WHO has reported 1, 82,166 laboratories confirmed cases of influenza A/H1N1 and 1799 deaths from 178 countries. In 2015 the instances of Swine Flu substantially increased to five year highs with over 12963 cases reported and 774 deaths in India. Figure 2.
Clinical features

Important clinical features of swine influenza include fever, and upper respiratory symptoms such as cough, running nose and sore throat. Headache, body ache, fatigue diarrhea and vomiting have also been observed (Lim, 2009). There is insufficient information to date about clinical complications of the current pandemic influenza A (H1N1) virus infection. Clinicians should expect complications to be similar to seasonal influenza: sinusitis, otitis media, croup, pneumonia, bronchiolitis, status asthmaticus, myocarditis, pericarditis, myositis, rhabdomyolysis, encephalitis, seizures, toxic shock syndrome and secondary bacterial pneumonia with or without sepsis (Lim, 2009; Cunha et al., 2011). Individuals at extremes of age and with preexisting medical conditions are at higher risk of complications and exacerbation of the underlying conditions (Cunha et al., 2011; Saha et al., 2010).

Diagnostic tests

Routine investigations required for evaluation and management of a patient with symptoms as described above will be required. These may include hematological, biochemical, radiological and microbiological tests as necessary. A diagnosis of confirmed swine flu requires laboratory testing of a respiratory sample (a simple nose and throat swab). Tests used to detect influenza virus infections in humans can include RT-PCR, virus isolation and assays to detect influenza virus antigens (Cohen, 2009; Kumar and Henrickson, 2012; St George, 2012; Uyeki, 2009). Many recent swine influenza cases were diagnosed by genetic methods, particularly RT-PCR (Hung et al., 2013). Confirmation of Pandemic influenza A (H1N1) infection is through:

- Real time RT PCR or
- Isolation of the virus in culture or
- Four-fold rise in virus specific neutralizing antibodies.

Routine diagnostic tests used to detect human influenza viruses, including commercial rapid test kits, do not necessarily detect zoonotic viruses (Kumar and Henrickson, 2012; St George, 2012; Okoye et al., 2013; Van et al., 2012; Marzoratti et al., 2012). One indication that a novel, possibly zoonotic influenza, virus might be present is the detection of influenza A virus, but not the hemagglutinins in seasonal human influenza viruses (Kumar and Henrickson, 2012). Zoonotic influenza virus infections are occasionally diagnosed retrospectively by serology, (Shi et al., 2013; Poon et al., 2009) but serological diagnosis can be complicated by crossreactivity with human influenza viruses. A further difficulty is that the HA and NA of some swine influenza viruses (the main targets of antibody responses) originally came from human influenza viruses, to which people may have already been exposed. Testing for novel influenza viruses is generally performed by state, regional or national public health laboratories (Kumar and
Real-time RT-PCR

The CDC has developed a real-time RT-PCR assay to detect seasonal influenza A, B, H1, H3, and avian H5 serotypes. This assay has been approved by the Food and Drug Administration (FDA) and was distributed in December 2008 through U.S. Public Health laboratories and the WHO's Global Influenza Surveillance Network. The CDC Real time RTPCR (rRTPCR) Protocol for Detection and Characterization of Swine Influenza includes a panel of oligonucleotide primers and dual labeled hydrolysis (Taqman®) probes to be used in realtime RT-PCR assays for the in vitro qualitative detection and characterization of swine influenza viruses in respiratory specimens and viral cultures. The InfA primer and probe set is designed for universal detection of type A influenza viruses. The swInfA primer and probe set is designed to specifically detect all swine influenza A viruses. The swH1 primer and probe set is designed to specifically detect swine H1 influenza. This assay is utilized for testing influenza A positive respiratory specimens (unsubtypable) taken from suspect swine influenza A infected patients (WHO, 2009; Calore et al., 2011; Ciçek et al., 2014). Nucleotide sequencing and phylogenetic analysis Amplicons for gene sequencing were generated by reverse transcription, followed by PCR amplification to generate overlapping double stranded DNA amplicons covering each of eight segments of the influenza virus genome.

Phylogenetic analysis

Phylogenetic analysis of sequences contained six gene segments (PB2, PB1, PA, HA, NP, and NS) which were found in triple reassortant swine influenza viruses circulating in pigs. The genes encoding neuraminidase (NA) and M protein (M) were most closely related to those in influenza A viruses circulating in swine populations (WHO, 2009). For confirmation of diagnosis, clinical specimens such as nasopharyngeal swab, throat swab, nasal swab, wash or aspirate and tracheal aspirate (for intubated patients) are to be obtained. The sample should be collected by a trained physician / microbiologist preferably before administration of the anti-viral drug. Keep specimens at 4°C in viral transport media until transported for testing. The samples should be transported to designated laboratories within 24 hours. If they cannot be transported then it needs to be stored at -70°C. Paired blood samples at an interval of 14 days for serological testing should also be collected (Lam et al., 2010; Whiley et al., 2009).

Treatment

The guiding principles are:

- Early implementation of infection control precautions to minimize household spread of disease.
- Prompt treatment to prevent severe illness and death.
- Early identification and follow up of persons at risk.

Infrastructure / manpower / material support

- Isolation facilities: if dedicated isolation room is not available then patients can be cohorted in a well ventilated isolation ward with beds kept one metre apart.
- Manpower: Dedicated doctors, nurses and paramedical workers.
- Equipment: Portable X Ray machine, ventilators, large oxygen cylinders, pulse oxymeter
- Supplies: Adequate quantities of PPE, disinfectants and medications (Oseltamivir, antibiotics and other medicines) (Pandemic Influenza A H1N1, 2015).

Standard operating procedures

- Reinforce standard infection control precautions i.e. all those entering the room must use high efficiency masks, gowns, goggles, gloves, cap and shoe cover.
- Restrict number of visitors and provide them with PPE.
- Provide antiviral prophylaxis to health care personnel managing the case and ask them to monitor their own health twice a day.
- Dispose waste properly by placing it in sealed impermeable bags labeled as Bio- Hazard (Pandemic Influenza A H1N1, 2015).

Medication

Two groups of antiviral drugs:- the adamantanes (amantadine, rimantadine), and neuraminidase inhibitors (zanamivir, oseltamivir, peramivir and laninamivir) – are used to treat some cases of influenza, although some of these drugs (peramivir and laninamivir) are not licensed in all countries (Reynolds et al., 2014; Allerson et al., 2013; Uscher et al., 2011; Cho et al., 2014; Thorlund et al., 2011). Both groups of drugs are effective against some influenza A viruses, although they may have some side effects. Antiviral drugs are most effective if they are started within the first 48 hours after the clinical signs begin, although they may also be used in severe or high risk cases first seen after this time (Reynolds et al., 2014; Uscher et al., 2011). Antiviral resistance can develop rapidly, and may emerge during treatment (Reynolds et
by weight

<table>
<thead>
<tr>
<th>Weight Range</th>
<th>Dose for Treatment</th>
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<tbody>
<tr>
<td>For weight &lt;15 kg</td>
<td>30 mg BD for 5 days</td>
</tr>
<tr>
<td>15-23 kg</td>
<td>45 mg BD for 5 days</td>
</tr>
<tr>
<td>24-&lt;40 kg</td>
<td>60 mg BD for 5 days</td>
</tr>
<tr>
<td>&gt;40 kg</td>
<td>75 mg BD for 5 days</td>
</tr>
<tr>
<td>&lt; 3 months</td>
<td>12 mg BD for 5 days</td>
</tr>
<tr>
<td>3-5 months</td>
<td>20 mg BD for 5 days</td>
</tr>
<tr>
<td>6-11 months</td>
<td>25 mg BD for 5 days</td>
</tr>
</tbody>
</table>

It is also available as syrup (12 mg per ml).

Zanamivir and Oseltamivir are members of a new class of drugs called neuraminidase inhibitors and are active against both influenza type A and type B. Zanamivir is provided as a dry powder that is administered by inhalation. It is approved for treatment of uncomplicated acute influenza A or B in persons 7 years of age and older who have been symptomatic for no more than 48 hours. Oseltamivir is provided as an oral capsule. It is approved for the treatment of uncomplicated influenza A or B in persons 1 year of age and older who have been symptomatic for no more than 48 hours. Zanamivir is approved for prophylaxis of influenza in persons 5 years and older. Oseltamivir is approved for prophylaxis of influenza infection among persons 1 year of age and older (Orozovic et al., 2011).

In 2007-08, a significant increase in the prevalence of Oseltamivir resistance was reported among influenza A (H1N1) viruses worldwide. During the 2007-08 influenza seasons, 10.9% of H1N1 viruses tested in the U.S. were resistant to Oseltamivir. During 2008 more than 90% of H1N1 viruses were resistant to Oseltamivir. For the 2008-09 influenza seasons CDC recommends that persons who test positive for influenza A should receive only zanamivir if treatment is indicated. Oseltamivir should be used alone only if recent local surveillance data indicate that circulating viruses are likely to be influenza A (H3N2) or influenza B viruses, which have not been found to be resistant to Oseltamivir (Butler, 2009). Antiviral agents for influenza are an adjunct to vaccine and are not a substitute for vaccine. Vaccination remains the principal means for preventing influenza related morbidity and mortality (Bucher 2009). Presently government of India recommends Tamiflu as a drug of choice which is available at all government health bodies. Human influenza A is susceptible to both Oseltamivir and zanamivir, two antiviral medications approved for the prevention and treatment of influenza in the United States (Centers for Disease Control and Prevention (CDC) Update, 2009). Oseltamivir

Oseltamivir is the recommended drug both for prophylaxis and treatment. In the current phase, if a person conforms to the case definition of suspect case, then he would be provided Oseltamivir (Butler, 2009; Tullu, 2009).

Adverse reactions

Oseltamivir is generally well tolerated, gastrointestinal side effects (nausea, vomiting) may increase with increasing doses, particularly above 300 mg/day. Occasionally it may cause bronchitis, insomnia and vertigo. Less commonly angina, pseudo membranous colitis and peritonsillar abscess have also been reported. There have been rare reports of anaphylaxis and skin rashes (Tullu, 2009).

Supportive therapy

Supportive care for uncomplicated influenza in humans includes fluids and rest. Additional adjunct and supportive treatments for more severe cases vary and can include various drugs, including antibiotics to treat or prevent secondary bacterial pneumonia, IV Fluids, Parenteral nutrition, Oxygen therapy/ ventilatory support and Vasopressors for shock (Kumar et al., 2009). Paracetamol or ibuprofen is prescribed for fever, myalgia and headache. Patient is advised to drink plenty of fluids. Smokers should avoid smoking. Salicylate / aspirin are strictly contra-indicated in any influenza patient due to its potential to cause Reye’s syndrome. Patients with signs of tachypnea, dyspnea, respiratory distress and oxygen saturation less than 90 per cent should be supplemented with oxygen therapy. Patients with severe pneumonia and acute respiratory failure (SpO2 < 90% and PaO2 <60 mmHg with oxygen therapy) must be supported with mechanical ventilation (Kumar, 2011). Maintain airway, breathing and circulation (ABC); Maintain hydration, electrolyte balance and nutrition. If the laboratory reports are negative, the patient would be discharged after giving full course of oseltamivir.
Immunomodulating drugs have not been found to be beneficial in treatment of ARDS or sepsis associated multi organ failure. High dose corticosteroids in particular have no evidence of benefit and there is potential for harm. Low dose corticosteroids (Hydrocortisone 200-400 mg/ day) may be useful in persisting septic shock (SBP < 90). Suspected case not having pneumonia does not require antibiotic therapy. Antibacterial agents should be administered, if required, as per locally accepted clinical practice guidelines. Patient on mechanical ventilation should be administered antibiotics prophylactically to prevent hospital associated infections (Kumar, 2011).

### Discharge policy

It has been observed that some of the patients even though asymptomatic, continue to test positive for influenza A H1N1. A treated and recovered patient, even though testing positive, has very little possibility of infecting others. In view of the above, the following recommendations are made: (Bridges et al., 2003).

- Patients who responded to treatment after two to three days and become totally asymptomatic should be discharged after 5 days of treatment. There is no need for a repeat test.
- Patients who continue to have symptoms of fever, sore throat etc. even on the 5th day should continue treatment for 5 more days. If the patient become asymptomatic during the course of treatment there is no need to test further.
- For patients who continue to be symptomatic even after 10 days of treatment or those cases with respiratory distress and in whom secondary infection is taken care of, and if patient continue to shed virus, then resistance of the patients to anti viral would be tested. The dose of anti viral may be adjusted on case to case basis. The family of patients discharged earlier should be educated on personal hygiene and infection control measures at home; children should not attend school during this period (Bridges et al., 2003).

### Chemoprophylaxis

i. Chemoprophylaxis for health care workers at high risk.
- The treating physicians and other paramedical personnel at the isolation facility would be put on chemoprophylaxis (Centers for Disease Control and Prevention (CDC) Update, 2009).

ii. Chemoprophylaxis for contacts
- Chemoprophylaxis is advised for those contacts with high risk (with underlying systemic diseases; extremes of age[< 5 years and 65> years]
- In phase-5, if the clusters are reported for the first time, and given that those exposed are known and can be traced easily, then family, social and community contacts should be given Chemoprophylaxis (Centers for Disease Control and Prevention (CDC) Update, 2009).

iii. Mass Chemoprophylaxis:
- The strategy of containment by geographic approach by giving oseltamivir to every individual in a prescribed geographic limit of 5 km from the epicenter would be applied:
  o If the virus is lethal and causing severe morbidity and high mortality.
  o Though affecting humans, is not efficiently transmitting in our population.
  o If the cluster is limited by natural geographic boundaries.
- All close contacts of suspected, probable and confirmed cases. Close contacts include household /social contacts, family members, workplace or school contacts, fellow travelers etc.
- All health care personnel coming in contact with suspected, probable or confirmed cases
- Oseltamivir is the drug of choice.
- Prophylaxis should be provided till 10 days after last exposure (maximum period of 6 weeks) Table 2.

### Non-pharmaceutical interventions

- Close Contacts of suspected, probable and confirmed cases should be advised to remain at
Table 3. Laboratories under the IDSP and ICMR network with capacity of testing Influenza virus (Pandemic Influenza A H1N1, 2015)

<table>
<thead>
<tr>
<th>S.No.</th>
<th>IDSP Network of Laboratories</th>
<th>ICMR Influenza Surveillance Network</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Sanjay Gandhi Post Graduate Institute, Lucknow, U.P.</td>
<td>Sher-e-Kashmir Institute of Medical Sciences, Srinagar</td>
</tr>
<tr>
<td>2</td>
<td>Indira Gandhi Medical College, Shimla</td>
<td>All India Institute of Medical Sciences, New Delhi</td>
</tr>
<tr>
<td>3</td>
<td>Haffkines Institute, Mumbai</td>
<td>National Institute for Cholera &amp; Enteric Diseases, Kolkata</td>
</tr>
<tr>
<td>4</td>
<td>Institute of Preventive Medicine, Hyderabad</td>
<td>Regional Medical Research Centre, Dibrugarh</td>
</tr>
<tr>
<td>5</td>
<td>Kasturaba Medical College, Manipal</td>
<td>Indira Gandhi Govt. Medical College, Nagpur</td>
</tr>
<tr>
<td>6</td>
<td>North Eastern Indira Gandhi Regional Institute of Health and Medical Sciences, Shillong</td>
<td>National Institute of Virology, Pune</td>
</tr>
<tr>
<td>7</td>
<td>NIMHANS, Bangalore</td>
<td>National Institute of Virology, Allapuzha, Kerala</td>
</tr>
<tr>
<td>8</td>
<td>JIPMER, Puducherry</td>
<td>King Institute of Preventive Medicine, Chennai</td>
</tr>
<tr>
<td>9</td>
<td>Central Research Institute, Kasauli</td>
<td>King George Medical University, Lucknow</td>
</tr>
<tr>
<td>10</td>
<td>B.J. Medical College, Ahmedabad</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>National Centre of Disease Control, Delhi.</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Post Graduate Institute of Medical Education &amp; Research, Chandigarh</td>
<td></td>
</tr>
</tbody>
</table>

home for at least 7 days after the last contact with the case. Monitoring of fever should be done for at least 7 days. Prompt testing and hospitalization must be done when symptoms are reported.

- All suspected cases, clusters of ILI/SARI cases need to be notified to the State Health Authorities and the Ministry of Health and Family Welfare, Govt. of India (Director, EMR and NICD)

Laboratory tests

The samples are to be tested in BSL-3 or BSL-2+ laboratory with BSL-3 precautions. The apex laboratories are:

- National Institute of Communicable Diseases, 22, Sham Nath Marg, Delhi [Tel. Nos. Influenza Monitoring Cell: 011-23921401; Director: 011-23913148]
- National Institute of Virology, 20-A, Dr. Ambedkar Road, Pune-411001 [Tel.No. 020-26124386]

There is a network of 16 other laboratories that can test for Influenza A H1N1. This network is being expanded to include private laboratories. The updated list is available on the web site of Ministry of Health and Family Welfare (Pandemic Influenza A H1N1, 2015). Table 3.

Guidelines on Infection control Measures

Infection control measures would be targeted according to the risk profile as follows (Bucher 2009; Bridges et al., 2003).

Health facility managing the human cases of Influenza A H1N1

During Pre Hospital Care

- Standard precautions are to be followed while transporting patient to a health-care facility. The patient should also wear a three layer surgical mask.
- Aerosol generating procedures should be avoided during transportation as far as possible.
- The personnel in the patient’s cabin of the ambulance should wear full complement of PPE including N95 masks, the driver should wear three layered surgical mask.
- Once the patient is admitted to the hospital, the interior and exterior of the ambulance and reusable patient care equipment needs to be sanitized using sodium hypochlorite / quaternary ammonium compounds.
- Recommended procedures for disposal of waste (including PPE used by personnel) generated in the ambulance while transporting the patient should be followed (Ryan et al., 2001; David, 2009).

During hospital care

- The patient should be admitted directly to the isolation facility and continue to wear a three layer surgical mask.
- The identified medical, nursing and paramedical personnel attending the suspect/ probable / confirmed case should wear full complement of PPE. If splashing with blood or other body fluids is anticipated, a water proof apron should be worn over the PPE.
• Aerosol-generating procedures such as endotracheal intubation, nebulized medication administration, induction and aspiration of sputum or other respiratory secretions, airway suction, chest physiotherapy and positive pressure ventilation should be performed by the treating physician/ nurse wearing full complement of PPE with N95 respirator on (Ryan et al., 2001; David, 2009).
• Sample collection and packing should be done under full cover of PPE with N-95 respirator.
• Perform hand hygiene before and after patient contact and following contact with contaminated items, whether or not gloves are worn.
• Until further evidence is available, infection control precautions should continue in an adult patient for 7 days after resolution of symptoms and 14 days after resolution of symptoms for children younger than 12 years because of longer period of viral shedding expected in children. If the patient insists on returning home, after resolution of fever, it may be considered, provided the patient and household members follow recommended infection control measures and the cases could be monitored by the health workers in the community (Ryan et al., 2001).
• The virus can survive in the environment for variable periods of time (hours to days). Cleaning followed by disinfection should be done for contaminated surfaces and equipments.
• The virus is inactivated by a number of disinfectants such as 70% ethanol, 5% benzalkonium chloride (Lysol) and 10% sodium hypochlorite. Patient rooms/areas should be cleaned at least daily and finally after discharge of patient. In addition to daily cleaning of floors and other horizontal surfaces, special attention should be given to cleaning and disinfecting frequently touched surfaces. To avoid possible aerosolization of the virus, damp sweeping should be performed. Horizontal surfaces should be dusted by moistening a cloth with a small amount of disinfectant (Ryan et al., 2001; David, 2009).
• Clean heavily soiled equipment and then apply a disinfectant effective against influenza virus (mentioned above) before removing it from the isolation room/area. If possible, place contaminated patient-care equipment in suitable bags before removing it from the isolation room/area.
• When transporting contaminated patient-care equipment outside the isolation room/area, use gloves followed by hand hygiene. Use standard precautions and follow current recommendations for cleaning and disinfection or sterilization of reusable patient-care equipment.
• All waste generated from influenza patients in isolation room/area should be considered as clinical infectious waste and should be treated and disposed in accordance with national regulations pertaining to such waste. When transporting waste outside the isolation room/area, gloves should be used followed by hand hygiene (Ryan et al., 2001; David, 2009).

Standard operating procedures on use of PPE

Personal protection equipments

PPE reduces the risk of infection if used correctly. It includes: Gloves (non sterile), Mask (high-efficiency mask) / Three layered surgical mask, Long-sleeved cuffed gown, Protective eyewear (goggles/visors/face shields), Cap (may be used in high risk situations where there may be increased aerosols), Plastic apron if splashing of blood, body fluids, excretions and secretions is anticipated (Centers for Disease Control and Prevention [CDC], 2015; Public Health Agency of Canada, 2012; USDA APHIS, 2009; Centers for Disease Control and Prevention [CDC], 2009).

The PPE should be used in situations where regular work practice requires unavoidable, relatively closed contact with the suspected human case / poultry. Correct procedure for applying PPE in the following order: Follow thorough hand wash, Wear the coverall, Wear the goggles/ shoe cover/and head cover in that order, Wear face mask, Wear gloves. The masks should be changed after every six to eight hours (Ryan et al., 2001; David, 2009). Remove PPE in the following order: Remove gown (place in rubbish bin), Remove gloves (peel from hand and discard into rubbish bin), Use alcohol-based handrub or wash hands with soap and water, Remove cap and face shield (place cap in bin and if reusable place faceshield in container for decontamination), Remove mask - by grasping elastic behind ears - do not touch front of mask, Use alcohol-based hand-rub or wash hands with soap and water, Leave the room, Once outside room use alcohol hand-rub again or wash hands with soap and water. Used PPE should be handled as waste as per waste management protocol (Ryan et al., 2001; David, 2009).

Guidelines/ operating procedures for infection control practices

Infection control measures at Individual level (Bridges et al., 2003; Ryan et al., 2001)

Hand Hygiene:

Hand hygiene is the single most important measure to reduce the risk of transmitting infectious organism from one person to other. Hands should be washed frequently with soap and water / alcohol based hand rubs/ antiseptic hand wash and thoroughly dried preferably using...
disposable tissue/paper/towel. After contact with respiratory secretions or such contaminated surfaces. Any activity that involves hand to face contact such as eating/normal grooming/smoking etc. (Orozovic et al., 2011; Bucher 2009).

**Respiratory hygiene/cough etiquette**

The following measures to contain respiratory secretions are recommended for all individuals with signs and symptoms influenza like illness. Cover the nose/mouth with a handkerchief/tissue paper when coughing or sneezing; Use tissues to contain respiratory secretions and dispose of them in the nearest waste receptacle after use; Perform hand hygiene (e.g., hand washing with nonantimicrobial soap and water, alcohol-based hand rub, or antiseptic hand wash) after having contact with respiratory secretions and contaminated objects/materials (Kumar et al., 2009; Bridges et al., 2003).

**Staying away**

Stay arms length away from those showing symptoms of influenza like illness.

**Use of mask**

Three layered surgical mask is recommended for medical personnel working in screening areas and in isolation facilities. Medical personnel working in isolation ward or critical care facility performing aerosol generating procedures such as suction, endotracheal intubation etc. (Orozovic et al., 2011; Bucher 2009).

**Infection control measures at health facility**

**Droplet precautions**

Advise healthcare personnel to observe Droplet Precautions (i.e., wearing a surgical or procedure masks for close contact), in addition to Standard Precautions, when examining a patient with symptoms of a respiratory infection, particularly if fever is present. These precautions should be maintained until it is determined that the cause of symptoms is not an infectious agent that requires Droplet Precautions (Bridges et al., 2003; Ryan et al., 2001; David, 2009).

**Visual alerts**

Post visual alerts (in appropriate languages) at the entrance to outpatient facilities (e.g., emergency departments, physician offices, outpatient, clinics) instructing patients and persons who accompany them (e.g., family, friends) to inform healthcare personnel of symptoms of a respiratory infection when they first register or care and to practice Respiratory Hygiene/Cough Etiquette (Bridges et al., 2003; Ryan et al., 2001; David, 2009).

**Use of PPE**

The medical, nurses and paramedics attending the suspect/probable/confirmed case should wear full complement of PPE. Use N-95 masks during aerosol generating procedures. Perform hand hygiene before and after patient contact and following contact with contaminated items, whether or not gloves are worn. Sample collection and packing should be done under full cover of PPE (Bridges et al., 2003; Ryan et al., 2001; David, 2009).

**Decontaminating contaminated surfaces, fomites and equipments**

Cleaning followed by disinfection should be done for contaminated surfaces and equipments. Use phenolic disinfectants, quaternary ammonia compounds, alcohol or sodium hypochlorite. Patient rooms/areas should be cleaned at least daily and terminally after discharge. In addition to daily cleaning of floors and other horizontal surfaces, special attention should be given to cleaning and disinfecting frequently touched surfaces. To avoid possible aerosolization of AI virus, damp sweeping should be performed. Clean heavily soiled equipment and then apply a disinfectant effective against influenza virus before removing it from the isolation room/area. When transporting contaminated patient-care equipment outside the isolation room/area, use gloves followed by hand hygiene. Use standard precautions and follow current recommendations for cleaning and disinfection or sterilization of reusable patient-care equipment (Bridges et al., 2003; David, 2009).

**Guidelines for waste disposal**

All the waste has to be treated as infectious waste and decontaminated as per standard procedures. Articles like swabs/gauges etc are to be discarded in the Yellow
coloured autoclavable biosafety bags after use, the bags are to be autoclaved followed by incineration of the contents of the bag. Waste like used gloves, face masks and disposable syringes etc are to be discarded in Blue/White autoclavable biosafety bags which should be autoclaved/ microwaved before disposal. All hospitals and laboratory personnel should follow the standard guidelines (Biomedical waste management and handling rules, 1998) for waste management (Bridges et al., 2003; Ryan et al., 2001; David, 2009).

DISCUSSION

Sequence analysis of the 1918 “Spanish” influenza virus genes has not revealed any obvious features that could account for its high virulence thus far. Analyses of the surface proteins of the 1918 pandemic strain, however, suggest that this strain may have had a different origin. The haemagglutinin gene segment of the virus may have come directly from an avian source different from those currently circulating. Alternatively, the virus, or some of its gene segments, may have evolved in an intermediate host before emerging as a human pathogen. Determining whether pandemic influenza virus strains can emerge via different pathways will affect the scope and focus of surveillance and prevention efforts. The key prevention strategy to reduce influenza pandemic associated morbidity and mortality will be the implementation of inactivated influenza virus vaccines effective against the pandemic strain. Zanamivir and oseltamivir block influenza neuraminidase and prevent the cleavage of sialic acid residues, thus interfering with progeny virus dispersement within the mucosal secretions and reducing viral infectivity. Current surveillance efforts focused on rapid identification of novel strains in humans as well as efforts to minimize the possibility of cross-infection between species are aimed at detecting and preventing a new pandemic.

CONCLUSION

Swine flu refers to swine influenza or the viral infection caused by any of the several types of swine influenza virus. Only people who used to have direct contact with pigs were observed to get swine flu in the past. But, H1N1 virus is a new swine flu virus and it contains the genetic material of swine, bird and human influenza virus. H1N1 is an Influenza A virus. Swine Flu is caused by influenza viruses, and is spread mainly by coughing, sneezing, and close contact. Prevention and control measures for swine influenza are based on our understanding of seasonal human influenza and consideration of potential modes of transmission. Presently government of India recommends Tamiflue as a drug of choice which is available at all government health bodies. Human influenza A is susceptible to both Oseltamivir and zanamivir, two antiviral medications approved for the prevention and treatment of influenza in the United States. Antiviral agents for influenza are an adjunct to vaccine and are not a substitute for vaccine. Vaccination remains the principal means for preventing influenza related morbidity and mortality.

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