Indian J Med Res 132, July 2010, pp 67-71

Pandemic influenza A(H1N1) 2009 outbreak in a residential school at Panchgani, Maharashtra, India

Yogesh K. Gurav, Shailesh D. Pawar, Mandeep S. Chadha, Varsha A. Potdar, Abhay S. Deshpande*, Santosh S. Koratkar, Abhijeet H. Hosmani* & Akhilesh C. Mishra

*National Institute of Virology (ICMR), Pune & *Primary Health Centre, Panchgani, India*

Received November 19, 2009

***Background & objectives*: An outbreak of influenza was investigated between June 24 and July 30, 2009 in a residential school at Panchgani, Maharashtra, India. The objectives were to determine the aetiology, study the clinical features in the affected individuals and, important epidemiological and environmental factors. The nature of public health response and effectiveness of the control measures were also evaluated.**

***Methods*: Real time reverse transcriptase polymerase chain reaction was performed on throat swabs collected from 82 suspected cases to determine the influenza types (A or B) and sub-types [pandemic (H1N1) 2009, as well as seasonal influenza H1N1, H3N2]. Haemagglutination inhibition assay was performed on serum samples collected from entire school population (*N* = 415) to detect antibodies for pandemic (H1N1) 2009, seasonal H1N1, H3N2 and influenza B/Yamagata and B/Victoria lineages. Antibody titres ≥ 10 for pandemic (H1N1) 2009 and ≥ 20 for seasonal influenza A and B were considered as positive for these viruses.**

***Results*: Clinical attack rate for influenza-like illness was 71.1 per cent (295/415). The attack rate for pandemic (H1N1) 2009 cases was 42.4 per cent (176/415). Throat swabs were collected from 82 cases, of which pandemic (H1N1) 2009 virus was detected in 15 (18.3%), influenza type A in (6) 7.4 per cent and influenza type B only in one case. A serosurvey carried out showed haemagglutination inhibition antibodies to pandemic (H1N1) 2009 in 52 per cent (216) subjects in the school and 9 per cent (22) in the community.**

***Interpretation & conclusion*: Our findings confirmed an outbreak of pandemic (H1N1) 2009 due to local transmission among students in a residential school at Panchgani, Maharashtra, India.**

Key words India - outbreak - pandemic influenza (H1N1) 2009 - residential school

The first outbreak of pandemic influenza A(H1N1) occurred in Mexico in April 2009[1]. It rapidly spread through United States of America (USA) and subsequently aided by travellers evolved into a pandemic[2]. The first confirmed case of pandemic influenza in India was reported in Hyderabad on May 16, 2009[3]. Initially, almost all cases were from travellers returning from the USA and their close contacts[3]. Transmission within the local populations started in various parts of India around mid-June 2009[3].

On July 22, 2009, the school authorities in Panchgani, Maharashtra, reported an unusual increase in influenza-like illness (ILI) among the school children. Some students had a history of recent foreign travel. Investigations were carried out to determine the viral aetiology and study the clinical features of the affected individuals as well as important epidemiological and environmental factors during the outbreak period. The study also included a seroepidemiological survey in the community to know the extent of transmission of pandemic influenza A (H1N1) in 2009. In this paper we report the investigation of this first outbreak of pandemic influenza A (H1N1) in a residential school in India.

Material & Methods

Setting: The study was conducted in a boys' residential school, 110 km from Pune at Panchgani, district Satara, Maharashtra, India. Panchgani is an important tourist destination and is also known for good residential schools. Students residing in the school premises are referred to as boarders and those who only attend the school in day time and reside outside are day-scholars. The staff includes teachers, cooks, nurses and other supporting personnel.

Case definitions: A case of ILI refers to a person with sudden onset of fever >38^{0}C and cough or sore throat in the absence of other diagnosis[4]. A case of pandemic (H1N1) 2009 refers to a person having ILI with laboratory confirmed pandemic (H1N1) 2009 virus infection. The case is confirmed if the person tested positive for pandemic (H1N1) 2009 virus on a throat swab by real time reverse transcriptase polymerase chain reaction (RT-PCR) and/or positive for haemagglutination inhibition (HI) antibodies in serum.

Data sources: The school has a small clinic managed by a qualified physician. It also has a facility for hospitalization in addition to daily out-patient services. All relevant data including travel records, clinical history and routine laboratory tests were available. Clinical and epidemiological information was collected in a questionnaire. The distribution of ILI cases and pandemic (H1N1) 2009 cases was determined on the basis of the onset date of first symptom as obtained from school hospital records and interviews between June 24 and July 30, 2009. For subjects reporting ILI more than once during this period, the onset date for the first episode only was considered. Weather data (rain fall, temperature, relative humidity) were collected from the Panchgani Municipal Council.

Clinical specimens and laboratory investigations: Throat swabs were collected from ILI cases between July 23-29, 2009 in sterile viral transport medium, transported at 4^{0}C and processed for detection of influenza A and B types and pandemic (H1N1) 2009, seasonal H1N1 and H3N2 by real time RT-PCR[5,6]. Blood samples (2-3 ml) were collected from school subjects between July 27-29, 2009 and from the community in the last week of August, 2009. All serum samples were treated with receptor destroying enzyme for removal of non specific inhibitors. Sera with non specific agglutinins were treated with turkey red blood cells (RBCs). The final dilution of the serum was 1:10. Pandemic (H1N1) 2009 virus isolated at National Institute of Virology, Pune, was grown in 10-day old specific pathogen-free embryonated chicken eggs, inactivated by beta propiolactone and used as antigen in the assay. Antigens of seasonal influenza viruses were obtained from World Health Organization Collaborating Centre for Influenza and Centres for Disease Control and Prevention, Atlanta, USA. Titres were reported as reciprocal of the highest dilution for complete inhibition. Haemagglutination inhibition assay was performed for detection of antibodies using 0.5 per cent turkey RBCs[5].

Control measures: Following the surge in ILI cases the school authorities implemented the following control measures: (*i*) symptomatic students were asked to stay in their respective dormitories and those having high-grade fever were admitted to the school hospital; (*ii*) all students were advised to strictly follow personal hygiene measures (*e.g.*, frequently washing hands and face, using a handkerchief while coughing and sneezing); (*iii*) avoid group activities and clustering; and (*iv*) therapeutic and prophylactic administration of Oseltamivir after the confirmation of outbreak on July 25, 2009.

Statistical analysis: Difference in attack rates/HI antibody positivity between the two groups was compared using chi-square test. $P<0.05$ was considered as significant.

Results

The school population ($N = 415$) consisted of 352 students (301 boarders and 51 day-scholars) and 63 staff. Serum samples collected from all persons were tested for HI antibodies. A total of 103 serum samples collected during the year 2008 were tested in HI assay to decide baseline antibody titres. The titres ≥ 10 for pandemic (H1N1) 2009 and ≥ 20 for seasonal influenza A and B were considered as positive for these viruses.

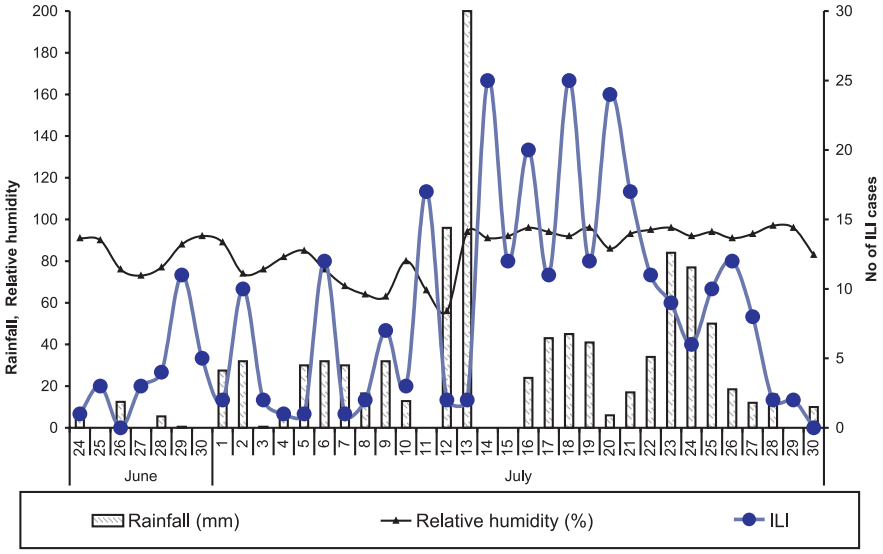

Fig. 1. Distribution of ILI cases in relation to environmental factors.

Based on the school hospital records and results of HI tests conducted in the study population, the index case was a boy (boarder) who reported ILI on June 24, 2009 and was hospitalized for six days. He had no history of foreign travel or direct contact with any person confirmed with pandemic (H1N1) 2009. The recorded history of foreign travel for students and staff revealed that during summer vacation a group of 22 students with two teachers visited USA between April 10-22, 2009 and another eight students with three teachers visited Holland and Finland between May 27-31, 2009. However, no epidemiological link could be established between the present outbreak and these foreign trips. The school reopened on June 7, 2009 after the summer vacation between April 4 and June 6, 2009.

The clinical attack rate of ILI cases was 71.1 per cent (295/415) for the school population. The attack rate of ILI in students was 76.4 per cent (269/352) and in staff 42.2 per cent (26/63). Of the 295 ILI cases, 60.3 per cent (178) were reported between July 11-22, 2009. The surge in ILI cases coincided with a spell of heavy rainfall on July 12 (96 mm) and 13 (200 mm) 2009 (Fig. 1). The most affected age group was 10-14 yr with the attack rate of 81.9 per cent (195/238) (Fig. 2). No significant difference was found in attack rates of ILI between boarders 75.7 per cent (228/301) and day-scholars 80.4 per cent (41/51).

Clinical presentations in ILI cases were fever (100%), cough (100%), nasal discharge (30%), headache (16.9%), sore throat (15.6%), body-ache (9.8%), fatigue (4.4%), vomiting (3.4%) and diarrhoea (1.4%). There was no significant difference between clinical presentation of ILI and confirmed pandemic (H1N1) 2009 cases.

The mean duration of illness (*i.e.*, symptomatic period) was 4 days. A total of 99 (33.5%) cases required hospitalization due to high-grade fever and received supportive treatment in terms of antibiotics and antipyretics, balanced diet and adequate rest. No fatality was reported. Hospitalization ranged between 1 and 6 days (median 3 days). No severe respiratory complications were observed in any case at discharge and even at follow-up till August 14, 2009. Chest radiographs of 5 ILI cases including 4 confirmed pandemic (H1N1) 2009 cases were normal. Blood parameters including total leucocyte count, differential

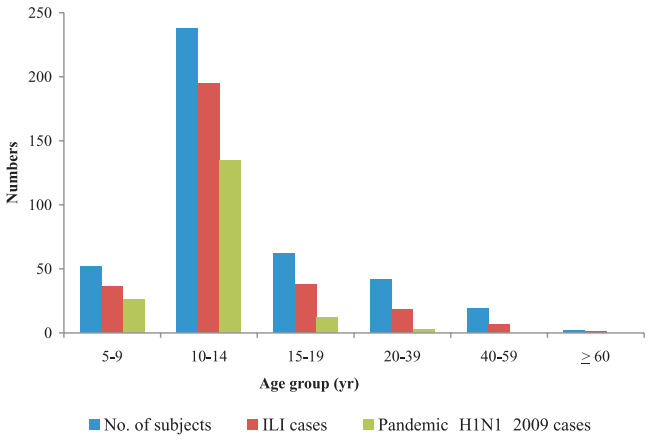

Fig. 2. Age group wise distribution of study population showing number of subjects, ILI and pandemic (H1N1) 2009 cases.

leucocyte count, haemoglobin content and erythrocyte sedimentation rate were within normal limits.

Throat swabs were collected from 82 persons (49 boarders, 24 day-scholars, 9 support staff). From these, pandemic (H1N1) 2009 virus was detected in 15 (18.3%) cases, seasonal influenza type A in 6 (7.3%) and influenza type B only in one case.

Out of 295 ILI cases, 176 were positive for pandemic (H1N1) 2009. The overall attack rate of pandemic (H1N1) 2009 was 42.4 per cent (176/415), maximum being in age group of 10-14 yr (135/238, 56.7%) (Fig. 2). The positivity of pandemic (H1N1) 2009 in the age group 20-39 yr was 7.1 per cent; no positivity was reported in the age group 40 and above. There was significant difference in attack rates between boarders (158/301, 52.5%) and day-scholars (15/51, 29.4%) ($P<0.001$).

Haemagglutination inhibition antibodies to pandemic (H1N1) 2009 virus were detected in 216/415 (52%) subjects. Amongst the positives, 165 (76.4%) were ILI cases and 51 (23.6%) were asymptomatic. Clinical to sub-clinical ratio was 3.2: 1. Amongst the 199 negatives, 130 had ILI and 69 were unaffected. In symptomatic 176 confirmed cases, 153 (86.9%) were positive for antibodies against seasonal H1, 156 (88.6%) for H3, 38 (21.5%) for B/Victoria, 41 (23.2%) for B/Yamagata. Haemagglutination inhibition antibodies were detected in 4 out of 19 members from 5 families. Sera collected from the community showed HI antibodies in 22 out of 245 (9%) persons.

Of the students reporting ILI, 64.3 per cent (173/269) were positive for pandemic (H1N1) 2009 HI antibodies. There was significant difference in HI antibody positivity between boarders (158/228, 69.3%) and day-scholars (15/41, 36.6%) ($P<0.001$). The affected students belonged to all the dormitories and classes in the school.

Following the confirmation of pandemic (H1N1) 2009 on July 25, 2009, Oseltamivir was administered to the confirmed cases and their close contacts under the supervision of school hospital staff and district public health authorities of the Government of Maharashtra. The school was closed down for 2 wk (August 15-31, 2009).

Discussion

This is the first report of outbreak of pandemic (H1N1) 2009 in a residential school setting in India. The index case had no associated history of foreign travel or contact with a confirmed or suspected case. Therefore the probable source of infection may be visitor(s) to the school. Panchgani being a hill station is cooler as compared to nearby cities and is a favorite destination for tourists. Our results suggest a high transmission rate of pandemic (H1N1) 2009 in this closed community and which has not been reported from anywhere else in India. This finding led to the change in policy for throat swab collection from community even if the cases had no foreign travel history or close contact with a confirmed case. Similarly, Oseltamivir administration in Maharashtra was initiated to suspected patients before laboratory confirmation. Due to the in-house hospital facility, symptomatic treatment was provided to the patients without delay. This is perhaps the main reason causing fewer complications in spite of high transmission rate. Delay in treatment has been found to be one of the major reasons for high complications and mortality[7].

Our serological study revealed that HI antibodies to pandemic (H1N1) 2009 virus were detected in 52 per cent subjects. A titre of ≥ 10 was considered positive in this study. Most of the seroprevalence studies in the earlier pandemics are also based on the titre cut-off of 1:10[8]. Majority of the subjects had HI antibodies for seasonal influenza H1, H3 and influenza B viruses. A higher percentage of antibodies to seasonal influenza viruses have been reported from Indian population[9-11]. The occurrence of large number of ILI cases in the present outbreak could be attributed to the fact that monsoon season is favourable for influenza viral transmission in this part of India[12].

The attack rate reported in this outbreak was higher than that reported for other schools[13,14]. This could be due to close interactions among boarders. Heavy rainfall just prior to high transmission perhaps led to restricted outdoor activities forcing students to stay indoors either in school or in dormitories. The significant difference observed between boarders and day-scholars additionally points to higher risk of transmission due to close contact among boarders for longer duration. The less percentage of positivity in the age group 20 yr and above could be because of less number of subjects screened.

High attack rates have also been observed in outbreaks involving close clustering of people in Mexico[15] and Japan[16]. Perhaps favourable climate for influenza virus transmission and residential nature

of the school may be the contributing factors in the present study. High prevalence of antibodies (52%) against pandemic (H1N1) 2009 was suggestive of intense transmission in the school.

Following our investigations, public health authorities since 2009 proactively began to administer Oseltamivir to cases and contacts. Measures like quarantine or removal of infected subjects from the school premises were not implemented. Students with high-grade fever were temporarily shifted to the hospital within the school campus. Students followed better personal hygiene and refrained from group activities (clustering) and close contacts with symptomatic cases. This led to curbing of transmission. Oseltamivir administered to confirmed cases and their close contacts prevented serious complications.

Acknowledgment

Authors thank the pandemic influenza technical team members (listed below) for providing diagnosis to patients during the pandemic. The authors are thankful to Dr V.H. Mohite, District Health Officer (Retd.), Zilla Parishad, Satara, health staff at the control room, Panchgani and the school authorities in Panchgani for the co-operation extended during the investigation. The authors acknowledge Dr B.V. Tandale, S.S. Cherian and P. Shil for technical advice during the investigation, and Shriyuts S.M. Jadhav and A.M. Walimbe for statistical analysis of the data.

Pandemic influenza technical team: Anand Singh, A.S. Aher, V.L. Awtade, B.G. Buwa, M.R. Dakave, K.B. Gadekar, Gurukumar Iyer, R.L. Ingulkar, S.M. Jadhav, J.P.N. Babu, A.N. Kadam, S.N. Kavade, S.M. Karambelkar, H.K. Kengale, S.S. Kang, A.A. Khirawale, S.S. Kode, V.R. Khond, P.B. Kulkarni, V.S. Kulkarni, M.R. Khude, N.S. Kumbhar, B.A. More, P.A. More, S.S. Naik, G.B. Patil, A.V. Patil, B.J. Payapalli, R.M. Phaltane, M.S. Rangole, S.S. Salunkhe, V.A. Sonawane, N.A. Sonar, S.A. Tikhe, V. Venketesh, S.K. Waghmare, B.D. Walhekar.

References

1. Centers for Disease Control and Prevention (CDC). Outbreak of swine-origin influenza A (H1N1) virus infection-Mexico, March-April 2009. *MMWR Morb Mortal Wkly Rep* 2009; *58* : 467-70.
2. Fraser C, Donnelly CA, Cauchemez S, Hanage WP, Van Kerkhove MD, Hollingsworth TD, *et al*. Pandemic potential of a strain of influenza A (H1N1): early findings. *Science* 2009; *324* : 1557-61.
3. Ministry of Health and Family Welfare, Government of India. Influenza A (H1N1). Press Release of 16th May 2009. Available at: *http:/mohfw.nic.in/swineachive.htm.*
4. WHO. *A practical guide to harmonizing virological and epidemiological influenza surveillance*. 2008. *www.wpro.who.int/internet/resources.ashx/CSR/Publications/GuideToHarmonizingInfluenzaSurveillance-revised2302.pdf.*
5. WHO. *Manual on animal influenza diagnosis and surveillance*, WHO/CDS/CSR/NCS. 2002.
6. WHO. *CDC protocol of real time RT-PCR for influenza A(H1N1)*. April 2009, Available at: *http://www.who.int/csr/resources/publications/swineflu/CDCRealtimeRTPCRprotocolSwineH1Ass-2009 20090428.pdf.*
7. Rogelio PP, Daniel RZ, Samuel PL, Mauricio H, Franisco QF, Edgar B, *et al.* Pneumonia and respiratory failure from swine-origin influenza A(H1N1) in Mexico. *N Engl J Med* 2009; *361* : 680-9.
8. Jackson C, Vynnycky E, Mangtani P. Estimates of the transmissibility of the 1968 (Hong Kong) influenza pandemic: Evidence of increased transmissibility between successive waves. *Am J Epidemiol* 2010; *171* : 465-78.
9. Michael JS, Sridharan G. A pilot study of seroprevalence of influenza virus type A in Vellore, south India. *Indian J Med Res* 2002; *115* : 173-5.
10. Rao BL. Prevalence of antibodies in different age groups to pandemic and epidemic strains of influenza virus. *Indian J Med Res* 1984; *80* : 390-5.
11. Yeolekar LR, Kulkarni PB, Chadha MS, Rao BL. Seroepidemiology of influenza in Pune, India. *Indian J Med Res* 2001; *114* : 121-6.
12. Rao BL, Gupta NP, Rao CVRM, Gogate SS, Shah U. Investigation on the outbreak of influenza by A/USSR/77 virus strain in Pune, Maharashtra in 1978. *Indian J Med Res* 1979; *70* : 681-6.
13. Health Protection Agency West Midlands H1N1v Investigation Team. Preliminary descriptive epidemiology of a large school outbreak of influenza A(H1N1)v in the West Midlands, United Kingdom, May 2009; Euro Surveill 2009; 14(27): pii=19264.
14. Smith A, Coles S, Jahnsan S, Saldana L, Ihekweazu C. An outbreak of influenza A(H1N1)v in a boarding school in south east England, May-June 2009. Euro Surveill. 2009;14(27):pii=19263.
15. Boelle PY, Bernillon P, Desenclos JC. A preliminary estimation of the reproduction ratio for new influenza A(H1N1) from the outbreak in Mexico, March-April 2009. Euro Surveill. 2009; 14(19):pll=19205.
16. Nishiura H, Castillo-Chavez C, Safan M, Chowell G. Transmission potential of the new influenza A(H1N1) virus and its age-specificity in Japan. Euro Surveill. 2009;14(22):Pll=19227.

Reprint requests: Dr A.C. Mishra, National Institute of Virology, 20-A, Dr Ambedkar Road, Pune 411 001, India
e-mail: mishraac@icmr.org.in, acm1750@rediffmail.com