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# Scoping review of non-pharmacological interventions to control H1N1 in India

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ABSTRACT

*Background:* A sudden increase in the estimated number of reported cases of patients infected with H1N1 virus and resultant number of deaths poses a challenging issue in the control and response to the disease. In the current study we sought to summarize a set of pre-defined measures and non-pharmacological interventions that can be employed to control the spread of H1N1 flu in India. The main purpose of this study is to document a basis for advice to health care providers on use of non-pharmacological treatments for patients and avoid further spread of this kind of illness.

*Methods:* Based on database search, some non-pharmacological interventions were identified and documented. The existing literature was scoped for this purpose to extract the relevant data for the analysis purpose. Studies with H1N1 outbreak and pandemic data of India were included and studies undertaken outside India were excluded.

*Results:* The critical non-pharmacological measures to control H1N1 as identified from this review include closing schools, training of health care providers, timely vaccination of health care workers, creation of isolation wards, spreading awareness about the flu, regular disease surveillance and monitoring program, washing hands, following disinfection and sanitary practices, avoiding crowded areas, using tissues and other face masks while sneezing, allocation of separate trained staff, preparing region specific pandemic preparedness plans & surveillance strategies.

*Conclusion:* The proposed recommendations should be clearly communicated to the target audience as a reference for preparation of health systems and providers for combating the H1N1 virus.

## 1. Introduction

The influenza epidemic caused by the new H1N1 virus has by now affected all the continents of the world including India. However, the extent and impact are uncertain. In majority of the cases, the risk of influenza may demand hospitalization. Estimates by Centers for Disease Control and Prevention (CDC) show that influenza has caused around 9.2 million to 60.8 million illnesses, and between 140,000 and 710,000 hospitalizations since 2010.[1] Influenza may also lead to severe complexities and sometimes even death as data from CDC show that even in US, since 2010 between 12,000 and 56,000 deaths happened due to influenza.[1] Therefore, the limited supply and lack of access to resources in most of the developing countries emphasizes the need to identify measures for prevention and control of disease at the very onset. This is an indirect way to both strengthen the prevention strategy and minimise social and economic effects. This is required to decrease the patient load in the near future and keep the fatality rate low.

Influenza, referred to as flu, is an infectious disease caused by RNA virus of the family Orthomyxoviridae, and represent major pathogens of both humans and animals with an estimated 1198 annual deaths till March 2015.[2] Influenza is a seasonal disease occurring regularly both in the northern and the southern hemispheres each in the colder months of the year. In spite of marked seasonal dependency, influenza can lead to temporary outbreaks in the respective countries as new and highly pathogenic viral subtype, where immunological resistance will be few or none in the human population.

Severe cases of H1N1 pandemic virus were first discovered in the regions of United States and Mexico which soon started spreading all across the world. By September 2010 44,687 positive H1N1 cases were reported in India, with a mortality rate of 5.76%. 10,527 confirmed cases with 118 deaths were reported in Delhi till August 2010.1 By the end of February 2015, India reported almost 18,000 suspected cases of swine flu outbreak. In the same year it was estimated that 1000 annual deaths Delhi were due to swine flu. From its inception in the year 2010 the numbers of death due to H1N1 virus is increasing per year.

Due to its transferable properties' swine flu spreads from one person to another. By the end of year 2015, Rajasthan, Telangana, Gujarat, Maharashtra and Delhi reported the highest number of estimated cases

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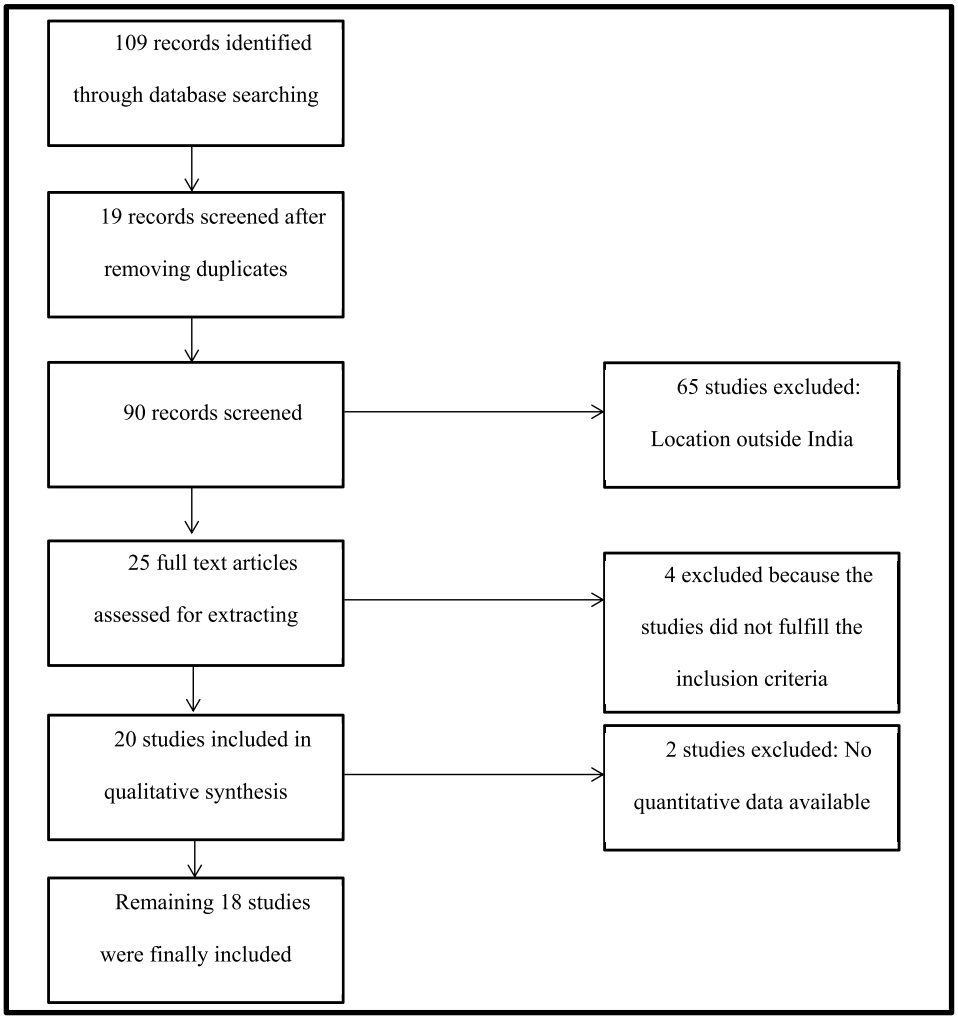


**Fig. 1.** Prisma search diagram.

of swine flu. The unexpected spurt of the disease at the commencement of the year left the Indian government disturbed.[6,7] The patients infected by this virus require serious care. However, Indian government has not institutionalised any vaccination for Influenza as a public health strategy. This scoping review evaluates several preventive interventions available for the disease outbreak of H1N1 and analyses the importance of non-pharmacological interventions.

Types of Influenza virus:

Flu (influenza) viruses are divided into three broad categories.[3]

i. **Influenza A:** It is divided into subtypes based on two proteins on the surface of the virus: hemagglutinin (H) and the neuraminidase (N).
ii. **Influenza B:** It causes seasonal epidemics of disease. Influenza B virus is not divided into subtypes but can be further broken into lineages and strains. Present circulating influenza B virus belongs to one of two lineages: B/Yamagata and B/Victoria.
iii. **Influenza C:** Influenza type C infections cause a mild respiratory illness.

Influenza A is the most common type & H1N1 is variety of influenza A. The term H1N1 indicates a unique trait, which exhibits characteristics that identify the virus to the immune system and allows for attachment and replication of the virus. The “H” (hemagglutinin) and the “N” (Neuraminidase) are both proteins that are found on the outer shell or envelope of the virus. Different viruses have different hemagglutinin and neuraminidase proteins. There are 18 (H1 to H18) types of known hemagglutinin and eleven (N1 to N11) known types of neuraminidase, which gives 198 different possible combinations of these proteins. For this reason, it is termed as H1N1 depending on the type of H & N antigens they express.[3–5]

## 2. Methodology

This chapter explains the research process that has been employed in the study to successfully undertake the study. In order to obtain non-pharmacological interventions to control H1N1 in India a review of observational studies, descriptive studies, reports, epidemiological studies were done to discover probable solutions for the current situation in India. The advantage of using this method is that a large amount already employed successful interventions can be easily gathered in a relatively short period of time from the existing literature.

### *2.1. Data collection*

The current study analysed and reviewed previous studies in India to unite and present all the probable non-pharmacological interventions that can be employed to prevent the spread of influenza. Hence, secondary data collected from review study has been critically examined to extract significant measures in different contextual situation to minimise the spread of this disease.

### 2.2. Time frame

In order to analyse all probable interventions that can be employed to avoid the spread of Influenza virus, the scoping review was conducted till 2016–17.

### 2.3. Selection criteria

**Inclusion criteria:** Observational studies, descriptive studies, case reports with H1N1 outbreak and pandemic data of India were included from 2008 till 2016.

**Exclusion criteria:** Studies or reports outside India were excluded.

### 2.4. Search methods for identification of studies

We searched literature on pharmacological and non-pharmacological interventions from databases like MEDLINE, PubMed, Science Direct, Google Scholar, and LANCET. The combined search strategy identified a total of 109 studies, 19 of which were duplicates and excluded. Out of the total of 90 studies, 65 studies were excluded as location was outside India. Remaining 25 studies were eligible for the review, 4 studies were excluded, as they were not fitting in our inclusion criteria. For 21 studies whose full-texts were reviewed two studies were excluded, as quantitative data was missing. Of the 19 potentially eligible studies, all studies were having data regarding number of cases of influenza virus and mortality and 10 studies were having data on non-pharmacological interventions. The PRISMA search diagram is given below (see Fig. 1):

## 3. Results

From the selected studies data was extracted which included sample sizes which were prone to influenza virus, number of confirmed cases who actually got disease and the subsequently calculated how many deaths occurred due to influenza virus, mentioned in Table 1. In second phase the non-pharmacological methods available are described in Table 2, which can reduce the influenza virus infection.

## 4. Discussion

The results derived from the review of studies identified several interventions that can be employed to control the complications related to H1N1 virus in India. Influenza viruses have affected animals and humans from time to time in the form of severe disease. Outbreaks, epidemics and even pandemics, cause severe economic losses and even threats to mankind. Among the common non-pharmacological methods, which are used in order to reduce or prevent the influenza virus infection, are isolation and personal hygiene (e.g. Frequent hand wash, use of facemask, covering mouth & nostrils while sneezing or coughing). One study proposed that closing schools immediately is an effective measure to combat spreading of this deadly virus at least amongst children.[8] His analysis suggested that the timing of school holidays in India and transmission rates are significantly correlated with each other. As specified in the literature direct contact with the infected person multiplies the causality of its occurrence.[25] Moreover, community health education about social distance and personal hygiene measures should be conducted so that physicians and healthcare workers should identify ILI (influenza like illness) patients and recommend home isolation. Some other measures are education and training programs for para - veterinary professionals, animal and poultry farmers and eating healthy food. Mahesh et al. (2014)[15] described three measures for hospitals to avoid the transmission of infectious diseases. A slew of measures were proposed for health care facilities to accommodate the sudden influx of patients infected with H1N1 virus. One study also proposed measures to combat the complications relating to H1N1 flu; prior to occurrence of the epidemic, at the time of epidemic and post epidemic stage. These included biosecurity measures, regular disease surveillance and monitoring programmes.[14] Such preventive measures have also been recommended by the Centre for Disease Control; some of which are aligned to the recommendation stated in the literature by World Health Organisation.[26,27]

### 4.1. Strengths and limitations

We did a literature search of five databases that publish research in healthcare. This is both a strength and limitation of the study as we searched a database (Lancet) that has exclusive studies. However, we did not include Embase and Cochrane registry of trials and so may have missed out on pertinent reviews. This is not a systematic review and so we did not conduct a quality appraisal of included studies using any published tool. Nevertheless, the studies we included demonstrated the preventive strategies that can be used in Indian healthcare settings. We were cautious in our scoping review to not include any study which did not fit into our review criteria. We acknowledge that more conventional systematic review methods may be congruent with a treatment strategy for influenza. However, our approach to identifying and selecting articles focused on preventive strategies rather than treatment studies. It seems reasonable to conclude that the studies we identified from our review mirror gaps in Indian healthcare settings for prevention of influenza.

**Table 1**
Studies included in the scoping review. Out of the above studies, only nine studies had relevant qualitative non-pharmacological methods which are described below.

| Study | Location | Sample size | Confirmed Cases | Deaths |
|---|---|---|---|---|
| Ali et al. (2013)[8] | India | – | – | – |
| Bagchi (2015)[2] | Rajasthan, Gujarat, Maharashtra, Madhya Pradesh, Uttar Pradesh & Telangana | 22,240 | – | 1198 (5.4%) |
| Biswas et al. (2012)[9] | West Bengal | 440 | 129 (29.3%) | – |
| Broor et al. (2012)[10] | AIIMS, Delhi | 3264 | 541(26.5%) | – |
| Chaudhry et al. (2012)[11] | India | 33,751 | 11,702(34.6%) | – |
| Dangi et al. (2014)[12] | Lucknow, UP | 2669 | 423 (15.8%) | |
| Dhama et al. (2012)[13] | | | | 2963 |
| Dhanya et al. (2014)[14] | Kerala | 4252 | 1725 (40.6%) | 49 (2.8%) |
| Mahesh et al. (2014)[15] | Tertiary hospital, Pune | 388 | 81 (20.8%) | 3 (3.7%) |
| Itolikar et al. (2015)[16] | India | 29,938 | – | 1703(5.6%) |
| Khan et al. (2013)[17] | Jammu & Kashmir | 84 | 12 (14.3%) | |
| Khanna et al. (2012)[15] | – | – | – | – |
| Kushwaha et al. (2014)[19] | Residential School, Belgaum, Karnataka | 96 | 96 (100%) | – |
| Mishra et al. (2010)[20] | Pune | 7866 | 2690 (34.2%) | 93 (3.4%) |
| Moorthy et al. (2012)[21] | Vellore | 2588 | 557(21.5%) | – |
| Muruganandam et al. (2015)[22] | Andaman & Nicobar | – | – | – |
| Sharma et al. (2015)[23] | Tertiary Hospital, Jaipur | 412 | – | 76(18.44%) |
| Singh et al. (2011)[24] | Andaman & Nicobar | 18 | 6 (33.3%) | 0 (0%) |

**Table 2**
Interventions suggested by the included studies.

| Study | Intervention used/Suggested Measures |
|---|---|
| Ali et al. (2013)[8] | • School Closure |
| Biswas et al. (2012)[9] | • Training of health care providers in case management and infection control.<br>• Vaccination of health care workers.<br>• Creation of isolation wards.<br>• Community health education about social distance and personal hygiene measures. |
| Dhama et al. (2012)[13] | • Biosecurity measures, regular disease surveillance & monitoring programme<br>• Farm Management practices: washing hands, following disinfection and sanitary practices<br>• People suffering from swine flu stay away from public places.<br>• Biosafety measures: use of face mask, covering mouth & nostrils while sneezing or coughing<br>• Education & training programmes for the para-veterinary professionals, animal and poultry farmers, etc. |
| Mahesh et al. (2014)[15] | • Infection control practices.<br>• Allocation of Separate trained staff.<br>• Creation of separate isolation ward.<br>• Distribution of IEC material in hospitals & schools. |
| Itolikar et al. (2015)[16] | • Hand hygiene<br>• Social distancing intervention<br>• Personal protective intervention: e.g. N95 mask, hand hygiene measures, and vaccination.<br>• Proper communication channels between medical fraternity & government officials for effective measures. |
| Khanna et al. (2012)[18] | • Social distancing.<br>• Eating habits.<br>• Public Awareness |
| Muruganandam et al. (2015)[22] | • Region specific pandemic preparedness plans & surveillance strategies. |
| Sharma et al. (2015)[23] | • Physician and healthcare workers should Identify ILI (Influenza like illness) patient and recommending them home isolation |
| Singh et al. (2011)[24] | • Frequent hand washing |

## 5. Conclusion

During an epidemic a copious amount of time is wasted in thinking and planning to face the challenges associated with it. An early identification of measures is an effective way to deal with any sudden outbreak. A review of such kind gives several do's and don'ts to be followed during an outbreak for reducing the number of patients, preventing the disease from spreading further and in social protection of the community on the whole. After this study, two things are possible. Firstly, hospitals can operationally prepare standard operating guidelines incorporating preventive measures for H1N1. Second, researchers can implement a full-scale randomised control trial or a systematic review to bring out a comprehensive H1N1 prevention and treatment plan. This kind of analysis can be used by several other researchers to study the effectiveness of preventive measures for H1N1 seasonal influenza.

## Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.cegh.2018.12.001.

## Appendix 1. Search terms for the study

| | |
|---|---|
| #1 | Search ((((((influenza h1n1) OR Viral infection) OR influenza virus) OR flu) OR RNA virus) OR Pathogenic viral) OR India |
| #2 | Search ((((((((((((((((((((((((non-pharmacological) OR school closed) OR training) OR vaccination) OR flu vaccine) OR isolation wards) OR awareness) OR regular disease surveillance) OR surveillance) OR monitoring) OR hand washing) OR disinfection) OR sanitation) OR napkin) OR tissue paper) OR tissue paper) OR face mask) OR outbreak preparedness) OR pandemic preparedness) OR education) OR iec material) OR hand hygiene) OR personal protective gear) OR social distance |
| #3 | Search ((((((((((Hospitalization) OR hospitalized) OR hospital) OR Death) OR mortality) OR complications) OR fatality rate) OR fatality [All Fields]) OR (low OR reduction)) OR prevention) OR immunological resistance |
| #1AND #2AND #3-AND | Search ((((((((((influenza h1n1) OR Viral infection) OR influenza virus) OR flu) OR RNA virus) OR Pathogenic viral) OR India)) AND ((((((((((((((((((((((((non-pharmacological) OR school closed) OR training) OR vaccination) OR flu vaccine) OR isolation wards) OR awareness) OR regular disease surveillance) OR surveillance) OR monitoring) OR hand washing) OR disinfection) OR sanitation) OR napkin) OR tissue paper) OR tissue paper) OR face mask) OR outbreak preparedness) OR pandemic preparedness) OR education) OR iec material) OR hand hygiene) OR personal protective gear) OR social distance)) AND ((((((((((Hospitalization) OR hospitalized) OR hospital) OR Death) OR mortality) OR complications) OR fatality rate) OR fatality[All Fields]) OR (low OR reduction)) OR prevention) OR immunological resistance) |

## References


1. CDC. *Estimated Influenza Illnesses, Medical Visits, Hospitalizations, and Deaths Averted by Vaccination in the United States.* 2015; 2015. Available from: https://www.cdc.gov/flu/about/disease/2015-16.htm.
2. Bagchi S. India tackles H1N1 influenza outbreak. *Lancet.* 2015;385(9972):e21.
3. CDC. *Types of Influenza Viruses. Seasonal Influenza (Flu) Influenza, Flu Basics, Influenza Viruses.* 2015; 2015. Available from: https://www.cdc.gov/flu/about/viruses/types.htm.
4. Fouchier RA, Munster V, Wallensten A, et al. Characterization of a novel influenza A virus hemagglutinin subtype (H16) obtained from black-headed gulls. *J Virol.* 2005;79(5):2814–2822. https://doi.org/10.1128/JVI.79.5.2814-2822.2005 PMC 548452. PMID 15709000.
5. Tong S, Zhu X, Li Y, et al. New world bats harbor diverse influenza A viruses. *PLoS Pathog.* 2015;9(10):e1003657https://doi.org/10.1371/journal.ppat.1003657 PMC 3794996. PMID 24130481.
6. Mukherjee S, Sen S, Nakate PC, Moitra S. Management of swine flu (H1N1 Flu) outbreak and its treatment guidelines. *Community Acquir Infect.* 2015;2(3):71.
7. Grewal I, Nandan D. Prevention and control of pandemic influenza a (H1N1) in India. *HPPI.* 2009;32(2).
8. Ali ST, Kadi AS, Ferguson NM. Transmission dynamics of the 2009 influenza A (H1N1) pandemic in India: the impact of holiday-related school closure. *Epidemics.* 2013;5(4):157–163.

9. Biswas DK, Kaur P, Murhekar M, Bhunia R. An outbreak of pandemic influenza A (H1N1) in Kolkata, West Bengal, India. *Indian J Med Res.* 2010;1135(4):529–533 2012.
10. Broor S, Krishnan A, Roy DS, et al. Dynamic patterns of circulating seasonal and pandemic A (H1N1) pdm09 influenza viruses from 2007–2010 in and around Delhi, India. *PLoS One.* 2012;7(1):e29129.
11. Choudhry A, Singh S, Khare S, et al. Emergence of pandemic 2009 influenza A H1N1, India. *Indian J Med Res.* 2012;135(4):534–537.
12. Dangi T, Jain B, Singh AK, et al. Influenza virus genotypes circulating in and around Lucknow, Uttar Pradesh, India, during post pandemic period, August 2010–September 2012. *Indian J Med Res.* 2014;139(3):418–426.
13. Dhama K, Verma AK, Rajagunalan S, et al. Swine flu is back again: a review. *Pak J Biol Sci.* 2012;15(21):1001–1009.
14. Dhanya VC, Sara PJ, Sanjai D, et al. Demographic and clinical characteristics of pandemic influenza a (H1N1) 2009 outbreak in Kerala, southern India. *Br Microbiol Res J.* 2014;4(10):1142–1153.
15. Mahesh SH, Kushwaha AS, Kotwal A. Pandemic influenza: experience in a flu OPD of a tertiary care hospital. *Med J Armed Forces India.* 2014;70(1):39–42.
16. Itolikar S, Nadkar MY. H1N1 revisited after six years: then and now. *The J Assoc Physicians India.* 2015;63(4):41–43.
17. Khan UH, Mir MA, Ahmad F, et al. An outbreak of influenza B in an isolated nomadic community in Jammu & Kashmir, India. *Indian J Med Res.* 2013;138(6):1012–1015.
18. Khanna M, Kumar B, Gupta A, Kumar P. Pandemic influenza A H1N1 (2009) virus: lessons from the past and implications for the future. *Indian J Virol.* 2012;23(1):12–17.
19. Kushwaha AS, Teli P, Mahen A. Outbreak of Influenza (H1N1) amongst children in a residential school. *Med J Armed Forces India.* 2014;70(3):274–276.
20. Mishra AC, Chadha MS, Choudhary ML, Potdar VA. Pandemic influenza (H1N1) 2009 is associated with severe disease in India. *PLoS One.* 2010;5(5):e10540.
21. Moorthy M, Samuel P, Peter JV, et al. Estimation of the burden of pandemic (H1N1) 2009 in developing countries: experience from a tertiary care center in South India. *PLoS One.* 2012;7(9):e41507.
22. Muruganandam N, Bhattacharya D, Chaaithanya IK, et al. Emergence of influenza A (H1N1) PDM09 in the remote Islands of India-A molecular approach. *Indian J Med Microbiol.* 2015;33(1):143–146.
23. Sharma R, Agarwal S, Mehta S, et al. Profiling the mortality due to influenza a (H1N1) pdm09 at a tertiary care hospital in jaipur during the current season-january & february 2015. *J Assoc Phys India.* 2015;63(4):36–39.
24. Singh SS, Muruganandam N, Chaaithanya IK, et al. H1N1 influenza A outbreak among the Nicobarese, an aboriginal tribe of the Andaman and Nicobar Islands. India. *Publ Health.* 2011;125(8):501–504.
25. CDC. *Information on Swine Influenza/Variant Influenza Virus.* 2009; 2009. Available from: https://www.cdc.gov/flu/swineflu/.
26. WHO. *Emergencies Preparedness, Response.* 2009; 2009. Available from: http://www.who.int/csr/disease/swineflu/en/.
27. CDC. *2009 H1N1 Flu.* 2009; 2009. Available from: https://www.cdc.gov/h1n1flu/.