Calculation of Reproductive Number Using Data from H1N1 Patients in Tamilnadu

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Abstract- In June 2009, the World Health Organization (WHO) confirmed that the novel influenza A, H1N1 as a pandemic. After six months, as of December 29, 2009, it was reported by WHO that more than 208 countries and territories were affected by the pandemic accounting for about 150,000 infected cases and at least 11,516 deaths. .Effective reproductive number is an index which considers the proportion of susceptible people in a community. There are different methods for calculation of basic reproductive number. The aim of this study was to evaluate the reproductive number using data from H1N1 patients in Tamilnadu.

I. Introduction

Effective influenza surveillance systems are essential to understand the epidemiology and seasonality of influenza and for optimizing influenza control strategies. Influenza occurs in distinct outbreaks of varying extent every year.[1,2] This epidemiologic pattern depends upon multiple factors, including transmissibility of the virus and the susceptibility of the population. [3,4] In temperate regions of the Northern and Southern Hemispheres (NH and SH), influenza peaks during respective winter months, whereas the pattern of influenza varies in tropical and subtropical regions.[5–8] The seasonal fluctuations in environmental and social factors have been associated with the complex seasonality and transmission of influenza around the world. [9,10] While the underlying cause of the variable nature of seasonality for influenza in tropical countries remains elusive, indoor crowding, lower temperatures, and decreased humidity at a given latitude may influence both transmission and host susceptibility. [4,9–12]. When a communicable disease is going to be epidemic, all susceptible individuals are at risk of the disease, thus the disease will spread rapidly among populations, will reach a peak and it slows down and eventually will be disappeared later. In absence of preventive measures, epidemic waves will be repeated for 2 or several times. Having data regarding this pattern, next epidemic of the disease is predictable. The transmissibility of the disease can be shown quantitatively by calculating basic reproductive number and epidemic curves of the disease. Basic reproductive number is the average number of individuals directly infected by a primary infected case during his or her infectious period without any preventive measure during the epidemic and when the infected person enters a totally susceptible population. This index (R0) is useful in assessing the past preventive measures and needs assessment for prevention and prediction for future. If R0 is less than 1, the disease will eventually die out. If R0 is equal to 1, the disease is endemic and when R0 is above 1, there will be an epidemic and increasing number of infected persons.1 Effective reproductive number (Re) is an index which considers the proportion of susceptible people in a community. When, due to immunization or health education and increasing awareness, all people are not susceptible, the transmissibility of the disease will be better explained by calculation of Re using R0. Influenza type A (H1N1) is a communicable disease and became pandemic and a major health problem in 2009. A great deal of studies on influenza H1N1 has been conducted worldwide.[2,5] there are some antigenic similarities between seasonal influenza and influenza type A. Therefore, because of cross reactions, some individuals are immune against influenza H1N1 and susceptibility decreased in the population.

II. Statistical Analysis

Study setting and design

Tamilnadu (n = 72138958) is one of the south Indian states. We reviewed the surveillance data on influenza A (H1N1) cases, which occurred during Jan2012 and December 2012. The State integrated disease surveillance project (IDSP) unit, Tamilnadu, received information regarding all diseases including A (H1N1) from all the 32 districts in Tamilnadu.

Case definitions:

A suspected case of influenza like illness (ILI) was defined as the occurrence of acute febrile respiratory illness (fever ≥38°C) with the onset within seven days of close contact with a person who is a confirmed case of pandemic influenza A (H1N1) virus infection or within seven days of travel to areas where there are one or more confirmed pandemic influenza A (H1N1) cases, or resides in a community where there are one or more confirmed pandemic influenza cases. A suspected case of ILI with laboratory confirmed influenza A (H1N1) virus infection in an accredited laboratory through RT-PCR11 was considered to be laboratory confirmed case. Death due to A (H1N1) was considered when the infection was confirmed by laboratory testing, either before or after death. All the case patients who were residents of Tamilnadu reported to IDSP from all districts, between Jan 2012 and December 2012 were included in the analysis.

Data source, collection and analysis:

Active and stimulated passive surveillance was set up through IDSP across all the districts in the state. Cases and deaths of A (H1N1) were notified to state surveillance unit using structured data collection tool developed by Ministry of Health and Family Welfare. Pharyngeal or nasopharyngeal swab

samples of suspected case-patients were sent to Institute of Preventive Medicine (IPM) from all treatment sites across the state. The samples were processed and analyzed using RT-PCR assay in accordance with the National protocol.15 The surveillance data available at the state IDSP cell (abstract line list of all cases and individual death reports) and IPM (line list of all samples received) was collected, collated and reviewed. Death reports had information on demographics, results of laboratory tests for A (H1N1), cause of death, time course of illness (date of symptom onset, hospital admission, start of antiviral drugs), and underlying medical conditions.

During the first wave of influenza A, H1N1, 750 cases were reported between Jan 2012 and December 2012 and a total number of 40 deaths in Tamilnadu as in Table 1 and the Figure 1. All patients were referred to public and private hospital.

Month	Confirmed cases	Death cases
Jan-Apr 2012	58	2
May 2012	72	1
Jun 2012	85	3
Jul 2012	50	0
Aug 2012	62	0
Sep 2012	79	1
Oct 2012	86	2
Nov 2012	78	6
Dec 2012	160	25
Total	750	40

Table 1

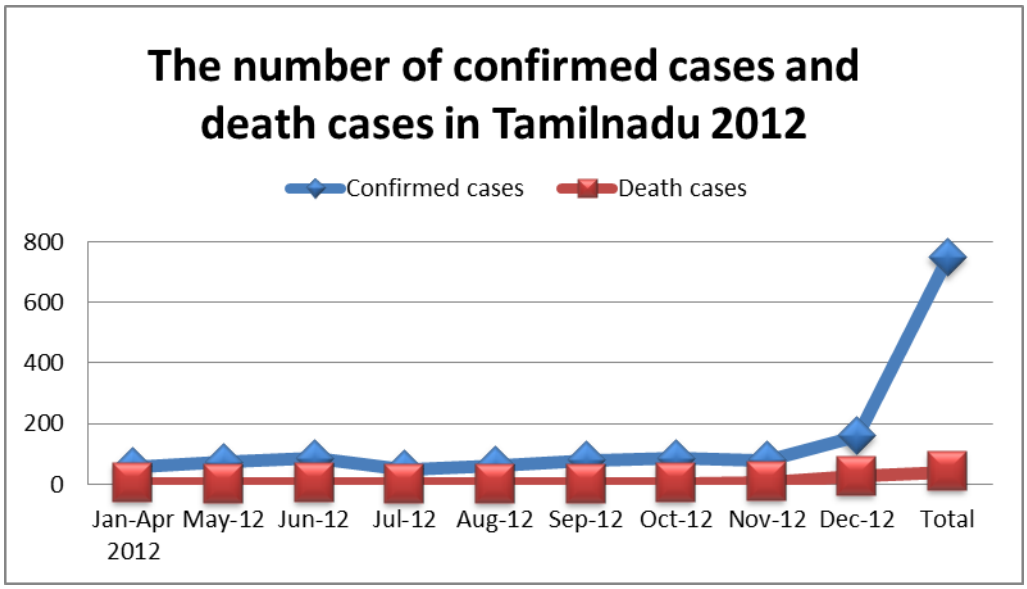

Figure 2

There are different methods to find the reproductive number R_0, which is the simplest method as following,

$$\mathbf{R_0} = \beta / \gamma \quad (1)$$

In this formula, beta (β) shows the probability of the disease transmission from an infected person to a healthy person. Some texts called it force of infection. Using Favier method, it can be calculated by epidemic data.[9] Gama (*g*) is recovery rate or one divided by average period of infection. In previous studies, the average period of infection has been reported as 7 days.[6,10] The second method for calculation of R0 is as follows .[11]

$$\mathbf{R_0} = \beta / \gamma + \delta \quad (2)$$

In this formula, beta shows the probability of the disease transmission from an infected person to a healthy person. Gama is recovery rate or one divided by average period of infection. Delta (δ) is the mortality rate which is calculated by the following formula

$$\delta = \gamma (CFP / 1 - CFP) \quad (3)$$

The third formula for calculation of R0 is as follows:

$$\mathbf{R_0} = (1 + \beta / \gamma) \quad (4)$$

According to the data obtained in the first wave of influenza A, H1N1 in Tamilnadu, it is founded that the probability of the disease transmission from an infected person to a healthy person, is 0.15. The recovery rate or one divided by average period of infection, is 1/7 days, and the reproductive number is1.033.

III. Conclusion

Based on theory of reproduction number, if *Ro* >1, then the pathogen is able to invade the susceptible population. This threshold behaviour is the most important and useful aspect of the *Ro* concept to determine which control measures and at what magnitude would be most effective in reducing *Ro* < 1, and providing important guidance for public health initiatives. Here, the role of health education when the cost of vaccination is high is of great importance because following health regulations and isolation of infected individuals have important roles in preventive meaures during the infectious period.

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