



Outbreak, Surveillance and Investigation Reports

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The 2009 Pandemic Influenza A Virus in an Outbreak during 2014 in Samut Prakan Province, Thailand

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Abstract

On 30 Jan 2014, a company employee in Samut Prakan Province developed severe pneumonia. Since many other employees also developed influenza-like illness (ILI), an investigation was conducted to describe the situation, identify risk factors and provide recommendations. Medical records and company employees' medical notes were reviewed. Case definition for ILI was based on the guideline of World Health Organization. Probable ILI cases were randomly sampled to confirm influenza A(H1N1)pdm09 using real-time polymerase chain reaction. A retrospective cohort study was performed using a self-administered questionnaire and a walk-through survey of the company was conducted. Total 102 respondents (18.8%) reported having ILI and among them, two were diagnosed with pneumonia. Seven of 21 throat swab specimens were positive for an influenza virus strain that appeared to be influenza A(H1N1)pdm09. The highest reproductive number (R_0) of this outbreak was 2.7 (95% CI=1.9-3.8). Risk factors for illness included attending the company party (adjusted OR = 9.1, 95% CI = 2.73-56.35, PAF = 0.86) and having contact with persons who developed ILI (adjusted OR = 2.7, 95% CI = 1.46-4.93, PAF = 0.24). This outbreak showed that the pandemic strain of influenza in 2009 became the circulating strain during 2014.

Keywords: outbreak, influenza A(H1N1)pdm09, company, employee, Thailand

Introduction

In April 2009, a new strain of influenza, influenza A(H1N1)pdm09, caused 1,300 illnesses and 83 deaths in Mexico. The disease quickly spread throughout the world. In Thailand, the first imported case was reported in May 2009, with the first local transmission occurred in June 2009 and almost half of the population had influenza-like illness (ILI) by the end of the pandemic in October 2010.¹

Influenza vaccination in Thailand is voluntary, which is recommended for high risk population such as health care workers, people who are likely to develop complications after being infected with influenza viruses and relatives of high risk people.^{2,3} Number of influenza cases declined after launching of the influenza vaccination program. However, sporadic influenza outbreaks still occur in some specific population such as students, military personnel and participants in training camp.⁴

On 30 Jan 2014, the Bureau of Epidemiology (BOE) was notified of a cluster of ILI cases and one severe pneumonia case in a copper alloy valve production company (Company A) in Samut Prakan Province. The outbreak investigation was conducted from 30 Jan 2014 to 24 Feb 2014 by the BOE team in order to confirm an influenza outbreak, describe the situation,

identify risk factors for the outbreak, and provide control measures and recommendations for local health authorities and employees in Company A.

Methods

We reviewed medical records of the index case and interviewed medical personnel who cared for the patients and the index case's family and co-workers. Active case finding consisted of reviewing medical notes and absenteeism records in Company A. We administered a self-report questionnaire to all employees about their symptoms, risk behaviors and history of contact with ILI cases since 1 Jan 2014.

The case definition of ILI was a person with fever and cough or sore throat, based on World Health Organization (WHO)⁵. We defined a probable case as an employee of Company A who developed symptoms compatible with ILI during 2-30 Jan 2014 which was seven days before onset date of the first confirmed case and seven days after onset date of the last confirmed case. A confirmed case was an employee of Company A who developed ILI and had a positive test for influenza A(H1N1)pdm09 by polymerase chain reaction (PCR) during 2-30 Jan 2014. A severe case was a confirmed case who developed severe respiratory illness that needed respiratory assist devices.

All specimens from probable cases were sent to the National Institute of Health (NIH), Thailand. Fluid specimens from tracheal lavage of a severe case were tested for respiratory virus multiplex and atypical respiratory bacteria pathogens. The respiratory virus multiplex PCR assay was then tested for influenza A and B viruses, human respiratory syncytial virus (types A and B), human adenovirus, human metapneumovirus, human coronavirus (229E, NL63, OC43), human parainfluenza virus (types 1, 2, 3 and 4), human rhinovirus, human bocavirus and human enterovirus. Atypical respiratory bacteria pathogens tested were *Mycoplasma pneumoniae* and *Chlamydia pneumoniae*. Throat swab specimens were randomly collected from probable cases who had symptoms on 1 Feb 2014 and sent to NIH for testing influenza A(H1N1)pdm09 by real-time reverse transcription polymerase chain reaction technique.

An on-site investigation was conducted on 30 Jan 2014 and 21 Feb 2014 to describe the workplace, and identify risk processes and events that might contribute to disease transmission.

Descriptive data was stratified by cases and non-cases, and presented in percent, mean and standard deviation. Chi-square, Fisher's exact test and t-test were used to assess differences between the two groups. Attack rate calculation used all the employees as population at risk because we could not verify their immunization status before the outbreak.

A retrospective cohort study was conducted to identify risk factors related to ILI among employees in Company A. Risk ratio and 95% confidence interval (CI) were calculated to determine strength of association of each factor with ILI. Multiple logistic

regression was used to control for possible confounders and adjusted odds ratio of each factor was reported. To quantify the contribution of risk factors to this outbreak, population attributable fraction (PAF) was calculated.

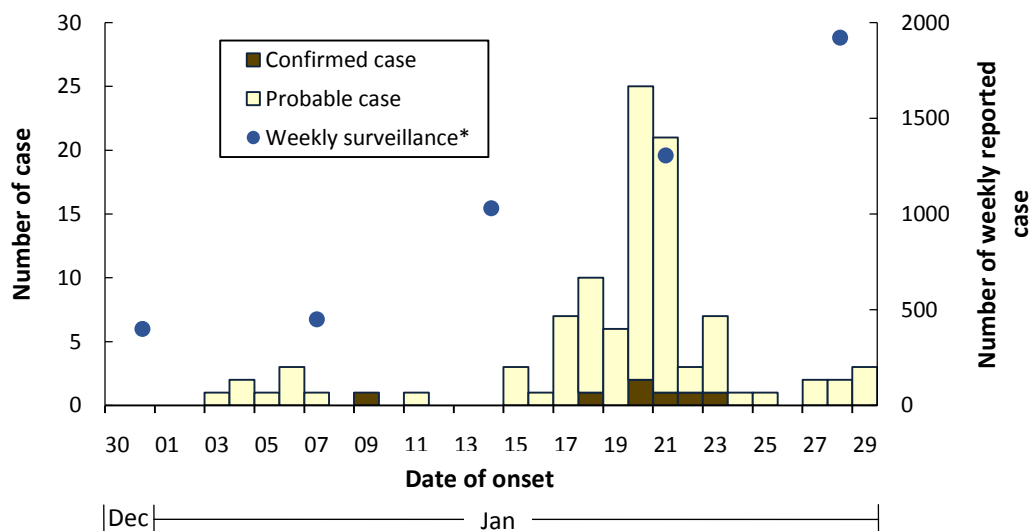
To describe the outbreak situation after the New Year Party, we assumed that employees who developed ILI symptoms before the party were not at risk. Thus, probable or confirmed cases that developed ILI symptoms before 18 Jan 2014 were excluded from the risk factor analysis.

An estimated reproduction number (R) was calculated on the method described by Cori et al with mean serial interval (SI) as 2.6 days, standard deviation (SD) as 1.5 days⁶, aimed posterior coefficient of variance (CV) as 0.2, length of time step as 2-day periods by every day estimation, and mean of prior distribution for R was 1.96 (SD=0.5)⁷.

Results

The outbreak occurred in Company A located in Bangplee Industrial Estate, Bang Sao Thong District, Samut Prakan Province, Thailand. The company had total 572 employees in 18 departments and produced copper alloy valves. Ninety five percent of the employees were Thai, 2% Cambodian, and 1% each of Laotian, Myanmar and Japanese.

Response proportion of the questionnaire was 95.1% (544 out of 572 employees). Mean age of the respondents was 33.8 years (SD=7.3). Total 102 (18.8%) out of 544 met probable case definition (Figure 1). Among them, two developed pneumonia and 21 throat swabs were collected which seven were tested positive for influenza A(H1N1)pdm09.



* Weekly aggregated number of influenza cases reported to R506 surveillance system in Thailand, 2014¹

Figure 1. Probable and confirmed influenza A(H1N1)pdm09 cases among employees in Company A, Samut Prakan Province, Thailand, 2-30 Jan 2014 (n=102)

There were no significant differences in gender, nationality, or reported weight, height and BMI between cases and non-cases. Cases were significantly younger though the difference was small (Table 1). The most common symptoms among probable and confirmed cases were fever (100%), cough (91%), headache (81%) and sore throat (81%) (Figure 2).

Among two cases who developed pneumonia, one had severe pneumonia and multi-organ failure. The case with severe pneumonia was a 42-year-old male with hypertension. He was deputy chief engineer of casting department. He developed fever, headache, cough and sore throat on 22 Jan 2014, and visited a physician on 25 Jan 2014. His vital signs at the first visit were body temperature 39°C, pulse rate 100 bpm, respiratory rate 16 per min and blood pressure 110/70 mmHg. Rapid tests of influenza A and B were negative. He was diagnosed as systemic infection and admitted to a private hospital. On 26 Jan 2014, he developed dyspnea and acute respiratory failure. He

was then intubated and treated with oseltamivir (75 mg oral twice a day). During treatment, he developed renal failure, followed by multi-organ failure. Finally, he stayed in hospital for 58 days at a cost of nearly 1 million Baht (30,500 USD). From the investigation, his tracheal suction was positive for influenza A(H1N1)pdm09 by real-time PCR. *Mycoplasma pneumoniae* and *Chlamydomphila pneumonia* were also identified by PCR testing. However, the immunology test for these pathogens could not be performed due to limitation of laboratory facilities.

From active case finding, we found another employee with pneumonia who was a 30-year-old female working in quality control department. Her onset of illness was on 20 Jan 2014 and was diagnosed as community-acquired pneumonia at a private hospital on 24 Jan 2014. Later, she fully recovered and was discharged from the hospital on 28 Jan 2014. Her medical records showed no laboratory evidence of influenza A(H1N1)pdm09.

Table 1. Demographic data of cases and non-cases in influenza A(H1N1)pdm09 outbreak among employees of Company A, Samut Prakan Province, Thailand, 2014

	Case (n=101) [¶]	Non-case (n=442) [¶]	P-value
Mean age in years (SD)	31.9 (5.9)	34.3 (7.5)	<0.001*
Gender (Male/Female)	0.91	1.08	0.479
Nationality (%)			
Thai	100 (99.0)	386 (87.3)	0.148**
Cambodia	0(0)	9 (2.0)	
Laotian	1 (1.0)	5 (1.1)	
Myanmar	0 (0)	5(1.1)	
Mean body weight in kg (SD)	58.8 (9.5)	60.1 (11.0)	0.267*
Mean height in cm (SD)	161.5 (6.9)	162.4 (8.0)	0.257*
Mean BMI (SD)	22.5 (3.3)	22.7 (3.4)	0.678*

* T-test

** Fisher's exact test, compared Thai and non-Thai nationalities

¶ Regarding mean body weight, height and BMI, there was missing data for 4 cases and 35 non-cases.

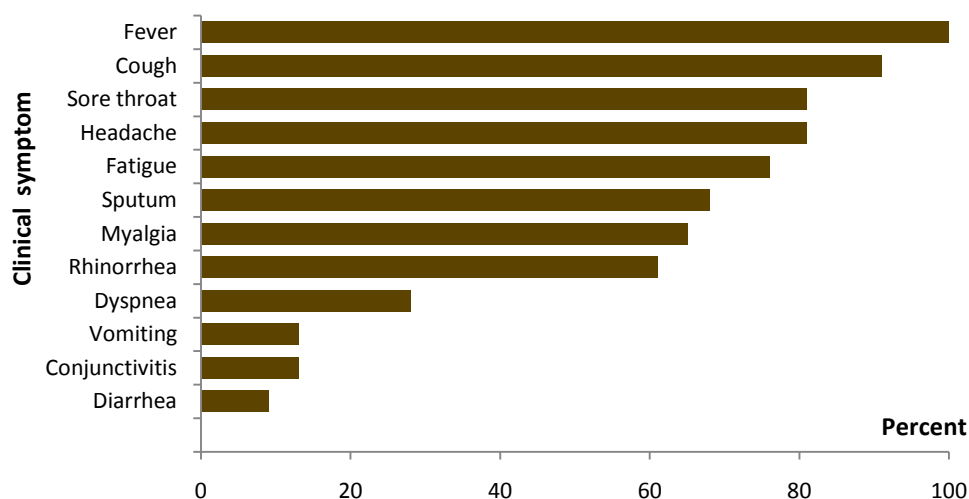


Figure 2. Clinical symptoms of probable and confirmed influenza A(H1N1)pdm09 cases among employees of Company A, Samut Prakan Province, Thailand, 2014

Among 544 employees who responded to the questionnaire, none had an influenza vaccination in the previous year or an underlying disease. Total 100 persons (18.4%) had a history of ILI contact within one month before the outbreak and nearly half of them (49.0%) shared a bedroom with an ILI case. More than half of the employees (61.0%) reported using a N95 mask regularly as a dust protector and seven persons reported sharing a face mask with others. There were 406 employees (74.6%) that attended New Year Party in the company. The party was held in an air-conditioned room of a restaurant near the company, which started at 18:00 and ended at 24:00. During the party, 26.4% of the employees shared drinking glasses and 33.7% reported contact with an ILI case at the same table (Table 2).

Table 2. Behavioral risk factors in influenza A(H1N1)pdm09 outbreak among employees in Company A, Samut Prakan Province, Thailand, 2014

Behavioral risk factor	Number of exposed (%)
Contact history	
Contacted with ILI case (n=100)	100 (18.4)
Shared bedroom with ILI case	49 (49.0)*
Vehicle	
Used company provided vehicle	169 (31.1)
Shared vehicle with ILI case	96 (17.6)
New Year Party on 18 Jan 2014	
Attended the party (n=406)	406 (74.6)
Shared glass with others	107 (26.4)*
Shared table with ILI case	137 (33.7)*
Cafeteria in the company	
Used the company cafeteria (n=419)	419 (77.0)
Shared dining table with ILI case	79 (18.9)*
Drinking glass	
Have individual water glass	405 (74.4)
Used company provided glass	179 (32.9)
Used straw for drinking	18 (3.3)
Face mask and outfit	
Used face mask regularly	332 (61.0)
Shared face mask with others	7 (1.3)
Shared outfit with others	11 (2.0)

* Percentage calculated among exposed group

After the New Year Party, high number of employees took sick leave, including 71 employees who were sick during the outbreak. The company did not deduct the sick period from employee's wages or the vacation time. Subgroup analysis was conducted for 513 employees since 31 cases were excluded due to having onset of illness before the party. The results showed that employees who went to the party and share a dining table with ILI cases in the company cafeteria were higher risk to develop ILI symptoms (Table 3).

Total 463 persons were included in multiple logistic regression since 50 observations were excluded due to missing information. Having a history of going to the New Year Party on 18 Jan 2014 (adjusted OR=9.1, 95% CI=2.73-56.35, PAF=0.86), using company cafeteria (adjusted OR=2.7, 95% CI=1.12-8.03, PAF=0.55), and having a contact history with ILI cases (adjusted OR= 2.7, 95% CI=1.46-4.93, PAF=0.24) were associated with ILI symptoms (Table 4). Thus, history of going to the party contributed the strongest impact to ILI occurrence in this population.

The highest reproductive number (R_0) of this outbreak was 2.7 (95% CI=1.9-3.8) during 17-18 Jan 2014 and dramatically dropped to 1.1 (95% CI=0.8-1.5) on 21-22 Jan 2014, a week before the investigation.

The surveillance was continued until late February 2014. There were 2-4 employees with ILI per week for three consecutive weeks.

Discussion

An outbreak of influenza A(H1N1)pdm09 occurred in Company A because employees were not vaccinated before. No employees reported receiving the seasonal influenza vaccine. This was not surprising because they were not included in the targeted population for influenza vaccination which was for only young people, elderly, persons with underlying diseases such as cardiovascular and pulmonary diseases and immunocompromised persons².

A study that modeled influenza transmission and vaccination in employees in a large company showed that immunization has an important role to mitigate epidemic.⁸ Thus, studies were needed to assess cost effectiveness and risk-benefit of influenza vaccination among the specific high risk population in Thailand such as company employees, military personnel and prisoners.

The attack rate of ILI among company employees in this study was 18.8% while outbreaks of influenza A(H1N1)pdm09 had attack rates, ranging from 7% to 37%⁹⁻¹³. In confined settings such as cruise ships, military camps or schools, the attack rate could be even higher, ranging from 22-37%.¹¹⁻¹³

In this outbreak, we found two pneumonia cases while one of them developed severe symptoms. Although severe cases are uncommon, about 0.01-5.00% of persons infected with influenza A(H1N1)pdm09 could have severe outcomes.¹³⁻¹⁵ Fortunately, the employees with severe cases in this outbreak recovered later.

Transmissibility of ILI in this outbreak was high when compared with median seasonal influenza

Table 3. Behavioral risk factors and risk ratio in influenza A(H1N1)pdm09 outbreak among employees in Company A, Samut Prakan Province, Thailand, 2014

Risk factor	Percent		Risk ratio	95% CI
	Expose	Non-expose		
Contact history				
Contacted with ILI case	25.3 (22/87)	11.3 (48/425)	2.2	1.43-3.51
Shared bedroom with ILI case	28.3 (13/46)	22.5(9/40)	1.3	0.60-2.62
Vehicle				
Used company provided vehicle	12.9 (20/155)	14.7 (46/312)	0.9	0.54-1.43
Shared vehicle with ILI case	15.1 (13/86)	14.4 (44/306)	1.1	0.59-1.86
New Year Party on 18 Jan 2014				
Attended the party	16.9 (64/378)	2.0 (2/98)	8.3	2.07-33.30
Shared glass with others	21.6 (21/97)	16.6 (37/223)	1.3	0.81-2.11
Shared table with ILI case	26.2 (32/122)	13.2 (18/136)	2.0	1.17-3.34
Cafeteria in the company				
Used the company cafeteria	15.8 (62/392)	5.6 (5/89)	2.8	1.17-6.80
Shared dining table with ILI case	22.1 (15/68)	11.8 (23/195)	1.9	1.04-3.37
Drinking glass				
Have individual water glass	12.7 (48/378)	17.6 (18/102)	0.7	0.44-1.18
Used company provided glass	15.6 (27/173)	13.1 (39/298)	1.2	0.76-1.88
Used straw for drinking	5.9 (1/17)	14.0 (65/464)	0.4	0.06-2.85
Face mask and outfit				
Used face mask regularly	13.0 (41/315)	13.5 (20/148)	1.0	0.59-1.58
Shared face mask with others	0 (0/7)	13.9 (67/483)	0	Undefined
Shared outfit with others	10.0 (1/10)	13.6 (65/478)	0.7	0.11-4.79

Table 4. Multiple logistic regression of behavioral risk factors and adjusted odds ratio in influenza A(H1N1)pdm09 outbreak among employees of Company A, Samut Prakan Province, Thailand, 2014

Risk factor	Adjusted odds ratio	95% CI	Population attributable fraction
Contacted with ILI case	2.7	1.46-4.93	0.24
Went to the company party on 18 Jan 2014	9.1	2.73-56.35	0.86
Used the company cafeteria	2.7	1.12-8.03	0.55

reproductive number that was 1.5⁷. However, some outbreaks in institutional settings reported that confined settings might promote disease spread as well.¹¹⁻¹³ We found that attending the New Year Party promoted spread of disease from ill persons to other healthy individuals. Activities such as sharing a dining table with ill persons and drinking from the same glass might have contributed to the outbreak.

We identified no other report of ILI outbreak associated with large group gatherings, including dining in the cafeteria. There were reports that a person with ILI who came to work might be the first case of ILI outbreak in the company. Sick employees who continue to work can spread the disease to others. Thus, ill employees in this outbreak might also have

attended the company party, contributing to the outbreak.

However, we found that the transmission rate reached the peak and dramatically dropped before the investigation was conducted. It might be due to the fact that many employees took sick leave after the company party. Thus, timeliness reporting of outbreak is needed in order to prevent severe disease and spreading in the community.

In 2004-2005, influenza A subtypes H1N1 and H3N2 were predominant strains circulating in Thailand.¹⁶ Since after 2009, influenza A(H1N1)pdm09 became more significant than other strains until 2011 when the dominant strain changed to be influenza A subtype H3N2.¹⁷ Nevertheless, occurrence of influenza

A(H1N1)pdm09 was higher again during 2014 as the same period of this outbreak.¹⁸

This study was subjected to limitations such as recall bias and social desirability bias for response to the questionnaire. However, we tried to find other evidences to support our findings with the environmental survey and employees' records. Finally, we could not confirm the co-infecting agent of the severe pneumonia cases due to limitations in laboratory testing.

Conclusions

During 2-30 Jan 2014, there was an influenza A(H1N1)pdm09 outbreak among employees in a valve production company. One employee developed pneumonia and another one had severe illness with respiratory and multi-organ failure. Attending the company party was associated with developing ILI.

Recommendations

Continuous surveillance on influenza strains and study on vaccine prevention intervention in specific population of Thailand should be encouraged to prevent sporadic outbreaks and severe cases.

We provided recommendations to the company in order to prevent influenza outbreaks in the future. First, the company should allow employees who developed ILI symptoms to have paid sick leave for at least 2-3 days or until they have no symptoms. In addition, all company workers should avoid contact with ILI cases, especially during company gatherings, which could cause rapid disease spreading. The company should also provide a drinking glass for every employee to prevent sharing of glasses. In addition, hand hygiene should be promoted among the company workers. Finally, an influenza vaccination campaign should be considered in big company. In February 2014, Company A implemented an influenza vaccination campaign and totally 322 workers (56.3%) had received the vaccination.

Acknowledgements

We would like to sincerely thank managers and workers in Company A who supported us during field investigation. We also appreciate local surveillance and rapid response team of health promotion hospital in sub-district for assisting in investigation and conducting intervention activities. Finally, we would like to express our gratitude to Dr. Matthew Biggerstaff in editing the manuscript and providing guidance for calculating the reproductive number.

Suggested Citation

Sirirungreung A, Yimchoho N, Monpungteim K, Pinthadis W, Jiraphongsa C. The 2009 pandemic influenza A virus in an outbreak in 2014 in Samut Prakan Province, Thailand. OSIR. 2015 Sep;8(3):1-7. <<http://osirjournal.net/issue.php?id=85>>.

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