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Field Epidemiology Training Program, Bureau of Epidemiology
Department of Disease Control, Ministry of Public Health, Thailand
Tel: +6625901734-5, Fax: +6625918581, Email: osireditor@osirjournal.net, http://www.osirjournal.net

Non-pharmaceutical Control Measures in Response to a Large Cluster of Influenza A(H3N2) in a Workplace, Northeastern Thailand, August-September 2015

Achara Nithiapinyasakul[1], Anek Mungaomklang[2,*], Unchulee Pruankratoke[2], Pongchan Na-Lampang[3], Claire Elizabeth North[4], Pilaipan Puthavathana[5]

1 Collaborative Project to Increase Production of Rural Doctor, Nonthaburi Province, Ministry of Public Health, Thailand

2 Occupational Health Department, Debaratana Nakhon Ratchasima Hospital, Nakhon Ratchasima Province, Ministry of Public Health, Thailand

3 School of Animal Production Technology, Suranaree University of Technology, Nakhon Ratchasima Province, Thailand

4 General Education and English Language Division, Khon Kaen University International College, Thailand

5 Center for Research and Innovation, Faculty of Medical Technology, Mahidol University, Nakhon Pathom Province, Thailand

*Corresponding author, email address: fetp28@gmail.com

Abstract

The study reports on an epidemiological investigation of an influenza A(H3N2) outbreak which occurred in a manufacturing company in Thailand during September 2015. The workplace consisted of three buildings. Employees in building 1 did not wear protective equipment and masks while those in buildings 2 and 3 wore C-level suit for protection from chemicals inhalation. The disease spread and involved 216 (8.4%) cases from a total of 2,585 employees. Nine out of 18 throat swab samples were found to have influenza A(H3N2) virus. Influenza illness mostly occurred in building 1, with attack rate of 22%. The investigation revealed that the first case possibly contacted the disease from a family member and spread it among employees through direct contact with clinically active cases, and sharing of hand towels in the company toilets. The study emphasized practical control measures, particularly in health education and strong policy regulations in the workplace. It enforced all employees in building 1 to wear masks which lead to the successful control of the outbreak within 10 days without using oseltamivir post-exposure prophylaxis. The event-based surveillance system should be implemented in every workplace for outbreak detection as well as for rapid response.

Keywords: influenza outbreak, non-pharmacological intervention, control measures, work-related infection

Introduction

Influenza outbreaks cause about 250,000-500,000 hospitalizations every year. The influenza infection can occur in all age groups, and outbreaks can be mainly found in schools, hospitals, child care centers and workplaces.[1] Influenza virus can spread through direct or indirect contact with respiratory droplets when the infected persons cough or sneeze. The incubation period of influenza ranges from 1-4 days, with average two days. Infected persons with normal immune function can spread the virus from one day before onset of symptoms to seven days after the illness.[2]

Severity for influenza illness may occur, depending on types and strains of the virus, and strength of the host responses. Risk factors for severe complications include diabetes mellitus, chronic kidney disease, congestive heart failure, immunocompromised state, asthma, elderly, children under five and pregnant women.[3]

United States Occupational Safety and Health Administration (OSHA) suggested engineering controls, administrative controls, healthy work practices and personal protective equipment (PPE) to prevent an influenza outbreak in the workplace.[4] In general, guidance for influenza prevention in workplace simply focuses on personal hygiene such as frequent hand washing, not sharing utensils and wearing protective masks. Sick leave of an employee should follow physician's recommendations and the policy of each workplace. Moreover, there was no standard guideline or regulation for disinfection in manufacturing companies available in Thailand.[5]

On 7 Sep 2015, a nurse in a company in the northeast of Thailand detected influenza-like illness (ILI) in a cluster of four employees working in the same department. The onset of illness varied between 4 and 6 Sep 2015. The nurse immediately reported to local public health authorities for prevention and control measures. This study aimed to describe an epidemiological investigation of an influenza outbreak which occurred in a private manufacturer and the activities intended to stop the outbreak without using anti-viral post-exposure prophylaxis.

Methods

The influenza outbreak occurred in a company manufacturing electronics and automobile devices in the Nakhon Ratchasima Province of Thailand, which is approximately 295 km northeast of Bangkok.

Epidemiologists from the local health authority, Ministry of Public Health, together with nurses of the manufacturer investigated this ILI outbreak. The investigation team conducted case finding retrospectively by reviewing patient records at the nursing unit in the company and the local hospital from 17 Aug to 10 Sep 2015, and developed a cross-sectional questionnaire survey based on ILI definition to find out more patients. The team walked through the surroundings and sent out a risk-behavior survey to trace back to an implicated source of the outbreak at the workplace. They established a proactive surveillance system which was composed of daily employee and families self-monitoring for ILI symptoms and screening of staff in other departments before start to work from 10 Sep until the end of the outbreak on 20 Sep 2015 when no new case was detected after 14 days from the onset date of the last reported case.

An influenza suspected case was a patient with at least two symptoms of: sore throat, rhinorrhea, malaise and headache while an influenza probable case was a suspected case with fever above 38°C and an epidemiologically linked to a confirmed case. An influenza confirmed case was a probable or suspected case with laboratory confirmed influenza virus infection.

Laboratory Testing

Throat swab samples were collected and tested for influenza virus by antigen detection using rapid diagnostic test (SD Bioline, Gyeonggi-do, Republic of Korea[9]) at the workplace and also by viral genome detection using real time reverse transcription-polymerase chain reaction (RT-PCR) at King Chulalongkorn Memorial Hospital, Faculty of Medicine, Chulalongkorn University.

Analytical Study

The data of this study were analyzed via distributions of time, place and person, using frequency and percentage. Risk of influenza among the group without using PPE (Building 1) compared to workers who wore a level-C equivalent suit (Buildings 2 and 3) were determined by risk ratio (RR) and 95% confidence interval (CI).

Ethical Consideration

This descriptive epidemiological study was approved by the Institutional Review Board (COA no. 144/2015, IRB no. 479/57) of the Faculty of Medicine, Chulalongkorn University, Bangkok, Thailand. All participants signed a written informed consent document prior to their participation.

Results

Description of the First Case

After tracing back, the first case of the outbreak was a 24 year-old managing staff working in building 1. She never had an influenza vaccination or influenza infection diagnosed by a physician during previous three years. She reported having a family member developed ILI on 15 Aug 2015 as well as having history of contact with that family member three days before she developed ILI on 20 Aug 2015. The disease was then transmitted to other managing staff and rapidly spread to the workers in the production line of the same building (Figures 1, 2).

Outbreak Description

On 7 Sep 2015, the nurse team in the manufacturing plant detected four ILI patients in the same department. The characteristics of each department: all divisions were in the same building area. There were several units without divisions or partition walls with a common air system.

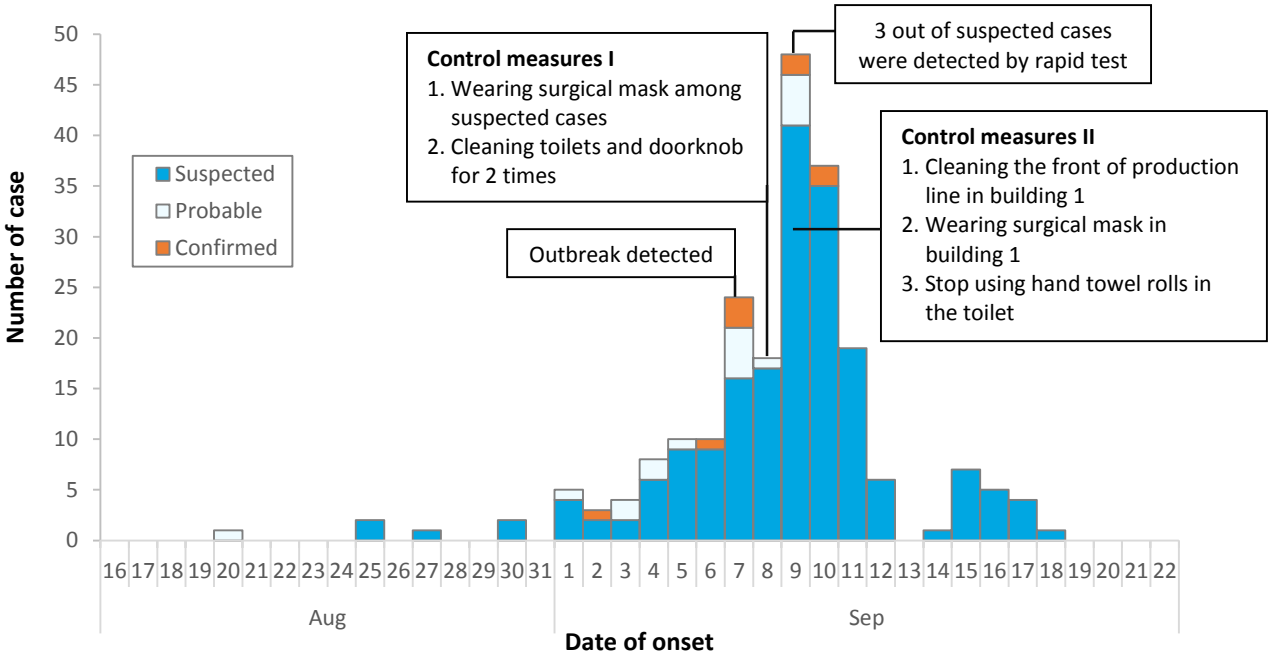
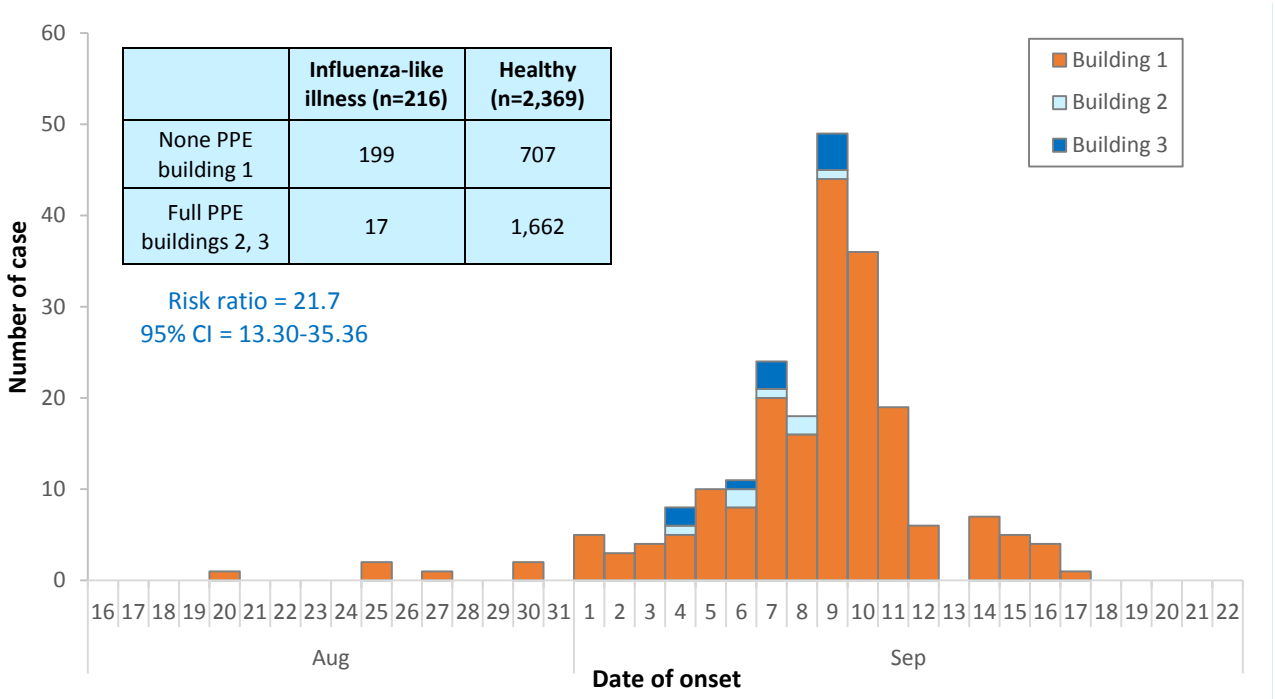


Figure 1. An epidemic curve and control measures of an influenza outbreak at a workplace in Nakhon Ratchasima Province, Thailand, 17 Aug - 20 Sep 2015 (n=216)



	Influenza-like illness (n=216)	Healthy (n=2,369)
None PPE building 1	199	707
Full PPE buildings 2, 3	17	1,662

Figure 2. An epidemic curve by buildings 1, 2 and 3 of an influenza outbreak at a workplace in Nakhon Ratchasima Province, Thailand, 17 Aug - 20 Sep 2015 (n=216)

Employees were able to walk through the entire building. The onset dates of illnesses were between 4 and 6 Sep 2015. On 8 Sep, a discussion was conducted among the nurse team, human resource management office, and executive safety officers of the workplace to develop a guideline for patient screening and set up an active surveillance system which composed of daily employee self-monitoring for ILI symptoms and screening of other department staff before starting the work. Data of sick employees from both active and passive surveillance systems were reported to the nursing unit.

On 9 Sep 2015, 10 throat swab specimens collected from recently ill workers were sent to a local hospital for rapid diagnostic test, and three of them were positive for influenza A virus infection, which later also found to have influenza A(H3N2) by RT-PCR. The influenza outbreak in this manufacturing plant was the second outbreak in Nakhon Ratchasima Province in 2015 (Figure 3).

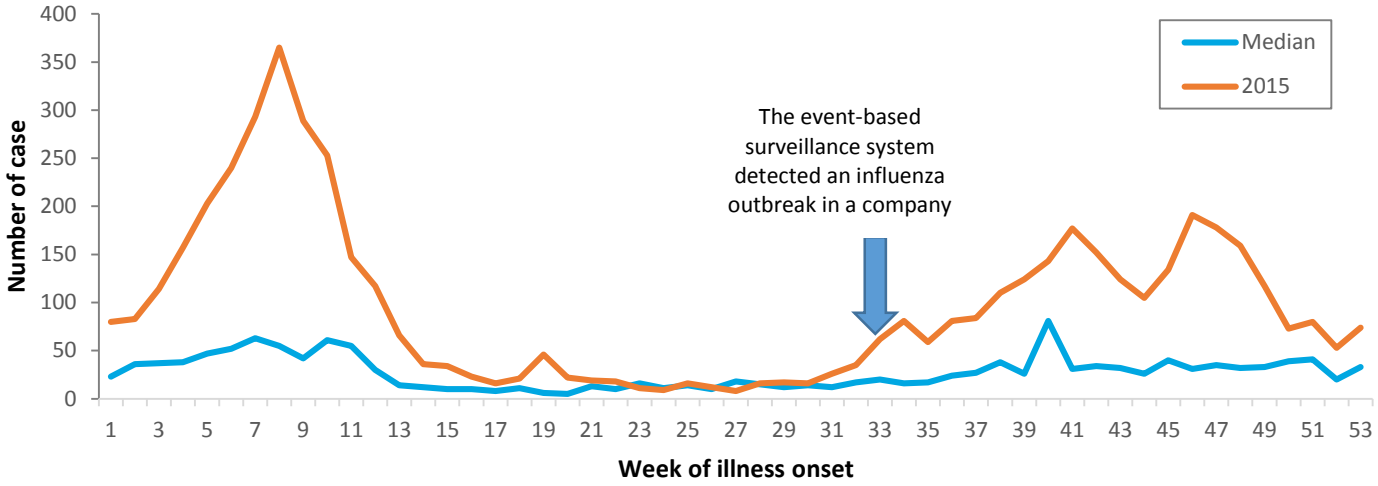


Figure 3. Influenza-like illness cases reported by week in 2015 compared to 3-year median (2012-2014) in Nakhon Ratchasima Province, Thailand

Descriptive Findings

A total of 216 (8.4%) cases out of 2,585 employees were identified. There were 41 (6.8%) cases out of 601 male employees and 175 (8.8%) out of 1,984 female employees. With respect to buildings 1, 2 and 3, there were 199 (22.0%), 7 (1.1%) and 10 (0.9%) cases respectively. In terms of age, the highest attack rate group was 21-25 years old, followed by 26-30 years and 31-35 years (Figure 4). None of the employees had been vaccinated for influenza infection in 2013-2015.

Cough (91.2%) was most commonly observed among 216 cases, followed by sore throat (90.3%), rhinorrhea (43.5%), fever (30.1%), headache (18.1%) and malaise or myalgia (1.4%). Three patients received oseltamivir (75 mg) every 12 hours for five days and stayed home for three days. The rest of the patients received no treatment and were able to carry on their works.

Laboratory Findings

A total of 18 throat swab samples was sent for laboratory investigation, and influenza A(H3N2) virus was diagnosed in nine samples by RT-PCR, which included seven samples from building 1, and one each from buildings 2 and 3. Collectively, 216 cases were classified as 189 suspected, 18 probable and nine confirmed influenza cases.

Analytical Findings

The outbreak investigation showed that most of the cases occurred in the production line of every building, particularly in building 1. Not only workers in the production line, but also managing staff and office workers were affected (Table 1). The attack rate in building 1 was 21.7 times higher than those of buildings 2 and 3 (95% CI = 13.30-35.36).

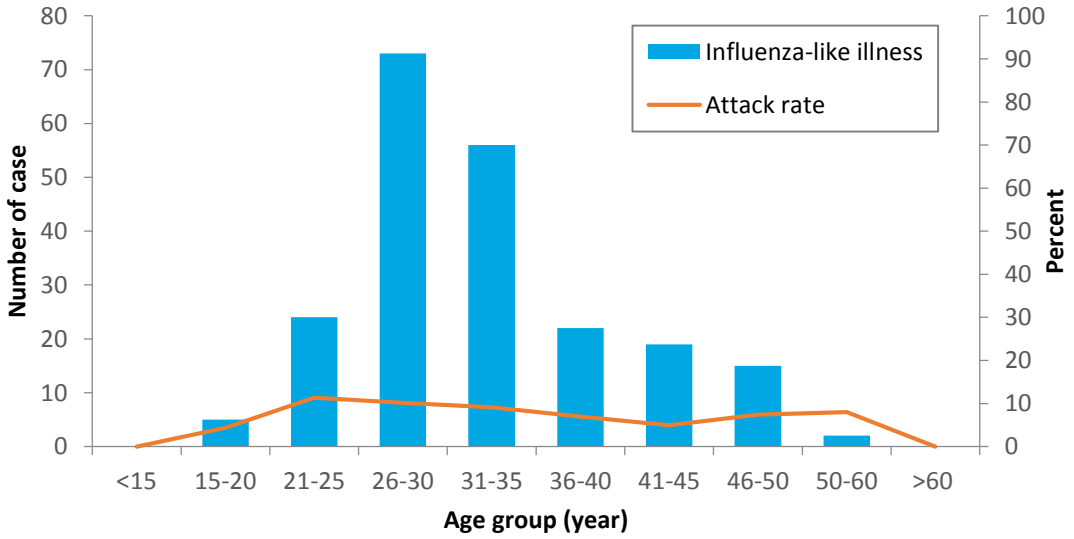


Figure 4. Age-specific attack rate of an influenza outbreak at a workplace in Nakhon Ratchasima Province, Thailand, 17 Aug - 20 Sep 2015 (n=216)

Table 1. Attack rate of influenza by nature of work and building at a workplace in Nakhon Ratchasima Province, Thailand, 17 Aug - 20 Sep 2015 (n=216)

Nature of work	Building 1 (Percent)	Building 2 (Percent)	Building 3 (Percent)
Production line worker	23.9 (192/803)	1.3 (7/545)	1.0 (10/965)
Managing staff	15.8 (6/38)	0 (0/46)	0 (0/77)
Office worker	1.6 (1/62)	0 (0/19)	0 (0/20)
Manager	0 (0/3)	0 (0/2)	0 (0/5)
Attack rate	22.0 (199/906)	1.1 (7/612)	0.9 (10/1,067)

Contacts

Moreover, 278 family members of 216 patients were also monitored for influenza associated-symptoms. The disease spread to eight persons in five families, which revealed the secondary attack rate as 2.9% (8/278 family members).

Workplace Environment

The company employed a total of 2,585 people who were working in three buildings and shared a common cafeteria. Each building served different functions in the production line, with individual air-conditioning (AC) system. Watch cases were produced in building 1, and employees did not wear protective equipment or protective masks (Figure 5). Activity in buildings 2 and 3 were in clean rooms for production of electronic parts and thus, employees were required to wear anti-static protection suits, protective cloth masks and boots (Figure 6). This type of suit was equivalent to level C suit for protection from chemicals inhalation[6].

Figure 5. Employees in building 1 without wearing protective equipment or masks at a workplace in Nakhon Ratchasima Province, Thailand, 2015

Figure 6. Employees in buildings 2 and 3 with anti-static protection suits, protective masks and boots at a workplace in Nakhon Ratchasima Province, Thailand, 2015

Surveillance and Response

A surveillance program pertaining to occupational diseases, work-related illnesses and communicable diseases, including ILI had been implemented in this manufacturing plant for two years before the outbreak. There was a comprehensive training of the nurse team working in the infirmary, which belonged to a social enterprise company. An ILI surveillance program was set up with the notification criteria to report to local health authority, defining the trigger as the disease occurring in two or more workers in the same production line within a week.[5]

In this event, the nurses immediately reported the outbreak information to local public health authorities. Subsequently, all employees in building 1 were screened for ILI symptoms in each department before employees entered the workplace. Initially, health education on frequent hand washing and protective masks for ILI cases were provided to contain the outbreak. In the same period of time, the national notifiable disease (R506) surveillance detected a wave of influenza outbreak in the community of Nakhon Ratchasima Province as well (Figure 3).

Public Health Actions

On 10 Sep 2015, a medical epidemiologist team examined the workplace and found that sharing cloth towel rolls in the restrooms and sharing drinking cups were the potential sources of disease transmission. The prevention and control measures of this influenza outbreak were conducted according to the recommendations from the OSHA on work practice, administrative controls and PPE. Nevertheless, there was no change in engineering controls which included usage of AC and ventilation system while several aspects of control measures were implemented in the workplace, particularly on intensive health education (Table 2).

At the initial phase of the outbreak, only cases were requested to wear protective masks before entering building 1. However, poor cooperation achieved, with merely 20% compliance. On the following day, stricter policies were implemented in demanding all employees to wear masks and on-site checking for ILI symptoms before employees entered the workplace. This increased wearing of mask to 80% on the second day and 100% on the third day until the outbreak stopped.

Table 2. Interventions for an influenza A(H3N2) outbreak at a workplace in Nakhon Ratchasima Province, Thailand, 17 Aug - 20 Sep 2015

Intervention	Monitoring period		Duration of intervention
	Start date	End date	
Engineering controls - Use of air-conditioning	No change	No change	No change
Work practices			
1. Intensive health education - Hand washing with alcohol gel - Use of personal drinking cups - Use a serving spoon for shared dishes - Avoid direct contact with the patients	7 Sep	19 Sep	13 days
2. Stop using hand towel rolls in toilet	10 Sep	Current	
3. Hand washing with alcohol gel	10 Sep	Current	
4. Increase frequency of toilet cleaning from 2 to 4 times a day	10 Sep	19 Sep	10 days
5. Cleaning door knobs frequently and wiping surface of working benches with alcohol for 1 time	9 Sep	19 Sep	11 days
6. Active surveillance set up in workplace - On-site managing staff to check for influenza-like symptoms before entering the workplace - Self monitoring influenza-like symptoms among employees and their family members - Nursing unit of workplace	10 Sep	31 Sep	22 days
Administrative controls Isolation precautions		3 out of 216 patients received oseltamivir and stayed at home for 3 days	
Personal protective equipment in building 1			
1. Wearing protective mask among suspected cases	8 Sep	19 Sep	12 days
2. Informing all employees and staff to wear protective masks	9 Sep	19 Sep	11 days

The nursing unit at the workplace was strengthened with medical screening and an observation room for detecting workers who needed hospitalization as well as on-site respiratory specimen collection for influenza rapid test. Employees requiring hospitalization had to inform the nurse team to record their symptoms and evaluate disease control compliance. Moreover, influenza cases were detected through hospital-based surveillance, active screening in the nursing unit, and self-monitoring of employees and their family members.

All employees were followed up until the end of September 2015. No new case occurred after 14 days of observation, which implied that the outbreak had ended (Figures 4, 5). The cost belonged to workplace for prevention and control measures during the outbreak was 40,400 Baht (1,222 USD) in total, including 700 Baht (21 USD) for environmental cleaning at workplace with 70% alcohol, 2,500 Baht (75 USD) for cotton roll, 12,000 Baht (363 USD) for 68.5% alcohol gel for hand washing and 25,200 Baht (762 USD) for protective masks.

Discussion

An outbreak of influenza A(H3N2) virus occurred in a manufacturing plant in the northeastern Nakhon Ratchasima Province of Thailand. This was the second outbreak of influenza in this province in 2015.

The influenza attack rates in employees working in buildings 2 and 3 were lower than those working in building 1 possibly due to the mandatory requirement to wear a C-level suit for protection from chemicals inhalation. The first case was found in building 1 who might have contacted the disease from a family member. This suggested that the disease might spread among employees through direct contact with clinically active cases who coughed and sneezed without wearing protective masks. This study clearly demonstrated that a key to success of influenza epidemic control was wearing protective masks.

One factor that might contribute to occurrence of an influenza outbreak was lack of vaccination among employees for seasonal influenza. The United States Centers for Disease Control and Prevention (US CDC)

recommends vaccination to prevent influenza illness or severe illness. Effective control measure include combination of various methods such as seasonal influenza vaccination, decontamination in the environment, encouraging sick employees to stay home and installing a ventilation system to prevent the spread of the disease.[4]

In Thailand, the health care system provides influenza vaccination free of charge to high risk people, e.g. health care workers and elderly, yet not for the general population.[3] Of 65 million population in Thailand, around 12 million are in high risk groups to receive influenza vaccination. The National Health Security Office purchases and delivers around 2.1-3 million vaccine doses annually to these population.[7] Therefore, influenza vaccination for employees in private sectors have to rely on welfare plans in the workplace.

The Ministry of Public Health, Thailand, followed the guidelines on influenza treatment as recommended by US CDC. Hence, oseltamivir should be administered to patients at risk of developing complications and for prophylaxis in contact cases who might develop serious illness or death[8,9]. On the other hand, systematic reviews with meta-analysis suggested that oseltamivir prophylaxis could reduce the risk of symptomatic influenza in healthy individuals and household contacts.[10,11] Oseltamivir prophylaxis decreased the odds of developing influenza among the elderly in long-term care facilities by 50%, and significantly reduced the attack rate and deaths as well.[12] There was an evidence that implementation of oseltamivir prophylaxis in a nursing home had stopped the influenza outbreak within 10 days.[13]

Despite that, oseltamivir prophylaxis and influenza vaccination were not provided to most employees as the primary control measures in this study. Oseltamivir was prescribed merely for treatment of three patients who developed high fever with malaise. Whereas, the duration of this influenza outbreak with non-pharmaceutical measures was not different from the one with oseltamivir prophylaxis[13]. The control of influenza epidemic within 10 days without oseltamivir prophylaxis was previously reported in a primary school in Thailand in 2007[14]. Nonetheless, the control measures in both outbreaks were different. School closure was one of the measures carried out in the previous study. However, the sick employees in this study continued working due to mild infection and financial constraints.

A study among health care workers during 1999 proved AC systems as a risk factor in the workplace.[15] However, this study did not engage engineering controls through AC system to stop the outbreak due to obstacles for the manufacturing processes. The systematic reviews were not conclusive that upper respiratory tract infection was not related to AC systems, outdoor air ventilation, poorer thermal control or lack of openable windows[16].

In most workplaces in Thailand, the nursing unit as required by the Labor Law of an infirmary is just a place for medicine dispensing. This minimal requirement is not adequate for early detection of clusters with similar symptoms. The event based-surveillance system recommended by the World Health Organization (WHO)[17] should be implemented in every workplace to assess the outbreak situation. This unit should serve as the first line for rapid response to prevent the disease spread, which could lessened business impacts and treatment costs to the public health system. A linkage system among workplaces, communities and public health sectors could facilitate the control of a disease and stop the disease spread to the surrounding communities or other workplaces. This complex health care system was pending for good coordination and trust between government agencies and the private sectors, and it could be implemented successfully through the social enterprise system, according to reports from Thailand[5] and elsewhere[18].

Conclusion

An influenza A(H3N2) epidemic in a workplace was successfully controlled without using anti-viral drugs or influenza vaccination. Early detection of sick employees by the nursing unit at the workplace, together with rapid response from the public sectors on epidemiological investigation, contributed to the success of the outbreak control. This incident supported the recommendations of WHO in using an event-based surveillance system at the workplace in complement to the passive surveillance system in the hospital.

Public Health and Policy Recommendations

Effective detection of this outbreak should apply to every nursing unit in workplaces to set up an ILI event based-surveillance system along with the passive surveillance system in hospitals. The Department of Disease Control, Ministry of Public Health, and the Department of Labor Protection and Welfare, Ministry of Labor should encourage the manufacturing companies to develop an on-site surveillance program pertaining to occupational diseases, work-related illnesses and communicable diseases in their nursing unit. This investigation revealed high value of an event based-surveillance system for outbreak detection and rapid response, and therefore, an event-based

surveillance should be implemented in every workplace.

Acknowledgement

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Suggested Citation

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