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Editorial

Coronavirus Disease - 2019: A Test of National and Global Preparedness and Responses against Emerging Communicable Diseases

Wiwat Rojanapithayakorn, Chief Editor

In just less than three months, an emerging respiratory disease caused by a new coronavirus - severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) - has spread from one country to over 170 countries around the world. It becomes the most recent pandemic of an emerging communicable disease, affecting not only the people who are infected, but also the entire global society.

The coronavirus disease (COVID-19) epidemic began in late December 2019, with the first report on pneumonia of unknown cause in Wuhan, China. Within a few weeks, the cause of the disease was identified to be a new coronavirus. On 30 January 2020, the World Health Organization (WHO) declared the outbreak to be a Public Health Emergency of International Concern and gave the virus a name as severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). On 11 March 2020, the epidemic was classified to be a pandemic by WHO. The main reasons are very clear. The disease is reported to occur in countries around the world with rapid spread, resulting in high numbers of cases and deaths. As of 20 March 2020, WHO reported that the disease has spread to 177 countries, areas or territories, with 234,073 confirmed cases and 9,840 deaths. In addition to health consequences, the disease has caused massive and widespread social reactions, affecting socio-economic wellbeing of people in all affected and non-affected countries. Such undesirable outcomes are interference or interruption on population mobility, closure of various social functions, including educational institutions, and many others, including huge impact on economy and investment for control of the outbreak. It is very unbelievable that an infectious disease has caused such a high magnitude of consequences within a very short time period. It is a big challenge and a test of the national and global responses for prevention and control of emerging communicable diseases.

In the past century, medical and health communities have learned a lot from various emerging diseases. Since the deadliest pandemic - the Spanish flu - in 1918, many subsequent outbreaks and pandemics of influenza, acquired immunodeficiency syndrome (AIDS), sever acute respiratory syndrome (SARS), Ebola, Middle East respiratory syndrome (MERS-CoV), various lessons generated from the responses have made people believe that all emerging infectious diseases can be put under control by applying epidemiological principles and tools. In Asia and Pacific Region, WHO has developed the Asia Pacific Strategy for Emerging Diseases (APSED) which has been implemented by 48 countries under two WHO regions: the South-East Asia and the Western Pacific. The original strategy developed in 2005, and the revised 2010 version have captured all essential areas of work to make countries well prepared for delivery of effective responses against any emerging communicable disease. In particular, the APSED 2010 has identified eight "focus areas" which included: (1) surveillance, risk assessment and response; (2) laboratories; (3) zoonoses; (4) infection prevention and control ; (5) risk communication; (6) public health emergency preparedness; (7) regional preparedness, alert and response; and (8) monitoring and evaluation. Despite such recommended strategies, rapid spread and failure to prevent and control the outbreaks of COVID-19 are, to some degree, clear evidences of ineffective responses against the disease. Currently, countries are implementing different control strategies, ranging from routine screening, contact tracing, regular quarantine to country lockdown. The common measures toward the public include selective individual temperature screening, viral testing, symptomatic and physiological treatment of cases, isolation of cases, quarantine of contacts, and physical distancing (social isolation) for the rest population. People are advised to wear masks, wash hands frequently and refrain from traveling. Up to now, there is still no concrete evidence of success reported at the national level. Varying degrees of severity of outbreaks are believed to be associated with different phases of epidemic each country is facing. Thus, we are in urgent need of more effective strategies, in addition to the current recommended ones.

There are still many questions to be answered with regard to the COVID-19 pandemic. The coordinated global research roadmap recently released by WHO highlights most of the essential areas for research. At least, the following issues may need clarification in order to improve effectiveness of prevention and control interventions.

- The whole set of questions about the virus, including origin, transmission modes and its survival in different environmental surfaces.
- The virulence of the virus with regard to different levels of spread in many locations and varying degrees of case-fatality. Among seven countries where the number of cases exceed 10,000, the dead rates are 8.6% in Italy, 7.3% in Iran, 5.0% in Spain, 4.0% in China, 3.5% in France, 1.3% in United States and 0.2% in Germany. It should be noted that, currently, deaths in these seven countries represent 93.2% of the overall reported mortality from the disease. The numbers of deaths in most affected countries are still very low.
- On prevention and control, there are controversies about benefits (or risks) of wearing a mask, use of a common serving spoon for shared food, types of social activities that need to be locked down, need for hoarding food, and differentiation between panic behaviors and over-protection practices.

Many experts gave varying opinions, both optimistic and pessimistic, on postulation of the pandemic duration and severity. It is still very unpredictable, depending on strengths of the national and global responses, availability of antiviral drugs and coronavirus vaccine, and underlying socio-economic situation associated with the disease. No matter when the disease is put under control, this pandemic will certainly generate a lot of lessons for the medical and health communities to learn and share. The experiences learned from COVID-19 pandemic will certainly become important inputs for developing a more effective and realistic global strategy against emerging and re-emerging communicable diseases in the far future.

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Factors Associated with Knowledge and Practice of Healthcare Workers in Cervical Cancer Screening in Ratchaburi Province, Thailand

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Abstract

Thailand's 2010-2014 national program for cervical cancer screening guidelines recommends that women aged 30-60 years should be screened every five years with the Papanicolau smear (Pap smear) method or visual inspection with acetic acid and that coverage should be at least 80%. However, from 2010-2014, the national coverage of cervical cancer screening was only 53.9%. We therefore evaluated healthcare workers' knowledge of the guidelines and their practices regarding cervical cancer screening by Pap smear. We collected data using a structured questionnaire from 258 healthcare workers who had ordered or conducted cervical cancer screening for at least one year. Most (74.8%) healthcare workers knew that Pap smears should be done every five years among women aged 30 to 60 years. General practitioners and gynecologists had lower knowledge of the age criteria compared to nurses and technicians. Knowledge of the target age criteria was significantly associated with type of healthcare worker, workplace, gender and recent training (within the previous 3 years). The screening practice was significantly associated with type of healthcare worker and workplace. Providing up-to-date training on the national cervical cancer screening guidelines is necessary for all public hospital healthcare workers.

Keywords: cervical cancer, cancer screening, Papanicolau smear

Introduction

In Thailand cervical cancer is one of the five most common cancers among women.[1] Since 2005 the Thailand national cervical cancer screening programme, developed by the National Health Security Office and the Ministry of Public Health, recommended 5-yearly cervical cancer screening with a Papanicolau smear (Pap smear) for women aged 35-60 years.[2,3] This programme was evaluated and the coverage of screening increased from 25% (before establishing the screening programme) to 68% during 2005-2009.[2,4]

Updated national guidelines were developed for 2010-2014 with the recommendations of screening for women aged 30-60 years with Pap smear or visual inspection with acetic acid.[3,5,6] The target for coverage of screening in the target population was 80%.[3,6] However, an evaluation of the 2010-2014 programme found that national coverage for cervical cancer screening among women aged 30-60 years was 53.9%.[3] This finding included data from women screened at public hospitals only and did not include university or private hospitals.[3]

Previous studies found that less than optimal screening rates may be due to low knowledge among healthcare workers about the national guideline's recommendations.[7] In the 2009 fiscal year, 9.8% of the healthcare workers in Nong Bua Lamphu Province in the northeastern region of Thailand had medium to high levels of knowledge of cervical cancer screening.[8] The coverage of cervical cancer screening in the target population was 56.9%.[8]

Between 2010 and 2014, Ratchaburi Province in the central-western region of Thailand had a coverage of cervical cancer screening in the target population of 56.5%, which was slightly higher than the national level but similar to that in Nong Bua Lamphu Province.[8,9] We hypothesized that knowledge of cervical cancer screening among healthcare workers in Ratchaburi Province was similar to the coverage in

Nong Bua Lamphu Province. Hence, we conducted the study to evaluate the knowledge of healthcare workers in Ratchaburi Province, Thailand, about the 2010-2014 national screening guidelines for cervical cancer, their practice of recommending cervical cancer screening and associated factors of knowledge and practice of healthcare workers in cervical cancer screening.

The findings from this study could be used by policy makers to determine the need for national campaigns to encourage the target groups to be screened. Findings could also be used by implementers to improve the next 5-year guidelines (2020-2024).

Methods

Study Design and Setting

A facility-based cross-sectional study was conducted in public hospitals of Ratchaburi Province, Thailand in 2016. Ratchaburi is one of the rural provinces of Thailand with a population of 850,000. All of the Ministry of Public Health hospitals, including community, provincial or general hospitals and health promoting hospitals were included in the study.

Study Population

All healthcare workers, including nurses, public health officers, general practitioners and gynecologists, who had been involved in conducting or ordering cervical cancer screening were eligible for the study. Exclusion criteria were those healthcare workers who worked less than one year in these public hospitals.

Data Collection

We collected data using a questionnaire adapted from the US National Survey of Primary Care Physicians' Cancer Screening Recommendations and Practices: Breast and Cervical Cancer Screening Questionnaire.[10] The questionnaire was pretested and reviewed by ten public health technical officers and experts at the Division of Epidemiology. Information regarding the type of healthcare worker (public health technician, nurse, general practitioner, gynecologist), and their age, gender, work experience, time since last training (years), work location, and knowledge and practice of cervical cancer screening was elicited. Knowledge regarding cervical cancer screening was assessed based on their responses to questions on cervical cancer screening criteria and age group of the target population. A healthcare worker's knowledge on cervical cancer screening criteria was tested using six scenarios on the recommended test or combination of tests for women of various ages. (Table 1)

Table 1 Scenarios and recommendations for healthcare workers involved in cervical cancer screening in public hospitals, Thailand

Scenarios	Recommendation from guideline
18-year-old woman, no sexual intercourse, 1st OPD gynecology visit	No screening
18-year-old woman, sexual intercourse 1 month ago, 1st OPD gynecology visit	No screening
18-year-old woman, sexual intercourse 3 years ago, 1st OPD gynecology visit	No screening
33-year-old woman, no sexual intercourse with a new partner in the past 5 years, normal Pap smear in past year	Screening
55-year-old woman, no sexual intercourse with a new partner in the past 5 years, normal Pap smear result 3 times	Screening
65-year-old woman, no sexual intercourse with a new partner in the past 5 years, normal Pap smear result 3 times	No screening

Data analysis

The data were coded, cleaned, and analyzed using Epi Info version 7.1. For the descriptive part of the study, frequencies with percentages, and means with standard deviations were used to summarize the results. Average scores and standard deviations were calculated to summarize the response of the six criteria on the recommended test. For the analytic part of the study, univariate analysis was performed. Associated factors of knowledge and practice of healthcare workers in cervical cancer screening for the provincial level were determined using prevalence ratios with 95% confidence intervals. A healthcare worker's practice on cervical cancer screening criteria was categorized as 'good' if they advised more than 10 women per month to have a Pap smear.

Table 2 Demographic characteristics of healthcare workers involved in cervical cancer screening in public hospitals of Ratchaburi Province, Thailand 2016 (n=258)

Variable	Type of healthcare workers				Total
	Public health technician officers	Nurses	General practitioners	Gynecologists	
Sex					
Male	49	169	9	11	238
Female	2	2	10	6	20
Age in years (Mean ± SD)	43.7 ± 9.2	43.9 ± 7.4	29.7 ± 7.4	43.8 ± 8.0	42.8 ± 8.6
Training in cervical cancer screening					
< 3 years ago	30 (23.4%)	81 (63.3%)	9 (7.0%)	8 (6.3%)	128
3-6 years ago	14 (19.2%)	47 (64.4%)	5 (6.8%)	7 (9.6%)	73
6-10 years ago	3 (17.6%)	14 (82.4%)	0	0	17
> 10 years ago	3 (7.9%)	28 (73.7%)	5 (13.1%)	2 (5.3%)	38
Place of work					
Health promoting hospital	48 (31.0%)	107 (69.0%)	0	0	155
Community hospital	3 (4.8%)	41 (66.1%)	18 (29.0%)	0	62
Provincial and general hospital	0	23 (56.1%)	1 (2.4%)	17 (41.5%)	41

Ethical considerations

All public health workers in the study provided informed written consent. The study was reviewed and approved by the ethical review committee of the Department of Disease Control, Ministry of Public Health, Nonthaburi, Thailand (FWA 00013622).

Table 3 Knowledge regarding target population and criteria among healthcare workers involved in cervical cancer screening in public hospitals of Ratchaburi Province, Thailand 2016 (n=258)

Item	Type of healthcare worker				Total
	Public health technician officers	Nurses	General practitioners	Gynecologists	
Percentage who knew that Pap smear should be done every five years for women aged 30-60 years	88.2%	81.3%	21.0%	29.4%	74.8%
Mean ± SD (score) of criteria of cervical cancer screening	3.8 ±0 .2	3.9 ± 0.1	3.3 ± 0.3	2.8 ± 0.3	3.7 ± 0.8

Results

Demographic Data

A total of 283 healthcare workers from 11 Ministry of Public Health hospitals and 162 health promoting hospitals were approached. Of these, 277 questionnaires were returned for a response rate of 98%. We analyzed 258 complete questionnaires. (Table 2)

Health care workers included public health technician officers (n=51, 19.8%), nurses (n=171, 66.3%), general practitioners (n=19, 7.3%) and gynecologists (n=17, 6.6%). Of these, 155 (60.1%) worked at health promoting hospitals, 62 (24.0%) at community hospitals, and 41 (15.9%) at provincial/general hospitals. Approximately 92% were female. The mean age was 43 years. Almost half of them had trained in cervical cancer screening within the last three years. (Table 2)

Knowledge Related to Cervical Cancer Screening

Awareness of the 2010-2014 national cervical cancer screening guidelines was stated by 87.2% (225/258) of participants. Knowledge that a Pap smear should be done every five years for women aged between 30 and 60 years was mentioned by 74.8% (193/258) of the participants. Gynecologists (29.4%) and general practitioners (21.1%) had lower knowledge of the target age group for cervical cancer screening compared to public health technician officers (88.2%) and nurses (81.3%). The mean (SD) knowledge score in criteria of cervical cancer screening was 3.7 (0.8). The mean scores of gynecologists and general practitioners were lower than those of public health technician officers and nurses. (Table 3)

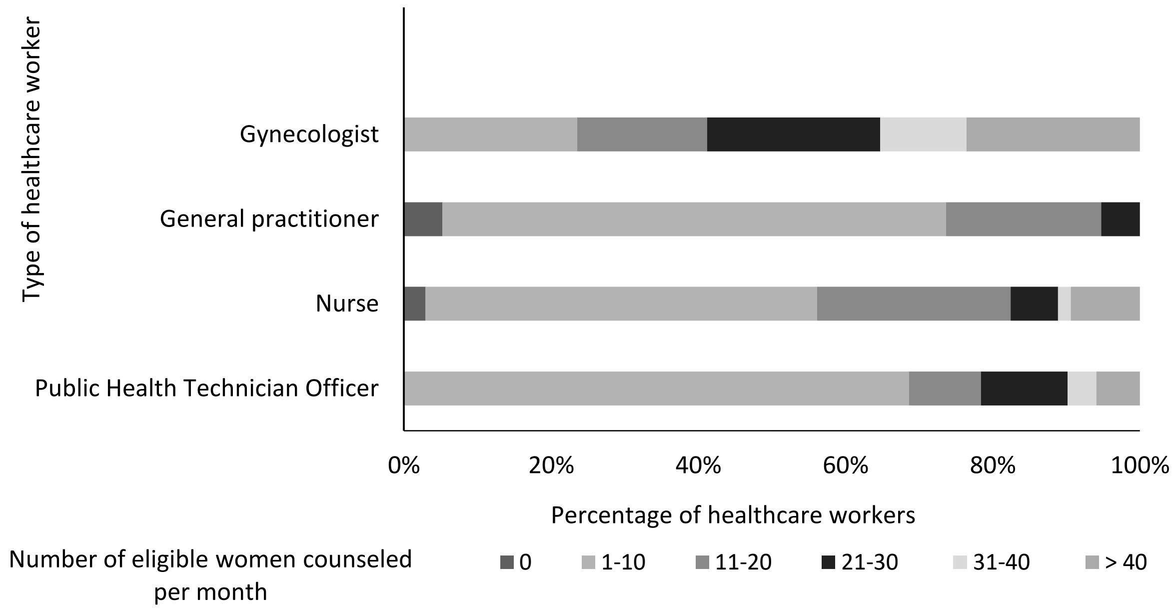
Practice Related to Cervical Cancer Screening

Almost all healthcare workers (97.7%) advised the target population to undergo cervical cancer screening. Approximately 55% advised 1-10 women/month and gynecologists tended to advise more eligible women to be screened than the other healthcare workers (Figure 1). The popular methods of advice were direct communication (89.1%), providing brochures (67.3%) and posting letters (43.3%). Telephone (79.2%) was the most preferred way to convey the screening results to the women.

Factors Associated with Knowledge and Practice of Cervical Cancer Screening

Table 4 shows factors associated with knowledge and practice of cervical cancer screening among the study participants using a prevalence ratio (PR) with 95% confidence interval (CI) to compare the categories within each factor. The prevalence of healthcare workers who knew the appropriate target age to screen women for cervical cancer among those who had recent (within the previous 3 years) training was 1.16 times higher (95% CI 1.01–1.34) than that among those who did not. Workplace and type of healthcare worker were also significantly associated with knowledge. Screening practice was significantly associated with type of healthcare worker and workplace. Gynecologists had a significantly higher prevalence of screening than general practitioners (PR 2.90, 95% CI 1.31–6.45) while healthcare workers from health promoting hospitals (PR 0.60, 95% CI 0.45–0.81) and community hospitals (PR 0.50, 95% CI 0.32–0.75) each had a significantly lower prevalence compared to those from provincial and general hospitals.

Figure 1 Frequency of cervical cancer screening (per month) in public hospitals of Ratchaburi Province, Thailand 2016 classified by type of healthcare worker (n=258)



Discussion

Approximately 75% of healthcare workers in Ratchaburi Province had correct knowledge of the target age for cervical cancer screening according to the 2010-2014 national guidelines. The majority of healthcare workers advised the target population to undergo cervical cancer screening and approximately half advised between 1 and 10 women per month to be screened. Workplace, worker type, gender and recent training were all associated with knowledge while only workplace and worker type were associated with screening practice.

In the study setting, most (75%) of the healthcare workers had correct knowledge of the national cervical cancer guidelines. However, correct knowledge of the criteria was found in a low percentage of general practitioners (21%) and gynecologists (29%). This could be because there are several cervical cancer screening guidelines such as those published by the American College of Obstetricians and Gynecologists and the American Cancer Society.[5] Some medical doctors may use these guidelines in their practice rather than the one published by Thailand's National Health Security Office. Having little or no information or encouragement from healthcare workers has been highlighted as a reason for poor uptake of Pap smear.[11-14]

We found that the majority of healthcare workers advised the target population to undergo cervical cancer screening. The positive effect of doctors' recommendation on cancer screening uptake is well highlighted by previous studies.[13,15-17] In our study, the majority of gynecologists recommended, among the target population, more than 10 women/month to undergo cervical cancer screening. Better performance in cervical cancer screening will improve the cervical screening uptake in Ratchaburi province, resulting in an improvement to the cervical cancer screening coverage.

We found that healthcare workers from health promoting hospitals had significantly higher knowledge of the target age criteria compared to those from provincial and general hospitals.

Health promoting hospitals had the highest proportion of workers compared to other health facilities. A possible explanation may be that most public health technician officers who were responsible for health promotion worked at health promoting hospitals.

There are some limitations in this study which should be acknowledged. Almost one third (n=77) of our study participants were not available for interview and thus self-completed the questionnaire. These participants did not have any chance for clarification if they could not understand any of the questions.

Table 4 Association between key study variables and knowledge and practice of cervical cancer screening among healthcare providers in public hospitals, Ratchaburi Province, Thailand 2016 (n=258)

Study variable	Knowledge of target age	Practice of recommending cervical cancer screening
Types of healthcare worker		
Public Health Technician Officer (n=51)	88.2% (45/51)	30.8% (16/52)
Prevalence Ratio (95% CI)	4.20 (1.75-10.07)*	1.17 (0.50-2.75)
Nurse (n=171)	81.3% (139/171)	43.9% (75/171)
Prevalence Ratio (95% CI)	3.90 (1.61-9.25)*	1.67 (0.77-3.60)
Gynecologist (n=17)	29.4% (5/17)	76.5% (13/17)
Prevalence Ratio (95% CI)	1.40 (0.45-4.37)	2.90 (1.31-6.45)*
General practitioner (n=19) Reference	21.1% (4/19)	26.3% (5/19)
Workplaces		
Health promoting hospitals (n=155)	91.6% (142/155)	40.0% (62/155)
Prevalence Ratio (95% CI)	1.90 (1.37-2.58)*	0.60 (0.45-0.81)*
Community hospitals (n=62)	50.0% (31/62)	32.3% (20/62)
Prevalence Ratio (95% CI)	1.00 (0.69-1.53)	0.50 (0.32-0.75)*
Provincial and general hospitals (n=41) Reference	48.8% (20/41)	65.9% (27/41)

*Note *statistically significant association*

Table 4 Association between key study variables and knowledge and practice of cervical cancer screening among healthcare providers in public hospitals, Ratchaburi Province, Thailand 2016 (n=258) (con't)

Study variable	Knowledge of target age	Practice of recommending cervical cancer screening
Sex		
Female (n=238)	78.2% (186/238)	43.3% (103/238)
Prevalence ratio (95% CI)	2.23 (1.22-4.07)*	1.44 (0.73-2.76)
Male (n=20)	35.0% (7/20)	30.0% (6/20)
Reference		
Training		
< 3 years ago (n=128)	80.5% (103/128)	44.9% (57/128)
Prevalence ratio (95% CI)	1.16 (1.01-1.34)*	1.08 (0.81-1.43)
≥ 3 years ago (n=130)	69.2% (90/130)	41.6% (52/130)
Reference		

*Note *statistically significant association*

Conclusion

In conclusion, most healthcare workers knew the 2010-2014 cervical cancer screening guidelines and followed the guidelines in their workplace. Gynecologists advised more women to undergo cervical cancer screening than other workers. To improve the cervical cancer screening program, we recommended that the Ratchaburi Provincial Health Office should train healthcare workers to become more familiar with the cervical cancer screening guideline, especially among those whose training was more than three years ago. In addition, the cervical cancer screening guidelines should be displayed in all examination rooms to encourage more healthcare workers to follow the guidelines.

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Factors Associated with Disability and Mortality among Necrotizing Fasciitis Patients in Thailand, 2018

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Abstract

Necrotizing fasciitis (NF) is a serious skin and soft tissue infection that can lead to disabilities and mortalities. A study was carried out to describe demographic characteristics of NF patients, and determine factors associated with disability and mortality. Information on all patients who were diagnosed as NF from 1 Jan to 31 Dec 2018 were extracted from the databases of Health Data Center in Thailand. Univariate and multivariate analyses using logistic regression were performed to determine the associated factors. In 2018, of total 19,071 NF cases, 6.3% died. Median age was 59.7 years old (Q1-Q3 = 49.1-69.5 years). Most of the cases developed NF at ankle and foot (43.0%), followed by lower leg (28.2%). The amputation rate among the cases was 8.2%. Multivariable analysis showed the significant risk factor for amputation as having diabetes mellitus (adjusted OR 6.81, 95% CI 5.97-7.77). Risk factors for mortality included being elderly (OR 1.81, 95% CI 1.56-2.11), and having hypertension (OR 1.17, 95% CI 1.00-1.36), cirrhosis (OR 4.26, 95% CI 3.42-5.28) or cancer (OR 1.88, 95% CI 1.33-2.59). Morbidity and mortality among NF patients were significant in Thailand. Health workers should be trained for early diagnosis and intensive treatment for NF, especially among elderly and patients with chronic diseases in order to prevent the subsequent complications.

Keywords: necrotizing fasciitis, NF, disability, mortality, risk factor

Introduction

Necrotizing fasciitis (NF) is one of the serious skin and soft tissue infections as it can cause the death of tissues, subsequently leading to disability and mortality.[1-3] Most patients who develop NF require prompt treatment with proper antibiotics and surgical procedures in order to save lives.[2,3] In some developed countries such as Canada, Norway and the United States, the incidence of NF ranged from 0.1 to 3 per 100,000 population.[4-6] Moreover, recent studies suggested that NF usually occurred among elderly and people with chronic diseases like diabetes and hypertension, as compared to the normal population.[3,7] Complications such as limb loss, sepsis or even death can also develop. According to Khammuan et al, amputation rate among NF patients was found to be 8.4% while case fatality rate was reported to be 5.4%.[8]

In Thailand, knowledge on the nationwide situation of NF as well as factors associated with disability and mortality among NF patients remained limited. This study, thus, was carried out in order to describe demographic characteristics, and determine factors influencing amputation and death among NF patients.

Methods

Study Design

A cross-sectional analytic study using secondary data extracted from Health Data Center (HDC) of Thailand was conducted. The HDC is the database system with big data technology, developed by the Information and Communication Technology Center, Office of the Permanent Secretary, Ministry of Public Health. Basically, the HDC database consisted of 43 files; however, only 8 files named “person”, “address”, “diagnosis_opd”, “diagnosis_ipd”, “procedure_opd”, "procedure_ipd", "chronic" and "admission" , were extracted for this study.

Study population were all patients diagnosed as NF (ICD-10 code: M72.6) from 1 Jan to 31 Dec 2018. Variables selected were gender, age, occupation, nationality, diagnosis date of NF, underlying diseases (diabetes, hypertension, cirrhosis, alcoholism, cancer or HIV infection) and treatment results (cured, amputated or dead). Based on International Standard Classification of Occupations (ISCO-08), patients' occupations were classified into 10 major groups: (i) managers, (ii) professionals, (iii) technicians and associate professionals, (iv) clerical support workers, (v) services and sales workers, (vi) skilled agricultural, forestry and fishery workers, (vii) craft and related trades workers, (viii) plant and machine operators and assemblers, (ix) elementary occupations, and (x) armed forces occupations. Patients who reportedly did not have a job were categorized as "unemployed". The infection site of NF in a patient was identified by the fifth character of the ICD10 code (e.g., M72.67 for NF at ankle and foot).

Data Analysis

The data were analyzed using R software version 3.5.2 and RStudio® version 1.2.1335. In descriptive statistics, key categorical variables such as gender, nationality, occupation, and underlying diseases were described in percentage, whereas age variable was calculated as median with interquartile range (Q1-Q3). In the analytic study, univariate logistic regression was initially performed to determine prevalent odds ratio (OR) with 95% confidence interval (CI). Significant variables from the univariate analysis were then selected for multivariate logistic regression in order to calculate adjusted odds ratio (adjusted OR) with 95% CI.

Table 1. Characteristics of necrotizing fasciitis patients reported in the database of Health Data Center, Thailand, 2018

Characteristics	Number of cases (%)
Gender (n=18,725)	
Male	11,084 (59.2)
Female	7,641 (40.8)
Nationality (n=18,702)	
Thai	18,404 (98.4)
Others	298 (1.6)
Occupation (n=18,140)	
Elementary occupations	5,935 (32.7)
Skilled Agricultural, Forestry and Fishery Workers	5,816 (32.1)
Unemployed	1,566 (8.6)
Services and Sales Workers	1,215 (6.7)
Managers	250 (1.4)
Professionals	209 (1.1)
Technicians and Associate Professionals	162 (0.9)
Others	2,987 (16.5)
Underlying disease (n=19,071)	
No	7,258 (38.1)
Yes	11,813 (61.9)

Table 1. Characteristics of necrotizing fasciitis patients reported in the database of Health Data Center, Thailand, 2018 (con't)

Characteristics	Number of cases (%)
Patients with underlying diseases (n=11,813)	
Hypertension	8,525 (72.2)
Diabetes mellitus	8,073 (68.3)
Cirrhosis	963 (8.2)
Alcoholism	663 (5.6)
Cancer	445 (3.8)
HIV infection	111 (0.9)
Affected part (n=19,071)	
Ankle and foot	8,191 (43.0)
Lower leg	5,372 (28.2)
Hands	1,395 (7.3)
Forearm	669 (3.5)
Upper leg	449 (2.3)
Arm	249 (1.3)
Shoulder	25 (0.1)
Others	474 (2.5)
Unspecified	1,949 (10.2)
Multiple sites	298 (1.6)
Amputation (n=19,071)	
No	17,505 (91.8)
Yes	1,566 (8.2)

Results

Descriptive Study

In 2018, a total of 19,071 NF patients were recorded in the HDC database, with incidence rate as 31.1 per 100,000 population. Male to female ratio was 1.5:1. Median age was 59.7 years old (Q1-Q3 49.1-69.5 years). The majority of the NF cases (98.4%) were Thai. According to ISCO, most of the patients (32.7%) were classified with elementary occupations, followed by skilled agricultural, forestry and fishery workers (32.1%) and unemployed (8.6%). (Table 1)

In addition, 8,191 (43.0%) NF patients developed infection at ankle and foot, followed by lower leg (28.2%), hands (7.3%) and forearm (3.5%). We found that 1,566 patients had severe infection, and required amputation, with the amputation rate as 8.2%. Additionally, 1,209 patients died after developing NF, and case fatality rate was 6.3%. In 2018, out of 19,071 patients, 11,813 (61.9%) had underlying diseases. Hypertension (72.2%) was the most common disease, followed by diabetes mellitus (68.3%), cirrhosis (8.2%), alcoholism (5.6%), cancer (3.8%) and HIV infection (0.9%). (Table 1)

Analytic Study

Regarding to the univariate logistic regression, factors that were significantly associated with amputation were being female (OR 1.29, 95% CI 1.17-1.44); under 15 years of age (OR 0.11, 95% CI 0.04-0.27); having diabetes mellitus (OR 6.81 95% CI 5.97-

7.77), hypertension (OR 2.06, 95% CI 1.86-2.29), cirrhosis (OR 0.52, 95% CI 0.38-0.70), alcoholism (OR 0.47, 95% CI 0.31-0.67), or cancer (OR 0.60, 95% CI 0.38-0.90); and experiencing single infection site (compared with multiple infection site) (OR 1.83, 95% CI 1.11-3.29). (Table 2)

Table 2. Univariate analysis on amputation and mortality among necrotizing fasciitis patients reported in the database of Health Data Center, Thailand, 2018

Characteristics		Odds ratio for amputation (95% CI)	Odds ratio for mortality (95% CI)
Gender	Female	1.29 (1.17-1.44)*	0.97 (0.86 – 1.09)
	Male	Ref.	Ref.
Age	< 15 years old	0.11 (0.04-0.27)*	0.10 (0.02-0.31)*
	> 60 years old	1.02 (0.92-1.13)	1.66 (1.47-1.87)*
	15-60 years old	Ref.	Ref.
Occupation	Elementary	1.02 (0.84-1.25)	0.76 (0.62-0.93)*
	Skilled Agriculture	0.91 (0.71-1.17)	0.67 (0.52-0.86)*
	Others	0.97 (0.81-1.21)	0.40 (0.33-0.50)*
	Unemployed	Ref.	Ref.
Diabetes mellitus	Yes	6.81 (5.97-7.77)*	0.88 (0.78-0.99)*
	No	Ref.	Ref.
Hypertension	Yes	2.06 (1.86-2.29)*	1.24 (1.11-1.40)*
	No	Ref.	Ref.
Cirrhosis	Yes	0.52 (0.38-0.70)*	3.76 (3.15-4.46)*
	No	Ref.	Ref.
HIV infection	Yes	0.99 (0.46-1.85)	0.99 (0.42-1.99)
	No	Ref.	Ref.
Alcoholism	Yes	0.47 (0.31-0.67)*	1.44 (1.08-1.87)*
	No	Ref.	Ref.
Cancer	Yes	0.60 (0.38-0.90)*	2.52 (1.90-3.28)*
	No	Ref.	Ref.
Number of infection site	Single	1.83 (1.11-3.29)*	0.70 (0.48-1.08)
	Multiple	Ref.	Ref.

Note: ** Statistical significance at α< 0.05*

Ref. stands for reference

However, in terms of mortality, being under 15 (OR 0.10, 95% CI 0.02-0.31) and over 60 years old (OR 1.66 95% CI 1.47-1.87), and having diabetes mellitus (OR 0.88, 95% CI 0.78-0.99), hypertension (OR 1.24, 95% CI 1.11-1.40), cirrhosis (OR 3.76, 95% CI 3.15-4.46), alcoholism (OR 1.44, 95% CI 1.08-1.87) or cancer (OR 2.52, 95% CI 1.90-3.28) were significant. Regarding to occupations, the NF patients with elementary occupations (OR 0.76, 95% CI 0.62-0.93), skilled agricultural, forestry and fishery works (OR 0.67, 95% CI 0.52-0.86), and others (OR 0.40, 95% CI 0.33-0.50) had lower risk of mortality when compared with unemployed group. (Table 2)

Statistically significant variables (P-value< 0.05) in the univariate analysis were included in the multivariate logistic regression model. The findings showed that patients with diabetes had greater risk of amputation (adjusted OR 6.81, 95% CI 5.97-7.77) compared to the non-diabetic patients. Nonetheless, chance of amputation among NF patients seemed to be lower among children aged under 15 years (adjusted OR< 0.001, 95% CI< 0.0001-0.0014), and patients with cirrhosis (adjusted OR 0.64, 95% CI 0.44-0.90) or cancer (adjusted OR 0.52, 95% CI 0.30-0.84). (Table 3)

Considering mortality as an outcome, the significant risk factors included being in the elderly age group (adjusted OR 1.81, 95% CI 1.56-2.11), and having hypertension (adjusted OR 1.17, 95% CI 1.00-1.36), cirrhosis (adjusted OR 4.26, 95% CI 3.42-5.28) or cancer (adjusted OR 1.88, 95% CI 1.33-2.59). Nevertheless, diabetic patients (adjusted OR 0.79, 95% CI 0.67-0.92) and those who worked as skilled agricultural workers (adjusted OR 0.44, 95% CI 0.35-0.55) or other occupations (adjusted OR 0.74, 95% CI 0.57-0.96) were less likely to die due to NF. (Table 3)

Table 3. Multivariate logistic regression analysis for amputation and mortality among the NF patients, Thailand, 2018

Characteristics		Adjusted odds ratio (95% CI) for amputation	Adjusted odds ratio (95% CI) for mortality
Gender	Female	1.00 (0.89-1.13)	1.04 (0.90-1.20)
	Male	Ref.	Ref.
Age	< 15 years old	<0.001 (<0.0001-0.0014)*	0.23 (0.01-1.03)
	> 60 years old	0.91 (0.80-1.03)	1.81 (1.56-2.11)*
	15-60 years old	Ref.	Ref.
Occupation	Elementary	1.04 (0.84-1.29)	0.92 (0.75-1.13)
	Skilled Agriculture	0.84 (0.69-1.04)	0.44 (0.35-0.55)*
	Others	0.80 (0.62-1.03)	0.74 (0.57-0.96)*
	Unemployed	Ref.	Ref.
Diabetes	Yes	7.27 (6.19-8.58)*	0.79 (0.67-0.92)*
	No	Ref.	Ref.
Hypertension	Yes	0.99 (0.87-1.13)	1.17 (1.00-1.36)*
	No	Ref.	Ref.
Cirrhosis	Yes	0.64 (0.44-0.90)*	4.26 (3.42-5.28)*
	No	Ref.	Ref.
Alcoholism	Yes	0.66 (0.41-1.01)	0.93 (0.67-1.28)
	No	Ref.	Ref.
Cancer	Yes	0.52 (0.30-0.84)*	1.88 (1.33-2.59)*
	No	Ref.	Ref.
Number of infection site	Single	1.53 (0.86-3.02)	0.78 (0.49-1.32)
	Multiple	Ref.	Ref.

Note: ** Statistical significance at α< 0.05*

Ref. stands for reference

Discussion

This study shed light on the factors that posed a risk to disability or mortality following NF. The findings could be helpful to aid health care workers in making a rational decision on treatment and disease control of NF.

One of the strengths of this study was that all the NF (19,071) patients recorded in HDC during 2018 were included in this study. These data were reported from all provinces throughout the country, except Bangkok. Thus, the results from this study could represent the characteristics of all NF patients nationwide.

In this study, we had determined the amputation rate among NF patients in Thailand during 2018 as 8.2%. This finding was compatible with a study by Khamnuan et al.[8], conducted in three provinces of Thailand – Chiang Rai Province, Kamphaeng Phet Province and Phayao Province. Based on the multivariate logistic regression analysis, the significant risk factor of amputation among NF patients was found to be presence of underlying diseases such as diabetes. This finding was consistent with the previous studies by Khamnuan, Ahn and Cheng.[8-10] The possible explanation was that diabetes mellitus can lead to peripheral vascular disease, especially at lower extremities, thereby increasing risk of infections and causing a delay in wound healing.[11-16] Consequently, once diabetic patients develop NF and fail to receive early appropriate treatment, severe tissue necrosis will occur, which requires extensive surgery. Some patients would subsequently end up with amputation of limbs.

Interestingly, our study had shown that the diabetic NF patients were less likely to be dead, compared to those without diabetes. The medical doctors tend to give close attention on the NF patients with diabetes due to high risk of developing tissue necrosis as previously mentioned. Thus, the diabetic patients tend to receive early recognition and aggressive surgical treatment in order to save their lives. This might possibly be the convincing explanation as to why diabetes was found to be a significant protective factor for mortality, but a significant risk factor for amputation.

Case fatality rate among NF patients in this study was found to be 6.3%. This result was similar to a study by Awsakulsutthi which reported the case fatality rate of 5.9%.[17] In accordance to other previous research studies, we also demonstrated that the significant risk factors for mortality among NF patients were over 60 years of age, and presence of hypertension, cirrhosis or cancer.[18,19] Aging, cirrhosis and cancer can cause alterations of immunity.[20-23] Once the patients with these underlying conditions develop severe infection like NF, they are more likely to end up with septicemia which is one of the major causes of death.[24] In addition, being hypertensive is known to be strongly associated with age as well.[25,26]

In addition, results from the multivariate logistic regression demonstrated that the unemployed patients had higher risk of mortality, compared with those with an occupation. Patients engaged in elementary occupations did not show statistically difference from the unemployed group. It could be explained that unemployment is closely related to elderly, or people with some medical conditions or low socio-economic status.[27-29] These 3 groups of people are usually prone to have severe infection and death, compared to general population.[20-23,30]

There were some limitations in this study. Laboratory findings such as total white blood count, C-reactive protein or serum creatinine were not available in the HDC database. Lack of such data might affect the accuracy of diagnosis. Moreover, although there was no information on some variables, it was not substantial since even for the occupation variable with the highest missing data, proportion of missing data was merely 4.9%.

Conclusion

In conclusion, morbidity and mortality among NF patients were among the important public health concerns in Thailand. Health care workers should be trained and reminded to initiate prompt diagnosis and adequate treatment for NF patients. The service for NF should be more emphasized in high risk populations, particularly among unemployed, elderly and patients with chronic diseases such as diabetes, hypertension, cirrhosis and cancer, in order to prevent serious subsequent complications.

Suggested Citation

Praekunatham H, Tantirat P. Factors associated with disability and mortality among necrotizing fasciitis patients in Thailand, 2018. OSIR. 2020 Mar;13(1): 9-16.

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Predicting Blood Lead Levels among Children Living in Households Making Fishing Nets with Lead Weights in Phuket and Phang Nga Provinces

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Abstract

This study aimed to validate the Integrated Exposure Uptake Biokinetic (IEUBK) model, the computed risk assessment tool, by comparing the predicted blood lead levels and the observed one among children aged 1-7 years old in households making fishing nets, and to develop a predictive model based on environmental lead level in Phuket and Phang Nga Provinces, in the South of Thailand. We identified children in households, which made fishing nets and participated in the Office Disease Prevention and Control 11 Blood Lead Levels Surveillance System (BLLSS). We collected blood lead information, surveillance address and samples from the environment such as soil, water and dust. We calculated the predicted value by using IEUBK program and the site-specific model and compared with observed value to calculate Mean Absolute Error (MAE) and Mean Absolute Percent Error (MAPE). Forty children from different households were recruited. Geometric mean observed blood lead level was 7.6 µg/dL. We found 45% of households with excess lead in surface dust, and 19% in water. The MAE and MAPE of IEUBK model revealed a substantial difference between the observed and predicted values. The site-specific model, including soil, dust in the bed and workwear as predictive variables, had more accuracy predictive capacity. However further study of the IEUBK in other scenarios is needed.

Keywords: child, lead, Thailand

Introduction

Lead exposure results in neurobehavioral impairment in young children due to their hand-to-mouth activities and higher absorption rate than adults.[1] The US Centers for Disease Control and Prevention (CDC) has stated that there is no safe blood lead level for children.[2] The major sources of lead exposure in Thailand are ambient lead contamination in the environment and take-home exposures such as living with parents who are involved in lead manufacture, and in-house exposure such as attaching lead weights during making net process.[3]

The Office of Disease Prevention and Control 11 (ODPC 11), responsible for the upper southern coast of Thailand, established a sentinel blood lead levels surveillance system (BLLSS) in 2013. The BLLSS aimed to focus on children who lived in households making fishing nets. Population under surveillance was children aged 1-7 years old who lived in households making fishing nets.[4] Seven fisheries communities were purposively selected in the upper Southern Thailand. Children who lived in households where their parents made fishing nets were invited to participate. Local nurses took blood sampling from children and sent the blood samples to the Reference Laboratory and Toxicology Center, Department of Disease Control (DDC), Ministry of Public Health (MOPH). In 2014, data from the surveillance indicated that 61% of children aged 1-7 years old in Phang Nga Province had blood lead levels≥ 10 µg/dL.[4]

The Integrated Exposure Uptake Biokinetic (IEUBK) model, designed by the US Environmental Protection Agency (EPA), is a simulation risk assessment program to integrate exposure from lead in air, water, soil, dust and other sources in a pharmacokinetic equation to compute and predict the blood lead level distribution for children in site-specific lead levels and the probability that children in that environment having a blood lead level that exceeds a defined threshold.[5,6] The IEUBK model has been empirically validated, upgraded and widely applied in Greece, Hungary, Ghana and China.[7-12]

This study aimed to validate the IEUBK model by comparing the predicted blood lead levels in children using its site-specific model against the observed blood lead level from the BLLSS and to develop a predictive model based on environmental lead level in households making fishing nets in two provinces in Southern Thailand.

Methods

Study Design and Population

A cross-sectional study design was conducted using secondary data from the BLLSS combined with primary data collection on-site of environmental samples. All participants were selected from the BLLSS that was gathered in 3 sites: Paklok Subdistrict, Thalang District, Phuket Province; Bang Muang Subdistrict, Takuapa District, Phang Nga Province; and Kura Subdistrict, Kuraburi District, Phang Nga Province. All study sites are located on the Andaman Sea coast.

Sample Size, Assumptions and Sampling

Number of children sampled was calculated by using single calculation for correlation formula

$$C = 0.5 * \ln[(1+r)/(1-r)] = 0.436$$

$$N = [(Z\alpha+Z\beta)/C] *2 + 3$$

Giving alpha = 0.05, power = 0.8, and lowest correlation coefficient from review literature = 0.41[8]

This resulted in a sample size of 40 children. Quota sampling was applied into the 3 communities including 17 for Takuapa District, 17 for Kuraburi District, and 6 for Thalang District. Of 54 children under the BLLSS from 48 different houses, 45 children from 40 different houses could be traced to collect data.

Data Collection

Health volunteers surveyed and informed parents who made fishing net to bring their children aged 1-7 years old to participate in the study. All parents consented to the child's participation and provided their household address. All blood and environmental samples were tested at the Reference Laboratory and Toxicology Center, which was the reference laboratory of the DDC, MOPH, Thailand in 2015.

Blood Samples

Children aged 1-7 years old, living in households making fishing nets in the study sites, were invited to participate in the study. After parents /guardians consented to the child's participation, 3-ml venous blood samples were drawn in EDTA tubes by nurses from community hospitals.[14] All blood samples were kept at 4 degree Celsius until analysis by Graphite Furnace Atomic Absorption Spectroscopy (GFAAS).[15]

Environmental Media Collection

Sampling of environmental media was collected at each participant's house. All samples were collected according to the user's guidance for IEUBK by EPA and guidelines from Division of Occupational and Environmental Diseases, Thailand.[13,14] All specimens were tested at the Reference Laboratory and Toxicology Center, the DDC, MOPH by Flame Atomic Absorption Spectrometry Method.[16]

Outdoor soil sampling

Soil sampling was conveniently collected from 10 points in each participant's house. The one kilogram of soil samples was mixed and put in polyethylene bags. All soil samples were kept at 4 degree Celsius until analysis by Flame Atomic Absorption Spectrometry Method.[16] The Pollution Control Department (PCD) defined standard level for soil lead concentration as below 400 mg/kg.[14]

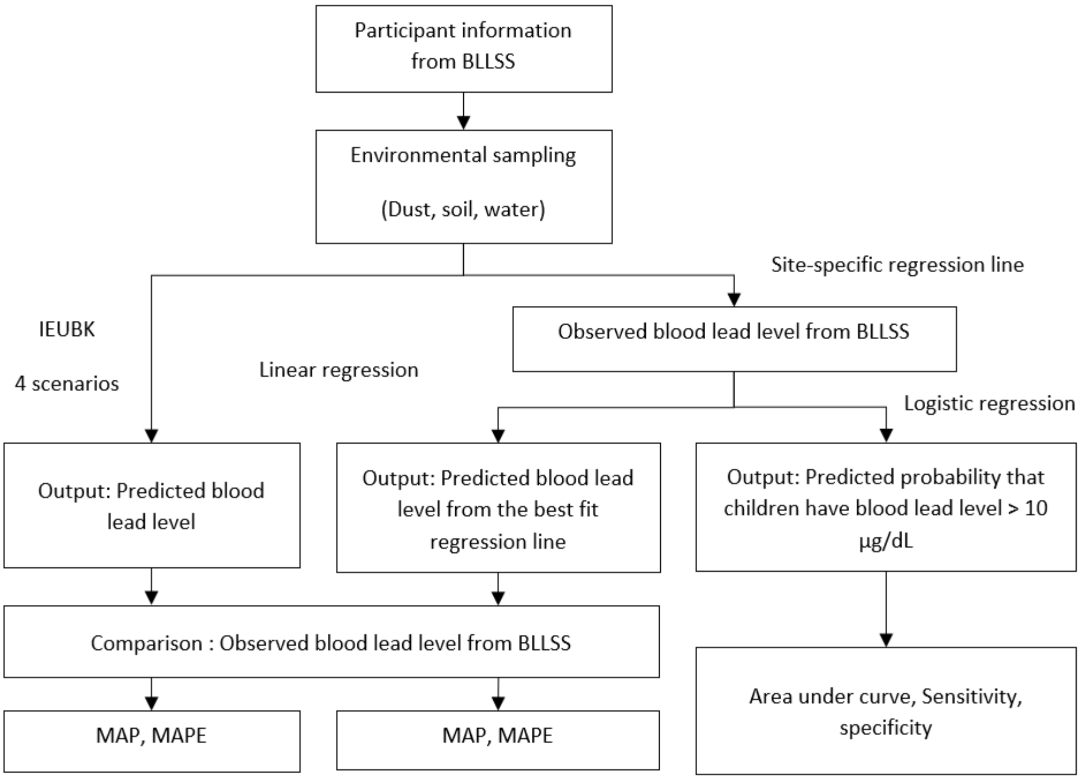

Figure 1 Overview of data analysis method

Tap water sampling

In houses with tap water, 500-ml water samples were collected from running water. For those houses using groundwater, 500-ml water samples were collected from the well. The water containers were cleansed and washed twice or thrice with sampling water, then 1-2 ml of nitric acid was added after each sample. All water samples were kept at 4 degree Celsius until analysis by Flame Atomic Absorption Spectrometry Method.[16] The PCD defined standard level for water lead concentration as below 0.05 mg/dL.[14]

Indoor residential dust sampling.

Surface dust sampling was collected from three areas of each house: bed, clothes hanging areas and parents' workwear. If the workwear was already washed, dust was collected in the making fishing net area. Beryllium paper was used to wipe an area of 100 cm^2 in the three places. The samples were kept in polyethylene tubes at room temperature prior to laboratory analysis.[14] All dust samples were tested by Flame Atomic Absorption Spectrometry Method.[16] The PCD defined standard level of dust lead loading for lead operating area as 26.9 µg/100 cm^2.[14]

IEUBK Model Validation and Statistical Analyses

The demographic data and laboratory results were divided into two separate parts for analysis, IEUBK model and site-specific predictive models. (Figure 1) The IEUBK model (Windows® version 1.1 build 11) was downloaded from US EPA website. Batch mode in IEUBK was used for analyzing predicted blood lead level. Environmental lead values from soil, water and dust were put in four different scenarios. The scenarios included (1) soil, water, dust and default air lead (0.1 µg/m^3), (2) soil, dust, default air lead and default water lead (4 µg/L), (3) water, dust, default air lead and default soil lead (estimated from dust lead), and (4) dust, default water lead, default air lead and default soil lead.

The correlation between predicted and observed blood lead level was analyzed using STATA V.10. Mean Absolute Error (MAE) and Mean Absolute Percent Error (MAPE) were calculated to quantify the difference between predicted and observed blood lead levels. Values close to 0 indicated that the predicted approximated to the observed blood lead levels. These were calculated using the following formula.

Table 1 Demographic data and blood lead level of children from household sampling

Characteristics	Total (n=45)	Study site		
		Thalang District (n=8)	Takuapa District (n=19)	Kuraburi District (n=18)
Sex				
Male (%)	23 (51.1%)	4 (50.0%)	13 (68.4%)	6 (33.3%)
Female (%)	22 (48.9%)	4 (50.0%)	6 (31.6%)	12 (66.7%)
Age				
Mean age ± SD (years)	3.93 ± 1.6	4.4 ± 0.6	3.7 ± 0.4	3.9 ± 0.4
1-3 years	18 (40.0%)	2 (25.0%)	10 (52.6%)	6 (33.3%)
4-7 years	27 (60.0%)	6 (75.0%)	9 (47.4%)	12 (66.7%)
Blood lead Level				
Geometric mean blood lead level (µg/dL)	7.6	7.2	3.8	16.0
Less than 5 µg/dL	7 (15.6%)	2 (25.0%)	5 (26.3%)	0
5.0-9.9 µg/dL	13 (28.9%)	4 (31.6%)	6 (31.6%)	3 (16.7%)
10.0-24.9 µg/dL	19 (42.2%)	2 (25.0%)	5 (15.8%)	12 (66.7%)
More than 25.0 µg/dL	6 (13.3%)	0	3(18.8%)	3 (16.7%)

$$\text{Mean Absolute Error (MAE)} = \frac{\sum|E_t|}{n}$$

$$\text{Mean Absolute Percent Error (MAPE)} = \frac{\sum\left|\frac{E_t}{A_t}\right|*100}{n}$$

Where E_t = Observed blood lead levels - Predicted blood lead levels

A_t = Observed blood lead levels

n = Number of house samplings

Developing Predictive Model

Age, gender, blood and environmental lead levels from soil, water and indoor dust were used to develop a predictive model of log blood lead level by using multiple linear regression. A binary logistic regression model was developed to predict probability that children would have blood lead levels≥ 10 µg/dL. We selected variables into the model by using stepwise backward elimination using the criteria of *P*-value> 0.1 out of model. MAE and MAPE were also calculated for the multiple linear regression model. Sensitivity, specificity and area under ROC curve were also calculated from multiple logistic regression.

Results

Demographic Data of Children

According to the BLLSS, 45 children from 40 different houses were tested for blood lead levels since five of the children were siblings. Forty different houses could be traced for their exact address. Mean age of children in the study was 3.9 ± 1.6 years old. The geometric mean blood lead level was 7.6 µg/dL. Six children had extreme blood lead levels≥ 25 µg/dL. The geometric mean blood lead levels in Kuraburi District was 16.0 µg/dL. (Table 1)

Environmental Samples

A total of 193 specimens were collected from 40 households. Of the soil samples, 33/40 (82.5%) were collected; five houses did not contribute soil samples because the house was located on mangrove and two houses were built on cement ground. All houses contributed water samples and dust wipe sample specimens. (Figure 2)

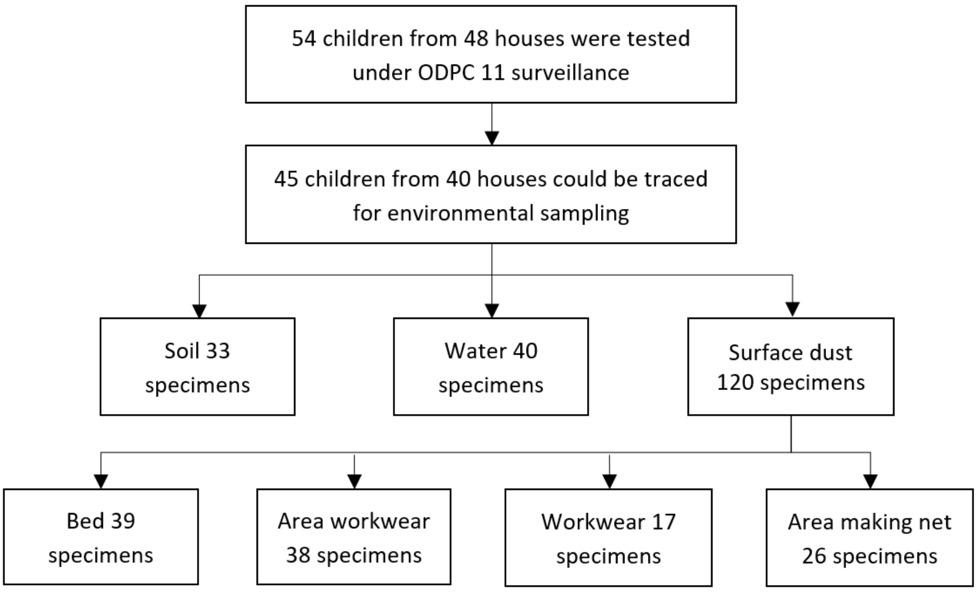

Figure 2 Children and environmental sampling

Lead concentration in soil in the study sites did not exceed the PCD threshold. However, median lead concentration in soil in Kuraburi District was higher than that of the other two sites. For water 8/40 samples (20.0%) had lead concentrations above the PCD threshold. Additionally, Kuraburi District had largest proportion of water samples (29.4%) which exceeded the standard. (Table 2)

Of the surface dust lead samples, 45% (18/40) of households had one sample exceeding the dust standard. The making fishing nets area revealed the highest median dust lead load, followed by workwear. (Table 3)

Table 2 Outdoor soil and water lead level sampling in households making trawl net in Phuket and Phang Nga Provinces

Area	Outdoor soil (mg/kg)				Water (mg/L)			
	n	Median	Range	Number of specimens exceed standard# (%)	n	Median	Range	Number of specimens exceed standard* (%)
Total	33	40.7	4.4-371.1	0	40	0.001	0.001-1.2	8 (19.1%)
Thalang District	7	31.6	20.0-41.2	0	7	0.004	0.003-1.05	1 (14.2%)
Takuapa District	14	40.4	4.4-371.1	0	16	0.001	0.001-1.2	2 (12.5%)
Kuraburi District	12	62.9	27.6-112.6	0	17	0.001	0.001-0.30	5 (29.4%)

Note: # Standard level for soil lead level for residency and agriculture by Department of Pollution Control: not exceed 400 mg/kg
** Standard level for water lead level in surface water and consumption by Department of Pollution Control: not exceed 0.05 mg/L*

Blood Lead Level Prediction by IEUBK Model

Overall predicted blood lead levels by IEUBK model showed lower blood lead levels than the observed blood lead levels. Geometric means of the predicted blood lead level were highest in scenario 3 (6.9 mg/dL), followed by scenario 1 (5.4), scenario 4 (4.5), and scenario 2 (3.4), respectively. We detected the differences between observed and predicted blood lead level, using MAE and MAPE. The lowest difference by MAE and MAPE was scenario 3, accounting for 9.2 and 59.0%, followed by scenario 4 (9.3, 58.2%), scenario 2 (10.3, 65.4%) and scenario 1 (10.1, 65.5%). (Table 4)

Table 3 Indoor dust lead loading in households making trawl net in Phuket and Phang Nga Provinces

Area	Indoor residential dust loading (µg/100 cm^2)			
	n	Median	Range	Number of specimens exceed standard$^{\beta}$ (%)
Child's bed	39	2.1	0.001-190.8	3 (7.3%)
Parents' workwear	17	4.2	0.001-297.3	4 (22.2%)
Area where workwear was left	38	6.4	0.001-241.2	10(25%)
Making fishing net areas	26	8.86	0.6-132.8	9 (34.6%)
Total	120	4.03		26 (21.7%)

Note: $^{\beta}$ Standard level dust lead loading for lead operating area = 26.9 µg/100 cm^2

Site Specific Multiple Linear Regression Model

The best fit predictive model after being adjusted for age, lead level in soil, water, child's bed, area making net, and area clothes left to predict log blood lead level is shown as the following equation:

*Log blood lead = 1.284566 + 0.1765779*age(year) + 0.0070465*lead level in soil + 0.0234221*dust lead loading at bed - 0.0140896*dust lead loading at area clothes left.*

The model showed that age, soil lead, dust lead at bed, and dust lead at area clothes left provided the most accurate predictive ability. MAE was 4.8 (0.01-15.8) and MAPE was 40.5% (0.08%-161.5%). Adjusted R-squared was equal to 60.7.

Site Specific Multiple Logistic Regression Model

To predict probability that children had blood lead levels≥ 10 µg/dL, the model was developed by automatically selecting variables including lead level in soil, water, child's bed, area making net, and area clothes left. The predictive model associated with lead level in soil only and did not show statistical significance. Sensitivity for this predictive model was 60% while specificity showed 83% and area under ROC curve was approximately 0.82.

Discussion

In this study we found that the geometric mean of predicted values of the blood lead levels in children in households making fishing nets with lead weights ranged from 3.4 to 6.9 µg/dL, while the observed blood lead level from the BLLSS was 7.6 µg/dL. Additionally, the environmental samples of soil, water and surface dust were collected and calculated at 40.7 mg/kg, 0.001 mg/L and 4.0 µg/100 cm^2, respectively, which was 28.3% (34/120) exceeded the standard.

From results of blood lead levels and environmental lead levels in our study, we are fairly confident that a primary source of exposure was from attaching lead weight with fishing net. The findings indicated that the 84.4 % of the children showed blood lead levels greater than 5 µg/dL which is the recommended reference level from the US National Health and Nutrition Examination Survey (NHANES). Additionally, the geometric mean of blood lead levels was similar to the study of blood lead levels among children in Umpang District, Tak Province in 2010 which showed 7.71 µg/dL. Primary source of exposure came from lead-contaminated water from a nearby lead smelter.[17]

Regarding to environmental lead level, our results

Table 4 Types of environmental variables filled into each scenario

Scenario (Environment parameter filled)	n	Geometric mean of predicted blood lead levels (µg/dL)	Correlation between predicted and observed value	Absolute Error			Absolute Percent Error		
				Min	Max	MAE[a]	Min	Max	MAPE[b]
Scenario 1 (soil, water, dust)	35	5.4	-0.057	0.2	36.1	10.1	6.1	92.3	65.5
Scenario 2 (soil, dust)	45	3.4	0.731*	0.2	36.0	10.3	6.1	91.3	65.4
Scenario 3 (dust, water)	35	6.9	-0.042	0.2	34.0	9.2	6.1	88.5	59.0
Scenario 4 (dust)	45	4.5	0.664*	0.2	33.8	9.3	6.1	90.1	58.2

Note: **Statistical significance at alpha< 0.05*

[a] Mean Absolute Error

[b] Mean Absolute Percent Error (MAPE)

indicated that primary source of exposure might come from indoor dust especially in the making fishing net area as well as workwear and laundry area. Sahmel et.al mentioned that handling fishing weights contributed to deposition of lead on hand, then, 24% of lead on hand is ingested by biting lead split-shot hand during homemade fishing weights process.[18]

We found marked differences between observed and predicted blood lead level by MAP and MAPE. This might be a result of measurement errors in collecting specimens or laboratory analysis.[19] Another reason for the discrepancy may be that default values in IEUBK model may not be appropriate in empirical situation. Hu et. al., 2013 showed some difference between predicted and observed lead levels in Chinese children resulting from the differences in metabolic rate, ingestion rate, and diet variables, compared to the US children.[20] Although the IEUBK model was developed in 1990 and has been widely applied in the US and several studies globally, experience with the application is still limited in Thailand.[21] Only one study applied IEUBK model for risk assessment and to set up cleaning goal in old lead smelting area, Klity mine.[22] The strengths of this initial study to validate the IEUBK model is the use of site-specific data in a high-risk population.

In this study, we might only suspect attaching fishing weights was the primary source of exposure since there was no comparison group. We would encourage further study to collect information on other houses in community to ensure that there was no other source in the community rather than fishing nets. Additionally, we were unable to collect fishing weights to analyze their components as well as children's food that might result in underestimation of the IEUBK prediction.

Conclusion

This is the first study to explore the relationship between blood and environmental lead levels in households making fishing nets. The IEUBK model might not be appropriate to predict blood lead levels in this site-specific area due to underestimation. Site specific predictive model showed that indoor dust loading was highly predictive in the regression model, making it highly likely that the process of attaching lead weights to fishing nets could be a source of lead exposure. Nonetheless further study in this area is needed to better understand the variations in blood lead level that are the results of metabolic rate, ingestion rates and other predictors of elevated blood lead level in Thai children

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Measles Immunity among New Health Personnel at a Faculty of Medicine in Khon Kaen Province, Thailand, 2019

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Abstract

Measles continues to be an important global health problem despite the implementation of vaccination. Health personnel, a high-risk group, are considered to have immunity to measles. We aimed to investigate the measles immunity status among health personnel during pre-placement at the Faculty of Medicine, Khon Kaen University, northeastern Thailand. The sample included health personnel who were examined in the pre-placement program from October 2018 to September 2019. Data collected included sex, age, department, job characteristic (direct or indirect contact with patients), position, measles immunity status, based on serology tests, history of previous infection, and history of immunization. A total of 652 health personnel were included, of which 53.8% tested positive to measles IgG class antibodies, indicating prior exposure to the virus. Among them, the percentage testing positive to measles immunity was 59.5%. Two-thirds of personnel who could not recall their infection or vaccination history had a positive measles immunity status. A consensus for the definition of acceptable presumptive evidence of measles immunity in Thailand according to context must be stipulated, leading to improved management of measles immunization.

Keywords: measles, immunity, health personnel, Thailand

Introduction

Deaths from the measles virus has decreased worldwide from 2000 to 2018 due to increased coverage of vaccination.[1] However, in the first half of 2019, the United States reported 1,022 new measles cases compared to only 120 cases in 2017 and 372 in 2018. The increase is suspected to be due to outbreaks caused by travelers who visited measles endemic areas and brought the virus back home to non-vaccinated residents.[2] In Thailand, an online measles database showed an increasing trend of cases from 0.4 per million in 2016 to 98.12 per million in 2019.[3]

After a person receives one dose of the Mumps-Measles-Rubella (MMR) vaccine, that person is generally immunized up to 95%, which increases up to 99% after the second dose.[4] A person's immunization status can be verified by evidence of two doses of the MMR vaccine, laboratory confirmation, diagnosis by a physician, or their age - those born before 1957, which was the year that the USA included MMR vaccine in the National Compulsory Vaccination Schedule, are likely to not be immune.[5] Thailand included vaccination for measles in the National Compulsory Vaccination Schedule in 1984. The Bureau of General Communicable Diseases recommends that health personnel, a high-risk group, should receive one dose of MMR vaccine prior to starting work duties regardless of their immunity status.[6] In the case of measles exposure, their immunization history should be noted, but no determination of their immunity status is required. A previous study conducted in South Korea on the measles immunity status of health personnel after the occurrence of a measles outbreak found that 75.9% tested positive.[7]

Since the last outbreak in the Faculty of Medicine, Khon Kaen University, no current measles immunity information on health personnel is available. Health personnel are a high-risk group due to occupational hazards. With their potential to also compromise patient safety, it is therefore important to have up-to-

Table 1 Characteristics of study samples and distribution of serologic measles immunity test by socio-demographic characteristics

Characteristics	Total n (%)	Tested n=351 (53.8%)	Not Tested n=301 (46.2%)
Sex			
Male	192 (29.4)	115 (59.9)	77 (40.1)
Female	460 (70.6)	236 (51.3)	224 (48.7)
Median age in years (Q1-Q3)	24.5 (18-47)	24 (19-43)	25 (18-47)
Age group (years)			
<20	3 (0.5)	2 (66.7)	1 (33.3)
20-24	323 (49.5)	202 (62.5)	121 (37.4)
25-29	212 (32.5)	103 (48.6)	109 (51.4)
30-34	70 (10.7)	34 (48.6)	36 (51.4)
≥35	44 (6.8)	10 (22.7)	34 (77.3)
Job characteristics			
Direct contact	535 (82.1)	322 (60.2)	213 (39.8)
Non-direct contact	117 (17.9)	29 (24.8)	88 (75.2)
Positions			
Registered nurse	199 (30.5)	106 (53.3)	93 (46.7)
Medical physician	198 (30.4)	187 (94.4)	11 (5.6)
General service officer	52 (8.0)	15 (28.8)	37 (71.2)
Nursing assistive personnel	46 (7.0)	17 (37.0)	29 (63.0)
Nurse assistant	19 (2.9)	5 (26.3)	14 (73.7)
Others	138 (21.2)	21 (15.2)	117 (84.8)
Total	652 (100.0)	351	301

date information on the immunity status of health personnel for post-exposure management purpose and primary measles prevention. Therefore, this study aimed to investigate the measles immunity status

Table 2 Distribution of serologic measles immunity among newly employed health personnel categorized by socio-demographic characteristics.

Characteristics	Total n (%)	Measles immunity status, n (%)	
		Positive IgG≥ 250 mIU/ml	Negative IgG< 250 mIU/ml
Sex			
Male	115 (32.8)	80 (69.6)	35 (30.4)
Female	236 (67.2)	129 (54.7)	107 (45.3)
Median age in years (Q1-Q3)	24 (19 -43)	23.5 (19 -43)	24 (19 -42)
Age group (years)			
<20	2 (0.6)	1 (50.0)	1 (50.0)
20-24	202 (57.6)	104 (51.5)	98 (48.5)
25-29	103 (29.3)	67 (65.0)	36 (35.0)
30-34	34 (9.7)	28 (82.4)	6 (17.6)
≥35	10 (2.8)	9 (90.0)	1 (10.0)
Job characteristics			
Direct contact	322 (91.7)	197 (61.2)	125 (38.8)
Non-direct contact	29 (8.3)	12 (41.4)	17 (58.6)
Positions			
Medical physician	187 (53.3)	141 (75.4)	46 (24.6)
Registered nurse	106 (30.2)	39 (36.8)	67 (63.2)
Nurse assistive personnel	17 (4.8)	9 (52.9)	8 (47.1)
General service officer	15 (4.3)	6 (40.0)	9 (60.0)
Nurse assistant	5 (1.4)	4 (80.0)	1 (20.0)
Other	21 (6.0)	10 (47.6)	11 (52.4)
Total	351 (100.0)	209 (59.5)	142 (40.5)

among new health personnel. during pre-placement examination for proper immunization management.

Methods

Study Design and Participants

This descriptive survey study was carried out in the Faculty of Medicine, Khon Kaen University, Thailand from October 2018 to September 2019. The study population consisted of health personnel who were examined in the pre-placement program of Faculty of Medicine, Khon Kaen University and had information on pre-placement examination regardless of the availability of the measles immunity data. With these criteria, we included all (n=652) new health personnel into the study.

Table 3 Distribution of serologic measles immunity status of the new health personnel in accordance with infection and vaccination history

Measles infection and vaccination history		n (%)	Serologic immunity status	
Infection	Vaccination		Positive IgG n (%)	Negative IgG n (%)
Positive	None	4 (1.2)	4 (100.0)	0
Negative	Complete (two doses)	75 (21.4)	46 (61.3)	29 (38.7)
	Incomplete (one dose)	19 (5.4)	18 (94.7)	1 (5.3)
	None	21 (6.0)	10 (47.6)	11 (52.4)
Unknown	Unknown	232 (66.1)	131 (56.5)	101 (43.5)
Total		351 (100.0)	209 (59.5)	142 (40.5)

Data Collection

The data were extracted from the Occupational Health and Safety Office, Faculty of Medicine, Khon Kaen University. Variables were sex, age, department, job characteristic (direct/indirect contact with patients), position, and measles immunity status.

Measurements

Measles immunity status was determined from serology tests, history of previous measles infection, and history of measles immunization. The IgG threshold for measles immunity was 250 mIU/mL using an enzyme-linked immunosorbent assay (ELISA) at the reference laboratory of Srinagarind hospital.

Statistical Analyses

All data were analyzed using SPSS version 20 (IBM SPSS Inc, Chicago, IL). Demographic data, job characteristic, position and measles immunity status were described using frequencies and proportions.

Ethical Approval

The Research Ethics Committee of the Faculty of Medicine, Khon Kaen University, Thailand approved this study on 8 Oct 2019.

Results

The median age of the 652 health personnel in the study was 24.5 years (range: 18-47) and the majority were female (70.6%). 82.1% had job characteristic that involved direct contact with patients. The majority were registered nurses (30.5%) followed by medical physicians (30.4%), and other (21.2%). Of the 535 health personnel who had a job characteristic that involved direct contact with patients, 322 (60.2%) were tested for measles immunity. Almost all (94.4%) physicians were tested for measles IgG, followed by registered nurses (53.3%) and nursing assistive personnel (37.0%). (Table 1)

Of the 351 participants who were tested for IgG, the median age was 24 years (range: 19-43). Most (91.7%) had job characteristic that involved direct contact with patients. Physician was the most common position (53.3%), followed by registered nurse (30.2%) and nurse assistive personnel (4.8%). The overall proportion of personnel with positive measles immunity was 59.5%. The median age of the positive immunity group was 23.5 years (range: 19-43). Personnel whose job characteristic involved direct contact with patients had a higher proportion of positive immunity (61.2%) than those who did not. Nurse assistants had the highest immunity (80.0%), followed medical physicians by (75.4%), and nurse assistive personnel (52.9%). (Table 2)

Table 3 shows the distribution of measles immunity status according to infection and vaccination history. Most (66.1%) could not recall ever having measles,32.8% denied ever being infected, while only 4 (1.2%) reported having had a positive history of measles infection, of which all four tested positives on ELISA. Among the 115 who denied ever being infected, 46 out of 75 (61.3%) health personnel who had a history of complete measles vaccination (2 doses) had positive immunity,18 out of 19 (94.7%) who had partial vaccination (1 dose) had positive immunity, and 10 out of 21 (47.6%) who were not vaccinated at all had positive immunity. Among 232 personnel who could not recall their infection or vaccination history, 131 (56.5%) had a positive serologic immunity status.

Discussion

This study demonstrated a lower proportion of positive measles immunity (59.5%) when compared to previous studies in 2009 (78.5%) and 2016 (81.0%) in Thailand, both of which used similar thresholds for positive measles (IgG≥ 250 mIU/ml and≥ 255 mIU/ml).[8,9] Immunity to measles can be increased by up to 95% in children who are vaccinated at 12 months, and 98% at 15 months.[4] However, many studies found a decline in the protective measles immunity level.[10-13] The reason for the low proportion of positive measles immunity could be due to the low coverage of vaccination in Thailand when, in 1984, measles vaccination was first included in Expanded Program of Immunization (EPI). Coverage of measles vaccination was only 5% during the initial phase, and the second dose of measles vaccination had only just been recommended by the Ministry of Public Health in 1996, which was given to students in their first year of elementary education.[14]

Another explanation for the inconsistent results of studies in Thailand might be due to the different types of vaccines used. The MMR vaccine was widely used in Thailand in 1997.[14] However, the median ages of the study populations ranged from 20-29 years, and these populations had a lower proportion of positive measles immunity compared to other age ranges. Thus, this might be clarified by other previous studies that this range of age was far from the last dose of vaccination to measles, which is correlated with the lowest proportion of positive measles immunity among the range of age.[9,11,12] Apart from the different vaccines, the strain of measles in the vaccine might also be different, which could affect the vaccine's efficiency. In Thailand, the Schwarz strain of measles virus in the MMR vaccine was still available, while the strain was discontinued in the US in 1976.[5,15]

According to the Advisory Committee on Immunization Practices about measles prevention, the guideline suggests that pre-vaccination testing for measles immunity in health personnel, who had inadequate evidence of immunity, is unnecessary unless the medical facility considered it cost-effective.[4] Although serology testing in two documented doses of MMR vaccine group was, in two studies, reported to be negative, no further vaccination was recommended. This is considered as presumptive evidence of measles immunity.[4,16] In Thailand, there is controversy in the recommendations for measles vaccination. The Bureau of General Communicable Diseases, Department of Disease Control (Thailand) recommends that health personnel without a history of measles infection or vaccination are required to receive MMR vaccine without undergoing a pre-vaccination serology test.[5] However, the guideline for managing infectious diseases in health personnel by the nosocomial infection control group does not include measles vaccination in the EPI. Thus, it is not considered presumptive evidence of immunity to measles. Therefore, the Thai guideline recommends pre-vaccination serology testing before providing vaccines.[17] In addition, the threshold of measles IgG by the immunological basis for immunization series module 7 states that: " when using the 3rd International Standard Reference serum, the level of measles neutralizing antibody that corresponds with clinical protection is ≥120 mIU/mL ".[18] However, this guideline was not widely applied in Thailand considering previous studies. Agreement on a standardized threshold for positive measles IgG should be made.

Since we used secondary data, essential information for presumptive positive immunity was missing. More than two-thirds of health personnel could not recall their infection or immunization history. Those with a complete vaccination history had a lower percentage of positive immunity than those who received partial vaccination. Almost half of those who never received measles vaccination had positive measles immunity. Overall, the percentage of personnel with positive measles immunity in our study was lower than expected. This could be due to recall bias and missed documentation in medical records.

Reliable presumptive evidence of measles immunity is needed for identifying immunity status in order to specify as immunized personnel. The completed history or written documentation of vaccination must be declared. The current measures of measles immunization among health personnel, for instance, vaccination to all new health personnel from pre-placement examination, should be revised. Future studies could include a cost-benefit analysis of the necessity in pre-vaccine serological testing. Furthermore, a study in immunity status among health personnel in accordance with the implementation from the Ministry of Public Health of Thailand would provide useful information to policy makers. In 2015 the ideal age for receiving the second dose of the MMR vaccine was changed from 7 years (1st year of elementary education) to 2.5 years, which is expected to achieve a target of "not less than 95%" of vaccination coverage as herd immunity.[19] In consequence to the major change of second dose of vaccine, the longer period from the second dose of vaccine to working-age should be a focus of further research. In addition, a previous study found that 3% of vaccinated people can still develop measles infection, so post-exposure management is still recommended.[20]

Conclusion

Due to differences in characteristics of measles vaccine as well as vaccination coverage, the proportion of health personnel who had positive immunity to measles in our study was lower than in previous studies in Thailand. The history and documentation of measles immunization status were only partially available, and were difficult to correlate with actual measles immunity status from serology. The definition of presumptive measles immunity and guidelines for measles immunization among health personnel need to be revised. The consensus for definition in acceptable presumptive evidence of measles immunity must be stipulated according to context, leading to improved management of measles immunization.

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Thailand's Response against Coronavirus Disease 2019: Challenges and Lessons Learned

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Abstract

Since early January 2020, Thailand has been facing a rise in the number of patients infected with Coronavirus Disease 2019 (COVID-19), staring with imported cases from China then propagating to the Thai populations. The Thai Ministry of Public Health (MOPH) took a prompt response towards COVID-19 after the notification of the first case. Numerous strategic and operation plans were introduced. The plans comprise five key issues: (i) surveillance system, (ii) case management and hospital infection and control, (iii) laboratory testing, (iv) preparedness of healthcare staff and medical supply, and (v) risk communication. These plans are operated through the Emergency Operation Centre (EOC). A COVID-19 surveillance system at the airports and the hospitals was established. Criteria for identifying a patient under investigation (PUI) were set up. All confirmed COVID-19 cases are obliged to be isolated. Healthcare workers are recommended to wear appropriate personal protective equipment when taking specimens and providing care for the patients. Regarding laboratory testing, the Department of Medical Sciences (DMS) is the core unit in collaboration with other laboratory networks nationwide to ensure quality and standards of tests. The EOC operates all days and nights. Policy makers and high-level officers are obliged to meet together on a daily basis to provide strategic directions for the whole team. However several challenges remain. Fake news and stigmatization are amongst the most important concerns during the time of crisis. To tackle this, concerted effort needs be harnessed, from not only the health sector, but also all parts of the society including media and the Thai populations as a whole.

Keywords: COVID-19, SARS-CoV-2, Coronavirus, Thailand

Introduction

Thailand is one of the top tourist destination countries in the world. It is estimated that the country faces approximately three million international tourists in each month.[1] Tourism industry plays a critical role in driving the Thai economy, accounting for about 18.4% of the gross domestic product (GDP) in 2019.[2] The majority of the tourism revenue was from the Chinese mainland visitors, constituting about 27.5 % of the total international travelers. Therefore any health problems that originated from the Chinese tourists are likely to visit health of the Thai populations.

On 31 Dec 2019, a cluster of pneumonia cases caused by unknown pathogen were reported in Wuhan city, China.[3] The suspected linkage of cases was a seafood wholesale market in the city; however its original source was yet to be known. Soon after, the Chinese authorities declared the new emerging disease, which is currently known as Coronavirus Disease 2019 (COVID-19), and the causative pathogen was named as Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2).[4] As of 15 Mar 2020, the COVID-19 infected toll over the world expanded beyond 150,000 with over 5,700 deaths; and it seemed that the situation has not reached the acme.[5]

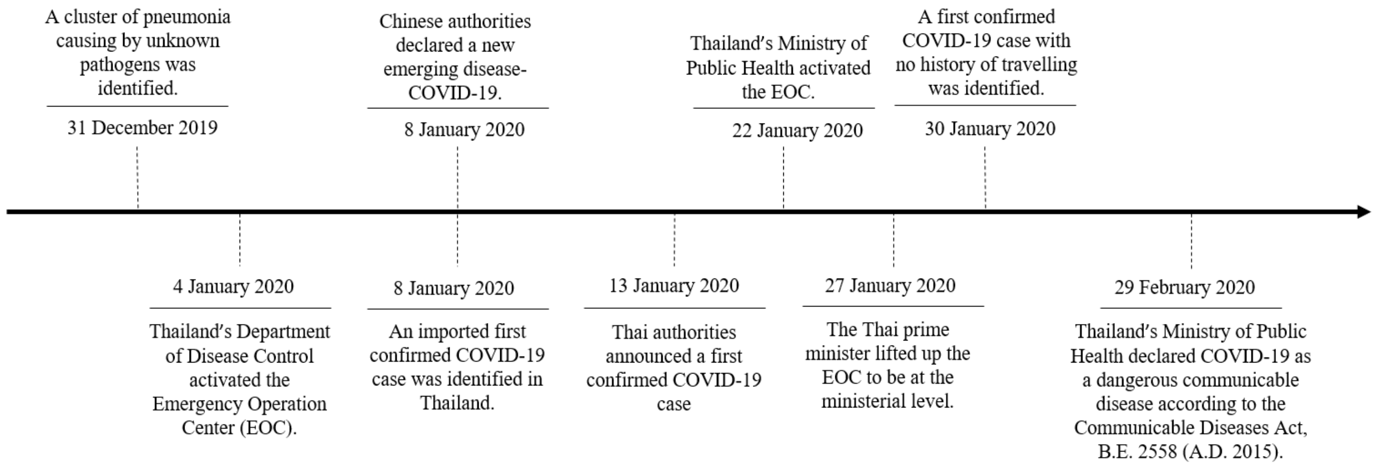

Figure 1 Mapping of chronological evolution of the Thai EOC and important events associated with COVID-19

Responses of the Thai Ministry of Public Health against COVID-19

The Thai Ministry of Public Health (MOPH) takes prompt response towards COVID-19 after the notification of the cases in China. Several strategic and operation plans were introduced with an aim to mitigate the impact of the disease. The plans comprise five key issues: (i) surveillance system, (ii) case management and hospital infection and control, (iii) laboratory testing, (iv) preparedness of healthcare staff, health facilities, and medical supply, and (v) risk communication. These plans are operated through the Emergency Operation Centre (EOC), which has been activated since 4 Jan 2020, just 4 days after the emergence of cases in China. Figure 1 provides a mapping of chronological evolution of EOC with important events related to COVID-19 in Thailand. (Figure 1)

Functions of the Emerging Operation Centre

The EOC is a central command and control facility responsible for carrying out emergency preparedness and emergency/disaster management at a strategic level during an emergency situation. This is to ensure the continuity of operation and synchronism of functions across organizations.[6] The Thai EOC consists of several teams/functions as follows.

- Scientific response team is designed to map and integrate needed resources, develop standards and health guideline to encounter COVID-19, and support scientific knowledge for all organizations under the EOC.
- Strategic response team is responsible for producing applicable operational guidelines for a timely response to COVID-19, based on the state of the arts of knowledge, taking into account the strategic directions of the incident commander.
- Planning team accounts for the development of numerous key action plans, including, hazard specific plan, incident action plan, and business continuity plan, and disseminated these plans to all relevant agencies.
- Situation awareness team serves as a situation monitoring system. Its main function is to monitor, follow, evaluate characteristics and severity of the outbreak, and report such information to the incident commander. The situation report is produced on a daily basis.
- Operation team acts as forefront officers to take prompt action against the outbreak. The team is divided into two sections: outbreak investigation section and data management section. Its concrete actions include field investigation, active case finding, tracing of contacts and providing appropriate measures on the scene. The data management section will then gather information from the outbreak investigation section, and will submit the summarized data to the situation awareness team and incident commander to ensure coherence of information.
- Risk communication team helps to identify, determine and evaluate social response towards the disease. Additionally, the team is responsible for providing press release and talking points, and disseminating of the disease information to the wider public via various means (such as websites, newspaper and social media) in an accurate and timely manner.
- Law support and enforcement team is responsible for reviewing and gathering related laws and regulations that are needed to support the EOC's operation. The team may also propose an amendment of laws/regulations if necessary should such change

be expected to facilitate the entire functions of the EOC.

- Logistics and stockpiling team is purposively set up to review and analyse the risk of medicine and medical supplies shortage and develop plan for supplies distribution. Also, this team will take necessary actions to ensure effective delivery of medical supplies.

- Point of entry team is designed to minimize disease burden and influx of patients. The team's major role is to develop procedures to screen and detect suspected cases in accordance to the 2005 International Health Regulation (IHR).

- Liaison team acts as a secretariat unit to support the entire EOC, and coordinate amongst units, either inside or outside the EOC.

Examples of Preventive and Control Measures

Here are some exemplified measures against COVID-19, exercised by the EOC. As the World Health Organization (WHO) declared that COVID-19 is Public Health Emergency of International Concern (PHEIC), COVID-19 surveillance system at the points of entry and hospitals was established. The criteria for identifying a patient under investigation (PUI) were set up. It should be noted that the criteria are not cast in stone as they are subject to change conditional upon the update of situation and knowledge on the disease.

In terms of case management and hospital infection prevention and control, all confirmed COVID-19 cases are obliged to be isolated in a negative pressure room in the designated facilities. Healthcare workers are recommended to wear appropriate personal protective equipment (N95 mask, goggle, and full coverage of torso and shoulders, for instance) when taking specimens and providing care for patients and the PUIs.

Regarding laboratory testing, the Department of Medical Sciences (DMS) is the core unit in collaboration with other laboratory networks nationwide to ensure quality and standards of tests. Nasopharyngeal and throat swabs of PUI cases or high-risk contacts are required to assess the likelihood of COVID-19 infection. A confirmation of COVID-19 infection necessitates the detection of SARS-CoV-2 genetic materials by Polymerase chain reaction conducted by two reference laboratory centres (DMS and Center for Emerging Infectious Diseases, Faculty of Medicine, Chulalongkorn University).

The EOC operates all days and nights. Policy makers and high-level officers are obliged to meet together to provide strategic directions for, not only the MOPH, but also the whole country, towards proper response to the outbreak.

Countermeasures of Non-health Sectors towards COVID-19

The emergence of COVID-19 in Thailand poses a critical challenge to not only the health sector, but also the whole society, in terms of both threats and opportunities.[7] The threats are obvious as evidenced by the continuing rise of infected cases and the nationwide economic downturn. Nonetheless it is of equal importance to mention how the COVID-19 pandemic brings about the concerted effort from all societal sectors.

One of the apparent instances is the reaction of the Ministry of Commerce put the brakes on face mask exports to ensure sufficient domestic supply. In February 2020, the Cabinet approved a proposal to put face masks and alcohol-based hand sanitizer on the state price control list as part of the attempts to deal with the deadly virus outbreak.[8]

Another example is the collaborative effort of the public media and the Ministry of Digital Economy and Society to respond to the widespread 'fake' news that comes into the public attention off and on.[9] The Thai Government has created an 'Anti Fake News Centre' to work with the police in tracking down and arresting individuals who release false information about the COVID-19 outbreak on social media and other online outlets. The maximum punishment is 100,000-Baht fine and/or five-year imprisonment, according to Section 14 (2) of Computer-related Crime Act BE 2560.

The military also plays pivotal role in the outbreak control. Its obvious engagement was the provision of naval base camp in Chon Buri, for 137 Thai evacuees from Wuhan, in February 2020; and this happened again, in March 2020, when a large number of Thai migrants from South Korea returned home and they were obliged to be quarantine in designated areas, for 14 days.[10]

The involvement of private sector and civic groups cannot be overlooked. Many retail shops and numerous department stores have installed alcohol-based sanitizer to the customers. Some mobile private companies have launched innovative smart-phone applications for public health volunteers to take care of community members.[11]

Remaining Challenges

Healthcare Related Challenges

The Thai health system is significantly galvanized by the advent of COVID-19. The impact of COVID-19 on the health system is more substantial than the consequences of SARS, MERS-CoV, and influenza A(H1N1) pdm09 (despite the fact that the toll of COVID-19 confirmed cases was far smaller than the cases found with influenza A(H1N1) pdm09). It also marks the first cornerstone of the entire health sector when the Communicable Disease Act BE 2558 comes into force. The Act offers authoritative power to 'Communicable Disease Control Officers' to implement necessary measures to topple down the outbreak, including inflicting quarantine measures on people at risk (such as the returnees from high-risk countries, or high-risk close contact of confirmed cases) or isolating the patients in institution-based care.

In addition, this event is probably the first time in the history that the EOC is fully activated at all levels. This means numerous institutes in the MOPH, apart from the Department of Disease Control, are not familiar with the EOC function (which requires unity of command), and this led to some 'hiccups' in intersectoral cooperation and incoherence of the information disseminated to the wider public. However, these problems were later addressed once the EOC was uplifted to the ministerial level, these problems were substantially alleviated. Another key challenge is the lack of protective equipment, particularly surgical face masks. This problem is ubiquitous, not only in the health facilities in the backdrop of skyrocketing demand of face masks. Despite the Government designating face masks as a controlled product with a fixed price of 2.5 Baht a piece, fewer people are finding them sold at that price range. In fact, most people pay 15-30 Baht for each mask.

Societal Challenges

Era of digitalization and social media

Computers, the Internet and social media enable all members in a society to be a publisher, communicating true or false information promptly and globally. This is a double-edged sword, where both truths and deceptions are omnipresent. Fakery affects science and social information and the two have become highly interactive and interweaved with each other.[12] Such a phenomenon undermines trust in science and the capacity of individuals and society to make evidence-informed choices. During the COVID-19 outbreak, the volume of fake news is on the rise. Such news is related to a wider of topics, such as false belief about disease characteristics and the announcement of suspected cases who are yet to be verified by the authority. The latter is more severe as it causes panic and anxiety in the affected communities. To overcome these challenges, the MOPH needs to have a strategic move including disseminating the correct health message to the 'in-trend' communication means, such as Facebook, Twitter, Podcast and Line; rather than being solely relying on the conventional dissemination methods (like official press release).

Fear and stigmatization

Ren et al pointed out in the 'World Journal of Clinical Cases' in February 2020 that 'fear can be more harmful than the SARS-Cov-2'.[13] This statement has been proven right in the current situation, not only in Thailand but all over the world; and it is more aggravated by the widespread of news through social media. The infected case is heavily criticized if they are found to be against the recommendations of the MOPH. The criticism now expands to all contacts of a case. Sometimes the fear is intensified more than what it should be. The closure of business sites or public spaces (for example, banks and restaurants), where the COVID-19 case visited, for at least 14 days, can be seen now and then—though such a visit happens in a short period of time and no high-risk exposure occurs. Some residents of a village in the province which is set to be a quarantining site of returnees from South Korea blocked prevented officials from operation.[14]

Conclusion

Thailand has taken several necessary measures to counteract the COVID-19 pandemic. However, the quest towards outbreak cessation is not yet finished. With more and more challenges coming in, there are lessons to be learned every day. This requires intellectual integrity and collective spirit amongst all units in the society; not merely the officials but also all people on the Thai soils. With all of these efforts, the day without COVID-19 will not be long.

Suggested Citation

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