PNEUMONIA SURVEILLANCE IN THAILAND: CURRENT PRACTICE AND FUTURE NEEDS

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Abstract. We reviewed reported pneumonia cases and deaths in Thailand since 1975 to evaluate the pneumonia surveillance system. In Sa Kaeo Province, we analyzed 3 years in detail (1999-2001) from electronic surveillance data, and compared deaths reported through surveillance to death certificate data in 1999 and 2000. In addition, we interviewed surveillance personnel who collected the data from all 7 hospitals and from a 10% random sample of health centers. Since the mid-1980s, reported illnesses and deaths from pneumonia have been increasing. In Sa Kaeo, an average of 925 pneumonia cases were reported each year, for an estimated average annual incidence of 211 per 100,000. The age-specific incidence peaked at 1,418 per 100,000 in children less than 5 years. In 1999 and 2000, there were 7 and 6 pneumonia deaths, respectively, reported through the surveillance system, compared with 28 and 53, respectively, reported by death certificate. Sixty-two (82%) of the 72 surveillance personnel reported receiving some training, but most of this was informal. Although written criteria to diagnose pneumonia were established in 1996, those who report cases did not know these criteria. A combination of physician, nurse, and public health workers diagnoses were used. According to the written criteria, cases of suspect or rule out pneumonia should be reported, but when asked about specific examples only 79% of persons interviewed said they would report "tuberculosis with pneumonia" and 44% would report "bronchitis, rule out pneumonia." Seventy-four percent of persons interviewed completed the surveillance report within one day of patient admission.

INTRODUCTION

In 1970, the Bureau of Epidemiology at the Thai Ministry of Public Health (MOPH) established a national surveillance system for infectious diseases. This is a passive surveillance system that uses a standard reporting form. In the beginning, there were 14 notifiable diseases, as of 2000, there were 68. In Thailand in the year 2000, pneumonia was ranked as the third leading cause of morbidity and the leading cause of mortality among notifiable diseases (Anonymous, 2000).

Historically, passive surveillance systems have been used to monitor broad trends and big changes in data. Now that interventions are possible, countries need active surveillance that can produce accurate, pathogen-specific data for decision making and monitoring. We evaluated the quality of the current passive surveillance system for pneumonia in Thailand. Our study highlights the importance of pneumonia and the need for accurate data, several shortcomings to the current system, and suggests that newer approaches are needed to more accurately measure the burden of pneumonia in Thailand.

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MATERIALS AND METHODS

Study design and population

This study was conducted in Sa Kaeo Province, which is located along the Thai-Cambodian border in eastern Thailand (Fig 1). According to the 2000 provincial census, there were 439,120 persons living in Sa Kaeo. In addition, there are

Fig 1–Map of Thailand highlighting Sa Kaeo Province.

an estimated 23,000 registered and unregistered Cambodian migrant workers in Sa Kaeo. The province has 9 government hospitals: 8 run by the Ministry of Public Health (including a mental health hospital) and one run by the Ministry of Defense. There are no private hospitals. The hospitals range in size from 30 to 230 beds. All hospitals are equipped with radiologic equipment and at least basic laboratory facilities. Although routine microscopy, chemistry, hematology, and serologic testing are available, equipment and materials to conduct bacteriological testing are lacking, except at the two largest hospitals. Each hospital has an outpatient clinic, and there are 109 health centers.

The study had four main parts. First, we reviewed the process of data collection and reporting. Second, we analyzed reported pneumonia cases and deaths in Thailand since 1975 and during the 3-year period, 1999-2001, to detail the pneumonia surveillance data from Sa Kaeo. Third, we reviewed the number of pneumonia deaths from death certificates (1999-2000) and compared these to the number of deaths reported by the surveillance system. Fourth, we interviewed surveillance personnel in Sa Kaeo to identify current surveillance practices that might deviate from the proscribed method. We selected the personnel at 7 public health hospitals (excluding the mental health hospital) and a 10% simple random sample of health centers. Persons responsible for the surveillance reporting were interviewed using a standard, written questionnaire.

Statistical analysis

To characterize the descriptive epidemiology, we used EpiInfo version 6.04d (CDC Atlanta, Georgia). Incidence in Sa Kaeo was calculated using 2001 census data from the Sa Kaeo Provincial Health Office as the denominator. Incidence in Thailand was calculated using the mid-year population from the Ministry of Interior as the denominator. To identify pneumonia deaths in the death certificate database, we selected deaths that were coded as International Classification of Disease volume 10 (ICD10) codes J12.9 through J18.9.

RESULTS

Process of data collection and reporting

The surveillance is a passive system run by the Bureau of Epidemiology. The written case definition is defined as a person who has fever, pleural pain, dyspnea, cough, and leukocytosis. In addition, lung crepitation should be documented by physical examination, and if a chest x-ray is performed, it must show infiltration or consolidation. Patients with occupational lung diseases are excluded. Although some patients had specimens taken for culture, the guidelines indicate that it is unnecessary to wait for results before reporting a case of pneumonia.

Cases meeting the definition are reported on a standard form (Form 506) and entered into a computer at the hospital or district health center. Data travels via disk from the hospital or district health center to the provincial health office and finally to the Bureau of Epidemiology in Nonthaburi. A second form (Form 507) is a follow-up form used for changing the diagnosis and/or the outcome of a previously reported case. These forms are used to collect data from all government, and some private, health facilities. Only

Thai residents are recorded in this system.

Pneumonia data

Over the last 20 years, reported rates of pneumonia in Thailand increased from 74 per 100,000 in 1982 to 227 per 100,000 in 2000 (Fig 2). Reported deaths from pneumonia were 17.8 per 100,000 in 1975, decreased to a low of 4.8 in 1987, and then increased steadily to 15.9 in 2001 (Fig 2). In Sa Kaeo, from 1999 through 2001, there were a total of 2,776 cases for an average of 925 cases per year (957 in 1999, 965 in 2000, and 854 in 2001). The median age was 4 years (range, 1 day to 99 years), 1,326 (48%) of the cases were female, and 1,956 (70%) were inpatients. There were 7 deaths reported in 1999, 6 in 2000, and 8 in 2001. None of the pneumonia records had any laboratory results.

The annual incidence of pneumonia in Sa Kaeo is shown in Fig 3. For comparison, data from Thailand as a whole are shown. The average annual incidence was 236 per 100,000 persons in Thailand and 211 in Sa Kaeo. In Sa Kaeo, age specific incidence peaked at 1,418 per 100,000 in children less than five years old, decreased to rates between 28 and 264 per 100,000 in persons aged 5 to 65, and then increased to 551 per 100,000 in persons over 65 years (Fig 4). The average monthly incidence in children less than 5 years (1,419 per 100,000) old was 13 times greater than that in persons aged 5 and older (108 per 100,000); the rates in both age groups peaked in the period of July through September (Fig 5).

Death certificates

There were 28 and 53 pneumonia deaths in 1999 and 2000, respectively, reported on death certificates in Sa Kaeo. By contrast, there were 7

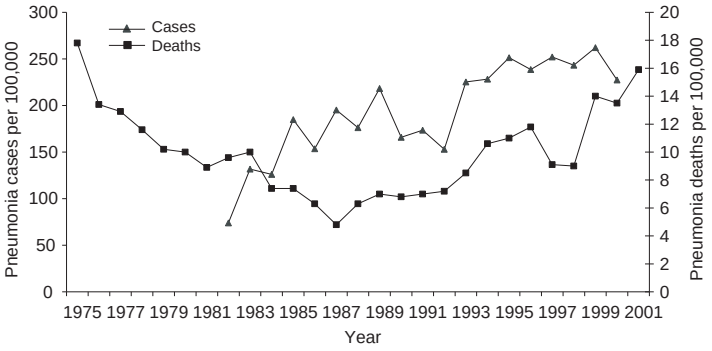

Fig 2–Reported cases and deaths from pneumonia, from 1975-2001, Thailand.

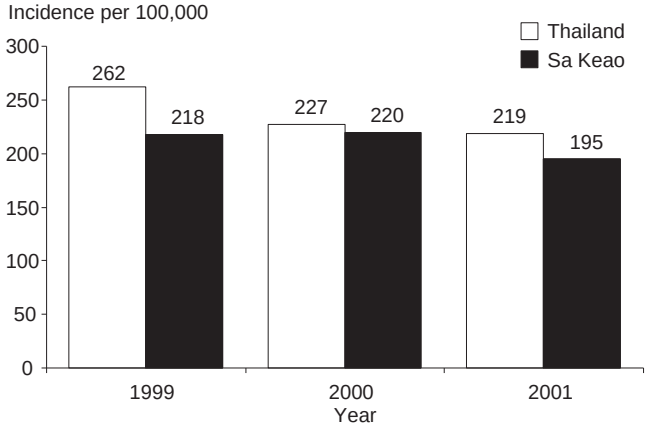

Fig 3–Incidence of pneumonia in Thailand and Sa Kaeo, 1999-2001.

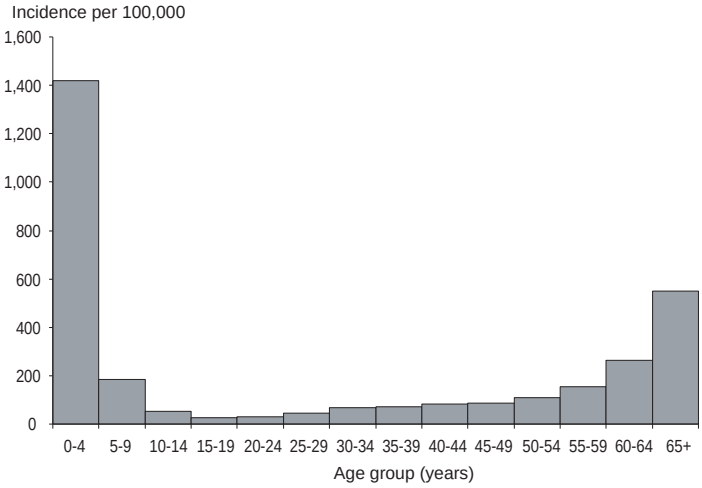

Fig 4–Incidence of pneumonia by age group in Sa Kaeo Province, 1999-2001.

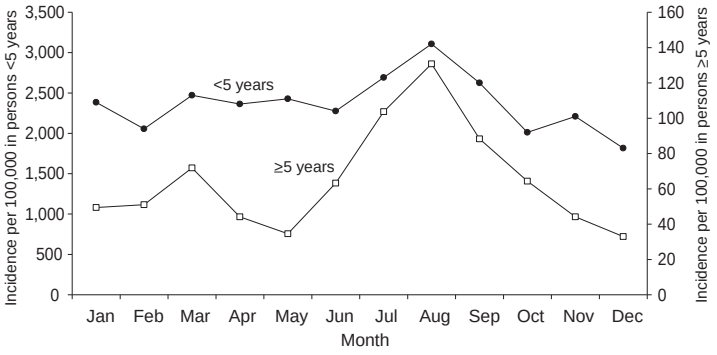

Fig 5–Age-specific incidence of pneumonia by month in Sa Kaeo, 1999-2001.

and 6, respectively, reported from the surveillance system. We were unable to ascertain if these deaths were reported in both systems because all data sets were stripped of names.

Surveillance personnel interviews

We interviewed 72 health personnel [56 (78%) from the 7 hospitals and 16 (22%) from 10 health centers]. The number of persons reporting surveillance data ranged from one to twenty in hospitals and from one to three in health centers. Of the interviewees, 47 (65%) were nurses, 14 (19%) public health personnel, and 11 were other hospital personnel. Sixty-two (86%) persons reported receiving some training for their job; 37 (60%) were trained informally by other hospital personnel and 8 (13%) by district and provincial health office staff.

The two methods used to identify cases were manual searches through logbooks and computerized ICD10 searches. When asked, "Whose diagnosis do you use to decide if a patient needs to be reported on Form 506?" 59 (82%) responded "physician diagnosis," 15 (21%) responded "nurse diagnosis," and 16 (22%) responded "public health personnel diagnosis." These categories were not mutually exclusive.

Although the written criteria specify that a diagnosis of both "with" and "rule out" pneumonia should be reported as a case, when interviewees were asked, " What would you report as pneumonia?" most reported pneumonia when the diagnosis said "with pneumonia" but if the diagnosis said "rule out pneumonia" under 50% of them reported pneumonia. For example, 79% reported "new tuberculosis with pneumonia", 76% reported measles with pneumonia, 44% reported bronchitis, rule out pneumonia, 42% reported cough, rule out pneumonia, 11% reported lower respiratory tract infection, and 3% reported dyspnea.

DISCUSSION

This passive surveillance system places pneumonia solidly among the leading causes of morbidity and mortality in Thailand. The age distribution is consistent with what is known of pneumonia elsewhere (Marrie, 1998), and the seasonal peak among young children in July through September bears further exploration. Nevertheless, weaknesses in the training of personnel, lack of use of a standard case definition, and underreporting of deaths emphasize the need to strengthen this system, and new opportunities for pneumonia prevention underline the necessity for a completely new approach to pneumonia surveillance.

Although there are several published studies from Southeast Asia that summarize pneumonia cases and etiologies at a single hospital (Boonsawat *et al*, 1990; Chan *et al*, 1992; Hui *et al*, 1993; Reechaipichitkul *et al*, 2002), we could find no reports in this region measuring the population burden of pneumonia as a clinical syndrome. Rates reported from all ages in Spain were 160 per 100,000 per year (Monge *et al*, 2001a,b). Adult surveillance had rates of 160 in Spain and 267 in the United States (Marston *et al*, 1997; Almirall *et al*, 2000). As expected, children less than 15 years old in Finland had a much higher annual incidence of 2,271 per 100,000 (Table 1). The rate in Sa Kaeo is similar to the passive system in Spain. In Thailand, the lower incidence in Sa Kaeo compared to the country as a whole is curious and may suggest that the rate of pneumonia varies geographically.

Most of the weaknesses of the existing surveillance system identified in this review are common to passive surveillance systems. A case definition is central to any surveillance system (CDC, 1988). Although this system has a standard, written case definition for pneumonia, this study identified many different interpretations making

Table 1
Population-based studies of community-acquired pneumonia.

Study dates	Country and reference	Age (years)	Setting	Case definition	Annual incidence per 100,000	Mortality
Sep 1981-Aug 1982	Finland (Heiskanen-Kosma *et al*, 1999)	<15	Doctor-based	Radiologically confirmed	2,271 in 0-14 years	-
Jan-Dec 1991	Ohio, USA (Marston *et al*, 1997)	≥18	Inpatients	New infiltrate on chest radiograph AND Fever, hypothermia, productive cough, or abnormal white blood cell count	267 in ≥18 years 92 in 18-44 years 279 in 45-59 years 1,014 in ≥65 years	8.8%
Dec 1993-Nov 1995	Spain (Almirall *et al*, 2000)	≥14	Outpatients and inpatients	Acute lower respiratory tract infection, focal signs on physical examination of chest, new infiltrate on radiograph	162	5%
Jan 1995-Dec 1996	Spain (Monge *et al*, 2001a,b)	All ages	Inpatients National surveillance system for hospital data	ICD 9 CM codes 480-486, first listed diagnosis	160 in all ages 494 in 0-4 years 128 in 5-9 years 30 in 10-24 years 73 in 25-39 years 95 in 40-64 years 433 in ≥65 years	7.4%
Apr 1994-Mar 1999	Canada (Marrie *et al*, 2003)	≥18	Hospital discharge data	ICD 10 CM codes 480-487, 507 (exclude 484)	129 in 18-39 years 191 in 40-54 years 1,321 in ≥55 years	3.2%
Jan 1999-Dec 2001	Sa Kaeo Province, Thailand	All ages	Inpatients (70%) and outpatients National surveillance system		211	0.76%

nondifferential misclassification a common occurrence. In other words, there will be both false positives (*eg*, some non-pneumonia will be reported as pneumonia) and false negatives (*eg*, some true pneumonia may be missed). Without standardized data collection it is difficult to know 1) if the reported numbers are an over or underestimate of the true numbers, 2) if trends can be followed, and 3) what interventions might be valuable. The absence of laboratory data is another limitation. Laboratory capacity is limited outside of Bangkok, and data that does exist is not routinely integrated with the case data.

Mortality from pneumonia is most likely underreported in the passive surveillance system since some patients may have died at home. For those who died in the hospital, the health personnel might not have sent a follow-up report to change the patient status. In other studies, the frequency of death among pneumonia patients ranged between 5% among adults in Spain (Almirall *et al*, 2000), to 9% in hospitalized adults in Ohio (Marston *et al*, 1997), to 21% in hospitalized adults in Khon Kaen, Thailand (Boonsawat *et al*, 1990). It is important to accurately measure and report deaths since they reflect the severity of the disease and can greatly influence health policy decisions.

New opportunities for treating and preventing pneumonia have accumulated rapidly in recent years, outpacing the capacity of many existing surveillance systems to provide the information needed for evidenced-based public health decisions. New and effective vaccines against *Haemophilus influenzae* type b, *Streptococcus pneumoniae*, and influenza viruses raise the potential to substantially reduce the burden of pneumonia in young children and perhaps the elderly. The ability to treat previously untreatable disease, such as influenza B with the neuraminidase inhibitors, or to improve treatment outcomes, such as with directly observed therapy for tuberculosis, open new, albeit expensive, opportunities. Rational public health decisions will require accurate information on the disease burden and costs associated with pneumonia caused by these pathogens. It is not clear whether the current pneumonia surveillance in Thailand is suited to give adequate information to effect such decisions.

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