Original Article *นิพนธ์ต้นฉบับ*

Monthly Rainfall and Severity of Melioidosis in Nakhon Phanom, Northeastern Thailand

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Abstract In a 6-year retrospective analytical study, 340 culture-confirmed cases of melioidosis with an average annual prevalence of 9.97/100,000 from Nakhon Phanom Hospital, Northeast of Thailand were included. The total monthly rainfall data was significantly linear correlated with number of patients with melioidosis in the years 2001-2006 [($r = 0.633$, $p < 0.05$), ($r = 0.622$, $p < 0.05$), ($r = 0.804$, $p < 0.01$), ($r = 0.734$, $p < 0.01$), ($r = 0.844$, $p < 0.01$), ($r = 0.884$, $p < 0.01$) respectively]. The 73.27 percent of the patients were affected in the rainy season (June to November). Admitted 321 cases affected all ages with the highest incidence in 41-60 years group (51.71%). The 72.27 percent of the cases had underlying diseases. The common risk factors included diabetes mellitus or chronic renal disease. The mainly clinical presentations were pneumonia (30.84%) and sepsis with bacteremia (30.22%). Overall mortality was 43.61 percent but mortality in proper antibiotic treatment cases was 32.57 percent. On multivariate regression analysis, the independence risk factors of case-fatality significantly associated with acute respiratory failure: adjusted odd ratio 21.83(95%CI 8.09,58.92) $p<0.001$, septic shock 4.39(1.77,10.87) $p<0.01$, non proper antibiotic treatment cases 3.20(1.34,7.63) $p<0.01$, tachycardia 2.69(1.20,6.07) $p<0.05$, white blood cell count <5,000 cells/mm^3 6.85(1.84,25.42) $p<0.01$, platelet count <100,000 cells/mm^3 3.78(1.59,9.03) $p<0.01$, band form of polymorphonuclear ≥ 1% 3.67(1.75,7.72) $p<0.01$, $NaHCO_3$ <15 meq/L 3.59(1.81,7.14) $p<0.001$. Melioidosis is an important infectious disease in Northeast of Thailand showing very high prevalence in Nakhon Phanom province ralative to other regions in Thailand. Rapid diagnosis and proper management of high risk cases can decrease morbidity and mortality. Studies exploring the role of preventive measures and earlier clinical identification in rainy season are required to reduce the burden of this disease.

Key words: **melioidosis, rainfall, severity**

Introduction

Melioidosis, which is infection with the gram-negative bacterium *Burkholderia pseudomallei*, is an important cause of sepsis in tropical climates, especially in Southeast Asia and Northern Australia, corresponding approximately to the tropical latitudes between 20°N and 20°S.(1) *B. pseudomallei* is an organ-

ism that has been considered as a potential agent for biological warfare and biological terrorism. Melioidosis primarily occurs in people with underlying comorbidities, such as diabetes, renal insufficiency, cirrhosis, alcoholism, or thalassemia, who have direct exposure to contaminated moist soil.[2] In the northeastern of Thailand, melioidosis accounts for 20 percent of all community-acquired bacteremias and causes of death in 40 percent of treated patients.[3] Epidemiological studies have defined an annual incidence rate in the Top End of the Northern Territory as 16.5 per 100,000 between 1989 and 1999[4], with rates as high as 41.7 per 100,000 in 1998, which were associated with two severe weather events and high annual rainfall.[5] The rates documented in northern Australia were very high relative to the annual incidence of 4.4 cases per 100,000 in Ubon Ratchathani province in Northeast of Thailand.[6] The association between surface water and melioidosis is supported by the strong association with monsoon rains[3,4,7] and with occupational and recreational exposure to surface water and mud[3,4], particularly with flooding of rice paddies and planting at the commencement of the rainy season.[6] The finding that higher rainfall is significantly associated with sepsis and pneumonia suggests that environmental conditions during the rainy season may be associated with inhalation rather than inoculation as the primary mode of acquisition.[7]

In Thailand, there were few studies of the epidemiology of melioidosis. Nakhon Phanom province (the Northeast of Thailand), the endemic area of melioidosis, has approximate 600,000 populations in 5,512 km^2 and approximates 95 percent of populations are in agriculture. Nakhon Phanom hospital is providing secondary care, with 300 beds and the only one referral hospital for patients in Nakhon Phanom province. There have been many admitted melioidosis cases and high fatality of the patients in Nakhon Phanom hospital but there was no study of the epidemiology of melioidosis in Nakhon Phanom province before. In this report, we studied the association of montly reainfall and number of patients with melioidosis, and the clinical manifestations as as well as risk factors that determined the clinical outcome of patients with melioidosis in Nakhon Phanom province, an area with high incidence of the disease.

Methodology

A 6-year retrospective study was conducted at Nakhon Phanom hospital in Nakhon Phanom province, Northeast of Thailand by using a systematic hospital record review. The culture-proven cases with melioidosis from central laboratory of Nakhon Phanom hospital that occurred in Nakhon Phanom province between 2001 and 2006 were included and their important clinical data, investigations at first admission and clinical outcome of treatments were assessed. The inclusion criteria for clinical outcome with septic shock patients, presented with hypotension that not responsive to fluid replacement and need vasopressure, and all of the acute respiratory failure patients required mechanical ventilators. The meteorology station in Nakhon Phanom province provided the total monthly rainfall data from 9 monitoring stations, located throughout the region. The patients from amphoe Nagae district, Na Kwa, and King Wang Yang were excluded from the total 12 amphoe because they have referred their cases to Sakon Nakhon hospital.

Data Analysis

All clinical, epidemiological and laboratory data collected were prospectively analyzed. The association between the number of patients each year and the total monthly rainfall were calculated by t-test. Demographic data and outcome of the patients were reported as percentage, mean, range, and standard deviation (SD), as appropriate. For the comparison between patients who survived or referred and those who

died, the χ^2 test and Wilcoxon rank sum test were used to test proportions and continuous variables, respectively. Factors significantly associated with the outcomes of interest (morbidity or mortality) were then analyzed by univariate and multivariate logistic regression model to confirm their influences. The probability (p) values less than 0.05 were considered significant.

Results

During the study for 6-year period, culture-proven 340 cases of melioidosis were diagnosed. There were four outpatients with melioidosis that had chronic abscess and the other 336 of patients were admitted cases. The medical records were available for reviewand an analysis only in 321 admitted cases, of which 318 patients lived in Nakhon Phanom province (Fig.1) accounting for the average annual prevalence of 9.97/100,000. The highest prevalence was in the year 2003 (14.69/100,000). The admitted 321 cases affected all ages with the highest incidence in 41-60 year group (51.71%). Melioidosis was 1.07 time common in females than males. An average duration of symptom was 12.95 days. A rapid onset of melioido-

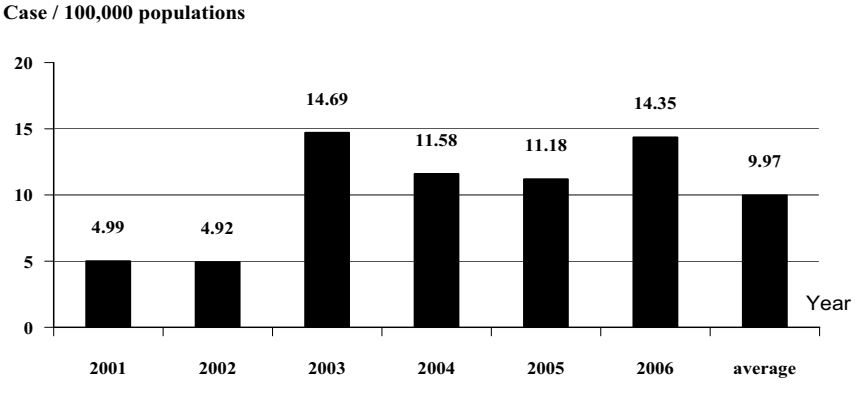

Figure 1 The number of meliolidosis cases/100,000 populations diagnosed in 2001-2006 by the year of diagnosis.

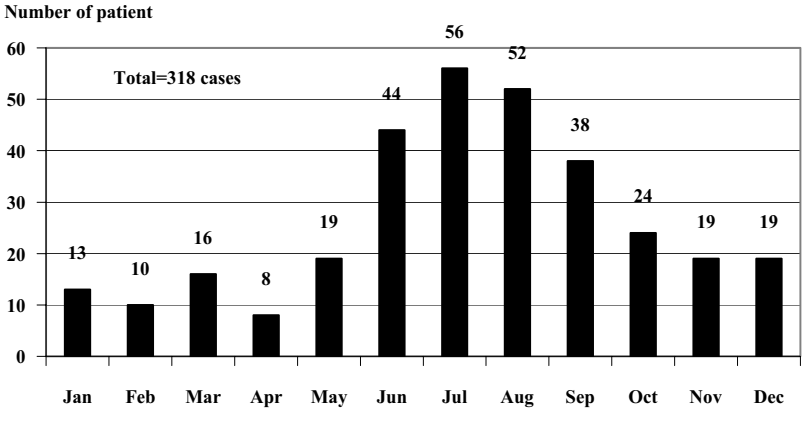

Figure 2 The number of all melioidosis cases diagnosis between January 2001 and December 2006 by the month of diagnosis.

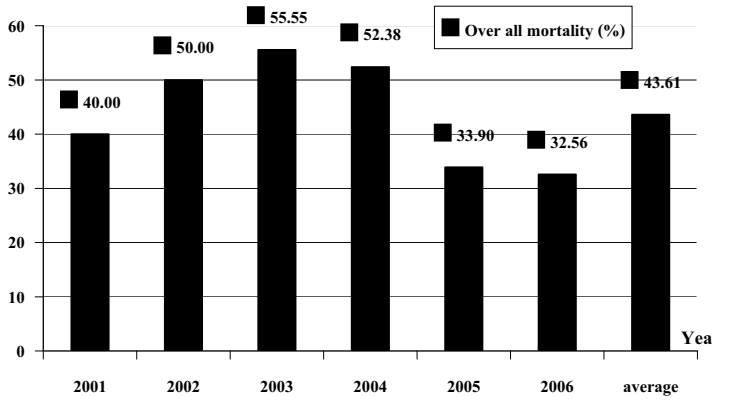

Figure 3 The over all mortality of monthly melioidosis cases diagnosed in 2001-2006 by the year of diagnosis and monthly rainfall.

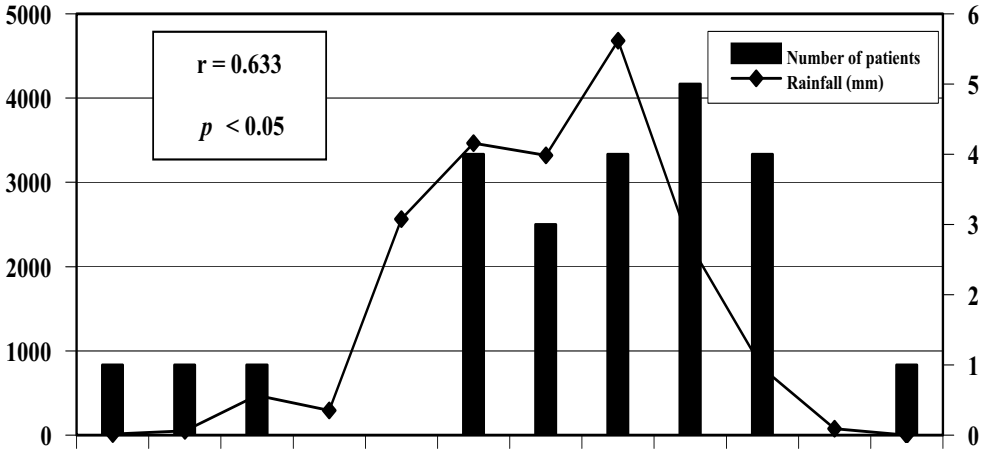

Figure 4 Monthly rainfall and the number of melioidosis cases diagnosed in the year 2001.

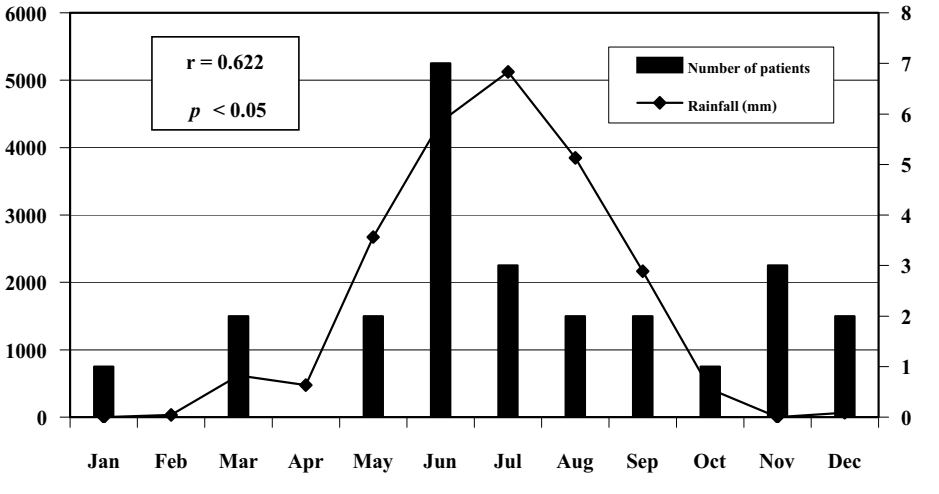

Figure 5 Monthly rainfall and the number of melioidosis cases diagnosed in the year 2002.

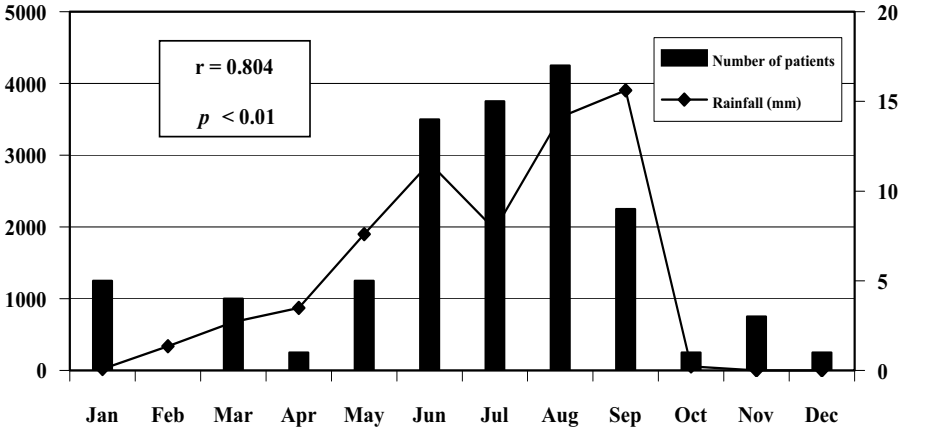

Figure 6 Monthly rainfall and the number of melioidosis cases diagnosed in the year 2003.

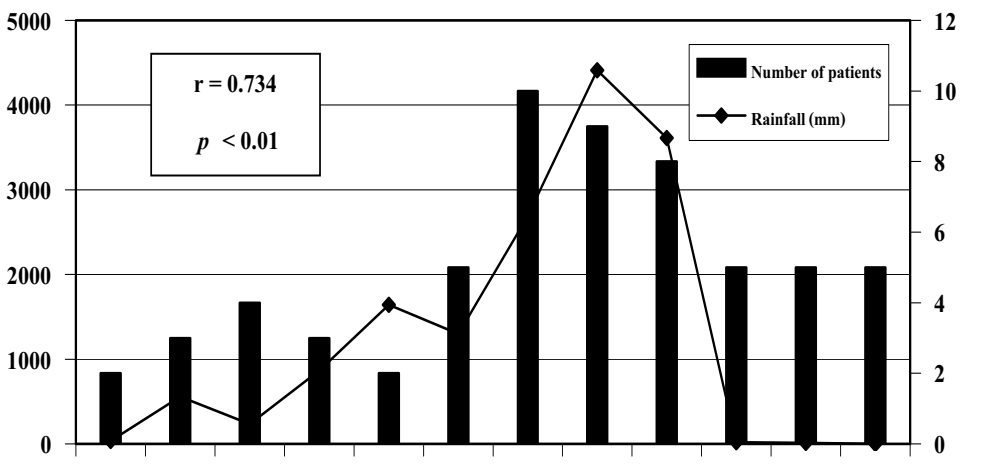

Figure 7 Monthly rainfall and the number of melioidosis cases diagnosed in the year 2004.

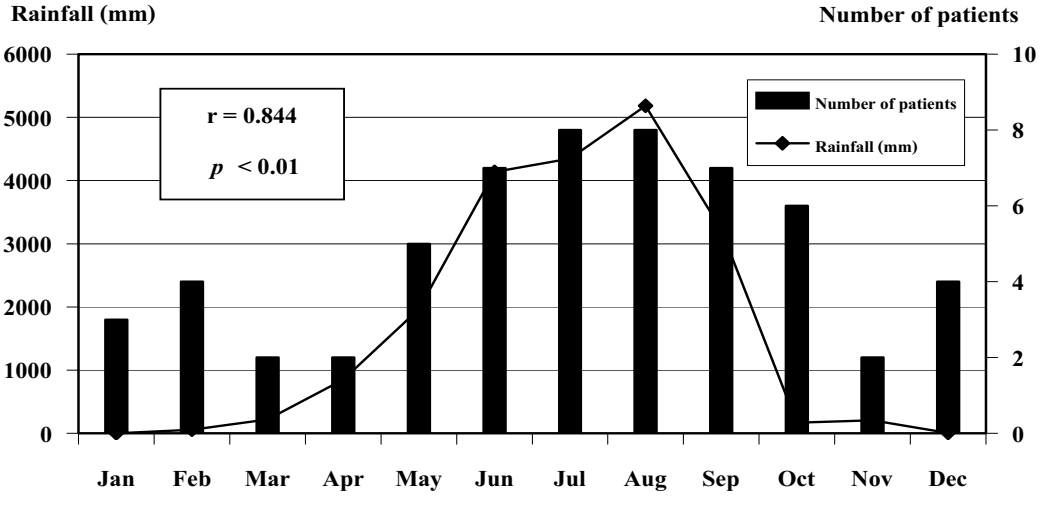

Figure 8 Monthly rainfall and the number of melioidosis cases diagnosed in the year 2005.

sis (within 2 hours) was the near drowning case with aspiration and the two chronic cases (within 1 year) presented with chronic abscess at abdomen and leg. The 72.27 percent of cases had underlying diseases. The major risk factors included diabetes mellitus or chronic renal disease but only one case with human immunodeficiency virus infection (HIV). Farmers accounted for 82.87 percent of patients. Department of medicine admitted most of the melioidosis patients (63.24%) and 39.87 percent needed the services of the intensive care unit (ICU).

The overall mortality was 43.61 percent but mortality in proper antibiotic treatment cases was 32.57 percent (Table1). Yet there was high mortality in the patients who had septic shock (76.87%) and acute respiratory failure (88.15%) as shown in Table 5. Almost half of them (45.71%) died after a short admission (< 24 hours) and most of them (70.71%) died within 72 hours. There was a highest mortality in the

Table 1 Characteristics of the patients (n = 321)

Sex (male: female)	155:166 (1:1.07) case
Age: mean (SD)	5 mo-89 years: 45.12 (18.99) years
Age group (year)	n, (%)
0-20	41 (12.77)
21-40	61 (19.00)
41-60	166 (51.71)
61-80	44 (13.71)
>80	9 (2.80)
Duration of symptom: mean (SD)	2 hr-1 year: 12.95 (33.90) days
Underlying disease*, n (%)	232 (72.27)
- Diabetes mellitus (DM), n (%)	172 (74.14)
- Chronic renal failure (CRF), n (%)	80 (34.48)
- DM and CRF, n (%)	46 (19.83)
- Chronic obstructive pulmonary disease, n (%)	9 (3.88)
- Renal stone, n (%)	8 (3.45)
- Cirrhosis, n (%)	4 (1.72)

Table 1(continued) Characteristics of the patients

- Steroid abuse, n (%)	3 (1.29)
- Thalassemia, n (%)	3 (1.29)
- Idiopathic thrombocytopenic purpura, n (%)	2 (0.86)
- Vulvular heart disease, n (%)	1 (0.43)
- Rheumatoid arthritis, n (%)	1 (0.43)
- Gout, n (%)	1 (0.43)
- Benign prostatic hypertrophy, n (%)	1 (0.43)
- HIV, n (%)	1 (0.43)
Occupations	
- Farmer, n (%)	266 (82.87)
- Unemployment, n (%)	26 (8.10)
- Student, n (%)	19 (5.92)
- Merchant, n (%)	5 (1.56)
- Government official, n (%)	3 (0.93)
- Prisoner, n (%)	1 (0.31)
- Monk, n (%)	1 (0.31)
Department of admission	
- Medicine, n (%)	203 (63.24)
- Surgery, n (%)	62 (19.31)
- Orthopedic, n (%)	20 (6.23)
- ENT, n (%)	17 (5.30)
- Pediatric, n (%)	15 (4.67)
- Obstetric - Gynecology, n (%)	3 (0.93)
- Eye, n (%)	1 (0.31)
- ICU, n (%)	128 (39.87)
Laboratory presentation	
- Creatinine: mean (SD) mg/dl	0.4-25: 3.86 (4.38)
- BUN: mean (SD) mg/dl	4-204: 48.06 (41.90)
- HCO_3: mean (SD) meq/L	1-35.5: 14.88 (6.49)
- WBC count: mean (SD) cell/mm^3	500-53,050: 12,238.54 (7,045.24)
- PMN count: mean (SD)	12-99: 80.96 (12.52) %
- Platelet count x 1,000: mean (SD) cell/mm^3	24-778: 242.55 (150.35) × 1,000
Result of treatment	
- Improve, n (%)	148 (46.11)
- Died (Over all), n (%)	140 (43.61)
- Died (Proper treatment), n (%)	71 (32.57)
- Refer, n (%)	33 (10.28)
- Septic shock, n (%)	160 (49.84)
- Acute respiratory failure, n (%)	135 (42.06)

**Some of patients had underlying diseases more than one disease.*

year 2003 (55.55%) and a lowest mortality in the year 2006 (32.56%) as shown in Figure 3. The 49.84 percent of patients had severe sepsis and septic shock. Some patients (10.28%) were referred to the Suppraisittiprasong hospital, Ubon Ratchathani province in Northeast of Thailand because of the severe sepsis as shown in Table 1.

The major clinical presentations were pneumonia (30.84%) and sepsis with bacteremia (30.22%). The mortality was high in pneumonia [62.63%, OR 3.15 (95%CI 1.93,5.16), p<0.001] and sepsis with bacteremia [53.61%, OR 1.79 (95%CI 1.10,2.89), p<0.05] and decreasing in soft tissue abscess [13.89%, OR 0.18 (95%CI 0.07,0.48), p<0.01], septic arthritis [17.65%, OR 0.26 (95%CI 0.07,0.94), p<0.05] and parotid abscess [6.67%, OR 0.09 (95%CI 0.01,0.67), p<0.05] as shown in Table 2.

The majority of patients who lived in Nakhon Phanom province (73.27%) were diagnosed in the rainy season (June to November) and highest in July as shown in Figure 2. There was significantly linear correlation between total monthly rainfall and the number of patients with melioidosis in the years 2001-2006 [(r = 0.633, p < 0.05), (r = 0.622, p < 0.05), (r = 0.804, p <0.01), (r =0.734, p < 0.01), (r = 0.844, p <0.01), (r =0.884, p < 0.01) respectively] as shown in Figure 4-9.

The methods of the diagnosis were blood culture, sputum culture, pus culture and urine culture. Some of patients diagnosed by more than one method. Blood culture was the majority of the methods of the diagnosis (65.73%) and pus culture was the second of the methods of the diagnosis (25.23%) as shown in Table 3. Table 4 shows the comparison of clinical

Table 2 Clinical presentations and mortality of patients

Clinical presentation	No. of patients (%)	No. of deaths (%)	Odd Ratio (95%CI)	p-value
Pneumonia	99 (30.84)	62 (62.63)	3.15(1.93,5.16)	<0.001
Sepsis with bacteremia	97 (30.22)	52 (53.61)	1.79(1.10,2.89)	<0.05
Soft tissue abscess	36 (11.21)	5 (13.89)	0.18 (0.07,0.48)	<0.01
Septic arthritis	17 (5.30)	3 (17.65)	0.26 (0.07,0.94)	<0.05
Parotid abscess	15 (4.67)	1 (6.67)	0.09 (0.01,0.67)	<0.05
Urinary tract infection	14 (4.36)	9 (64.29)	2.45(0.80,7.48)	0.116
Liver abscess	8 (2.49)	3 (37.50)	0.78(0.18,3.32)	0.738
Splenic abscess	6 (1.87)	0 (0.00)		
Cellulitis	5 (1.56)	1 (20.00)	0.32(0.36,2.92)	0.314
Necrotizing fasciitis	5 (1.56)	0 (0.00)		
Diabetic foot	4 (1.25)	1 (25.00)	0.43 (0.04,4.20)	0.470
Peritonitis	3 (0.93)	2 (66.67)	2.64 (0.24,29.44)	0.430
Pyomyositis	3 (0.93)	0 (0)		
Compound fracture femur, infected wound	2 (0.62)	0 (0)		
Calculous cholecystitis	2 (0.62)	0 (0)		
Acalculous cholecystitis	1 (0.31)	1 (100)		
Metritis, Pelvic inflammatory disease	1 (0.31)	0 (0)		
Septic abortion	1 (0.31)	0 (0)		
Liver and splenic abscess	1 (0.31)	0 (0)		
Prostatitis	1 (0.31)	0 (0)		

characteristics between non-survivors vs. survivors or referral patients. In the non-survivors, they were significant older, farmer, underlying disease, becteremia, septic shock and acute respiratory failure than the survivors or referred patients.

On multivariate regression analysis in clinical cause presentation, the independence risk factors of case-fatality significantly associated with acute respiratory failure: adjusted OR 21.83 (95%CI 8.09,58.92) p<0.001, septic shock 4.39 (1.77,10.87) p<0.01, un proper antibiotic treatment cases 3.20 (1.34,7.63) p<0.01, tachycardia 2.69 (1.20,6.07) p<0.05 as shown in Table 5. And on multivariate regression analysis in laboratory presentation, the independence risk factors of case-fatality significantly associated with white blood cell (WBC) count <5,000 cells/mm^3: adjusted OR 6.85 (95%CI 1.84,25.42) p<0.01, platelet count <100,000 cells/mm^3 3.78 (1.59,9.03) p<0.01, band form of polymorphonuclear (PMN) ≥ 1 percent 3.67 (1.75,7.72) p<0.01, $NaHCO_3$ <15 meq/L 3.59 (1.81,7.14) p<0.001 as shown in Table 6.

Table 3 Method of diagnosis

Diagnostic method	No. of cases* (%)
Hemoculture	211 (65.73)
Pus culture	81 (25.23)
Sputum culture	59 (18.38)
Urine culture	28 (8.72)
Sputum culture and hemoculture	25 (7.79)
Pus culture and hemoculture	16 (4.98)
Urine culture and hemoculture	14 (4.36)

**Some of patients diagnosed by more than one method*

Discussion

This study confirmed the observations that the

Table 4 Comparison of clinical characteristics in non-survivors vs. survivors or referred patients

	Non-survivors (n=140)	Survivors or Referred (n=181)	p-value
Age: mean (SD), N	50.28 (15.92), 140	41.13 (20.22), 181	<0.001
Male gender, %	45.00 (63/140)	50.83 (92/181)	0.300
Farmer, %	88.57 (124/140)	78.45 (142/181)	<0.05
Duration of symptom: mean (SD)	14.82 (37.97)	11.51 (30.41)	0.528
Underlying disease, %	77.86 (109/140)	67.96(123/181)	<0.05
Heart rate: mean (SD), N	105.85 (17.54), 140	106.72 (20.03), 181	0.858
Mean arterial blood pressure: mean (SD), N	81.59 (18.37), 136	79.65 (17.94), 179	0.464
Septic shock, %	87.86(123/140)	20.44(37/181)	<0.001
Bacteremia, %	90.40(113/125)	74.24(98/132)	<0.01
Acute respiratory failure, %	85.00(119/140)	8.84(16/181)	<0.001
BUN: mean (SD), N	43.36 (37.35), 114	51.22 (44.54), 169	0.144
Creatinine: mean (SD), N	3.26 (3.39), 114	4.26 (4.90), 169	0.269
HCO3: mean (SD), N	15.40 (6.22), 109	14.54 (6.66), 163	0.271
WBC count: mean (SD), N	12036.30 (6679.74), 135	12396.37 (7333.51), 173	0.659
PMN count: mean (SD), N	80.40 (12.15), 135	81.39 (12.82), 173	0.315
Band form of PMN: mean (SD), N	2.07 (6.64), 135	2.46 (7.01), 173	0.259
Platelet count x 1,000: mean (SD), N	241.43 (150.92), 135	243.43 (150.33), 173	0.914

Table 5 Predictors of case-fatality in clinical cause presentation and result of univariate & multivariate logistic regression analysis

Variable	Case	Case-fatality, n (%)	Univariate		Multivariable*	
			OR (95% CI)	p-value	OR (95% CI)	p-value
Age >60 years	53	30 (56.60)	2.61 (1.09, 6.35)	<0.05	2.64 (0.91, 7.62)	0.073
Female gender	166	77 (46.38)	1.26 (0.81, 1.97)	0.300		
Duration of symptom <7 days	175	101 (57.71)	3.74 (2.33, 6.01)	<0.001	1.62 (0.70, 3.75)	0.257
Farmer	266	124 (46.62)	2.13 (1.13, 3.99)	<0.05	2.41 (0.73, 7.93)	0.147
Chronic renal failure	80	52 (65.00)	3.23 (1.90, 5.48)	<0.001	0.69(0.20, 2.43)	0.563
DM with CRF	46	31 (67.39)	3.15 (1.62, 6.10)	<0.01	5.41 (0.59, 49.22)	0.134
Underlying > 1 disease	48	33 (68.75)	3.41(1.77, 6.58)	<0.001	1.06 (0.12, 8.91)	0.960
Tachycardia	166	101 (60.84)	4.62 (2.86, 7.46)	<0.001	2.69 (1.20, 6.07)	<0.05
Hypotension (MAP < 60)	29	25 (86.21)	9.40 (3.19, 27.73)	<0.001	1.21 (0.21, 6.90)	0.829
Pneumonia	99	62 (62.63)	3.15(1.93, 5.16)	<0.001	1.24 (0.50, 3.10)	0.645
Septic shock	160	123 (76.87)	28.16 (15.11, 52.48)	<0.001	4.39 (1.77, 10.87)	<0.01
Acute respiratory failure	135	119 (88.15)	58.44 (29.26, 116.72)	<0.001	21.83(8.09, 58.92)	<0.001
Un proper treatment	103	69 (66.99)	4.20 (2.55, 6.92)	<0.001	3.20 (1.34, 7.63)	<0.01

**Use only significant predictors*

Table 6 Predictors of case-fatality in laboratory presentation and result of univariate & multivariate logistic regression analysis

Variable	Case	Case-fatality, n (%)	Univariate		Multivariable*	
			OR (95% CI)	p-value	OR (95% CI)	p-value
Bacteremia	211	113 (53.55)	3.27(1.60, 6.65)	<0.01	1.39(0.59, 3.30)	0.449
WBC > 20,000 cells/mm^3	41	16 (39.02)	0.81(0.41, 1.59)	0.547		
WBC < 10,000 cells/mm^3	128	67 (52.34)	1.85 (1.17, 2.93)	<0.01	0.86 (0.42, 1.75)	0.678
WBC < 5,000 cells/mm^3	36	28 (77.78)	5.48 (2.41, 12.48)	<0.001	6.85(1.84, 25.42)	<0.01
PMN > 90 %	92	49 (53.26)	1.76 (1.07, 2.87)	<0.05	1.35 (0.69, 2.62)	0.376
PMN (Band form ≥ 1 %)	71	50 (72.42)	4.34(2.44, 7.71)	<0.001	3.67 (1.75, 7.72)	<0.01
Platelet < 100,000 cells/mm^3	56	45 (80.36)	7.49(3.69, 15.21)	<0.001	3.78 (1.59, 9.03)	<0.01
BUN ≥ 40 mg/dl	124	81 (65.32)	3.01(1.48, 6.14)	<0.001	2.33(0.94, 5.78)	0.067
Creatinine ≥ 3 mg/dl	110	73 (66.36)	3.36 (2.03, 5.55)	<0.001	0.58 (0.22, 1.50)	0.261
Na HCO_3 < 15 meq/L	139	100 (71.94)	6.65(3.92, 11.30)	<0.001	3.59(1.81, 7.14)	<0.001

**Use only significant predictors*

higher monthly rainfall was associated with the high prevalence of melioidosis cases in each year. The majority of cases (73.27% of patients) were diagnosed in the rainy season and very high prevalence in Nakhon Phanom province relative to other regions in Thailand and the annual incidence of 4.4 cases per 100,000 in Ubon Ratchathani province in northeast of Thailand.[6] This was similar to a report from Ubon Ratchathani province where the incidence was higher in the rainy season.[6] It is the season when farmers work in the

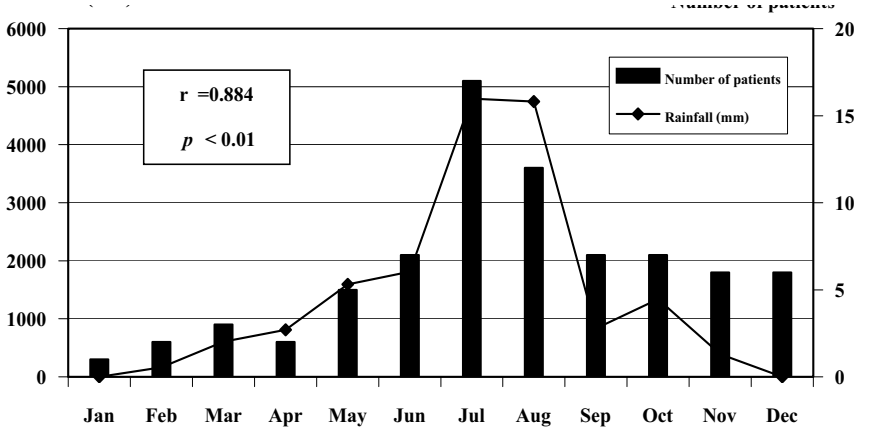

Figure 9 Monthly rainfall and the number of melioidosis cases diagnosed in the year 2006.

field and come into contact with the organism in the soil and water. The saprophytic nature of *B. pseudomallei* was first recognized in 1955 in French Indochina.[8] The first case of melioidosis in Thailand was reported in 1955.[9] Some early studies implicated the aerosolization of dry dusts as a route of acquisition for American servicemen in Vietnam, based on the high incidence in helicopter crews.[10] However, further studies have demonstrated highest yields from moist soils and pooled surface water. [11,12,13] The association between surface water and melioidosis is supported by the strong association with monsoon rains[3,4,7,14] and with occupational and recreational exposure to surface water and mud[3,4,14], particularly with flooding of rice paddies and planting at the commencement of the monsoon season.[6] The finding that the intensity of rainfall in the 14 days before a person is admitted to a hospital with melioidosis is an independent predictor of the patients having pneumonia, septic shock developing, and death and postulate that this may reflect a shift towards inhalation of *B. pseudomallei* as the mode of transmission after heavy monsoon rains and winds.[7]

The finding that higher monthly rainfall is significantly associated with the number of melioidosis cases in each year. Especially, environmental conditions during the monsoon season may be associated with inhalation as well as inoculation. Both are the important primary mode of acquisitions. The major risk factors of melioidosis in this study included diabetes mellitus or chronic renal disease that most of them were rice farmers. However, in a Thai study, diabetes mellitus, thalassemia, renal disease (defined as renal calculi or renal failure), and occupational exposure to surface water were all associated with an increased risk of melioidosis.[15] The major clinical presentations in this study were pneumonia (30.84%) and sepsis with bacteremia (30.22%) and in the previous studies; pneumonia is the most common presentation of melioidosis and is involved in approximately half of all cases.[3,10,14,16-21] The significant risk factor associated with death was having acute respiratory failure, septic shock, non-proper antibiotic treatment, tachycardia, leukopenia, thrombocytopenia, band form of PMN ≥ 1 percent, severe metabolic acidosis. However, in a study by Chaowagul and colleagues, unfavorable outcome was associated with a body temperation < 38°C, a low white blood cell count, high levels of aminotransferase, and a high serum bilirubin level.[3]

Most of the fatal cases came or referred to the hospital too late and had severe sepsis. Therefore, most of them died after a short admission (< 72 hours). However, after the year 2003, a greater awareness among the medical practitioners to diagnose and treated the disease early in high-risk patients in rainy season resulted in a decline of the case-fatality rate from highest 55.55 percent in the year 2003 to 32.56 percent in the year 2006.

Conclusion

Melioidosis is the important infectious disease in Northeast of Thailand showing very high prevalence in Nakhon Phanom province relative to regions in Thailand. There was significantly association between total monthly rainfall and the number of melioidosis in each year and high mortality and morbidity in the region. The rapid diagnosis and proper management of cases that have high risk factors for melioidosis can decrease the morbidity and the mortality of the disease. Studies exploring the role preventive measures such as putting simple surgical mask on first, wearing water proof gloves and shoes or boots during agricultural work when heavy monsoon rains and winds in high-risk patients (diabetes mellitus, chronic renal failure that are farmers) and earlier clinical identification in rainy season are required to reduce the burden of this disease.

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บทคัดย่อ **ปริมาณน้ำฝนรายเดือนและความรุนแรงของโรคเมลิออยโดสิสที่จังหวัดนครพนม ภาคตะวันออกเฉียงเหนือของประเทศไทย**

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วารสารวิชาการสาธารณสุข **2551; 17:363-75.**

การศึกษาย้อนหลังเชิงวิเคราะห์ผู้ป่วยเมลิออยโดสิสที่วินิจฉัยจากการเพาะเชื้อ ตั้งแต่ปี พ.ศ. 2544-2549 จำนวนทั้งหมด 340 ราย ที่โรงพยาบาลนครพนม ภาคตะวันออกเฉียงเหนือของประเทศไทย โดยมีความชุกของผู้ป่วยในจังหวัด 9.97 รายต่อแสนประชากร พบว่า ปริมาณน้ำฝนรายเดือนทั้งหมดที่ตกในจังหวัดมีความสัมพันธ์แบบเส้นตรงกับจำนวนผู้ป่วยที่เพิ่มขึ้นในแต่ละปีอย่างมีนัยสำคัญทางสถิติ [($r = 0.633$, $p < 0.05$), ($r = 0.622$, $p < 0.05$), ($r = 0.804$, $p < 0.01$), ($r = 0.734$, $p < 0.01$), ($r = 0.844$, $p < 0.01$), ($r = 0.884$, $p < 0.01$) ตามลำดับ] ผู้ป่วยร้อยละ 73.27 พบในช่วงฤดูฝนตั้งแต่เดือน มิถุนายน-พฤศจิกายน ผู้ป่วยที่เข้ารับการรักษาในโรงพยาบาลจำนวน 321 รายพบมากในช่วงอายุ 41-60 ปี (51.71%) ผู้ป่วยร้อยละ 72.27 มีโรคประจำตัวอยู่ก่อนแล้ว ซึ่งพบบ่อยได้แก่ เบาหวาน และไตวายเรื้อรัง ผู้ป่วยมักจะมีอาการทางคลินิกด้วยปอดอักเสบ (30.84%) และติดเชื้อในกระแสเลือด (30.22%) จากการวิเคราะห์ปัจจัยที่เป็นเหตุแห่งการเสียชีวิตขึ้นอยู่กับภาวะการหายใจล้มเหลวเฉียบพลัน adjusted odd ratio 21.83 (95%CI 8.09,58.92) $p<0.001$, Septic shock 4.39 (1.77,10.87) $p<0.01$, การได้รับยาฆ่าเชื้อไม่ถูกต้อง 3.20 (1.34,7.63) $p<0.01$, Tachycardia 2.69 (1.20,6.07) $p<0.05$, White blood cell count <5,000 cells/mm^3 6.85 (1.84,25.42) $p<0.01$, Platelet count <100,000 cells/mm^3 3.78 (1.59,9.03) $p<0.01$, Band form of polymorphonuclear ≥1% 3.67(1.75,7.72) $p<0.01$, $NaHCO_3$ <15 meq/L 3.59 (1.81,7.14) $p<0.001$ เมลิออยโดสิส เป็นโรคติดเชื้อที่สำคัญในภาคตะวันออกเฉียงเหนือของประเทศไทย และมีความชุกในจังหวัดนครพนมมากที่สุดเท่าที่เคยมีรายงานในประเทศ การให้การวินิจฉัยที่รวดเร็วและการรักษาที่ถูกต้อง ในผู้ป่วยที่มีความเสี่ยงต่อการเกิดโรค สามารถลดอัตราการเจ็บป่วยและอัตราการตายของผู้ป่วยลงได้ ควรศึกษาการป้องกันโรคและการให้การวินิจฉัยแยกโรคให้รวดเร็ว โดยเฉพาะในช่วงฤดูฝน เพื่อลดการเกิดโรคเมลิออยโดสิสต่อไป

คำสำคัญ: **โรคเมลิออยโดสิส, ปริมาณน้ำฝน, ความรุนแรงของโรค**