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# Clinical Characteristics, Antimicrobial Susceptibility, and Outcomes of *Streptococcus suis* Infection: A Case Series from Southern Thailand

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**Original Article**

# Clinical Characteristics, Antimicrobial Susceptibility, and Outcomes of *Streptococcus suis* Infection: A Case Series from Southern Thailand

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**Abstract:**

**Objective:** To describe the clinical characteristics, antimicrobial susceptibility profiles, and outcomes of patients with *Streptococcus suis* infection in Southern Thailand.

**Methods:** We conducted a retrospective case series of patients with microbiologically confirmed *S. suis* infection at Songklanagarind Hospital, a tertiary-care hospital in Southern Thailand, between 2019 and 2025. Clinical data were extracted from electronic medical records. Antimicrobial susceptibility testing was performed using automated minimum inhibitory concentration (MIC) methods and interpreted according to CLSI M100 criteria for viridans group streptococci.

**Results:** Sixteen cases were identified (median age 64.5 years [IQR 51.5–70.3]; 56.3% male). A potential zoonotic exposure (pig contact or raw pork consumption) was identified in 4 of 16 patients (25.0%). Bacteremia was the most frequent finding (75.0%); infective endocarditis was the most common focal manifestation (50.0%), followed by spondylodiscitis (25.0%). Ceftriaxone was the most frequently used definitive therapy (68.8%), with a median intravenous treatment duration of 42 days. Among 13 isolates tested, all were susceptible to ceftriaxone, and no penicillin-resistant isolates were detected, although 30.8% showed intermediate susceptibility. Resistance to erythromycin and tetracycline was universal. In-hospital mortality was 18.8%.

**Conclusion:** In this single-center series, *S. suis* infection in Southern Thailand frequently presented with infective endocarditis, while isolates retained susceptibility to beta-lactams. Ceftriaxone appeared to be a reliable treatment option, whereas resistance to macrolides and tetracyclines was widespread. These findings provide regional data that may help inform clinical management, although larger prospective studies are needed.

**Keywords**: Streptococcus suis, zoonotic infection, infective endocarditis, antimicrobial susceptibility, Southern Thailand

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## Introduction:

*Streptococcus suis* is an encapsulated Gram-positive coccus that colonizes the upper respiratory tract and gastrointestinal tract of swine and represents an emerging cause of invasive

zoonotic disease in humans.[1] Transmission occurs primarily through direct contact with infected pigs or consumption of raw and undercooked pork.[1,2] The clinical spectrum ranges from bacteremia and meningitis to infective endocarditis, spondylodiscitis, and septic arthritis. Less common manifestations such as pneumonia, endophthalmitis, and peritonitis have also been reported, with a case-fatality rate of approximately 7–19.5% in hospital-based series in Thailand.[3–6] In clinical microbiology laboratories, *S. suis* may be misidentified as viridans group streptococci or other alpha-hemolytic streptococci when conventional biochemical methods are used, potentially leading to underrecognition of this zoonotic infection.[7] Accurate species-level identification, particularly with matrix-assisted laser desorption ionization–time of flight mass spectrometry (MALDI-TOF MS), is therefore important for appropriate diagnosis, epidemiological surveillance, and clinical management.

Southeast Asia bears the highest global burden of human *S. suis* disease, with Thailand and Vietnam collectively accounting for the majority of reported cases worldwide.[8,9] Thailand alone is estimated to contribute approximately 11% of all human cases reported globally, representing the second-highest national total.[10] Human infection was first recognized in Thailand in 1987, and at least five large outbreaks have since been documented, predominantly in the northern region and, most recently, the Northeast. National surveillance through the R506 reporting system has shown a rising trend between 2011 and 2021, peaking at 586 reported cases in 2021, although the true burden is likely underestimated because many hospital laboratories cannot reliably identify the organism.[11] The reported national crude incidence is low (0–0.38 per 100,000 population per year) but varies markedly by region, ranging from 0.1–2.2 per 100,000 in northeastern Thailand to as high as 6.2 per 100,000 in northern Thailand, where raw-pork consumption is more common. [12,13] Reported in-hospital mortality ranges from approximately 9.5% to 19.5%.[11] Despite this recognized burden, virtually all published hospital-based cohort studies originate from the northern (Chiang Mai, Phayao), central (Bangkok), and northeastern (Nakhon Phanom) regions.[3–6,12,13] Southern Thailand, where Songklanagarind Hospital serves as the sole Level-1 referral center for a population exceeding three million, has not previously been studied.

Antimicrobial resistance in *S. suis* is an emerging concern. Previous studies from Thailand have demonstrated that human isolates generally remain highly susceptible to penicillin (greater than 90%) and uniformly susceptible to ceftriaxone.[4–6] However, a recent 16-year study from

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Siriraj Hospital, Bangkok, documented a significant declining trend in penicillin susceptibility, falling to 48.2% of isolates, while resistance to erythromycin (97.6%), clindamycin (98.8%), and tetracycline (94.0%) was near-universal.[3] Whether these trends are mirrored in southern isolates is unknown. We therefore conducted this study to describe, for the first time, the clinical characteristics, antimicrobial susceptibility profiles, and outcomes of *S. suis* infection at Songklanagarind Hospital. These data provide a basis for informing clinical management and optimizing treatment approaches for *S. suis* infection in Southern Thailand.

## Subjects and Methods:

### *Study design and setting*

We conducted a retrospective descriptive case series at Songklanagarind Hospital, Hat Yai, Songkhla, a 1,000-bed tertiary-care university hospital and the primary referral center for Southern Thailand. The study period was 1 January 2019 to 31 December 2025.

### *Case identification and data collection*

Cases were identified by searching the microbiology laboratory database for all positive cultures yielding *S. suis* from any sterile site. Patients with incomplete medical records and repeat episodes of *S. suis* infection in the same patient were excluded. Clinical data were extracted from the hospital electronic medical record and the Digital Innovation and Data Analytics (DIDA) unit using a standardized case record form, supplemented by manual chart review for variables not accessible through the administrative database, including exposure history, presenting symptoms, clinical diagnosis, and complications.

### *Microbiological methods*

Species identification was performed via MALDI-TOF MS (Bruker Microflex LT, Bruker Daltonics, Bremen, Germany). Identification was considered reliable when the highest MALDI-TOF score was ≥2.0, in accordance with the manufacturer's recommendations.

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Antimicrobial susceptibility testing was performed by determining minimum inhibitory concentrations (MICs) using the Sensititre ARIS 2X ID/AST system (Thermo Scientific, Massachusetts, USA). For three isolates collected prior to the routine implementation of automated MIC testing at our institution, susceptibility was assessed by disc diffusion and reported separately; these isolates were excluded from the MIC-based analysis. Susceptibility interpretations were based on Clinical and Laboratory Standards Institute (CLSI) M100 (35th edition, 2025) breakpoints for viridans group streptococci, as no species-specific criteria exist for *S. suis*.[14]

*Statistical analysis*

Descriptive statistics were used. Continuous variables are reported as median (interquartile range, IQR) and categorical variables as frequency and percentage. All statistical analyses were performed using RStudio.

*Ethical approval*

This study was approved by the Human Research Ethics Committee, Faculty of Medicine, Prince of Songkla University (REC No. 69-157-14-1). Informed consent was waived due to the retrospective design.

**Results:**

*Patient characteristics*

A total of 17 patients with positive cultures for *S. suis* were identified during the study period. One patient was excluded as this represented a relapse in a previously included patient, yielding a final cohort of 16 cases (Table 1). The median age was 64.5 years (IQR 51.5-70.3; range 48-90), and 9 patients (56.3%) were male.

A potential zoonotic exposure was identified in 4 of 16 patients (25.0%): direct pig contact in 3 (18.8%), comprising one pork seller, one butcher, and one pig farmer, and ingestion of

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undercooked pork in 1 (6.2%). Seven patients (43.8%) had a documented history with no identifiable risk factor, while exposure history was not recorded in the remaining 5 patients (31.2%). Comorbidities were present in 9 patients (56.2%), most commonly hypertension, dyslipidemia, and diabetes mellitus (each 25.0%), followed by heart failure (18.8%) and cerebrovascular disease (18.8%). Two patients (12.5%) had prosthetic heart valves.

*Clinical presentation and treatment*

Clinical presentations are summarized in Table 2. Infective endocarditis was the most frequent diagnosis, occurring in 8 patients (50.0%), including 6 native-valve IE and 2 prosthetic-valve IE. Bacteremia was present in 12 patients (75.0%). Four patients (25.0%) had spondylodiscitis, two (12.5%) had septic arthritis, and one case each of meningitis, mycotic aneurysm, peritoneal dialysis-related peritonitis, and biliary tract infection was observed.

Ceftriaxone was the most commonly used empiric (68.8%) and definitive antibiotic (68.8%). Median intravenous antibiotic duration was 42 days (IQR 14-42; range 5-84 days). Source control was required in 6 patients (37.5%): valve surgery in 3, surgical debridement in 2, and percutaneous biliary drainage in 1.

*Antimicrobial susceptibility*

MIC results were available for 13 of 16 isolates (Table 3). All 13 isolates were susceptible to ceftriaxone (MIC range ≤ 0.12-0.5 μg/mL), meropenem (MIC ≤ 0.25 μg/mL), levofloxacin (MIC ≤ 0.5-2 μg/mL), and vancomycin (MIC ≤ 0.5 μg/mL). For penicillin G, 9 isolates (69.2%) were susceptible and 4 (30.8%) were intermediate (MIC range ≤ 0.03-1 μg/mL); no resistant isolates were detected. Near-universal resistance was observed to erythromycin (13/13, 100%; MIC 2->2 μg/mL), tetracycline (13/13, 100%; MIC 8->8 μg/mL), and clindamycin (12/13, 92.3%).

*Clinical outcomes*

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In-hospital mortality occurred in 3 of 16 patients (18.8%). The median length of hospital stay was 17.5 days (IQR 9.8-33.8; range 5-143 days). Complications occurred in 5 patients (31.3%), including respiratory failure (n=3), septic shock (n=3), acute kidney injury (n=1), and massive hemoptysis secondary to aortobronchial fistula (n=1). The median total inpatient cost was 85,093 THB (IQR 46,463-226,962; range 23,767-1,688,575). A detailed summary of clinical features, treatment, and outcomes for each patient is shown in Supplementary Table 1.

**Discussion:**

This study represents the first case series of human *Streptococcus suis* infection from Southern Thailand and provides important regional data on clinical presentation, antimicrobial susceptibility, and outcomes. Several key findings emerged. First, infective endocarditis (IE) was the predominant clinical manifestation, occurring in half of all cases. Second, bacteremia was common and frequently co-occurred with focal complications. Third, all isolates remained susceptible to ceftriaxone, and no penicillin-resistant isolates were identified, although a proportion demonstrated intermediate susceptibility. Finally, resistance to macrolides and tetracyclines was nearly universal, consistent with national trends.

The high proportion of IE in our cohort (50.0%) was notably greater than that reported in earlier Thai series, where IE accounted for approximately 8–39% of cases.[3–6] Several factors may explain this difference, including referral bias at our tertiary-care center, the relatively older age of our cohort, the presence of prosthetic heart valves in a subset of patients, and differences in diagnostic practices such as the threshold for performing echocardiography. In addition, because cases were identified through microbiologically confirmed infections at a tertiary-referral hospital, severe or complicated manifestations such as IE may have been over-represented. However, our findings closely mirror a recently reported Thai series in which all the patients underwent echocardiographic evaluation, resulting in an IE prevalence of 51%.[15] Notably, that study demonstrated a rapid increase in penicillin resistance and reduced ceftriaxone susceptibility over time, and identified penicillin resistance and persistent bacteremia as independent factors associated with the development of IE.[15] Another recent Thai study further emphasized the clinical importance of S. suis IE by identifying a novel serotype 2-ST1688 lineage associated with

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endovascular infection, suggesting that specific bacterial genotypes may contribute to enhanced virulence and endovascular tropism.[16] Collectively, these findings reinforce that S. suis bacteremia carries a substantial risk of IE and severe endovascular complications. Clinicians should therefore maintain a high index of suspicion for IE in patients with S. suis bacteremia, and early echocardiographic evaluation should be strongly considered, particularly in those with persistent bacteremia or prosthetic valves.

Exposure history was identifiable in only a subset of patients, and most patients with documented exposure histories did not report direct pig contact or raw pork consumption. This may reflect regional sociocultural differences, including dietary practices, which differ from northern Thailand where raw pork consumption is more common.[6,17] However, incomplete documentation and potential recall bias limit interpretation. It is also possible that occupational exposures were underreported, or that transmission occurred through subclinical skin wounds or environmental sources not systematically captured in this retrospective review.[18] Prospective studies with standardized exposure assessment are needed to better characterize transmission pathways in Southern Thailand.

Our antimicrobial susceptibility findings are reassuring. All isolates tested by MIC were fully susceptible to ceftriaxone, supporting its continued use as a reliable first-line agent for empirical and definitive therapy. Although no penicillin-resistant isolates were detected, approximately one-third exhibited intermediate susceptibility (MIC range ≤0.03–1 μg/mL), which may have clinical implications for dosing strategies, particularly in severe infections such as IE. Notably, this proportion of intermediate penicillin susceptibility (30.8%) contrasts with findings from Siriraj Hospital, Bangkok, where only 48.2% of isolates were susceptible, 45.9% intermediate, and 5.9% fully resistant over a 16-year period, with a statistically significant upward trend in penicillin MICs.[3] While our southern isolates currently demonstrate a more favorable susceptibility profile, with no resistant isolates detected, the substantial proportion with intermediate susceptibility suggests that caution may be warranted when using penicillin G as sole therapy for severe infections. Ceftriaxone, to which 100% of our isolates remained susceptible, should therefore be preferred for empirical and definitive therapy, particularly in IE and other complicated presentations. In contrast, resistance to erythromycin, clindamycin, and tetracycline

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was nearly universal, consistent with prior studies from Thailand.[3,5] These findings reinforce that macrolides and tetracyclines should not be used for the treatment of invasive *S. suis* infection.

The observed in-hospital mortality of 18.8% is consistent with previously reported rates in Thailand.[3–6] Despite the high frequency of severe manifestations such as IE, outcomes in our cohort were comparable to other regions, which may reflect timely diagnosis and appropriate antimicrobial therapy. The median cost of 85,093 THB (2633 USD) is lower than the equivalent approximately 130,000 THB (4023 USD) reported from northern Thailand,[19] potentially reflecting differences in case mix, healthcare utilization, or resource allocation. All three deaths occurred in patients with severe, advanced disease, comprising massive hemoptysis from an aortobronchial fistula, prosthetic-valve endocarditis with concomitant meningitis, and dialysis-related peritonitis complicated by septic shock and multiorgan dysfunction, indicating that mortality clustered among patients with endovascular or multifocal involvement. The wide cost range (up to 1,688,575 THB) was driven by a small number of patients with prolonged intensive-care stays, cardiac or spinal surgery, and complications such as respiratory failure and acute kidney injury, rather than by antimicrobial therapy itself; consistent with prior Thai data, infective endocarditis and prolonged length of stay are recognized drivers of high treatment cost.[19] Finally, the median intravenous antibiotic duration (42 days) exceeded the median hospital stay (17.5 days), reflecting that a substantial proportion of clinically stable patients completed prolonged parenteral therapy after discharge through outpatient parenteral antimicrobial therapy or transfer to community hospitals.

Our series also illustrates the breadth of rare but severe manifestations that *S. suis* can cause. In addition to IE and spondylodiscitis, we observed individual cases of mycotic aneurysm, peritoneal dialysis-related peritonitis, and biliary tract infection. These manifestations, though infrequently reported, can be life-threatening and may not be immediately recognized as zoonotic in origin. The case of mycotic aneurysm resulting in aortobronchial fistula with massive hemoptysis is particularly noteworthy given its diagnostic complexity and high surgical risk. Awareness of these atypical presentations is important for clinicians, particularly in endemic regions, to ensure that *S. suis* is not overlooked as a causative pathogen in patients with relevant exposure history and atypical focal infection.

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This study has several limitations. Its retrospective, single-center design introduces the possibility of referral and selection bias, particularly toward more severe or complicated cases such as IE. The small sample size limits statistical power and precludes identification of factors associated with outcomes. Exposure history was incomplete in a substantial proportion of patients, and microbiological data were limited by the absence of MIC testing in early isolates and lack of molecular characterization, such as serotyping or sequence typing. Additionally, variations in diagnostic practices, including echocardiographic evaluation, may have influenced the observed clinical spectrum.

In conclusion, *S. suis* infection in Southern Thailand can present with a range of severe manifestations, including a notable proportion of infective endocarditis in this referral-based series, together with preserved susceptibility to beta-lactam antibiotics. Ceftriaxone remains a reliable therapeutic option, while resistance to macrolides and tetracyclines is widespread. These findings provide important regional evidence to guide clinical management and underscore the need for prospective, multicenter studies to further define epidemiology and optimize treatment strategies.

**Conflict of interest:** The authors declare no conflicts of interest.

**Funding:** This research received no external funding.

**Data availability statement:** Data supporting the findings of this study can be accessed by contacting the corresponding author.

**Author contributions:** SC designed the study, collected and analysed data, and wrote the manuscript.

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**Table 1.** Baseline characteristics of patients with *S. suis* infection

| **Characteristic** | **Value (n=16)** |
|---|---|
| **Demographics** | |
| Age, years, median (IQR) | 64.5 (51.5–70.3) |
| Male sex | 9 (56.3%) |
| **Risk factors** | |
| Direct pig contact | 3 (18.8%) |
| Ingestion of undercooked pork | 1 (6.2%) |
| No identifiable risk factor | 7 (43.8%) |
| Unknown / not recorded | 5 (31.2%) |
| **Comorbidities** | |
| Any comorbidity | 9 (56.2%) |
| Hypertension | 4 (25.0%) |
| Dyslipidemia | 4 (25.0%) |
| Diabetes mellitus | 4 (25.0%) |
| Chronic Heart failure | 3 (18.8%) |
| Cerebrovascular disease | 3 (18.8%) |
| Prosthetic heart valve | 2 (12.5%) |
| Solid tumor | 1 (6.2%) |
| CKD / ESRD | 1 (6.2%) |
| Cardiovascular disease (CAD) | 1 (6.2%) |
| HIV infection | 1 (6.2%) |
| COPD | 1 (6.2%) |
| Alcoholism / substance abuse | 1 (6.2%) |
| Liver cirrhosis | 0 (0%) |
| **Year of admission** | |

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| Characteristic | Value (n=16) |
|---|---|
| 2019–2021 | 4 (25.0%) |
| 2022 | 3 (18.8%) |
| 2023 | 5 (31.2%) |
| 2024–2025 | 4 (25.0%) |

**Table 2.** Clinical presentation, treatment, and outcomes

| Variable | Value (n=16) |
|---|---|
| **Clinical presentation** | |
| Bacteremia | 12 (75.0%) |
| Infective endocarditis | 8 (50.0%) |
| Spondylodiscitis | 4 (25.0%) |
| Meningitis | 1 (6.2%) |
| Septic arthritis | 2 (12.5%) |
| Mycotic aneurysm | 1 (6.2%) |
| Peritoneal dialysis-related peritonitis | 1 (6.2%) |
| Biliary tract infection | 1 (6.2%) |
| **Presenting symptoms** | |
| Fever | 13 (81.2%) |
| Back pain | 4 (25.0%) |
| Dyspnea | 4 (25.0%) |
| Abdominal pain | 2 (12.5%) |
| Headache / altered consciousness | 1 (6.2%) |
| Joint pain | 1 (6.2%) |

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| Variable | Value (n=16) |
|---|---|
| **Culture-confirmed infection source** | |
| Blood culture positive | 12 (75.0%) |
| CSF culture positive | 1 (6.2%) |
| Synovial fluid culture positive | 1 (6.2%) |
| Other sterile site positive* | 3 (18.8%) |
| **Laboratory findings at admission** | |
| WBC, median (IQR), ×10³/μL | 10.9 (8.9–11.9) |
| Hemoglobin, median (IQR), g/dL | 10.4 (9.2–12.4) |
| Platelets, median (IQR), ×10³/μL | 245.5 (178.2–319.2) |
| Creatinine, median (IQR), mg/dL | 0.8 (0.6–1.0) |
| Total bilirubin, median (IQR), mg/dL | 0.8 (0.7–1.2) |
| AST, median (IQR), U/L | 51.5 (24.2–163.5) |
| ALT, median (IQR), U/L | 64.5 (26.8–218.8) |
| Albumin, median (IQR), g/dL | 3.0 (2.8–3.4) |
| **Treatment** | |
| Empiric antibiotic included ceftriaxone | 11 (68.8%) |
| Empiric antibiotic included ampicillin | 6 (37.5%) |
| Definitive antibiotic — ceftriaxone | 11 (68.8%) |
| Definitive antibiotic — ampicillin | 3 (18.8%) |
| Definitive antibiotic — penicillin G | 1 (6.2%) |
| IV antibiotic duration — median (IQR), days | 42 (14–42) |
| Source control procedure | 6 (37.5%) |
| Valve surgery | 3 (18.8%) |
| Debridement (epidural / joint) | 2 (12.5%) |
| Biliary drainage (PTBD) | 1 (6.2%) |

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| Variable | Value (n=16) |
|---|---|
| **Complications** | |
| Any complication | 4 (25.0%) |
| Septic shock | 2 (12.5%) |
| Respiratory failure | 3 (18.8%) |
| Acute kidney injury | 1 (6.2%) |
| Massive hemoptysis | 1 (6.2%) |
| **Clinical outcomes** | |
| In-hospital mortality | 3 (18.8%) |
| Length of hospital stay, days, median (IQR) | 17.5 (9.8–33.8) |
| Total cost, median (IQR), THB | 85,093 (46,463–226,962) |
| Range, THB | 23,767–1,688,575 |

* Other sterile body fluids included peritoneal dialysate, vertebral abscess and bile

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**Table 3.** Antimicrobial susceptibility of *S. suis* isolates (n = 13 isolates)

| **Antibiotic** | **n** | **Susceptible, n (%)** | **Intermediate, n (%)** | **Resistance, n (%)** | **MIC range (µg/mL)** |
|---|---|---|---|---|---|
| Penicillin G[a] | 13 | 9 (69.2%) | 4 (30.8%) | — | ≤0.03 – 1 |
| Ceftriaxone[b] | 13 | 13 (100.0%) | — | — | ≤0.12 – 0.5 |
| Meropenem | 13 | 13 (100.0%) | — | — | ≤0.25 – 0.25 |
| Erythromycin | 13 | — | — | 13 (100.0%) | 2 – >2 |
| Clindamycin | 13 | 1 (7.7%) | — | 12 (92.3%) | 0.25 – >1 |
| Tetracycline | 13 | — | — | 13 (100.0%) | 8 – >8 |
| Levofloxacin | 13 | 13 (100.0%) | — | — | ≤0.5 – 2 |
| Vancomycin | 13 | 13 (100.0%) | — | — | ≤0.5 – 0.5 |

[a] CLSI M100 breakpoints for penicillin G: susceptible ≤0.12 µg/mL, intermediate 0.25–2 µg/mL, resistant ≥4 µg/mL.

[b] CLSI M100 breakpoints for ceftriaxone: susceptible ≤1 µg/mL, intermediate >1–2 µg/mL, resistant ≥4 µg/mL.

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**Supplementary Table 1:** Detailed summary of the clinical features, treatment, and outcomes for each patient

| Case | Year | Age (yr) | Sex | Primary diagnosis | Risk factor | Pen G MIC (µg/mL) | Pen G interpretation | Empiric ATB | Definitive ATB | IV duration (days) | Source control | Complication | LOS (days) | Outcome | Cost (THB) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1** | 2019 | 69 | Female | infective endocarditis, septicemia | none | *DD** | **ND** | ampicillin | ampicillin | 42 | — | — | 22 | **Survived** | 95,194 |
| **2** | 2020 | 50 | Female | infective endocarditis, septicemia | direct pig contact | 0.12 | **S** | ampicillin + ceftriaxone | ceftriaxone | 42 | — | — | 13 | **Survived** | 68,302 |
| **3** | 2020 | 64 | Male | infective endocarditis, septicemia, spondylodiscitis | None | 0.12 | **S** | ceftriaxone | ampicillin | 42 | — | — | 22 | **Survived** | 73,695 |
| **4** | 2021 | 65 | Female | septicemia | Unknown | <= 0.03 | **S** | ceftriaxone | ceftriaxone | 14 | — | septic shock, respiratory failure | 16 | **Survived** | 123,260 |
| **5** | 2022 | 70 | Male | septicemia, spondylodiscitis | None | 0.5 | **I** | cefazolin | ceftriaxone | 56 | debridement epidural abscess | septic shock, respiratory failure, AKI | 143 | **Survived** | 1,630,266 |
| **6** | 2022 | 52 | Male | spondylodiscitis | None | <= 0.03 | **S** | ceftriaxone+clindamycin | ceftriaxone | 84 | — | — | 44 | **Survived** | 190,398 |
| **7** | 2022 | 57 | Male | infective endocarditis, septicemia | direct pig contact | 0.25 | **I** | ceftriaxone, ampicillin, gentamicin | ceftriaxone | 42 | valve surgery | — | 36 | **Survived** | 336,652 |

Early Version - Uncorrected

Early Version - Uncorrected

| Case | Year | Age (yr) | Sex | Primary diagnosis | Risk factor | Pen G MIC (µg/mL) | Pen G interpretation | Empiric ATB | Definitive ATB | IV duration (days) | Source control | Complication | LOS (days) | Outcome | Cost (THB) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **8** | 2023 | 67 | Male | mycotic aneurysm, septicemia | None | <= 0.03 | **S** | ceftriaxone | ampicillin | 5 | — | massive hemoptysis | 5 | **Died** | 30,775 |
| **9** | 2023 | 75 | Male | infective endocarditis, meningitis, septicemia | Unknown | 0.06 | **S** | ceftriaxone, ampicillin | penicillin | 42 | valve surgery | respiratory failure | 67 | **Died** | 1,688,575 |
| **10** | 2023 | 71 | Female | infective endocarditis, septicemia, spondylodiscitis | Unknown | 0.12 | **S** | ceftriaxome, ampicillin | ceftriaxone | 56 | valve surgery | — | 33 | **Survived** | 399,329 |
| **11** | 2023 | 48 | Female | infective endocarditis, septicemia | None | 0.12 | **S** | ceftriaxone | ceftriaxone | 28 | — | — | 9 | **Survived** | 23,767 |
| **12** | 2023 | 81 | Female | septic arthritis | Unknown | *DD** | **ND** | cefazolin | cefazolin | 14 | joint debridement | — | 10 | **Survived** | 74,992 |
| **13** | 2024 | 60 | Female | cholangitis | Unknown | *DD** | **ND** | ceftriaxone + metronidazole | ceftriaxone | 7 | PTBD | — | 6 | **Survived** | 38,910 |
| **14** | 2025 | 50 | Male | PD-related peritonitis | None | <= 0.03 | **S** | piperacillin-tazobactam | ceftriaxone | 11 | — | Septic shock | 19 | **Died** | 156,696 |
| **15** | 2025 | 90 | Male | infective endocarditis, septicemia | ingested undercooked pork | 1 | **I** | ceftriaxone + ampicillin + gentamicin | ceftriaxone | 42 | — | — | 12 | **Survived** | 30,895 |

Early Version - Uncorrected

| Case | Year | Age (yr) | Sex | Primary diagnosis | Risk factor | Pen G MIC (μg/mL) | Pen G interpretation | Empiric ATB | Definitive ATB | IV duration (days) | Source control | Complication | LOS (days) | Outcome | Cost (THB) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **16** | 2025 | 49 | Male | septicemia | direct pig contact | 0.25 | **I** | ceftriaxone + doxycycline | ceftriaxone | 14 | — | — | 9 | **Survived** | 48,981 |

* DD = disc diffusion only (no automated MIC available); ND = not determined. For isolates tested by disc diffusion only, penicillin susceptibility cannot be reliably categorized as susceptible, intermediate, or resistant under current CLSI criteria for viridans group streptococci and is therefore reported as not determined.

Abbreviations: MIC = minimum inhibitory concentration; IE = infective endocarditis; LOS = length of stay; ATB = antibiotic; PD = Peritoneal dialysis; PTBD = percutaneous transhepatic biliary drainage.

Early Version - Uncorrected