BMJ Paediatrics Open

Underdiagnosis in clinical documentation of community-acquired sepsis among children admitted to hospitals in two rural provinces: Thailand, October–December 2017

Rewa Choudhary ,[1,2] Peeriya Watakulsin,[3] Pitiphon Promduangsi,[3] Nuttagarn Chuenchom,[4] Supachoke Khemla,[5] Woradee Lurchachaiwong,[6] Philip Mock,[7] James D Heffelfinger,[2,6] John R MacArthur,[2,6] Emily Bloss,[2,6] Somsak Thamthitiwat,[6] Carol Y Rao[2]

To cite: Choudhary R, Watakulsin P, Promduangsi P, *et al*. Underdiagnosis in clinical documentation of community-acquired sepsis among children admitted to hospitals in two rural provinces: Thailand, October–December 2017. *BMJ Paediatrics Open* 2024;**8**:e002293. doi:10.1136/bmjpo-2023-002293

Received 26 September 2023
Accepted 19 January 2024

For numbered affiliations see end of article.

Correspondence to
Dr Rewa Choudhary; rewac12@gmail.com

ABSTRACT

Paediatric sepsis prevalence data from low-income and middle-income countries are lacking. In a cross-sectional study, we assessed clinician recognition and documentation of non-neonatal community-acquired paediatric sepsis in two rural border provinces in Thailand among children admitted between October and December 2017. Of the 152 children meeting sepsis criteria (26.9 paediatric sepsis patients per 1000 admissions), 15 (9.9%) had a clinician-documented admission diagnosis of sepsis or septic shock and 18 (11.8%) had a discharge diagnosis with International Classification of Diseases-10 codes related to sepsis. Clinician underdocumentation may cause challenges in global paediatric sepsis surveillance.

Paediatric sepsis is a major cause of morbidity and mortality worldwide.[1] Sepsis is a clinical syndrome characterised by organ dysfunction caused by a dysregulated response to infection that can lead to death.[2] Although consensus definitions for paediatric sepsis exist,[3] in practice, diagnosing and treating paediatric sepsis is challenging, particularly in low-income and middle-income countries, where paediatric sepsis burden and mortality are higher due to limited access to primary care, intensive care units (ICUs) and tools for sepsis management.[1] These issues also contribute to challenges in paediatric sepsis surveillance. In Thailand, a study in rural settings estimated the annual incidence of community-onset bloodstream infection in the populations aged <5 years and 5–14 years to be 75 and 12 cases per 100 000, respectively,[4] and a multicentre study estimated the rate of community-acquired bacteraemia at 83.5 cases per 100 000 among children <1 year.[5] A retrospective descriptive study was conducted to assess clinical recognition, diagnosis and documentation of non-neonatal community-acquired paediatric sepsis in secondary-care referral hospitals in two rural border provinces in Thailand.

Patients were eligible for the study if they (1) were admitted to one of 12 secondary-care hospitals in Nakhon Phanom and Tak provinces, between 1 October 2017 and 31 December 2017 and were (2) were aged >28 days and <18 years at admission. Using the electronic hospital information system, eligible patients were screened for the following inclusion criteria: (1) either had a measured body temperature >38°C or <36°C and a haemoculture performed from hospital presentation to 24 hours postadmission, OR had a discharge diagnosis with International Classification of Diseases-10 (ICD-10) codes related to sepsis and (2) had evidence or clinician suspicion for community-acquired infection (ie, had a documented, suspected or definite, source of infection that was not attributed to a non-infectious cause such as burn, trauma or poisoning or a healthcare-associated infection). Sepsis-related discharge diagnoses (i.e. ICD-10 codes) are: A02.1: Salmonella sepsis; A03.9:Shigella sepsis; A24.1: Sepsis due to melioidosis; A40, A40.0, A40.1, A40.3, A40.8 and A40.9: Streptococcal sepsis, specified and unspecified; A41, A41.0–A41.2: Staphylococcal sepsis, specified and unspecified; A41.3: Sepsis due to *Haemophilus influenzae*; A41.4: Sepsis due to anaerobes; A41.5: Sepsis due to other Gram-negative organisms; A41.8: Other specified sepsis; A41.9: Sepsis, unspecified; A54.8: Gonococcal sepsis; R50.9: Fever, unspecified; R57.2: Septic

shock; R65.0: Systemic inflammatory response syndrome of infectious origin without organ failure; R65.1: Systemic inflammatory response syndrome of infectious origin with organ failure (septic shock); R65.9: Systemic inflammatory response syndrome, unspecified. Between July 2020 and April 2021, included patients' demographic and clinical data were abstracted from medical charts using a standardised medical record abstraction form. Case definitions for sepsis, severe sepsis and septic shock adapted from the 2005 International Pediatric Sepsis Consensus Conference guidelines[3] (figure 1) were applied. Because inclusion criteria required presence of clinical suspicion for infection, systemic inflammatory response syndrome and sepsis denote the same condition in this analysis.

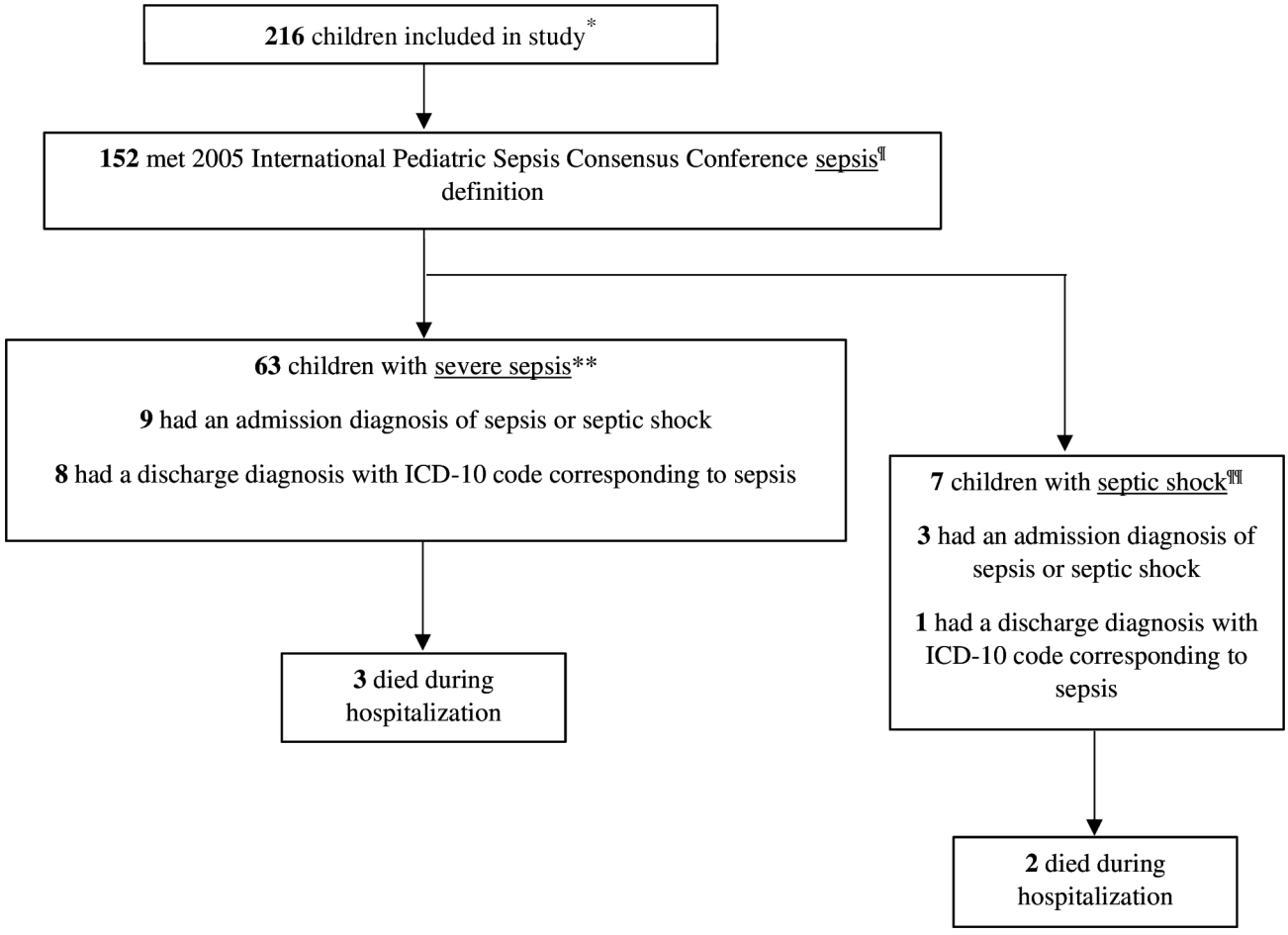

Figure 1 Clinical definitions of children with community-acquired sepsis admitted to hospitals in two rural provinces—Thailand, October–December 2017.

*Patients were eligible for the study if they (1) were admitted to one of 12 secondary-care hospitals in Nakhon Phanom and Tak provinces, between 1 October 2017 and 31 December 2017 and were (2) were aged >28 days and <18 years at admission and were included if (1) either had a measured body temperature >38°C or <36°C and a haemoculture performed from hospital presentation to 24 hours postadmission, OR had a discharge diagnosis with International Classification of Diseases-10 (ICD-10) codes related to sepsis and (2) had evidence or clinician suspicion for community-acquired infection (ie, had a documented, suspected or definite, source of infection that was not attributed to a non-infectious cause such as burn, trauma or poisoning or a healthcare-associated infection). ¶Sepsis is defined as presence of suspected or proven infection with systemic inflammatory response syndrome, which is the presence of at least two of the following criteria (according to age), one of which must be abnormal temperature or white cell count: temperature >38.5°C or <36°C; heart rate >2 SD above normal for age; respiratory rate >2 SD above normal for age; white count > 2 SD above normal for age. **Severe sepsis is sepsis plus evidence of cardiovascular organ dysfunction or acute respiratory distress syndrome or two or more other organ dysfunctions as follows: 1) Cardiovascular dysfunction defined as sepsis-induced decrease in blood pressure (BP) <5th percentile for age or systolic BP <2 SD below normal for age; or two of the following, increased arterial lactate >2 times upper limit of normal, urine output <0.5 mL/kg/hour, metabolic acidosis. 2) Respiratory dysfunction is PaO2/FIO2 ratio <300 (non-pneumonia). 3) Other organ dysfunction defined as serum creatinine ≥2 times upper limit of normal for age or twofold increase in baseline creatinine; Glasgow Coma Score ≤11; total bilirubin ≥4 mg/dL or alanine transaminase >2 times upper limit of normal for age; platelet count <80 x10^9/L; OR international normalised ratio >2. ¶¶Septic shock is defined as severe sepsis with hypotension or mean arterial pressure still low after adequate fluid resuscitation for 30 minutes and requiring vasopressor.

Table 1 Clinical characteristics of children with community-acquired sepsis admitted to hospitals in two rural provinces—Thailand, October–December 2017.

Characteristics, n (%)	Total (n=152)‡	Sepsis (n=82)	Severe sepsis (n=63)	Septic shock (n=7)
Age in years, median (IQR)	2.5 (<1 to 10)	2 (<1 to 9)	2 (<1 to 10)	15 (12 to 17)
Age group in years				
>28 days to 1 year	57 (37.5)	35 (42.7)	22 (34.9)	0
2–5 years	42 (27.6)	22 (26.8)	21 (33.3)	0
6–12 years	23 (15.1)	13 (15.9)	8 (12.7)	2 (28.6)
13–17 years	29 (19.1)	12 (14.6)	12 (19.0)	5 (71.4)
Male	86 (56.6)	47 (57.3)	36 (57.1)	3 (42.9)
Admitted to intensive care unit	3 (2.2)	0	3 (4.8)	0
Admission month				
October	68 (44.7)	35 (42.7)	32 (50.8)	1 (14.3)
November	61 (40.1)	33 (40.2)	25 (39.7)	3 (42.9)
December	23 (15.1)	14 (17.1)	6 (9.5)	3 (42.9)
Underlying condition*†				
Cardiovascular	6 (3.9)	3 (3.7)	3 (4.8)	0
Neurological	4 (2.6)	2 (2.4)	1 (1.6)	1 (14.3)
Haematological	6 (3.9)	2 (2.4)	4 (6.3)	0
Chief complaint*†				
Fever	140 (92.1)	81 (98.8)	54 (85.7)	5 (71.4)
Cough	71 (46.7)	30 (36.6)	37 (58.7)	4 (57.1)
Nausea/vomiting	36 (23.7)	18 (22.0)	14 (22.2)	4 (57.1)
Admission diagnosis*†				
Fever	56 (36.8)	39 (47.6)	15 (23.8)	2 (28.6)
Sepsis/possible sepsis	15 (9.9)	3 (3.7)	9 (14.3)	3 (42.9)
Pneumonia/lower respiratory infection	33 (21.7)	9 (11.0)	22 (34.9)	2 (28.6)
Organ dysfunction*†				
Hypotension	15 (9.9)	0	9 (14.3)	6 (85.7)
Acute kidney injury (creatinine >2 mg/dL)	3 (2.0)	0	2 (3.2)	1 (14.3)
Thrombocytopaenia (x10^9/L)	14 (9.2)	0	10 (15.9)	4 (57.1)
Clinical management within first day of hospitalisation				
Intravenous resuscitation	130 (85.5)	65 (79.3)	58 (92.1)	7 (100.0)
Antibiotics	131 (86.2)	64 (78.0)	55 (87.3)	7 (100.0)
Vasopressor	11 (7.2)	0	4 (6.3)	7 (100.0)
Mechanical ventilation	22 (14.5)	0	19 (30.2)	3 (42.9)
Discharge diagnosis*†				
Pneumonia	32 (21.1)	10 (12.2)	21 (33.3)	1 (14.3)
Diarrhoea/gastroenteritis	12 (7.9)	10 (12.2)	1 (1.6)	1 (14.3)
Pylonephritis/urinary tract infection	6 (3.9)	6 (7.3)	0	0
Hospital stay in days, median (IQR)	3 (2–6)	3 (2–4)	5 (2–13)	7 (5–13)
In-hospital outcomes				
Complete recovery	1 (0.7)	0	1 (1.6)	0
Partial recovery	131 (86.2)	77 (93.9)	51 (81.0)	5 (71.4)
Not improved	12 (7.9)	4 (4.9)	8 (12.7)	0
In-hospital mortality	5 (3.3)	0	3 (4.8)	2 (28.6)

*Most frequently reported variables are listed.
†Patients may have more than one category selected.
‡Numbers within categories may not add up to column totals due to missing data.

Of the 5658 eligible patients (ie, total number of patients admitted to the hospital in the study period who met eligibility criteria), 216 patients met the inclusion criteria, of which 152 (70.4%) met the sepsis definition (26.9 paediatric sepsis patients per 1000 admissions) (figure 1). The overall median age was 2.5 years with 2.2% admitted to the ICU (table 1). Among those, 15 (9.9%) had a clinician-documented admission diagnosis of sepsis or septic shock, 18 (11.8%) had a discharge diagnosis with ICD-10 codes related to sepsis and 5 (3.3%) had both admission and discharge diagnoses consistent with sepsis. Among the 152 patients with sepsis, 63 (41.4%) met the criteria for severe sepsis and 7 (4.6%) for septic shock. Blood cultures were drawn from 114 (75.0%) patients with *Escherichia coli* as the most identified organism. Respiratory (33, 21.7%), gastrointestinal (10, 6.6%) and blood (4, 2.6%) were the most common sites of infection sources. Within 24 hours of admission, 126 (82.9%) sepsis patients received empiric intravascular and/or oral antibiotics and 130 (85.5%) sepsis patients received intravascular fluid resuscitation. The five children who died met the definitions of either severe sepsis (3/63, 4.8%) or septic shock (2/7, 28.6%).

In these rural secondary-care referral hospitals, a small proportion of children meeting sepsis criteria had clinical diagnoses consistent with sepsis, either on admission or discharge (ie, sepsis-related ICD-10 code). This study was subject to some limitations. Because this study was based on retrospective medical record review, suspect sepsis patients may have been missed if elements of the inclusion criteria were not captured during the screening process which would underestimate the prevalence of sepsis among this population. In addition, mortality may have been underestimated since we did not follow up patients who were discharged or transferred to other hospitals.

While most children with sepsis received appropriate diagnostic workup and interventions within 24 hours of admission, underdiagnosis in clinical documentation may cause challenges in paediatric sepsis surveillance. Documenting and monitoring paediatric sepsis are essential to estimate the burden of paediatric sepsis. These data from a rural setting may provide a useful metric for future assessments of paediatric sepsis regionally.

Author affiliations
[1]Epidemic Intelligence Service, Centers for Disease Control and Prevention, Atlanta, Georgia, USA
[2]Division of Global Health Protection, Centers for Disease Control and Prevention Global Health Center, Atlanta, Georgia, USA
[3]Department of Disease Control (DDC), Royal Thai Government Ministry of Public Health, Bangkok, Thailand
[4]Mae Sot General Hospital, Mae Sot, Thailand
[5]Nakhon Phanom Hospital, Nakhon Phanom, Thailand
[6]Thailand Ministry of Public Health-US CDC Collaboration, Bangkok, Thailand
[7]Totally Joined for Achieving Collaborative Techniques (TJFACT) LLC, Atlanta, Georgia, USA

Acknowledgements Nartlada Chantharojwong, Thailand Ministry of Public Health-US CDC Collaboration and Christopher Prestel, Division of Healthcare Quality Promotion, CDC.

Contributors Study conceptualisation: JDH, JRM, SK, ST, WL, EB, PW and PP. Study design: JDH, JRM, SK, ST, EB and PW. Formal data analysis: CYR, RC and PM. Data interpretation: JDH, CYR, RC, PM and WL. Writing: original draft: CYR and RC. Writing: review and edit: JDH, CYR, RC, JRM, PM, SK, ST, WL, EB, PW, PP and NC. All authors have read, reviewed and approved the manuscript.

Funding This activity was supported by US Centers for Disease Control and Prevention Cooperative Agreement 6U01GH002084.

Disclaimer The findings and conclusions in this letter are those of the authors and do not necessarily represent the views of the US Centers for Disease Control and Prevention.

Competing interests None declared.

Patient and public involvement Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Patient consent for publication Not applicable.

Ethics approval This study involves human participants and this activity has been reviewed and approved by Centers for Disease Control and Prevention, Center for Global Health, Office of the Associate Director for Science's Human Subjects Contact. This activity meets the definition of public health surveillance as defined in 46.103(l)(2).

Provenance and peer review Not commissioned; externally peer reviewed.

ORCID iD
Rewa Choudhary http://orcid.org/0000-0002-5873-8118

REFERENCES

1 World Health Organization. Global report on the epidemiology and burden of sepsis: current evidence, identifying gaps and future directions; 2020. 16–42.
2 Singer M, Deutschman CS, Seymour CW, *et al*. The third International consensus definitions for sepsis and septic shock (Sepsis-3). *JAMA* 2016;315:801–10.
3 Goldstein B, Giroir B, Randolph A, *et al*. International pediatric sepsis consensus conference: definitions for sepsis and organ dysfunction in pediatrics. *Pediatr Crit Care Med* 2005;6:2–8.
4 Rhodes J, Jorakate P, Makprasert S, *et al*. Population-based bloodstream infection surveillance in rural Thailand, 2007-2014. *BMC Public Health* 2019;19(Suppl 3):521.
5 Kanoksil M, Jatapai A, Peacock SJ, *et al*. Epidemiology, microbiology and mortality associated with community-acquired bacteremia in northeast Thailand: a multicenter surveillance study. *PLoS One* 2013;8:e54714.