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Original article

Infants 21–90 days presenting with a possible serious bacterial infection – are evaluation algorithms from high income countries applicable in the South African public health sector?

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ABSTRACT

Background: Young infants with a possible serious bacterial infection (SBI) are a very common presentation to emergency centres (ECs). It is often difficult to distinguish clinically between self-limiting viral infections and an SBI. Available evaluation algorithms to assist clinicians are mostly from high-income countries. Data to inform clinical practice in low- and middle-income countries are lacking.

Objectives: To determine the period prevalence of SBI and invasive bacterial infection (IBI) and describe current practice in the assessment and management of young infants aged 21–90 days presenting with a possible SBI to a Paediatric Emergency centre (PEC) in Cape Town, South Africa.

Methods: A retrospective cross-sectional review of infants 21–90 days old presenting to the Tygerberg Hospital PED between 1 January 2016 and 31 May 2016.

Results: A total of 248 infants 21–90 days were included in the study. Sixty-two patients (25%, 95% CI 20–30) had an SBI and 13 (5.2%, 95% CI 3–8) had an IBI. One hundred and sixty-five infants had a possible SBI based on WHO IMCI criteria. The sensitivity of the WHO IMCI criteria in detecting SBI was 82.3% (95% CI 70.5–90.8) and the specificity 38.7% (95% CI 31.7–46.1). More than half (51.2%) of the infants received antibiotics within the 48 h prior to presentation, of which 33.5% included intramuscular injection of Ceftriaxone. Only 20 (8.0%) patients in this age group were discharged home after initial evaluation. A significant relationship was noted between fever and the risk of SBI (p-value 0.010) and IBI (p-value 0.009). There also appeared to be a significant relationship between nutritional status and IBI (p-value 0.013).

Conclusion: Period prevalence of SBI and IBI was higher compared to that published in the literature. Validated evaluation algorithms to stratify risk of SBI are needed to assist clinicians in diagnosing and managing infants appropriately in low- and middle-income settings.

African relevance

- Young infants with a possible serious bacterial infection (SBI) are a very common presentation to emergency centres
- Available evaluation algorithms to assist clinicians are mostly from high-income countries.
- Validated evaluation algorithms to stratify risk of SBI are needed to assist clinicians in diagnosing and managing infants appropriately in low- and middle-income settings.

Introduction

In young infants it can be difficult to distinguish clinically between viral infections and a serious bacterial infection [1]. Whilst the more common viral infections are often self-limiting, the delayed diagnosis and management of an SBI can have serious consequences [2,3]. This creates a clinical dilemma for medical practitioners who must weigh the risk of missing an SBI against the potential risk, harm and cost implications of investigating and managing a febrile infant who does not have an SBI.

Evaluation algorithms have been developed to evaluate young infants with possible SBI, with a view to stratifying risk and avoiding

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unnecessary investigations and treatment. Earlier algorithms, such as the ***Boston*** [4], ***Rochester*** [5], ***Philadelphia*** [6] and ***Milwaukee*** [7] criteria, were all published prior to the availability and widespread use of the Haemophilus influenzae type B (Hib) and pneumococcal vaccines [8]. More recent algorithms, such as the "Step by Step" approach [9] or that of Kupperman et al. [10] have shown good sensitivity and negative predictive value in modern European and North American contexts respectively, but rely on procalcitonin (PCT), a test which is not routinely available in the state sector in SA. These algorithms may not be appropriate for the South African context, given health system resource limitations, high prevalence of malnutrition and HIV infection, and the use of WHO Integrated Management of Childhood Illness (IMCI) guidelines [11,12] and patients' social circumstances.

The incidence of SBIs in febrile infants younger than 3 months is reportedly between 9% and 14% [13,14]. Data are lacking on the estimated incidence in SA. There is currently no standardised evaluation algorithm in the South African Standard Treatment Guidelines and Essential Drugs List for managing young infants <90 days with a possible serious bacterial infection. A recently released Western Cape provincial draft protocol [15] guides the initial investigation and management of infants <90 days of age presenting with a possible SBI to a hospital and incorporates the National Institute for Health and Care Excellence (NICE) traffic light system of clinical risk factors in infants younger than three months (see Appendices 1–3). We sought to determine the period prevalence of SBI and IBI and describe current practice in the assessment and management of young infants aged 21–90 days presenting with a possible SBI to a PEC in a lower middle-income country. Secondary objectives were to describe factors associated with increased risk of SBI/IBI and determine the sensitivity and specificity of the WHO IMCI criteria for possible SBI in the young infant.

Methods

Tygerberg Hospital (TBH) is a large central hospital and provides secondary and tertiary paediatric specialist services for half of the Cape Town metropole. The PEC sees about 15,000 children per annum, of which about a third are admitted. Patients are referred predominantly from primary health care facilities (including private general practitioners) and district hospitals. About 30% of patients are un-referred.

A retrospective cross-sectional review was done. The study population included all infants aged 21–90 days old presenting to the PEC between 1 January and 31 May 2016. The rationale for including infants in this age range was to compare the period prevalence of SBI and IBI between infants aged 21–27 days (neonatal period) to those aged 28–90 days of age. Clinicom®, a Western Cape provincial government patient administration system application, was used to identify infants in this age group and ECM, a Western Cape electronic content management system, was used to access clinical records. Children in whom clinical notes were incomplete were excluded.

Basic demographic information was recorded. Clinical records were reviewed looking specifically at the initial triage and clinical evaluation. On history HIV exposure and status, antibiotic administration in past 48 h, immunization status, birth gestation and weight-for-age were documented. Preterm was considered <37 weeks gestation, and the corrected age was used in infants born preterm when determining weight-for-age. Examination variables included axillary temperature, respiratory rate, whether the child "appeared well" (normal breathing, alert, active, normal muscle tone) and whether there was evidence of a focal infection (upper respiratory tract infection, conjunctivitis, soft tissue infection, bone/joint inflammation).

Management was described in terms of investigations, antibiotic choice and route of administration, and disposition from the PEC. Special investigations recorded were white cell count (WCC), absolute neutrophil count (ANC), C-reactive protein (CRP), blood culture, urinalysis, cerebrospinal fluid analysis, chest radiograph and other relevant investigations (nasopharyngeal aspirates, pus swab cultures and stool cultures).

Final diagnosis as decided by the attending *clinical team* was documented, and categorised into four diagnostic categories for analysis:

1. *Confirmed IBI*. All cases of bacteraemia and meningitis with a confirmed positive culture of a known pathogen.
2. *Presumed IBI*. Cases where cerebrospinal fluid was suggestive of bacterial meningitis, but culture remained negative.
3. *SBI*. All patients from groups 1 and 2 above plus all cases of urinary tract infections, suspected bacterial pneumonia, soft tissue and skin infections (cellulitis), osteomyelitis and septic arthritis.
4. *No SBI*. Patients who did not fit the criteria for groups 1–3.

The definition of a possible SBI according to WHO IMCI criteria [12] is shown in Box 1. The sensitivity and specificity of the WHO IMCI definition in predicting SBI and IBI was calculated, as well as the effect of IMCI guided intramuscular Ceftriaxone on yield of positive cultures.

Data was analysed using Microsoft Excel and OpenEpi software. Descriptive statistics was used to describe data. Inferential statistics, where appropriate, such as Chi-square and Fisher Exact test was used to determine associations according to the secondary objective. Statistical significance was set at 0.05. Where appropriate, proportions were presented as 95% confidence intervals. Statistical support was provided by the Division of Epidemiology and Biostatistics at the University of Stellenbosch. The study was approved by the Human Research Ethics Committee of the University of Stellenbosch (HREC: S16/10/227).

Results

Two hundred and sixty-two infants aged 21–90 days presented to the PEC during the study period. Fourteen patients were excluded due to incomplete records, leaving 248 infants included in the final analysis. The basic demographic data and clinical characteristics on history of the study population (N = 248) are reported in Table 1.

Seventy five percent (186/248) of the study population did not have an SBI. Of the sixty-two patients who had an SBI, 19.4% (12/62) patients had a confirmed IBI (positive blood or cerebrospinal fluid culture) and 1.6% (1/62) had a presumed IBI (cerebrospinal fluid suggestive of bacterial meningitis, but culture negative). The period prevalence of SBI was **25.4%** (95% CI 20–30) and IBI **5.2%** (95% CI 3–8). Table 2 describes the features on history, clinical examination and special investigations associated with SBI/IBI.

Performance of WHO IMCI criteria for possible SBI in young infants

Of 248 infants, 165 (66.5%) met the WHO IMCI criteria for possible SBI (Fig. 1 and Table 3). Some infants fulfilled more than one inclusion criterion. The most common reason for possible SBI according to IMCI criteria was fast breathing (56%), followed by severe chest-indrawing (36%).

Of the 165 patients identified as having a possible SBI by the WHO IMCI criteria, 51 (30.9%) had a confirmed SBI. Eleven patients with SBI, including two with IBI, did not fulfil any of the WHO IMCI criteria. The performance of the WHO IMCI criteria in detecting SBI compared to two other clinical triage tools for febrile infants is depicted in Table 4.

Current management practices

The majority (127/248, 51.2%) of infants received antibiotics within the 48 h prior to presentation to the PEC. This included intramuscular, intravenous and oral antibiotics. Intramuscular injection of Ceftriaxone according to IMCI guidelines was administered to 33.5% of infants prior to presentation.

The special investigations performed are demonstrated in Fig. 2. Thirty-three (13.3%) patients had a "full septic work-up" (WCC, CRP,

Box 1
WHO IMCI criteria for possible SBI in the young infant.

Not being able to feed since birth or stopped feeding well (confirmed by observations)

Convulsions

Fast breathing (60 breaths per minute or more)

Severe chest in-drawing

Fever (38 °C or greater)

Low body temperature (less than 35.5 °C)

Movement only when stimulated or no movement at all

Table 1
Epidemiologic and clinical characteristics on history of all infants 21–90 days.

	N = 248
Age	
Mean age in days (standard deviation)	52 (18.9)
21–27 days, n (%)	23 (9.3)
28–90 days, n (%)	225 (90.7)
Sex, n (%)	
Male	147 (59.3)
Female	101 (40.7)
Gestation, n (%)	
Term	175 (70.6)
Preterm (<37 weeks)	63 (25.4)
Unknown	10 (4)
Immunizations, n (%)	
Up to date	174 (70.2)
Not up to date	46 (18.5)
Unknown	28 (11.3)
HIV exposed, n (%)	
Unexposed	196 (79)
Exposed	48 (19.4)
Unknown	4 (1.6)
HIV status, n (%)	
HIV test not done	152 (61.3)
Confirmed negative	91 (36.7)
Confirmed positive	5 (2)
Nutrition, n (%)	
Normal	162 (65.3)
Underweight for age (below −2 Z score)	48 (19.4)
Severely underweight for age (below −3 Z score)	38 (15.3)

blood culture, chest X-ray, urinalysis and lumbar puncture). Of the 33 patients who had a full septic work-up, 13 (39.4%) did not end up having an SBI. Of the 33 patients who had a fever (temperature ≥ 38 °C) on presentation, only 6 (18.2%) had a "full septic work-up".

Twenty-one patients had positive bacterial cultures (blood, urine or cerebrospinal fluid), excluding suspected contaminants. Six (28.6%) of these 21 patients had a positive culture despite receiving IMCI intramuscular Ceftriaxone injection prior to collection of samples.

The empiric antibiotic combinations most often used on presentation were intravenous Ampicillin and Gentamycin (36.2%), oral Amoxicillin (14.5%) and intravenous Ampicillin and Cefotaxime (14.1%). Of the infants who did not have an SBI, 96 (51.9%) received intravenous antibiotics.

Final diagnoses and outcome

Bronchiolitis, viral lower respiratory tract infection and bacterial lower respiratory tract infection were the most common diagnoses. The single patient that died presented with apnoea and had an invasive bacterial infection (*Streptococcus agalactiae*). Of the 14 patients admitted to PICU, one had an SBI and one was an IBI. Seven (50%) of the patients admitted to PICU had confirmed RSV (Respiratory Syncytial Virus) on nasopharyngeal aspirate. Only 20 (8.0%) patients in this age group were discharged home after initial evaluation. None of these 20 patients were re-admitted to the PEC.

Discussion

The period prevalence of SBI in infants 21–90 days presenting to the PEC was 25.4% and IBI 5.2%. Studies estimate the incidence of SBI in *febrile* infants younger than 3 months to be 9% to 14% [13,14]. In a recent multi-centre study the incidence of IBI in febrile infants was 4% [9]. The period prevalence of SBI (39.4%) and IBI (18.2%) in febrile infants in our study is significantly higher than that quoted in literature [9,13,14].

There are several possible explanations for these findings. Firstly, we do not routinely perform viral testing for lower respiratory tract infections, and therefore bacterial pneumonia may have been over-diagnosed clinically. Secondly, we included all infants fulfilling the criteria for SBI and not just those with fever. Thirdly, a significant proportion of babies were HIV exposed, prematurely born, underweight for age or partially immunized, thus representing a potentially high-risk population. The fact that TBH is a referral centre may have caused some selection bias and therefore the generalizability of this finding should be considered in context.

Fever was associated with increased risk of SBI and IBI. There also appeared to be a significant relationship between nutritional status and IBI (p-value 0.013). Considering this finding, we have included underweight-for-age as a risk factor within our suggested revision of the local Western Cape guideline.

Nearly 20% of infants in our population were exposed to HIV. Contrary to Slogrove et al. [16], an infant exposed to maternal HIV infection were not found to have a significantly increased risk of SBI or IBI, but numbers were small. According to the current provincial guidelines' recommendation, HIV-exposed infants should be assessed for the risk of SBI as with other infants [15].

In our study, the majority (91.7%) of patients with a CRP >80 had an SBI. One patient with an IBI had a CRP of <5 on presentation. The predictive value of CRP >80 may be higher in the age group of our study

Table 2
Features on history, clinical examination and special investigations associated with SBI/IBI.

	SBI (%)	No SBI (%)	p-Value	IBI (%)	No IBI (%)	p-Value
Age						
21–27 days	6 (9.7)	17 (9.1)	0.878	3 (23)	20 (8.5)	0.065
28–90 days	56 (90.3)	169 (90.9)		10 (76.9)	215 (91.5)	
Sex						
Male	34 (54.8)	113 (60.8)	0.208	8 (61.5)	139 (59.1)	0.441
Female	28 (45.2)	73 (39.2)		5 (38.5)	96 (40.9)	
Gestation						
Term (>37 weeks)	44 (73.3)	131 (73.6)	0.479	10 (76.9)	165 (73.3)	0.408
Preterm	16 (26.7)	47 (26.4)		3 (23.1)	60 (26.7)	
HIV exposure						
Unexposed	45 (73.8)	151 (82.5)	0.074	9 (75.0)	187 (80.6)	0.312
Exposed	16 (26.2)	32 (17.5)		3 (25.0)	45 (19.4)	
Immunization status						
Immunizations not up to date	13 (23.6)	33 (20.0)	0.282	4 (30.8)	42 (20.3)	0.193
Immunizations up to date	42 (76.4)	132 (80.0)		9 (69.2)	165 (79.7)	
Clinical appearance						
Appears well	12 (19.4)	53 (28.5)	0.079	2 (15.4)	6 (26.8)	0.196
Appears unwell	50 (80.6)	133 (71.5)		11 (84.6)	172 (73.2)	
Nutrition						
Normal (above −2 Z score)	40 (64.5)	122 (65.6)	0.976	8 (61.5)	154 (65.5)	0.013
Low weight for age (on or below −2 Z score, above −3 Z score)	12 (19.4)	36 (19.4)		2 (15.4)	46 (19.6)	
Very low weight for age (on or below −3 Z score)	10 (16.1)	28 (15.0)		3 (23.1)	5 (14.9)	
Temperature						
Normal	49 (79.0)	152 (81.7)	0.010	7 (53.8)	194 (82.6)	0.009
Fever (≥38 °C)	13 (21.0)	20 (10.8)		6 (46.2)	27 (11.5)	
Hypothermia (<35.5 °C)	0 (0)	14 (7.5)		0 (0)	14 (6.0)	
C-reactive protein						
CRP 0 to 5	20 (34.5)	75 (61.0)	0.001	1 (8.3)	94 (55.6)	0.001
CRP 6 to 20	13 (22.4)	26 (21.1)		1 (8.3)	38 (22.5)	
CRP 21 to 80	14 (24.1)	21 (17.1)		5 (41.7)	30 (17.8)	
CRP 81 to 200	8 (13.8)	1 (0.8)		3 (25.0)	6 (3.6)	
CRP >200	3 (5.2)	0 (0)		2 (16.7)	1 (0.6)	
White cell count[a]						
Normal WCC	31 (53.4)	96 (78.0)	0.001	5 (41.7)	122 (72.2)	0.002
Leukopenia	5 (8.6)	1 (0.8)		3 (25)	3 (1.8)	
Leukocytosis	22 (37.9)	26 (21.1)		4 (33.3)	44 (26.0)	
Neutrophil count						
Normal neutrophil count	29 (63.0)	55 (59.8)	0.253	8 (88.9)	76 (58.9)	0.234
Neutropenia (<2.00 × 10^9/L)	6 (13.0)	22 (23.9)		0 (0)	28 (21.7)	
Neutrophilia (>8.00 × 10^9/L)	11 (23.9)	15 (16.3)		1 (11.1)	25 (19.4)	

[a] See Appendix 4 for cut-off values.

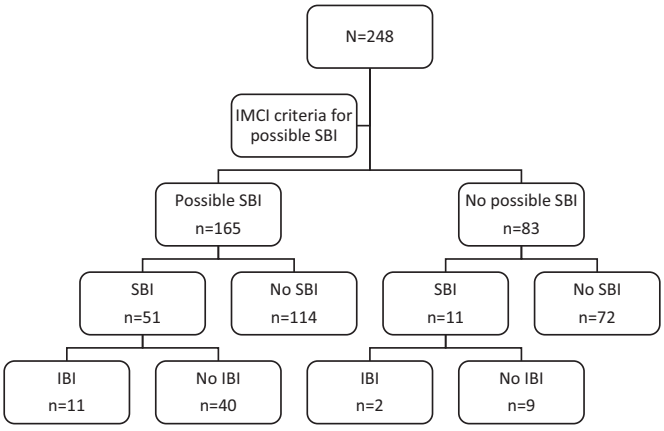

Fig. 1. Performance of WHO IMCI criteria as screening tool.

Table 3
Number of infants presenting with WHO IMCI inclusion criteria.

Criterion	n (%)
Not being able to feed since birth or stopped feeding well (Confirmed by observations)	23 (13.9%)
Convulsions or apnoea	18 (10.9%)
Fast breathing (60 breaths per minute or more)	92 (55.8%)
Severe chest in-drawing	59 (35.7%)
Fever (38 °C or greater)	33 (20%)
Low body temperature (less than 35.5 °C)	14 (8.5%)
Movement only when stimulated or no movement at all	5 (3%)

population, compared to that described by Dyer et al. in children [17]. There appeared to be a significant relationship between leukopenia and leucocytosis in predicting SBI (p-value 0.001) and IBI (p-value 0.002) in infants 21–90 days. The literature is conflicting with regards to the predictive value of WCC in SBI and IBI. Bonso et al. showed in two separate studies that the WCC is an inaccurate screen for bacteraemia in febrile young infants [18] and that it cannot be used to predict which febrile infants will need a lumbar puncture [19]. However, Olaciregui et al. [20] evaluated CRP, PCT and WCC and found all three to have intrinsic predictive value for SBI in febrile infants <90 days. They also found that the diagnostic value of PCT is greater than CRP for IBI and for fever of short duration [20]. A recent study (2016) also showed better diagnostic accuracy from PCT assay than CRP measurement for detecting IBI [21].

Urine dipsticks were performed in only 36% of patients, despite urinary tract infections being a common cause of SBI in vaccinated children [13]. This could mean that UTI's may have been missed. The reason for the low uptake of urine dipsticks in our PEC should be investigated.

Most authors agree that a febrile neonate should be admitted and that the full battery of screening tests including lumbar puncture should

Table 4
Performance parameters of clinical assessment tools for SI.

	Infants classified as high risk, n/total (%)	Prevalence of SBI among high risk infants n/total (%)	Sensitivity (95% CI)	Specificity (95% CI)	PPV (95% CI)	NPV (95% CI)	Positive likelihood ratio (95% CI)	Negative likelihood ratio (95%CI)
NICE [25]	932/1057 (88.2)	304/932 (32.6)	93.3 (90.0–95.7)	14.1 (11.7–16.8)	32.6 (31.7–33.5)	82.4 (75.1–87.9)	1.09 (1.0–1.1)	0.48 (0.3–0.7)
SIS [25]	768/1057 (78.7)	258/768 (33.6)	79.1 (74.3–83.4)	30.2 (26.9–33.7)	33.6 (32.0–35.3)	76.5 (71.9–80.5)	1.13 (1.1–1.2)	0.7 (0.5–0.9)
WHO IMCI	165/248 (66.5)	51/165 (30.9)	82.3 (70.5–90.8)	38.7 (31.7–46.1)	30.9 (27.6–34.5)	86.75 (78.8–92.0)	1.34 (1.1–1.6)	0.46 (0.3–0.8)

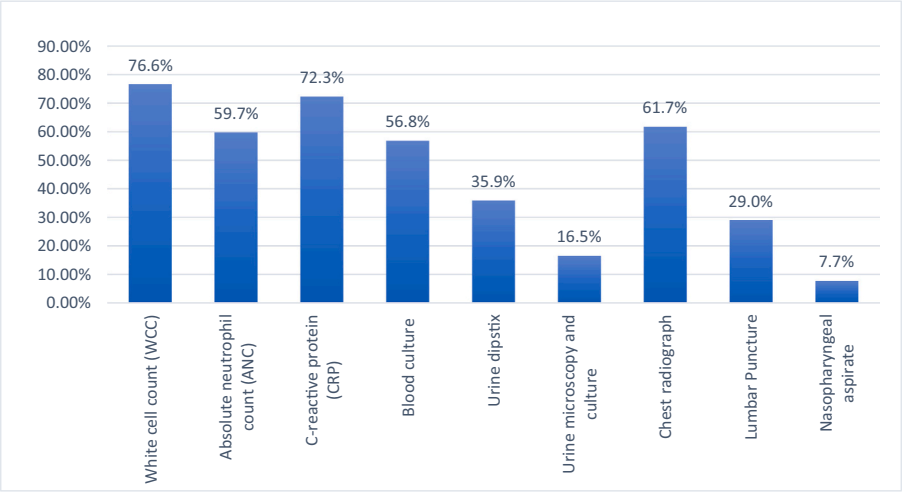

Fig. 2. Special investigations performed on all infants 21–90 days.

be performed [22]. However, Schwartz et al. found that infants 21 to 28 days old presenting with a fever without a clinical source, had a similar prevalence of bacterial infections compared with older patients and a lower rate than infants ≤21 days old [23]. In our sample the rate of SBI and IBI did not differ significantly between the 21–27 day and the 28–90 days age groups. It is interesting to note however that half of the SBI's (3/6) in the 21–27-day age group were IBI's.

Most patients were admitted (92%), and more than half of patients who did not have an SBI received initial IV antibiotics. It appeared as if clinicians were cautious to send infants in this age group home. Practical constraints such as delayed availability of laboratory results and patient lack of transport are likely to influence current practice, as out-patient management is often not feasible in our setting. IMCI criteria had a very low specificity. Given the need for reduced overall use and limited duration of antibiotics [24], there appears to be a need for an improved algorithm to risk stratify this group of infants. Application of the "Step-by-Step" algorithm [9] or the predictive rule described by Kupperman [10] could potentially significantly reduce admissions and antibiotic use, but it would need to be validated in our setting. Both these algorithms include PCT, which is not currently available in our setting, due to cost. There might be a place to compare the cost of an initial PCT, ideally done at point of care, against the cost of an 'unnecessary' admission and 48 h of antibiotics.

Intramuscular injection of Ceftriaxone according to IMCI guidelines was administered to 33,5% of infants prior to presentation. However, of the 21 patients who had positive cultures, six (28.6%) received IMCI guided intramuscular Ceftriaxone injection. It is, therefore, important to still do all relevant cultures even if the patient received Ceftriaxone prior to presentation.

A recent analysis of emergency centre prediction tools in evaluation of febrile young infants (<3 months) at risk of serious infections (SI) was done in Singapore [25]. Their definition of serious infections also included serious viral infections like viral meningitis and encephalitis. They compared the effectiveness of the National Institute for Health and Care Excellence (NICE) guideline and the Severity Index Score (SIS). The NICE guideline outperformed the SIS. Table 4 compares the NICE and SIS criteria from the Singapore study [25] with the WHO IMCI criteria from our study. It is important to note that we did not include serious viral infections in our case definition and our numbers were smaller.

The WHO IMCI tool was less sensitive than the NICE guideline for identifying infants with an SBI (sensitivity of 82.3% vs 93.3%). However, IMCI, in our study, had a higher negative predictive (NPV) value compared to the NICE and SIS tools. IMCI is designed to be used at primary care level in low-resource settings where diagnostic supports such as radiology and laboratory services are minimal and drugs and equipment are often limited [12]. Based on our findings, IMCI seems to be performing acceptably compared to NICE, with similar NPV and negative likelihood ratio. The low positive predictive value means that several children will potentially be referred and receive antibiotics unnecessarily. In the African context, the 'costs' of unnecessary use of

health resources needs to be balanced with the risk of missing serious infection, preventing death or need for intensive care, and other considerations such as antibiotic stewardship.

The retrospective nature of the study could have influenced data collection. TBH as tertiary referral centre may have resulted in possible selection bias of sicker infants. Axillary temperature, rather than rectal, was measured during triage, which could have resulted in under-reporting of fever on presentation. Not all patients presenting with a suspected lower respiratory tract infection had viral testing done due to cost implications. This would have enabled greater confidence in differentiating between viral and bacterial pneumonia [2]. The study was conducted during summer and autumn and not over a one-year period and seasonal variation in disease epidemiology might have skewed the results. The clinical team making the final diagnosis, often included junior doctors which may have resulted in an overdiagnosis of bacterial pneumonia.

Conclusion

The period prevalence of SBI and IBI in our study is significantly higher than that quoted in the literature, and application of international algorithms may be imprudent. IMCI performed reasonably well compared to similar clinical triage tools for the primary care setting but does not guide hospital management. The risk of SBI and IBI appeared to be the same in the 21–27 days and the 28–90 days age group. However, we suggest that this requires further study before the current guideline, which distinguishes between 0–28 days and 29–90 days, be changed. Our population of infants 21–90 days appeared to be high risk with a large proportion of infants being preterm, HIV exposed, immunizations not up to date and underweight for age. Risk stratification and outpatient management of low risk infants may not be feasible in our setting. An area for further study would be prospective validation of our revised Western Cape provincial draft protocol in the management of young infants with a PSBI, as well as an assessment of its diagnostic performance compared to similar guidelines from high-income settings such as the Step-by-Step approach [9].

It would be interesting to review the effect of breastfeeding versus formula feeding on the risk of SBI in this age group. The feasibility of including a point of care PCT in future management algorithms should be considered.

Dissemination of results

Results from this study was shared with staff members of the Department of Paediatrics and Child Health at Tygerberg Hospital and the University of Stellenbosch as a poster presentation at the 62nd Annual Academic day Maternal and Child Health programme on 21 August 2019.

Authors' contribution

Authors contributed as follow to the conception or design of the work; the acquisition, analysis, or interpretation of data for the work; and drafting the work or revising it critically for important intellectual content: JL contributed 50%, and LS and AR contributed 25% each. All authors approved the version to be published and agreed to be authors.

Declaration of competing interest

The authors declared no conflict of interest.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.afjem.2020.09.015.

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