Infant critters & Febrile fitters

Andrew Redfern

SAPA webinar 31 May 2023

Poll 1

A previously well 6 week old comes in to the emergency dept

Presenting complaint is fever

On assessment, T 38.2, RR 35, HR 120

Baby alert, drinking well, no clear source of fever

How would you manage this patient?

Poll 2

A previously well 10 week old comes in to the emergency dept

Presenting complaint is fever

On assessment, T 38.2, RR 35, HR 120

Baby alert, drinking well, no clear source of fever

How would you manage this patient?

Possible Serious Bacterial Infection in young infants

Let’s define the problem….

Healthcare costs

Unnecessary admission, invasive procedures, antibiotics

Declining rates of SBI due to preventable organisms

e.g GBS, S. pneumoniae, H. influenza

Risk of SBI increases with decreasing age

0-4 weeks: 13-25%

4-8 weeks: 8-13%

3-36 months: 2-12%

What about our setting?

- Disease burden
  - Increased prevalence of SBI?
  - Increased prevalence of risk factors
- Health system
  - Socio-economic context of parents
  - Communication barriers
  - Laboratory TATs


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NICE Fever <5y (2021)

<3m: all get urine, CRP, WCC, blood culture

<1m or 1-3m unwell or abnormal IMs*: LP & IV antibiotics

*Abnormal IMs: WCC <5 or >15 (2013)

NICE Traffic Light System of Clinical Risk Factors in Infants Younger than Three Months			
	Green—Low Risk	**Amber—Intermediate Risk**	**Red—High Risk**
Colour (of skin, lips, or tongue)	Normal colour	Pallor reported by parent or carer	Pale, mottled, ashen or blue
Activity	Responds normally to social cues Content or smiles Stays awake or awakens quickly Strong normal cry or not crying	Not responding normally to social cues No smile Wakes only with prolonged stimulation Decreased activity	No response to social cues Appears ill to a healthcare professional Does not wake, or if roused, does not stay awake Weak, high-pitched or continuous cry
Respiratory		Nasal flaring Tachypnea: Respiratory rate (RR) >50 breaths/min Oxygen saturation ≤95% in air Crackles in the chest	Grunting Tachypnea: RR >60 breaths/min Moderate or severe chest indrawing
Circulation and Hydration	Normal skin and eyes Moist mucous membranes	Tachycardia: >160 beats/min at age <12 months Capillary Refill Time ≥ 3 seconds Dry mucous membranes Poor feeding in infants Reduced urine output	Reduced skin turgor
Other	None of the amber or red symptoms or signs	Fever for ≥5 days Rigors Swelling of a limb or joint Non-weight bearing limb or not using an extremity	Temperature ≥38°C at age <3 months Non-blanching rash Neck stiffness Status Epilepticus Focal neurological signs Focal seizures

South Australia (2020)

1-2 months old with fever without focus:

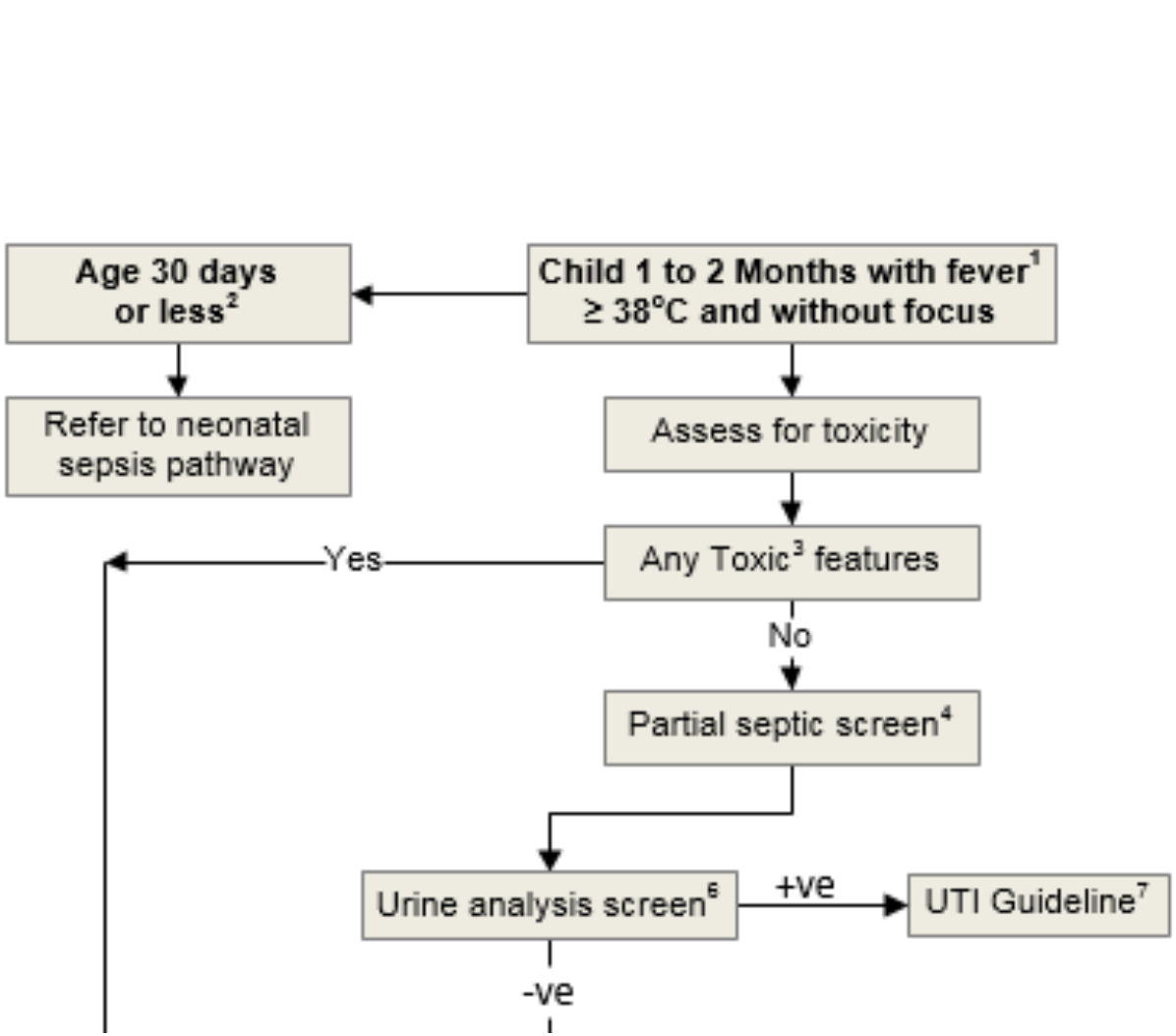
Partial septic screen, no LP

LP if ‘high risk’

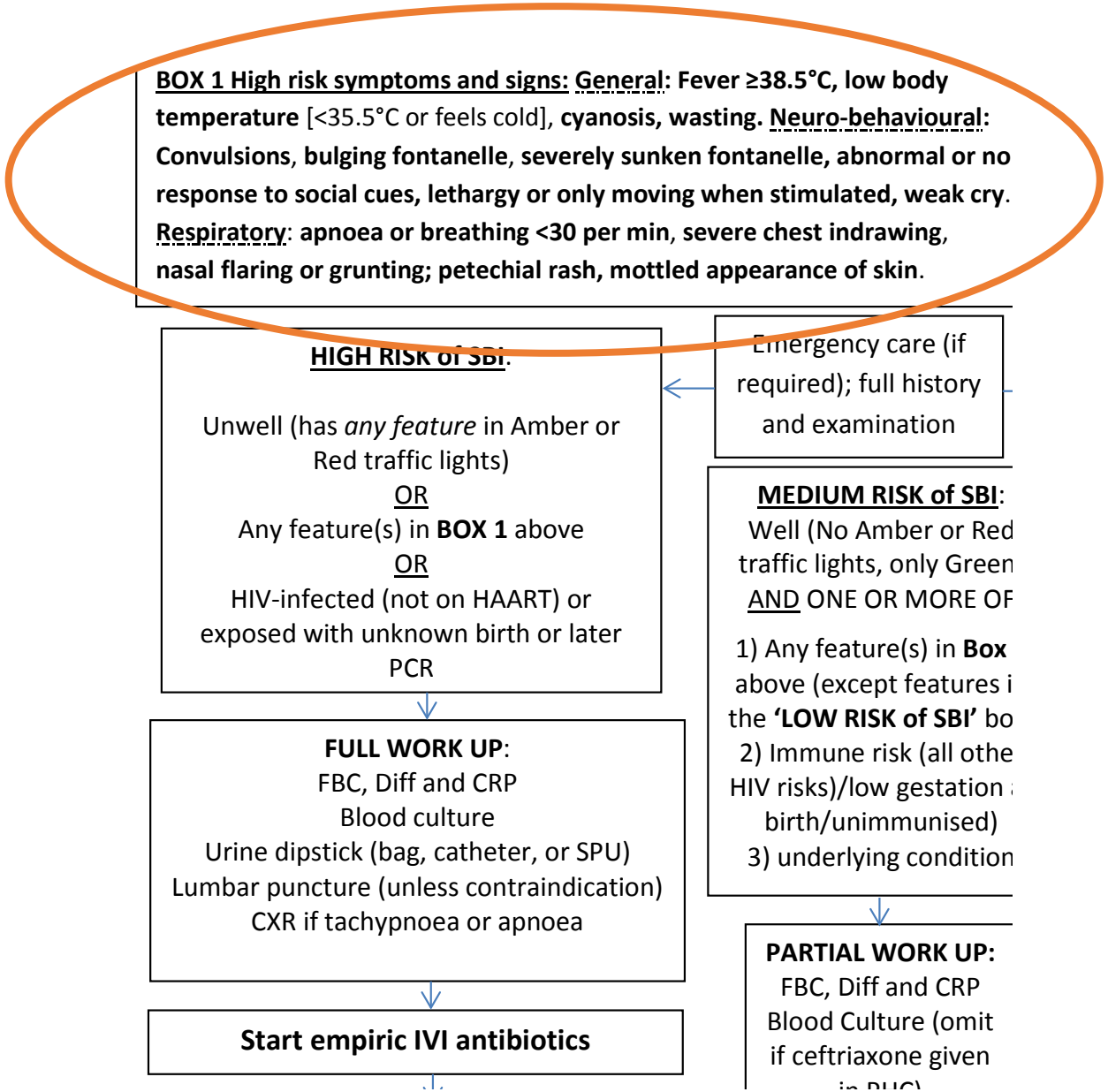
High risk determined by:

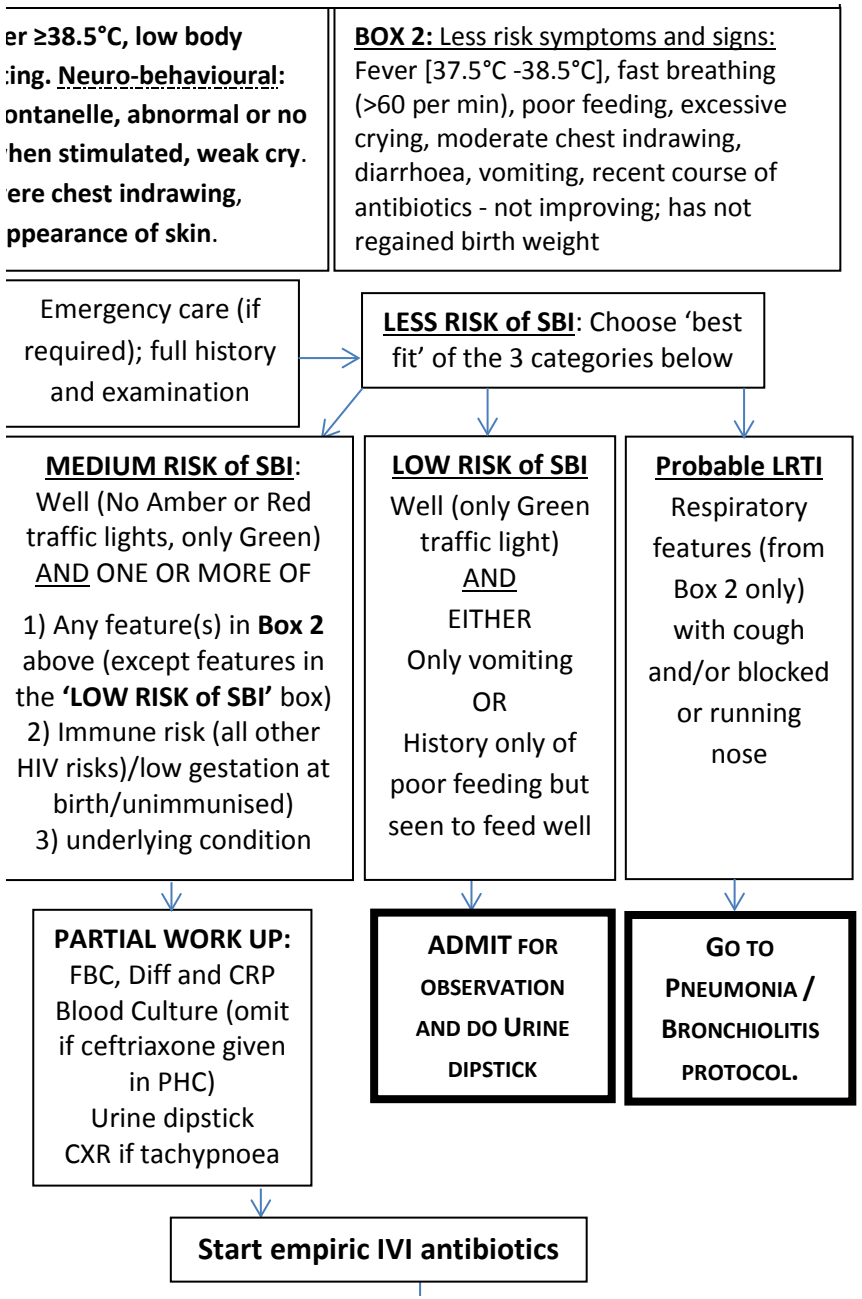
- Toxic features
- Abnormal IM (any of WCC <4 or >15, CRP >20, ANC >10000, PCT >0.5)

	Well	Unwell	Toxic
Alertness / Activity	Strong cry or not crying Content, smiles Stays awake Normal response to social cues	Drowsy / decreased activity Poor smile/response to social cues Irritable	Wakes only with prolonged stimulation or unable to rouse Weak/high pitched or continuous cry Bulging fontanelle
Breathing	Normal work of breathing	Nasal flaring	Chest in-drawing RR>60 Grunting
Colour / Circulation	Normal lips, skin and tongue colour	Pallor per caregiver	Pale, mottled Blue, ashen Cool Peripheries Bounding pulses or wide pulse pressure
Fluid / Urine output	Normal skin and eyes Moist mucous membranes	Poor feeding in infant Dry mucous membranes Reduced urine output	Reduced skin turgor Bilious vomiting Decreased fluid intake by <1/2 normal Decreased urine output less than 4 wet nappies over 24 hours
Other		New lump >2cm	Rigors, seizure Petechial rash Appears very unwell to healthcare professional Persistent tachycardia


Child 1 to 2 Months with fever[1] ≥ 38°C and without focus
Age 30 days or less[2]
Refer to neonatal sepsis pathway
Assess for toxicity
Any Toxic[3] features
Yes
No
Partial septic screen[4]
Urine analysis screen[6]
+ve
UTI Guideline[7]
-ve
-ve
Blood test results ≥ 1 or more of the following results:
Leucocytes: <4 or>15 (x10⁹/L)
and/or
CRP >20 (mg/L)
and/or
Absolute neutrophil count >10,000 or <1,000 (10⁹/L)
and/or
PCT >0.5 (µg/L) where test available
Yes
No
Discuss with paediatrician / Fellow / Senior registrar. Need for further investigations including LP
Yes
No
Providing low risk for bacterial meningitis[8]. No further routine investigations required unless deterioration in clinical condition
Admit for observation and monitoring
Full septic screen[5] Do not delay IV antibiotics. Refer to guideline for antibiotic recommendations
Admission to hospital. General paediatric/medical review
Remains well and fever resolving. Cultures negative at 24 hours
All discharge criteria fulfilled [9]
Discharge home with medical follow up

WC protocol 28-90 days




er ≥38.5°C, low body
ing. Neuro-behavioural:
ontanelle, abnormal or no
hen stimulated, weak cry.
ere chest indrawing,
ppearance of skin.
BOX 2: Less risk symptoms and signs:
Fever [37.5°C -38.5°C], fast breathing (>60 per min), poor feeding, excessive crying, moderate chest indrawing, diarrhoea, vomiting, recent course of antibiotics - not improving; has not regained birth weight
Emergency care (if required); full history and examination
LESS RISK of SBI: Choose 'best fit' of the 3 categories below
MEDIUM RISK of SBI:
Well (No Amber or Red traffic lights, only Green)
AND ONE OR MORE OF
1) Any feature(s) in Box 2 above (except features in the 'LOW RISK of SBI' box)
2) Immune risk (all other HIV risks)/low gestation at birth/unimmunised)
3) underlying condition
LOW RISK of SBI
Well (only Green traffic light)
AND
EITHER
Only vomiting
OR
History only of poor feeding but seen to feed well
Probable LRTI
Respiratory features (from Box 2 only) with cough and/or blocked or running nose
PARTIAL WORK UP:
FBC, Diff and CRP
Blood Culture (omit if ceftriaxone given in PHC)
Urine dipstick
CXR if tachypnoea
ADMIT FOR OBSERVATION AND DO URINE DIPSTICK
GO TO PNEUMONIA / BRONCHIOLITIS PROTOCOL.
Start empiric IVI antibiotics

Prediction rules - Identifying low risk

Rochester 1994	Step by Step 2017	PECARN 2018	AAP 2021
Well No focal infxn WBC 5-15 Band <1.5 Negative urine	Well Age >21d Negative urine PCT <0.5 CRP <20 ANC <10000	ANC <4000 PCT <1.7 Negative urine	T <38.5 ANC <4000 & PCT <0.5 OR ANC <5200 & CRP <20 Negative urine

	Sens	Spec	PPV	NPV
Rochester	82%	45%	5.7%	98.3%
Step by step	92%&	47%	6.7%	99.3%
PECARN	97.7%	60%	21%	99.6%
AAP (no CRP/PCT)	93%	32%	4%	99.3%

AAP: 28-60 days old

- Inflammatory markers include:
- PCT & ANC
- or
- CRP & ANC

Abnormal IMs defined as:

T > 38.5

CRP > 20

>5200 (no PCT avail) or >4000 (with PCT)

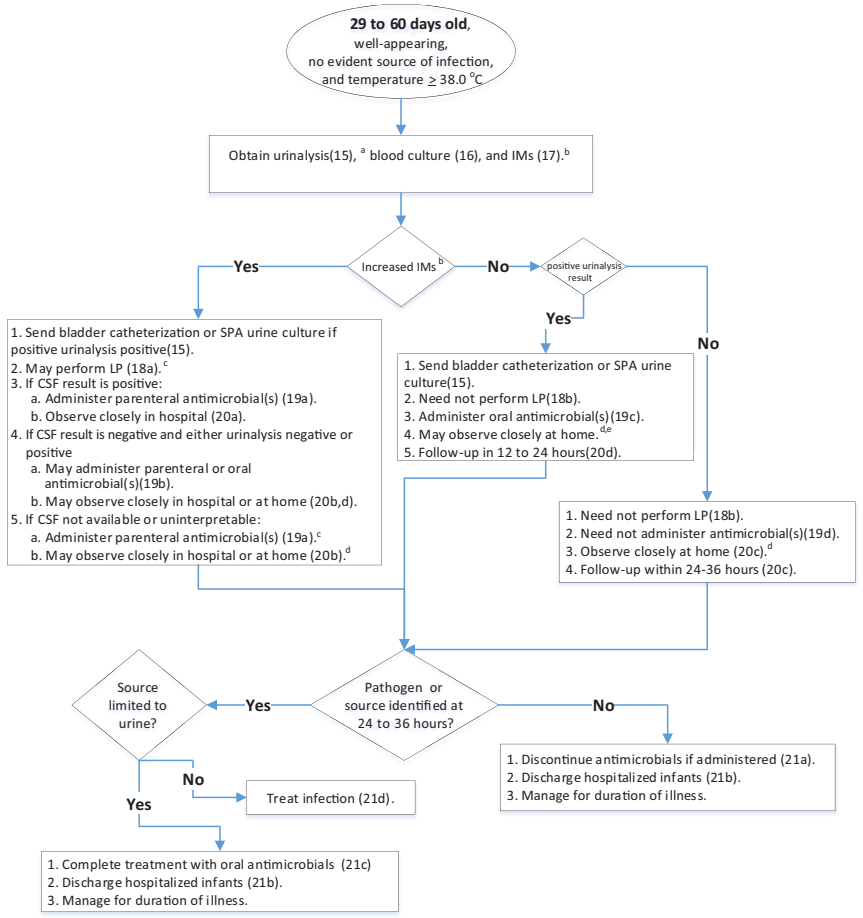


Figure 2. Kaplan-Meier Curve Representing the Time to Positivity of Blood Culture Results

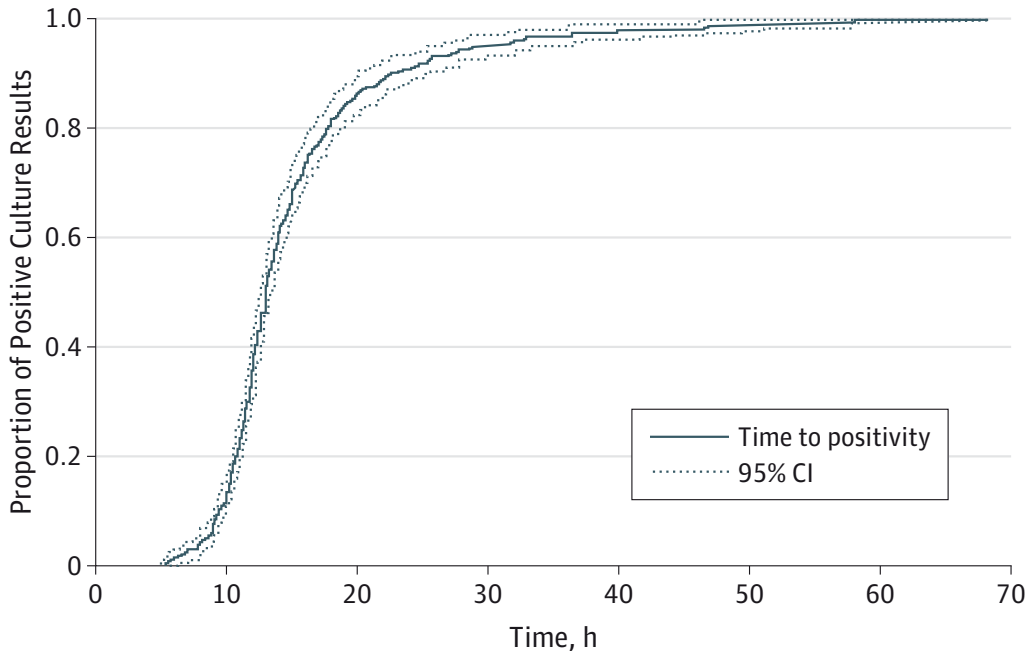


Table 3. Epidemiology of Bacteremia and Generalized Linear Model Comparing Median Time to Positivity Between Species

Organism	No. (%)	Time to Positivity, Median (Range), h	*P* Value
E coli	159 (41)	13.0 (7.8-53.3)	1 [Reference]
GBS	87 (22)	10.5 (5.2-39.5)	<.001
Viridans group streptococci[a]	32 (8)	17.2 (10.3-57.2)	<.001
S aureus	23 (6)	18.5 (12.4-40.1)	<.001
S pneumoniae	18 (5)	14.3 (11.2-36.1)	.19
Enterococcus spp	14 (4)	15.3 (9.8-25.7)	.46
Klebsiella spp	10 (3)	12.0 (8.9-15.0)	.10
Enterobacter spp	8 (2)	13.0 (9.2-19.0)	.38
Salmonella spp	6 (2)	15.1 (12.3-22.0)	.44
S pyogenes	5 (1)	13.6 (9.1-37.3)	.10
Other γ-hemolytic *Streptococcus*	5 (1)	14.1 (5.6-14.8)	.20
CoNS[a]	5 (1)	27.2 (15.0-68.3)	<.001
Moraxella spp	4 (1)	39.8 (22.7-56.0)	<.001
Neisseria spp	3 (1)	23.5 (17.6-27.2)	.003
Serratia spp	2 (0)	17.0 (16.2-17.8)	.46
Pseudomonas spp	2 (0)	29.0 (11.9-46.0)	<.001
Micrococcus spp[a]	1 (0)	58.8 (58.8-58.8)	<.001
Other	8 (2)	19.9 (9.4-58.2)	<.001

Blood culture Time to positive

Biondi, JAMA Pediatrics, 2014

Lishman et al

21-90 days

SBI 25%

IBI 5%

WHO performance

- Sens 82%
- Spec 38%
- NPV 87%

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

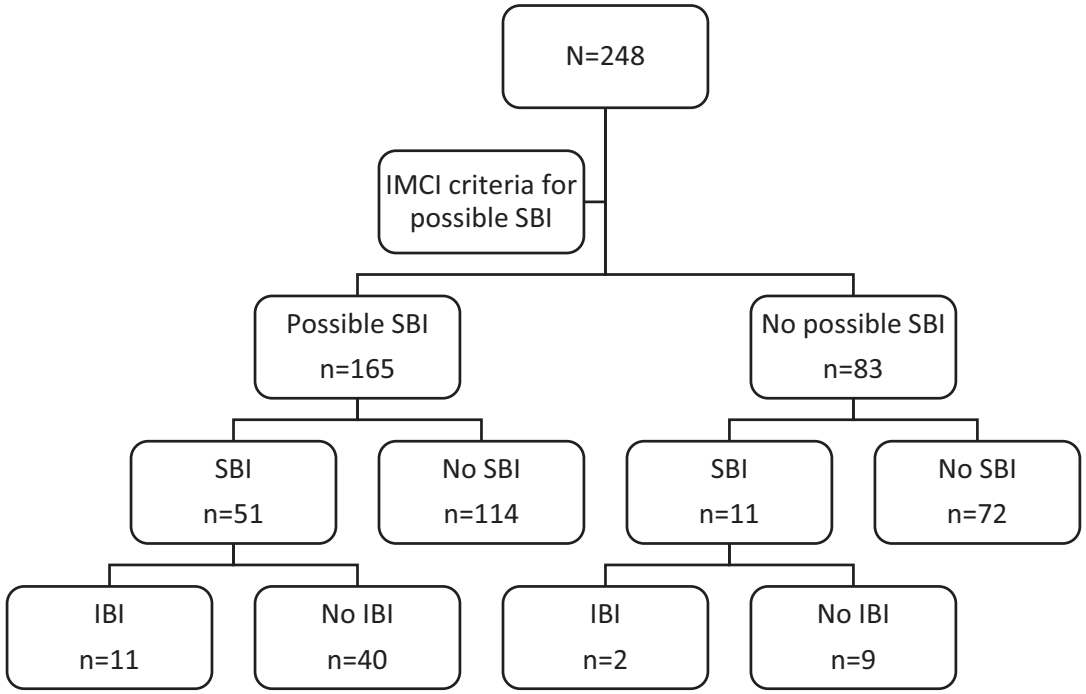


Fig. 1. Performance of WHO IMCI criteria as screening tool.

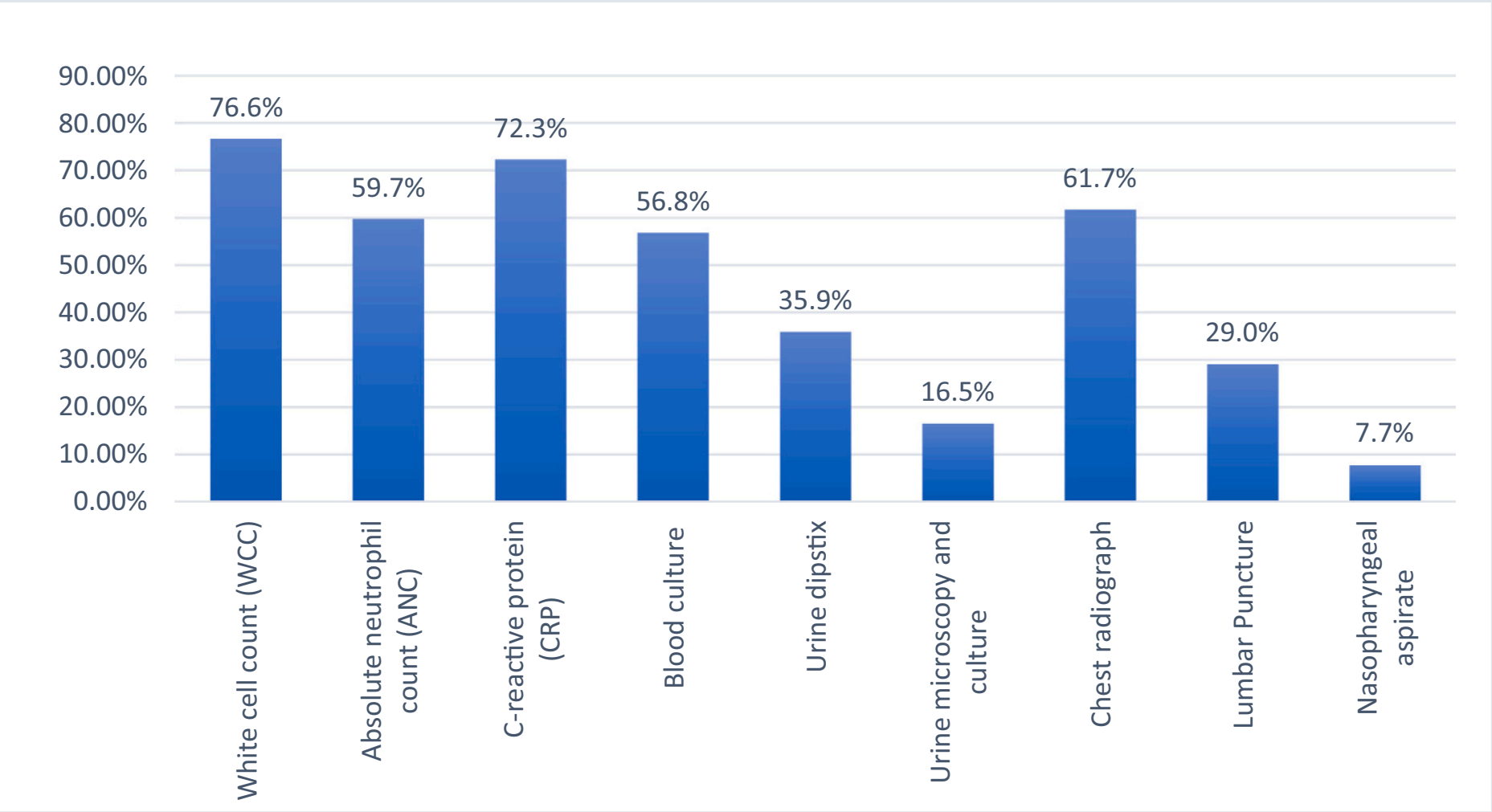


Fig. 2. Special investigations performed on all infants 21–90 days.

Summary

Neonates

- Full septic screen
- Consider HSV
- Empiric antibiotics

1-2(3) months

- Partial work up (urine!!!)
- Identify low risk

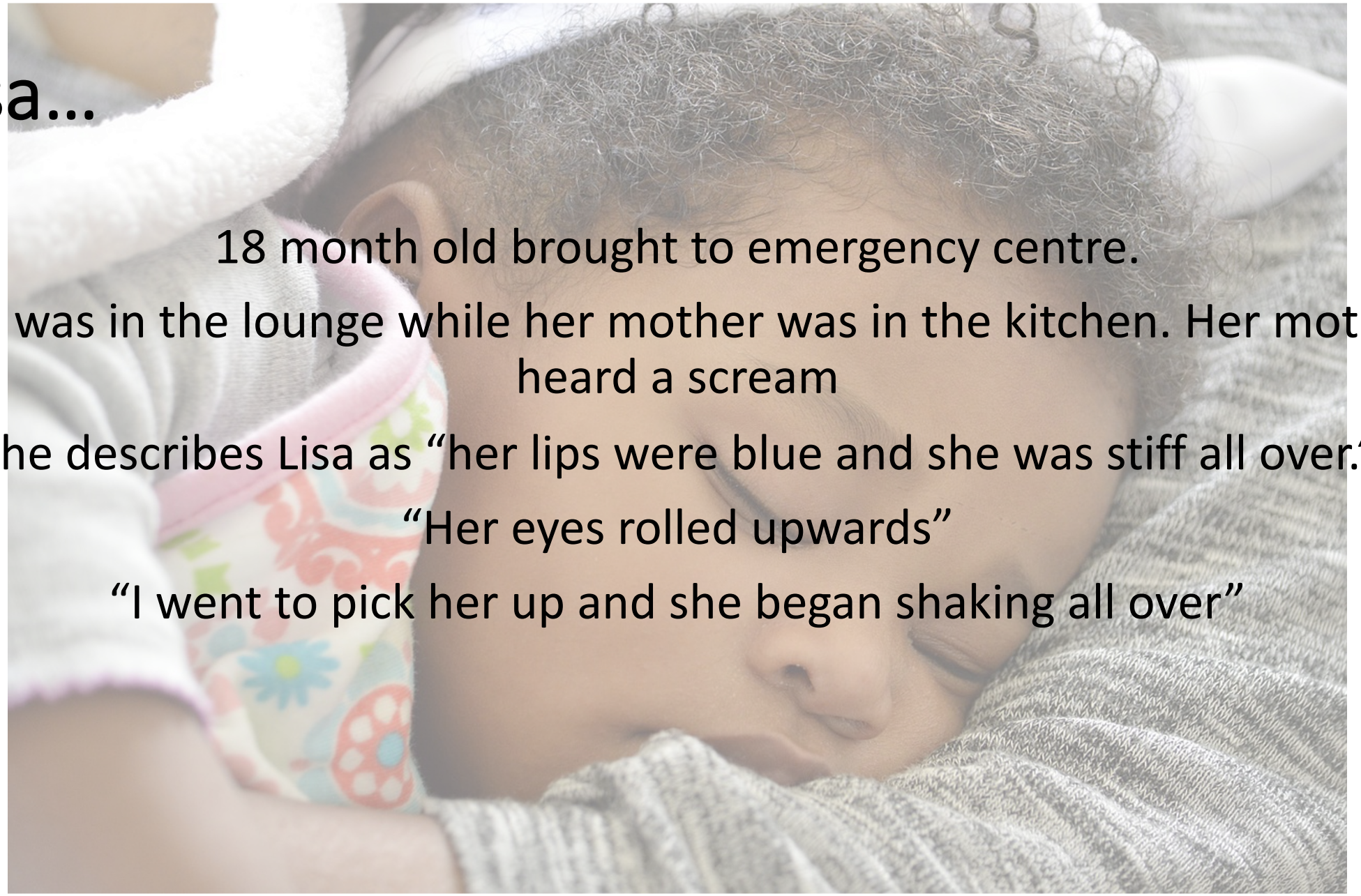
?Age cut off

?Empiric antibiotics

?Blood culture time

Febrile fitters

Lisa…



18 month old brought to emergency centre.

She was in the lounge while her mother was in the kitchen. Her mother heard a scream

She describes Lisa as “her lips were blue and she was stiff all over.”

“Her eyes rolled upwards”

“I went to pick her up and she began shaking all over”

Further history…

Event lasted about 8 minutes, and she was drowsy afterwards and fell asleep

She felt warm to touch. Her temperature was 37.5. She had a 12 hour history of runny nose and fever.

Mom had stripped her and put the fan on

She had a similar episode when she was 11 months old.

Mother says she had febrile seizures as child

Febrile seizure definition

Seizure accompanied by fever (T > 38),

without CNS infection,

that occurs between the ages of 6 months and 5 years

Differential diagnosis

Meningitis, encephalitis

Epilepsy – GEFS+, Dravet

Classification

SIMPLE (70%) - Require all of the following:

Generalized

<10-15 min duration

Only one episode in 24h

COMPLEX (30%)

Focal features (16%)

Prolonged > 10-15min (8%)

Recurrence in 24h or within same illness (6%)

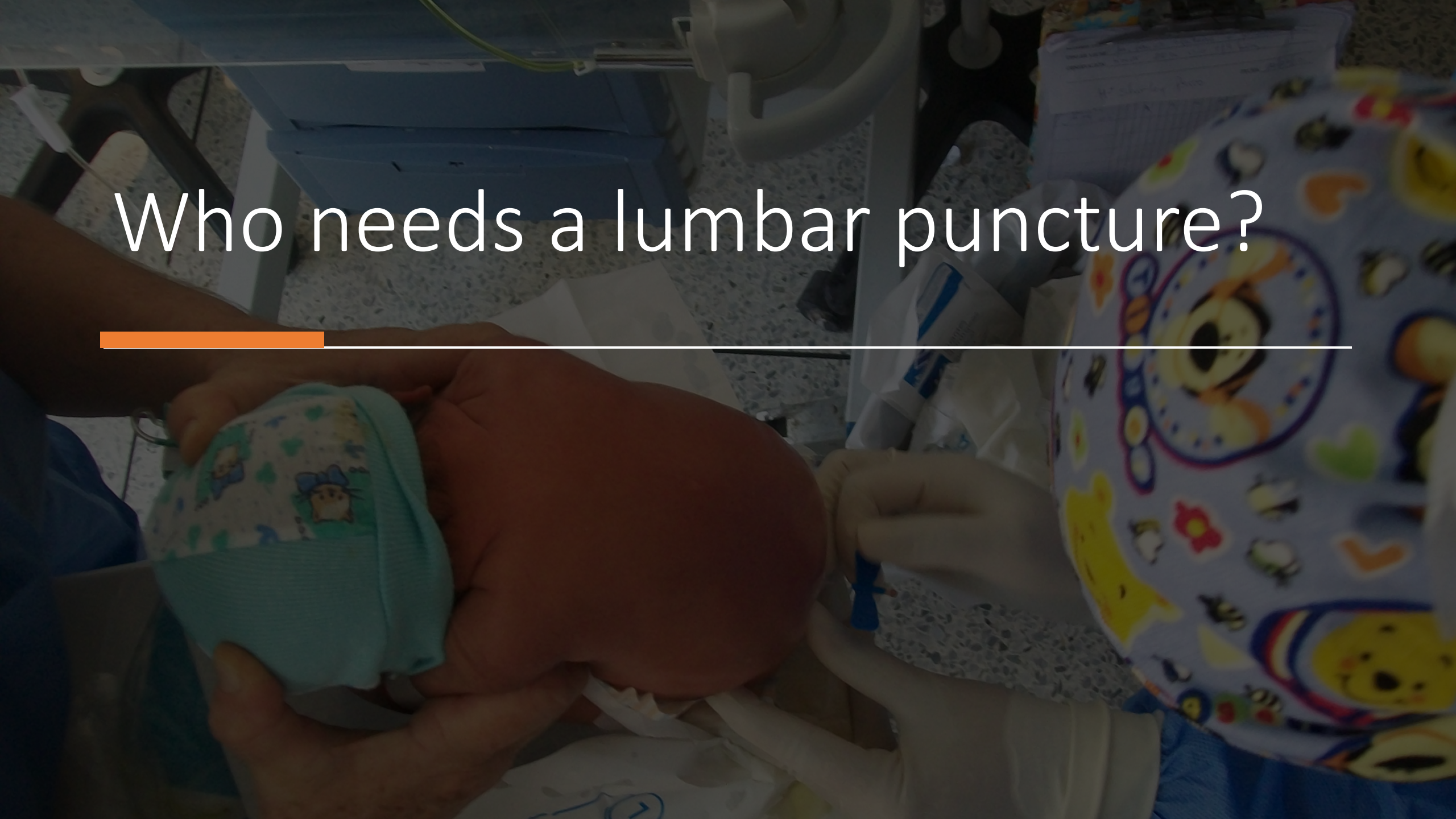
Pre-existing or New neurological abnormality

What investigations needed?

- No routine bloods
- No routine EEG or imaging

Admit

- Unwell/persistent neuro
- <18m
- Complex FS
- Social/parental factors



Who needs a lumbar puncture?

Poll 3

- 15 month old
- Generalised tonic clonic seizure lasting 5 minutes
- Fever, no clear source
- The maximum recorded temperature was 39.4^{o}C
- Active and feeding well
- No past history of seizures. Fully immunized
- Physical examination normal. No meningism

Poll 4

- 10 month old
- Generalised tonic clonic seizure lasting 2 minutes
- No clear source of infection
- The maximum recorded temperature was 39.4^{o}C
- Active and feeding well
- No past history of seizures. Fully immunized
- Physical examination normal. No meningism

Poll 5

- 18 month old
- 2 generalised tonic clonic seizures lasting 2 minutes each, 4 hours apart
- Red throat, ?OM
- T 38
- “Irritable when hot?

AAP 2011

TABLE 2 Indications for lumbar puncture after a febrile seizure

- Any child with physical examination findings suggestive of meningitis
- Simple febrile seizures
  - Children between 6 and 12 months old if immunization status is unknown or incomplete
  - Children on antibiotics
- Complex febrile seizures if under 12 months old
- All children with febrile status epilepticus

"In any infant between 6 and 12 months of age who presents with a seizure and fever, a lumbar puncture is an option when the child is considered deficient in *Haemophilus influenzae* type b (Hib) or *Streptococcus pneumoniae* immunizations (ie, has not received scheduled immunizations as recommended) or when immunization status cannot be determined because of an increased risk of bacterial meningitis"

Son, Ped Emerg Care 2018

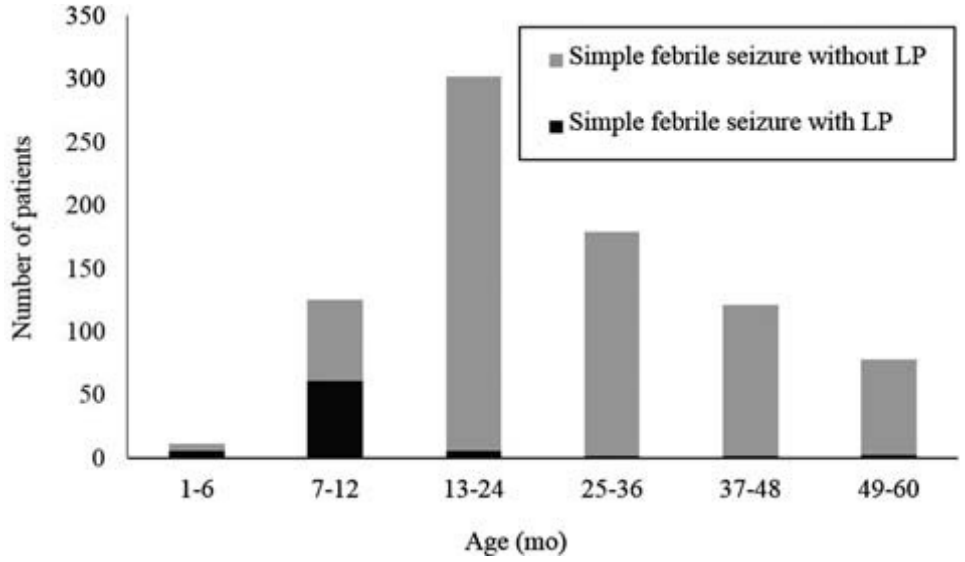


FIGURE 1. Lumbar puncture performance rates according to patient's age.

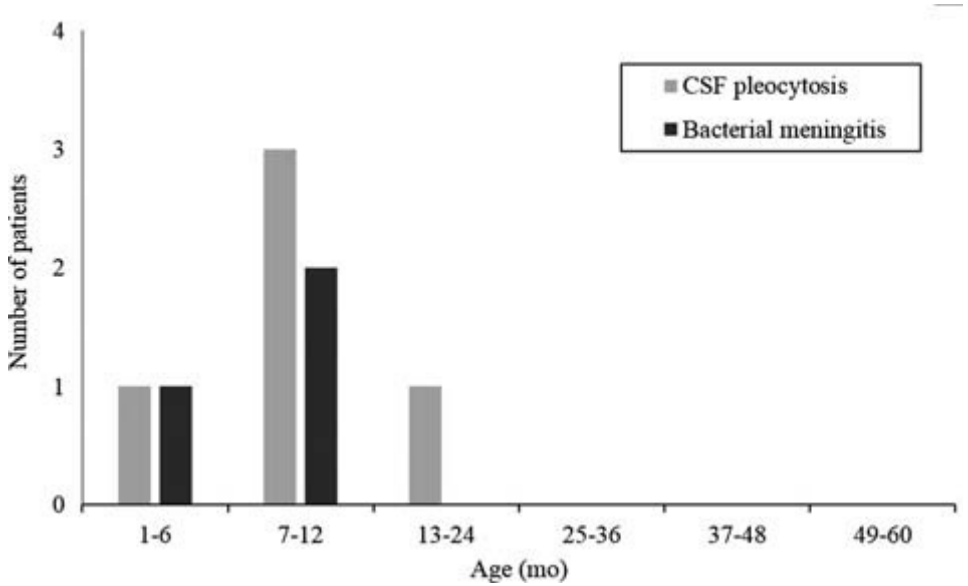


FIGURE 2. Cerebrospinal fluid pleocytosis and bacterial meningitis in simple FS cases in which patients underwent LP.

Guedj, Academic Emergency Medicine, 2018

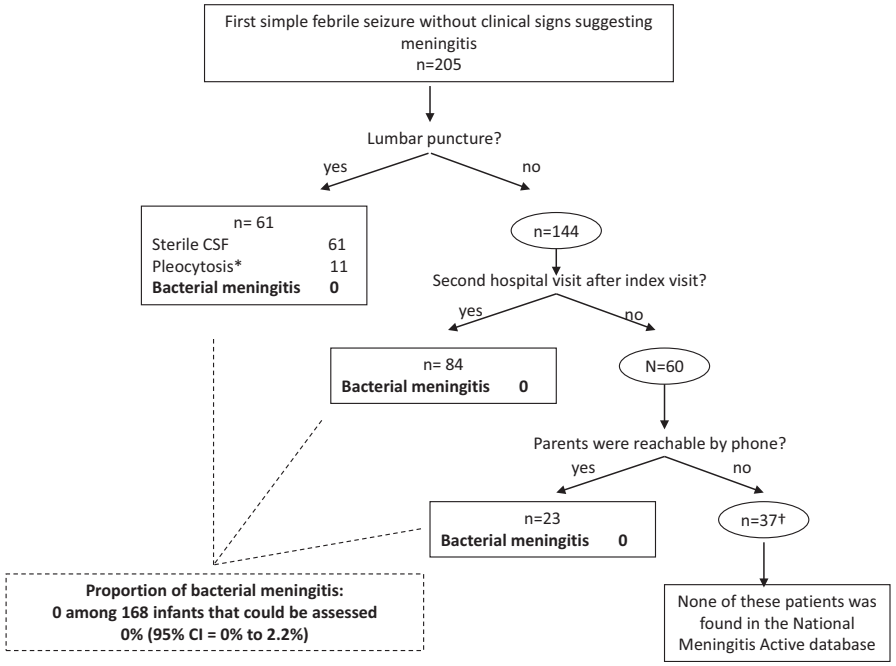


Figure 2. Risk of bacterial meningitis among infants 6 to 11 months old visiting in seven pediatric EDs between January 2007 and December 2011 with a first simple febrile seizure. *>4 white blood cell per mm^3 in CSF; the median of number of cells in CSFs of these 11 patients was 6 cells per mm^3. †Four of these patients were hospitalized for less than 7 days and did not show any sign of meningitis. CSF = cerebral spinal fluid.

Summary – who to LP

- FS < 12m
- All with signs of meningism
- Febrile status

>12m

- Incomplete Immunisations
- Immune compromise
- Complex FS

Recurrence prevention

- Anti-pyretics
  - Regular ibuprofen
  - Rectal diclofenac followed by regular ibuprofen & panado
- Anti-convulsants
  - Intermittent valproate
  - Intermittent clobazam
  - Intermittent oral diazepam
- Supplements
  - Zinc
  - Pyridoxine
- Other

Should you offer prophylaxis with AEDs?

Regular or intermittent treatment with antiepileptic medication is not recommended.

Why?

- Benign nature of febrile seizures
- High risk of adverse effect
- Masking of potential informative clinical features

WHO & Cochrane epilepsy group, 2017

Acknowledgment: BPNA PET course

Febrile seizures: risk of recurrence

- Overall risk is 30-40%
- Main risk factor is **age of febrile seizure**

<12 months	50% will have another febrile seizure
>3 years	20% will have another febrile seizure

- Complex features **not** a risk factor
- Other RF = FH, freq illness

Acknowledgment: BPNA PET course

Febrile seizures: risk of developing epilepsy

- Overall 3% develop epilepsy
- Risk factors
  - Abnormal neurology prior to first febrile seizure
  - History of afebrile seizures in a first degree relative
  - Complex febrile seizure
- Risk factors are cumulative
  - 0 risk factor 1%
  - 1 risk factors 2%
  - 2 or more risk factors 10%

Nelson & Ellenberg, Paediatrics, 1978

Acknowledgment: BPNA PET course

Who should be followed up?

- > 3 discrete febrile seizures events
- Children <6 months or >6 years
- Febrile seizures longer than 30 minutes
- Febrile seizures that have focal features
- Febrile seizures that are not tonic-clonic

NZ Epilepsy: guidelines & pathways for children and YP, 2017

Acknowledgment: BPNA PET course