

# **MMed and DCH Lectures**

## **Meningitis and encephalitis in children**

March 22, 2021

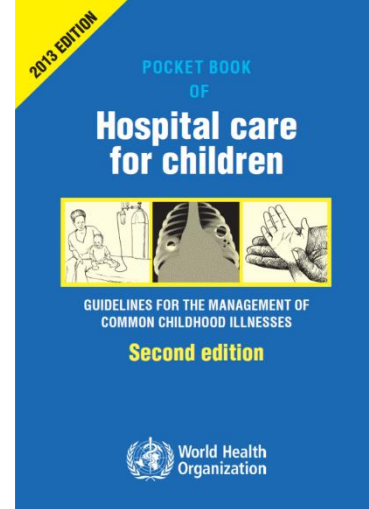
Prof Trevor Duke

7 year old girl with fever and a seizure  
Unwell only 2 days, cough, fever and ear discharge  
Sleepy this morning, could not be woken by father  
Seizure in COPD →



# Care of any seriously ill child

- Triage
- Emergency treatment
- History and examination
- Laboratory investigations, if required
- Main diagnosis and other diagnoses
- Treatment
- Supportive care
- Monitoring
- Discharge planning
- Follow-up

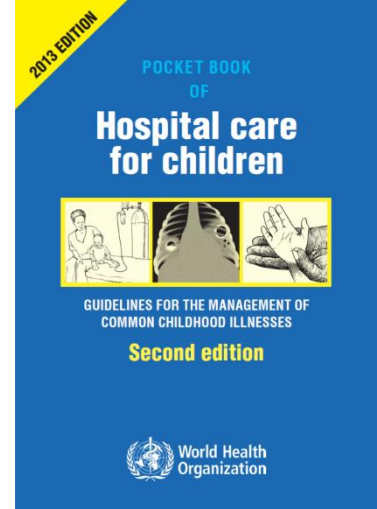


# Triage

Brief history of the problem

Take temperature and weight

- A. Listen for stridor or obstructed breathing
- B. Look for cyanosis and for signs of respiratory distress (chest indrawing, tracheal tug), check SpO<sub>2</sub>
- C. Feel the skin temperature of the hands and feet, feel the pulse for volume, capillary refill time
- D. Assess for lethargy and level of interaction



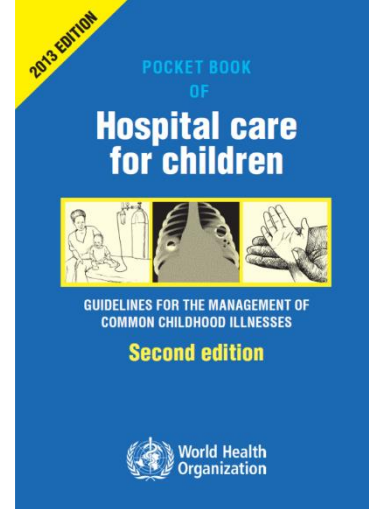
# Triage

## Emergency signs (p. 2, 6)

- Obstructed breathing
- Severe respiratory distress
- Central cyanosis
- Signs of shock
- Coma
- Convulsions
- Severe

## Priority signs (p. 6)

- Tiny baby
- Temperature
- Trauma
- Pallor
- Poisoning
- Pain (severe)
- Respiratory distress
- Restless, irritable
- Referral
- Malnutrition
- Oedema



# Emergency Treatment

- **A:** positioning, NG tube to protect from aspiration, artificial airway
- **B: oxygen**
- **C: fluid calculation**

## Antibiotics

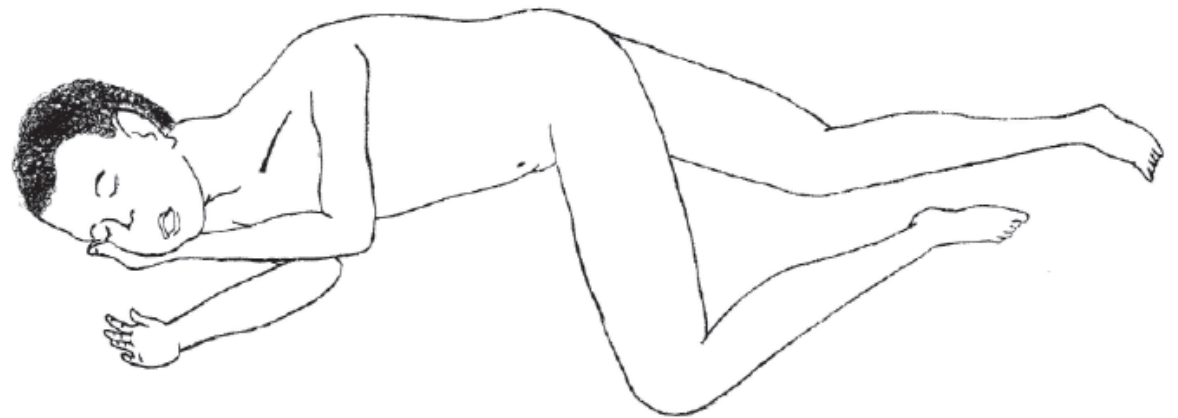
- Ceftriaxone + flucloxacillin
- +/- antimalarial

Anticonvulsants (Chart 9, p. 15)

Check blood glucose (Chart 10, p. 16)

Keep extend neck in midline (neutral position) in older child, stabilize by placing cheek on one hand

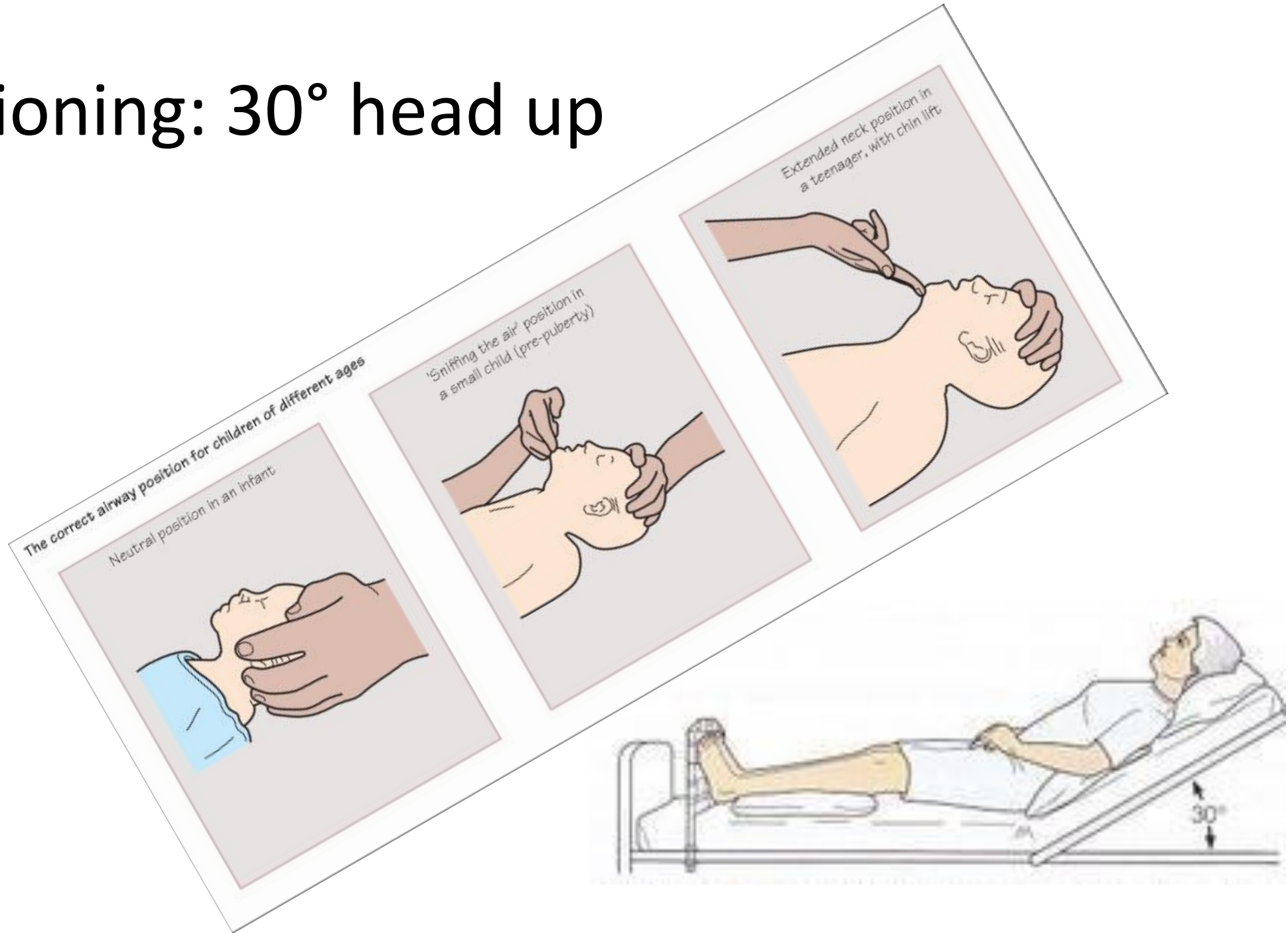
Turn child into coma position to reduce aspiration risk



Bend one leg to stabilize the body position



# Positioning: 30° head up



# Fluid calculation

- Weight = 18kg
- TFI: 4, 2, 1 rule (ml/kg/hour)
  - 4ml / kg for first 10kg = 40
  - 2ml/kg for next 8 = 16
  - Max TFI = 56ml/hour

## Reasons for *reduced* TFI

Unconscious  
Possibly cerebral oedema  
SIADH

## Reasons for *increased* TFI

Vomiting  
Poor oral intake  
Signs of dehydration

– **As child is unconscious give 50% (=28ml/hour)**

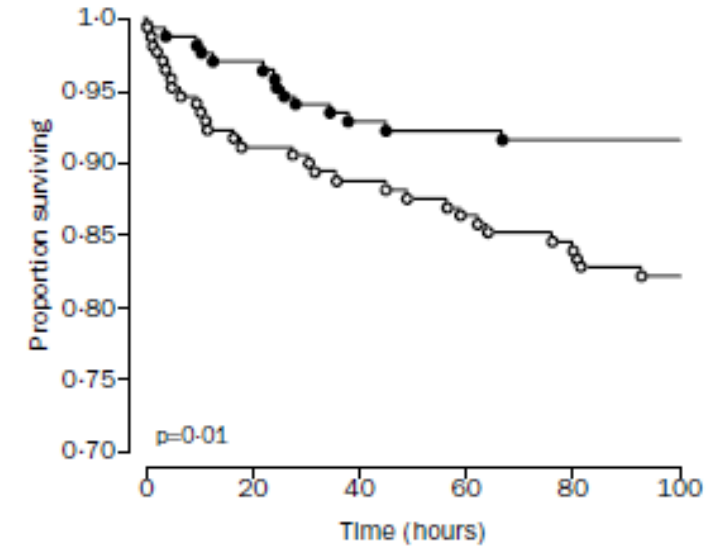
– If starting NG feeds can have more (i.e. close to full TFI)

If present correct dehydration, then give reduced TFI



## Effect of phenobarbital on seizure frequency and mortality in childhood cerebral malaria: a randomised, controlled intervention study

Jane Crawley, Catherine Waruiru, Sadik Mithwani, Isiah Mwangi, William Watkins, David Ouma, Peter Winstanley, Timothy Peto, Kevin Marsh



	Placebo (n=170)	Phenobarbital (n=170)	Unadjusted analyses		Adjusted analyses	
			Odds ratio (95% CI)	p	Odds ratio (95% CI)	p
<b>Seizures</b>						
Three or more of any duration	46 (27%)	18 (11%)	0.32 (0.18–0.58)	<0.001	0.34 (0.19–0.62)*	<0.001
Any lasting 5 min or longer	43 (25%)	20 (12%)	0.39 (0.22–0.70)	0.002	0.42 (0.24–0.76)*	0.004
Any episode of status epilepticus†	23 (14%)	9 (5%)	0.36 (0.16–0.78)	0.01	0.38 (0.17–0.85)*	0.02
<b>Death</b>						
	14 (8%)	30 (18%)	2.39 (1.28–4.64)	0.01	2.49 (1.19–5.23)‡	0.02
<b>Neurological sequelae</b>						
At discharge	33/156 (21%)	18/140 (13%)	0.55 (0.30–1.02)	0.06	0.56 (0.30–1.05)*	0.07
3 months after discharge	15/144 (10%)	9/131 (7%)	0.63 (0.27–1.47)	0.39	0.69 (0.29–1.65)*	0.40

\*Adjusted for seizures before admission.

†Lasting >30 min or more than six within 2 h.

‡Adjusted for factors associated with increased mortality (Blantyre score, respiratory distress, base excess, glucose, urea, creatinine).

Table 2: **Clinical outcome**

\*\*\* Greatest risk of death when diazepam combined with phenobarbitone

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<b>Diazepam doses</b>	<b>Placebo</b>	<b>Phenobarbital</b>	<b>Odds ratio (95% CI)</b>	<b>p</b>
<3 doses	13/150 (9%)	25/162 (15%)	1.9 (0.9–3.9)	0.07
≥3 doses	1/20 (5%)	5/8 (62%)	31.7 (1.2–814)	0.001

**Table 3: Mortality in phenobarbital and placebo groups, according to number of doses of diazepam**

**\*\*\* Three or more doses of diazepam plus phenobarbitone loading increases risk of death from respiratory depression**

# Supportive care

- Nurse in ICU / high dependency area of ward
  - 30° head up
  - Airway support
  - Oxygen
  - NG feeding, careful use of IV fluids
  - Monitor seizures, glucose and electrolytes (Na<sup>+</sup> especially)
  - Start NG feeding

# Steroids in meningitis

- Effective in:
  - Reducing sensorineural hearing loss in Hib meningitis
  - Reducing mortality in adults with pneumococcal meningitis
- If given at the same time or 15 minutes before the first dose of antibiotics (ceftriaxone)
- Dose
  - Dexamethasone: 0.15mg/kg IV Q6 x 48 hours
  - Methylprednisolone: 1mg/kg Q6 x 48 hours

# Anticonvulsants in meningitis

- Safer anticonvulsant drugs than diazepam, phenobarbitone, paraldehyde and phenytoin, especially if monitoring limited and no ICU support
- Levetiracetam (Keppra)
- Sodium valproate (Epilim)

# Monitoring

Hourly, use a monitoring chart  
Response and escalation

## Paediatric monitoring and response chart

Name: Ratu Age: 11 months  
Frequency of observations: 1-2 Hourly

Hospital: Weight: 8.2 kg UR number: 267198



Date	Time	Temp °C	Respiratory Rate (bpm)	SpO <sub>2</sub> (%)	Oxygen L/min	Respirat distress	Heart rate (bpm)	Cap refill	Blood Pressure (mmHg) (systolic danger range)	AVPU response to stimuli	Pain score (/10)	Blood sugar	Feeds given: volume
15/4	0800	37.9	X	X		Severe	X	X	110	X		1.8	
	1000	38.0	X	X		Mod.	X	X	110	X		4.5	
	1200	37.8	X	X		Mild	X	X	110	X			
	1400	37.9	X	X		Normal	X	X	110	X			
	1600	36.6	X	X		Normal	X	X	110	X			

Oxygen  
 IV glucose  
 Antibiotics  
 Blood Transfusion  
 Feeds commenced (kg)

# Complications

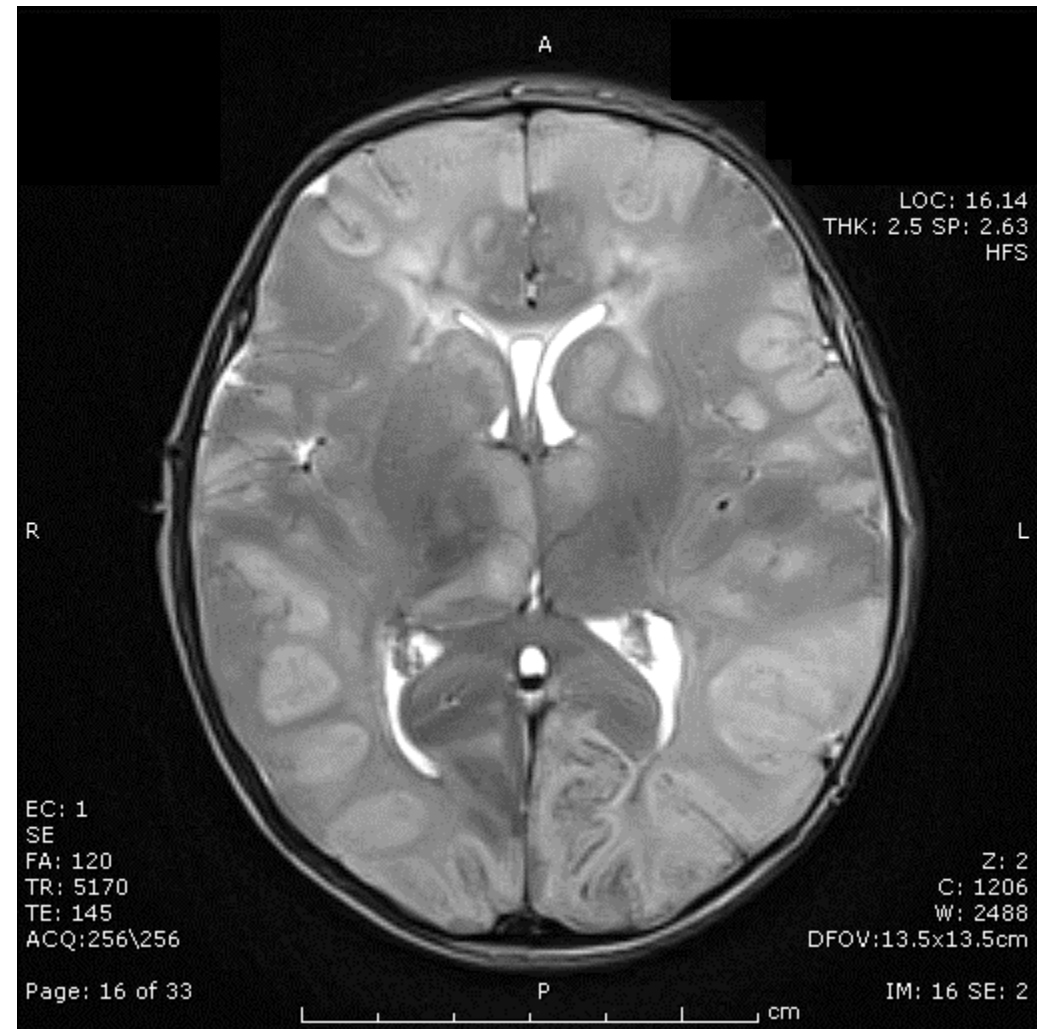
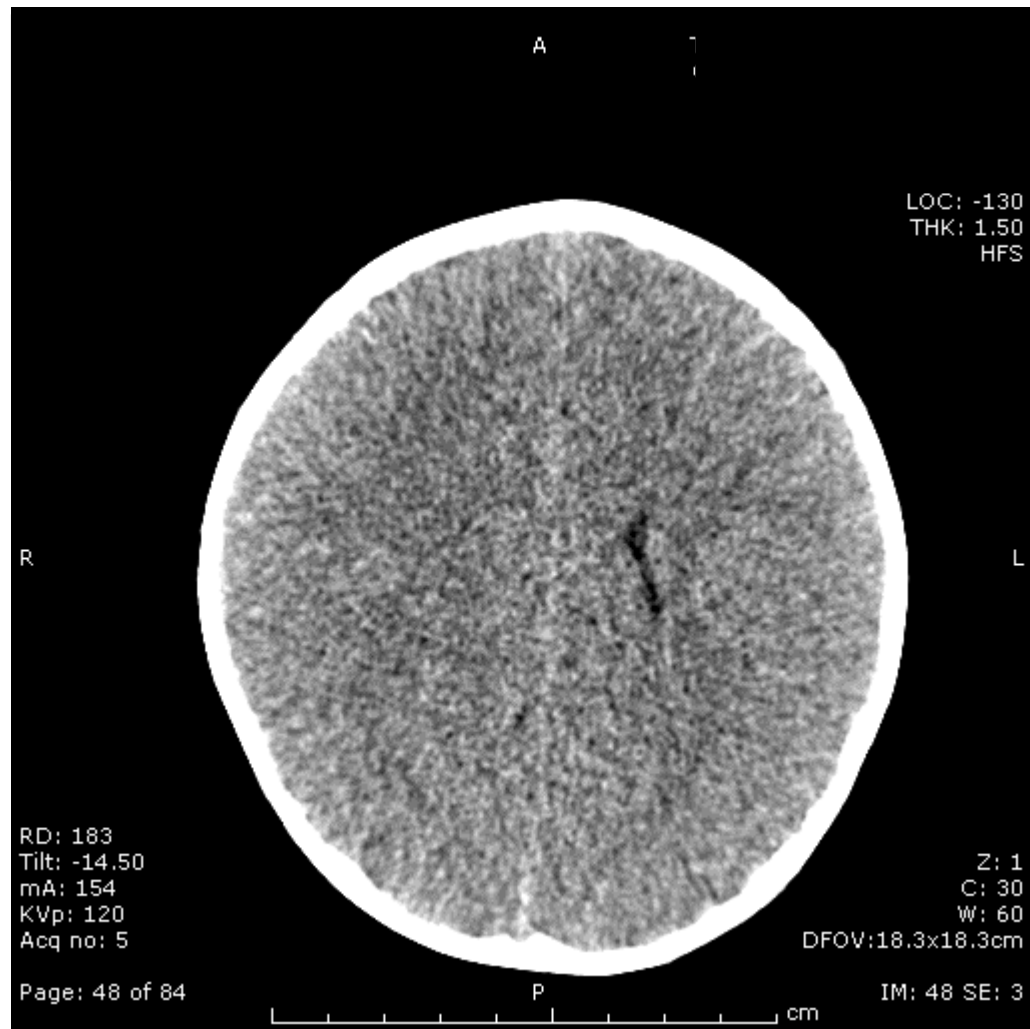
## Acute complications

- A. Airway obstruction, aspiration
- B. Breathing: hypoxaemia, hypercarbia
- C. Circulation: Shock
- D. Drowsiness / disability: seizures / coma
- E. Electrolytes – hyponatraemia, acidosis
- F. Fluid overload, dehydration
- G. Glucose – hypoglycaemia
- H. Haematology – coagulopathy, thrombosis

## Chronic / long term complications

- Motor - ischaemic stroke, hemiplegia, cerebral palsy
- Hearing loss – neurosensory 10%
- Visual impairment
- Epilepsy
- Hydrocephalus
- Sub-dural collections





# Antibiotic resistance in meningitis pathogens

	1996–2000	2001–2005	<i>P</i> value
<i>S. pneumoniae</i>			
Penicillin	29/116 (25.0)	9/61 (14.8)	0.12
Chloramphenicol	1/115 (0.9)	3/61 (4.9)	0.09
Cotrimoxazole	9/116 (7.8)	6/60 (10.0)	0.64
Tetracycline	2/69 (2.9)	2/27 (7.4)	0.32
<i>H. influenzae</i>			
Ampicillin	27/104 (26.0)	27/58 (46.6)	0.01
Chloramphenicol	27/104 (26.0)	24/58 (41.4)	0.04
Cotrimoxazole	35/104 (33.7)	28/58 (48.3)	0.07

**Up to 70% of  
*H. influenzae* type b  
resistant to chloramphenicol**

CSF specimens in children with meningitis, Goroka

# Immunisation

- Encapsulated bacteria (polysaccharide outer covering)
  - Limited immune response to polysaccharides <2 years
  - Protein conjugate with polysaccharide
- *Haemophilus influenzae* type b vaccine (Hib, Pentavalent)
  - Introduced in PNG 2008
  - Protein conjugate with Hib-polysaccharide
- Pneumococcal conjugate vaccine (PCV)
  - Introduced in PNG 2014
  - 13-valent (90+ serotypes)

# Febrile encephalopathy

- Fever plus:
  - a change in mental state (e.g. confusion, disorientation, coma or inability to talk)
  - new onset of seizures (not including simple febrile convulsions)

# Causes of febrile encephalopathy

## 12 studies, n=2077

- India (4)
- PNG (3)
- Nepal (1)
- Kenya (1)
- Cambodia (1)
- China (1)
- Vietnam (1)

*Annals of Tropical Paediatrics* (2010) 30, 109–118

### **The aetiology, clinical presentations and outcome of febrile encephalopathy in children in Papua New Guinea**

G. ANGA, R. BARNABAS, O. KAMINIEL\*, N. TEFUARANI†, J. VINCE†, P. RIPA‡, M. RIDDELL<sup>§</sup> & T. DUKE\*\*†

<b>Causes of febrile encephalopathy</b>	<b>Total N (%)</b>
Total	2077
Viruses	297 (14.3)
Bacterial meningitis	262 (12.6)
Cerebral malaria	203 (9.8)
Tuberculous meningitis	108 (5.2)
Septicaemia	13
Disordered electrolytes	6
Hepatic encephalopathy	3
DKA	3
Reyes syndrome	3
Acute Disseminated Encephalomyelitis	2
Cryptococcus neoformans	1
Shigellosis	1
Enteric fever	1
Prolonged coma after seizure	1
Intracranial bleed	1
Known causes	905 (44%)
Unknown	1172 (56%)

# Bacterial meningitis aetiology

- Children >1 months
  - *Streptococcus pneumoniae*
  - *Haemophilus influenzae* type b
    - Plasmid-mediated beta-lactamase
  - *Neisseria meningitidis*
- Neonatal meningitis (up to 2 months)
  - *E. coli*
  - Group B streptococcus



<b>Viruses causing encephalitis</b>	<b>297 (14.3)</b>
Japanese Encephalitis	156 (7.5)
Enterovirus	58 (2.8)
Dengue	31 (1.5)
Cytomegalovirus	19
Herpes Simplex Virus	15
Mumps	13
HHV-7 (Roseola: febrile seizures)	12
HHV-6 (Roseola: fever, seizures, diarrhoea, rash)	11
Influenza	9
Rubella	7
Measles	4
Varicella zoster	3
Epstein-Barr Virus	1

# Anga G, et al 2010

- 149 children; 129 had CSF examination
  - 66 (51%) normal CSF white cell count
  - 55 (37%) definite pathogen identifiable
    - Bacterial meningitis: 33 (*S. pneumoniae* 16, *H. influenzae* 13 and *N. meningitidis* 4)
    - Tuberculous meningitis confirmed (5), probable (18)
    - Malaria (10)
    - Cryptococcal meningitis (1)
    - Flavivirus encephalitis (5) – dengue / JE
    - Rubella encephalitis (1)
    - Hepatic encephalopathy (1)
    - HIV encephalopathy (1)
    - 28 cases meningitis of unspecified aetiology

# Kiromat K, et al 2018

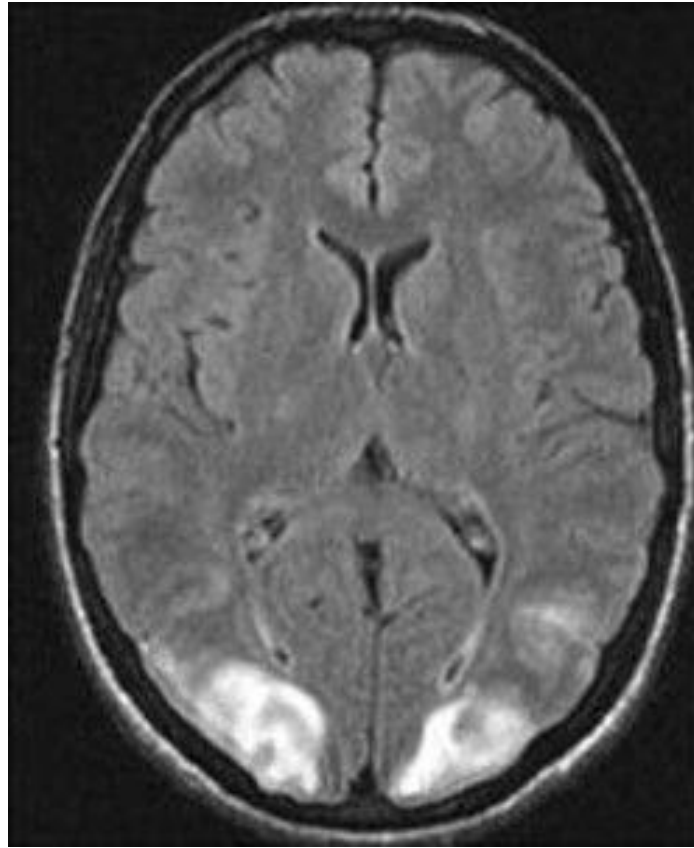
- 97 children with febrile encephalopathy in PMGH
  - 5 JEV encephalitis
  - 5 dengue
  - 5 Streptococcus pneumoniae
  - 1 Haemophilus Influenzae
  - 6 malaria
  - 19 probable tuberculosis meningitis
  - 14 aseptic meningitis - no identifiable cause
  - 41 acute encephalopathy with no CSF inflammation, ? cause
- 58% of cases had no identifiable microbial cause

# *Non-infective* encephalopathy

- Trauma
- Haemorrhage
- Toxins / drugs
- Metabolic / electrolytes – ammonia, sodium
- Hypertensive (PRESS)
- Epilepsy syndrome



Cerebral haemorrhage  
AV malformation

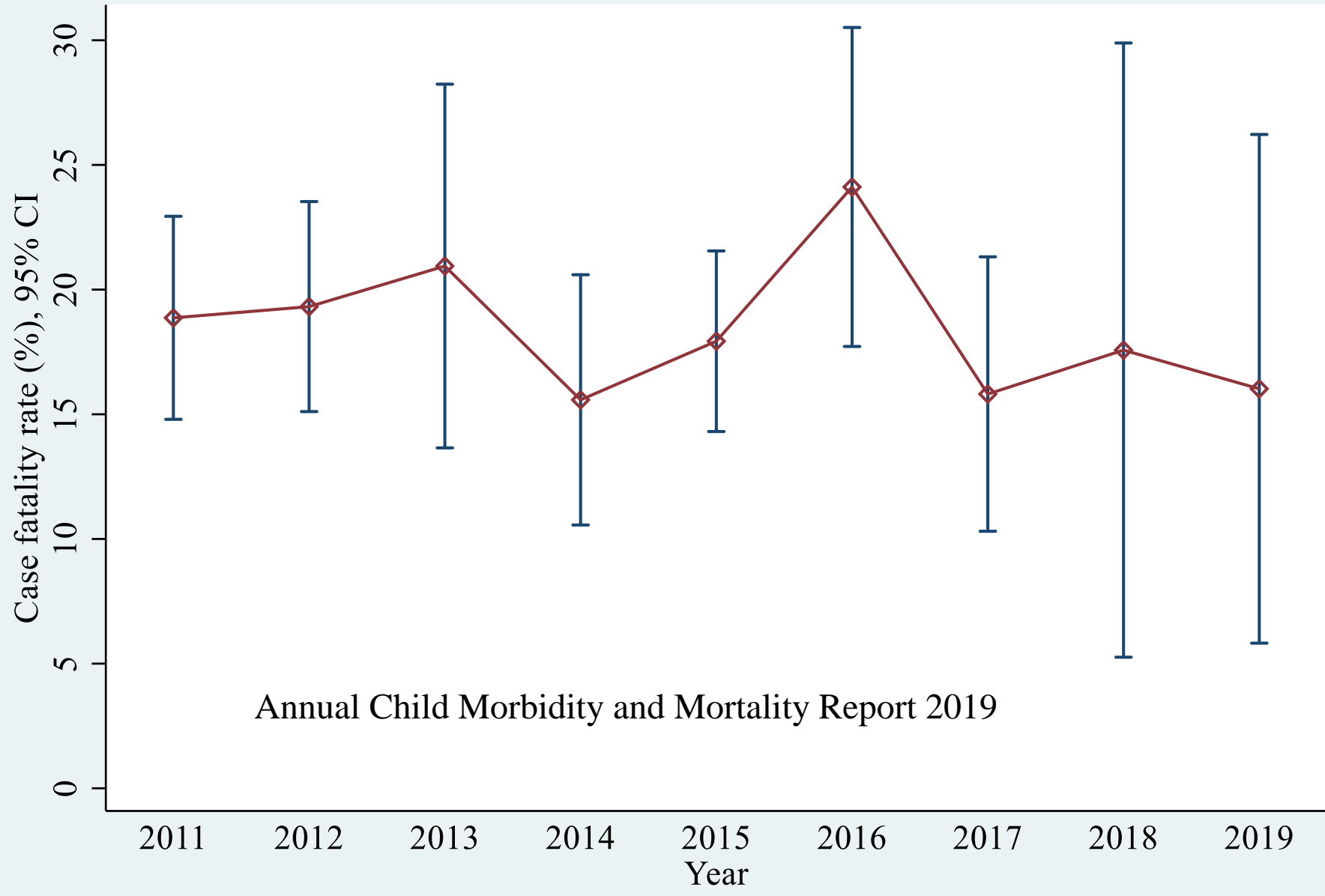


PRESS: posterior reversible  
encephalopathy syndrome  
Hypertensive encephalopathy



HHV-6 encephalitis

# Meningitis case fatality rates 2011-2019



Annual Child Morbidity and Mortality Report 2019

# Care of any seriously ill child

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- Emergency treatment
- History and examination
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- Main diagnosis and other diagnoses
- Treatment
- Supportive care
- Monitoring
- Discharge planning
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