CHILDHOOD PNEUMONIA: THE FORGOTTEN KILLER

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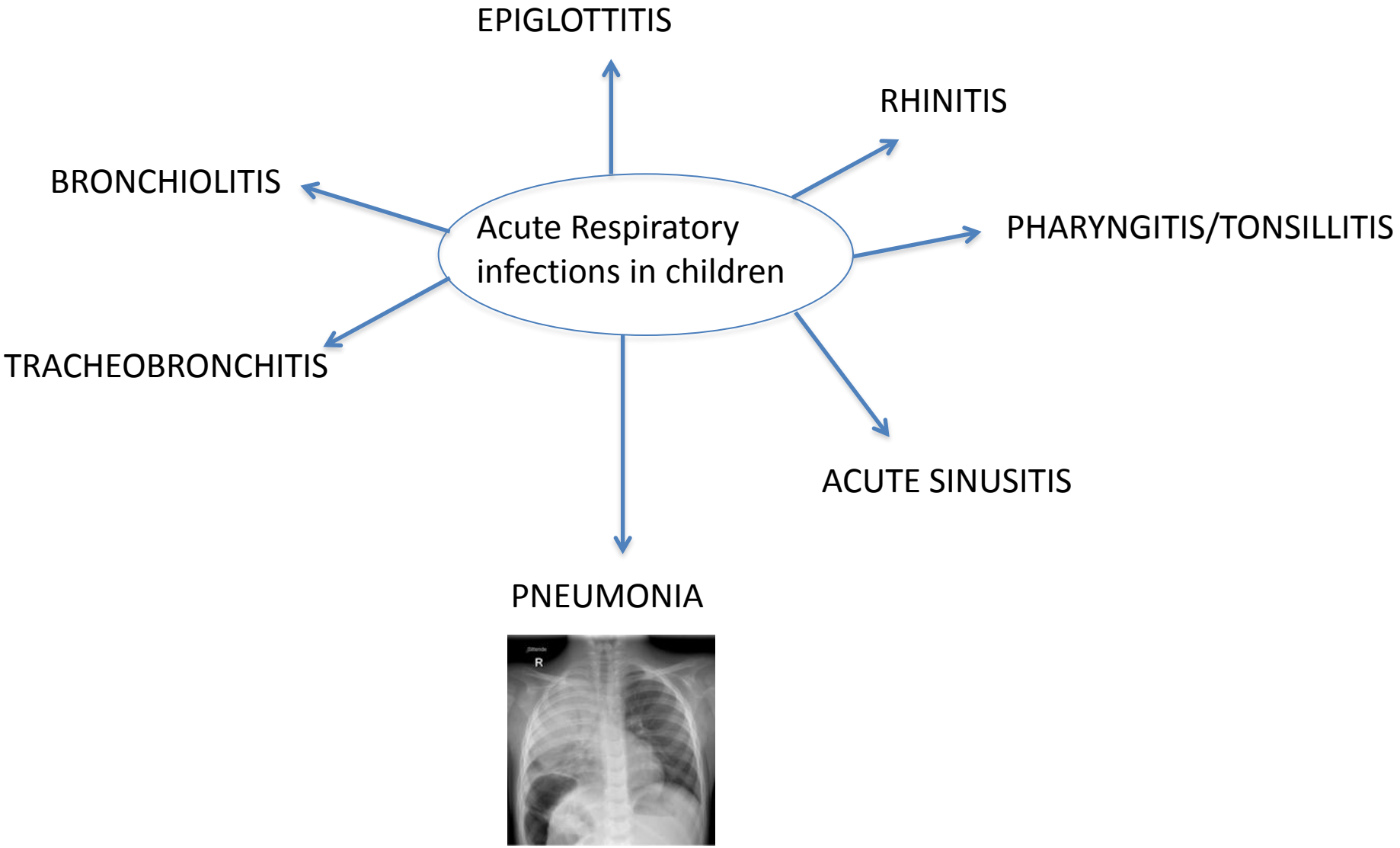
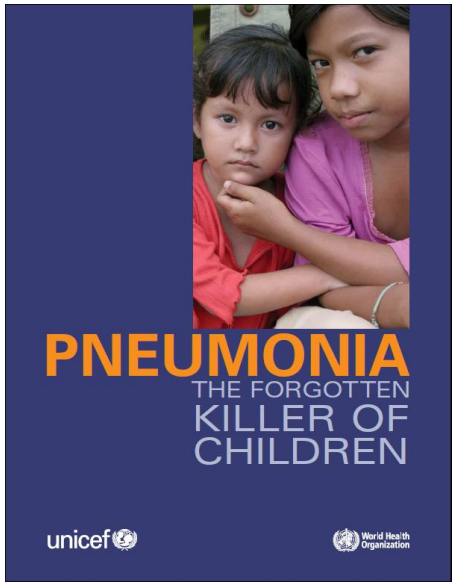
Respiratory infections in children

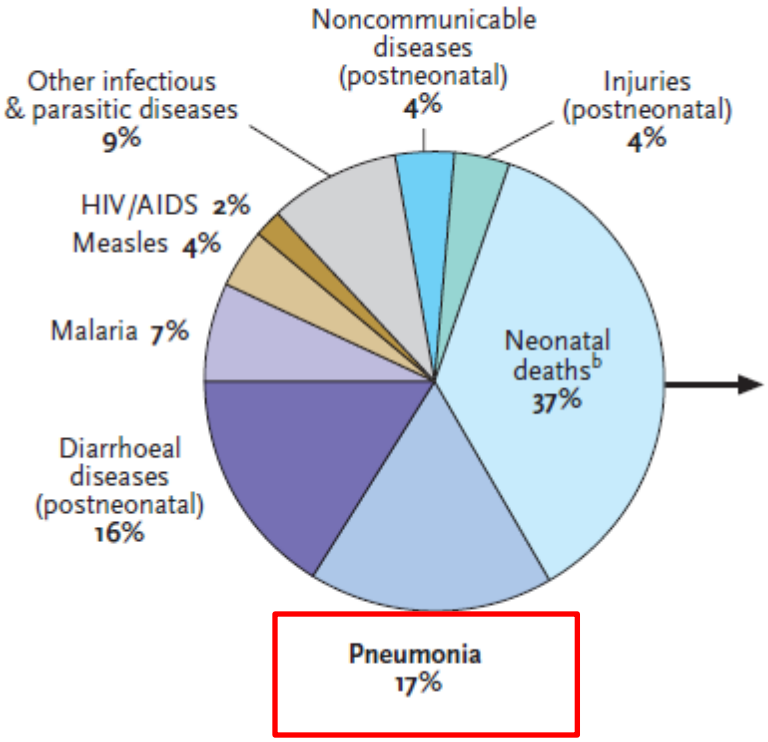


CHILDHOOD PNEUMONIA – SCOPE OF THE PROBLEM

- Pneumonia kills more children than any other single illness
- 1 in 5 deaths in children under 5 years worldwide are attributable to pneumonia



Deaths among children under five



Childhood pneumonia – a disease of the developing world

- Developing world: 151 million new episodes per year. 0.29 episodes per child-year. Mortality rate 1.3-2.6%

- Developed world: 4 million new episodes per year. 0.05 episodes per child-year. Negligible mortality.

EPIDEMIOLOGY OF CHILDHOOD PNEUMONIA

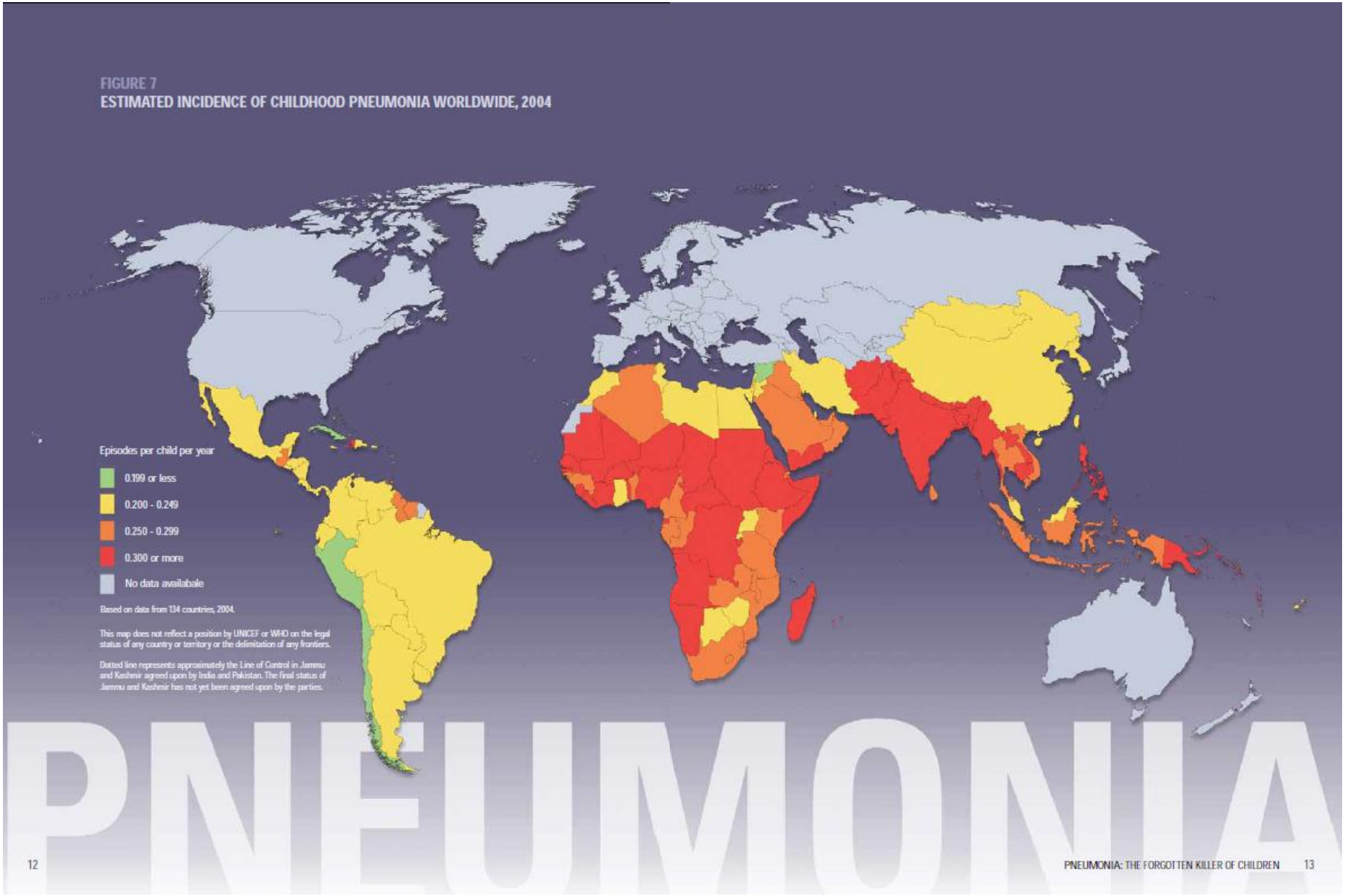
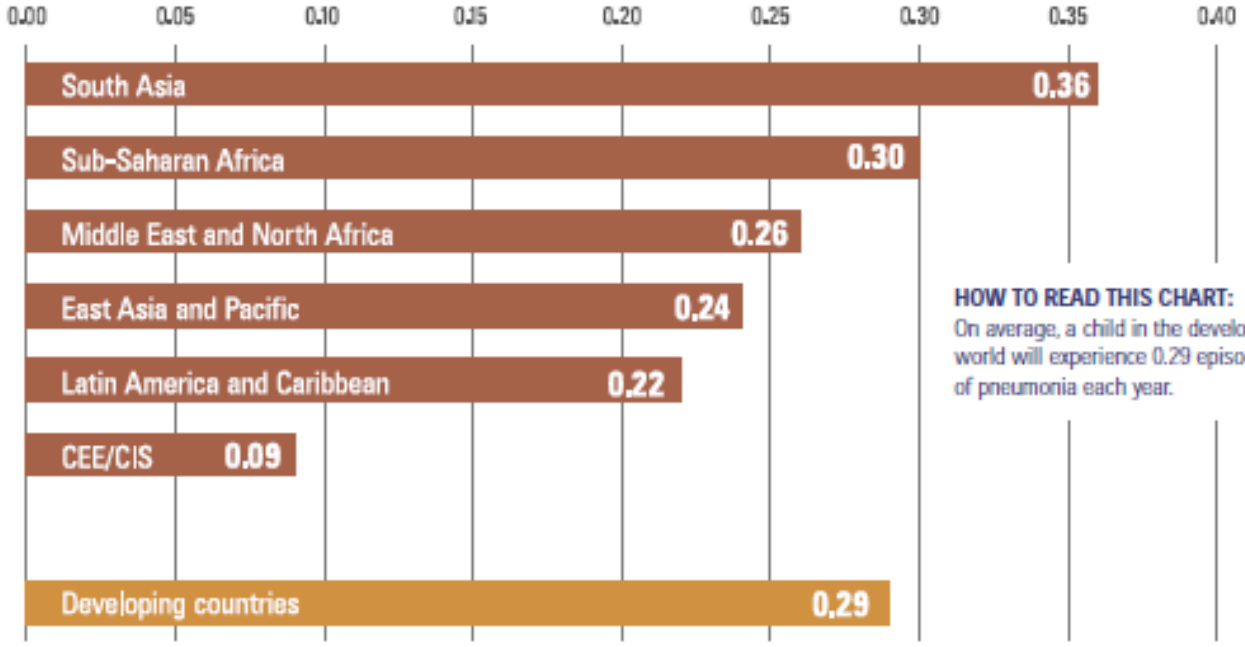


FIGURE 6

INCIDENCE OF PNEUMONIA IS HIGHEST IN SOUTH ASIA AND SUB-SAHARAN AFRICA

Episodes per child per year, by regions, 2004



Based on data from 134 countries, by UNICEF region, 2004.

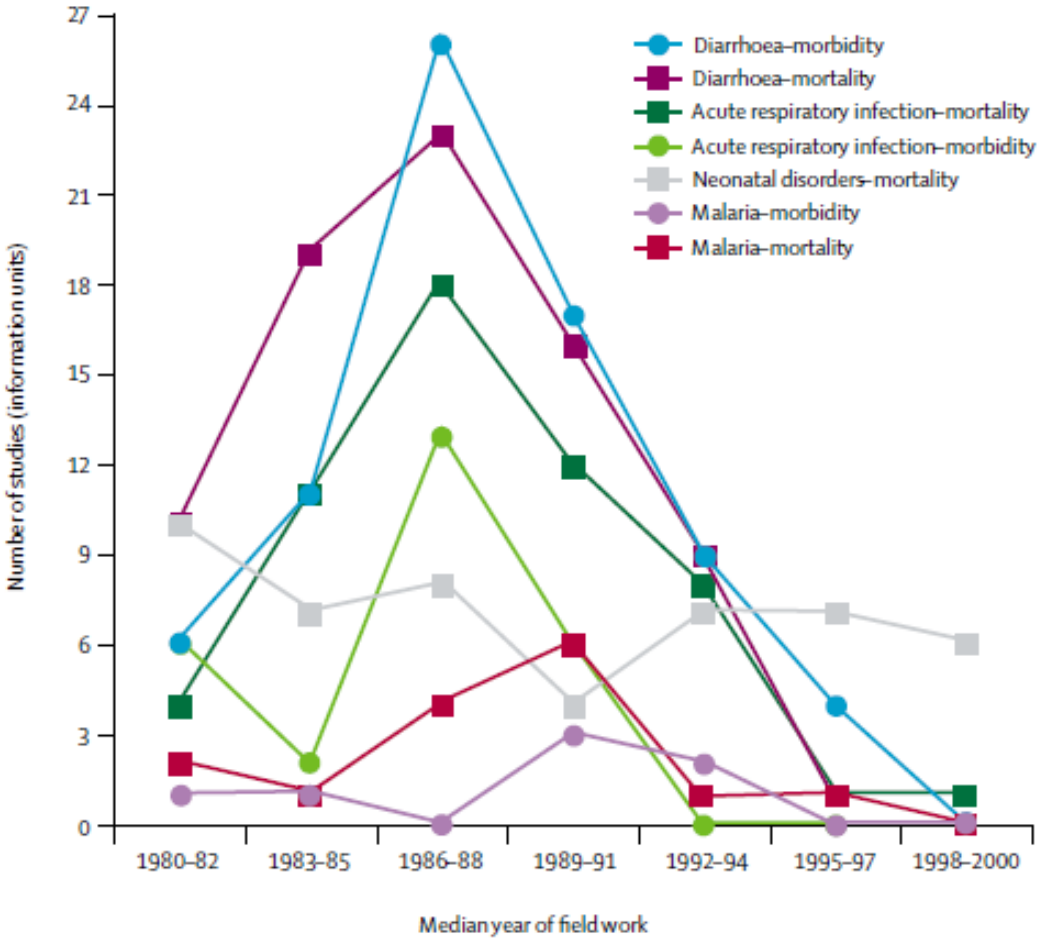
Why is pneumonia a bigger problem in the developing world?

- Malnutrition
- Over-Crowding
- Low birth weight
- Increased HIV/immunocompromised
- Lack of vaccination programme
- Poor maternal education
- Living in polluted areas
- Lack of efficient of heath care systems
- Lack of available antibiotics

The Forgotten Killer

- ~30,000 children under age of 5 years die every day worldwide from pneumonia
- Malaria, TB and HIV/AIDs have received global attention, despite only accounting for around 11% of all child deaths combined
- Childhood pneumonia is responsible for 20% of deaths

Decreasing trend in research publications on childhood pneumonia



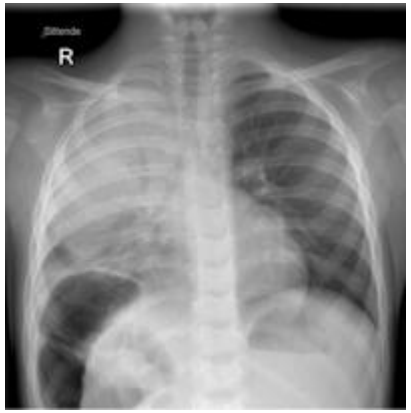
Rugan I et al. *Lancet Infect Dis* 2007; 7: 56-61

Why has there been reduced interest?

- Interventions exist that were developed >2 decades ago
- These interventions not being delivered to children who need them most
- Programmes to deliver these interventions inadequately funded
- Expert opinion believes that failures to implement interventions may be applicable in the future to AIDS, TB or malaria

Diagnosis of pneumonia and severity assessment

- Developed countries: Chest radiograph



- Developing countries: limited radiographic availability => clinical symptoms and signs

Severity assessment – developed and developing countries

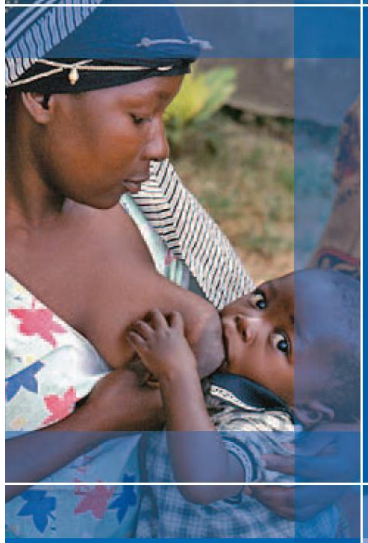
Table 1 Criteria used in developing and developed countries to define the severity of community-acquired pneumonia (CAP)

Developing countries	
Severe CAP	In children with CAP diagnosed on the basis of fast breathing and on possible evidence of lower respiratory tract involvement, severe cases are identified in the presence of cough or difficult breathing plus at least one of the following signs: ► lower chest wall indrawing ► nasal flaring ► grunting (in young infants)
Very severe CAP	In children with a diagnosis of CAP or severe CAP, a diagnosis of very severe CAP is based on the presence of at least one of the following: ► central cyanosis ► inability to breastfeed or drink, or vomiting everything ► convulsions, lethargy or unconsciousness ► severe respiratory distress
Developed countries	
Severe CAP	
Infants	Temperature >38.5°C Respiratory rate >70 breaths/min Moderate to severe recession Nasal flaring Cyanosis Grunting respiration Not feeding Sa_{O_2} <92%
Older children	Temperature >38.5°C Respiratory rate >50 breaths/min Severe difficulty in breathing Nasal flaring Cyanosis Grunting respiration Signs of dehydration Sa_{O_2} <92%

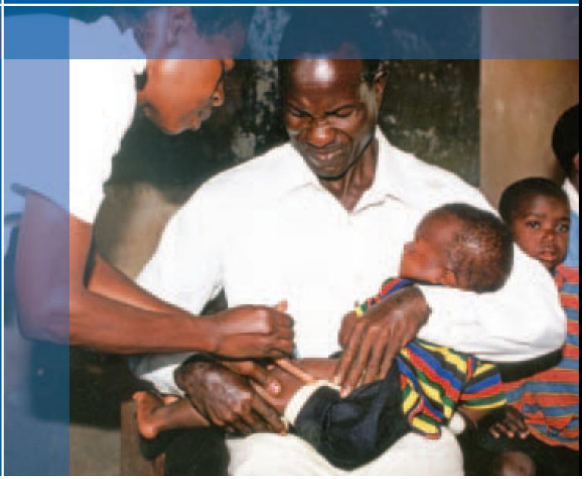
Adapted from the World Health Organization[11] and the British Thoracic Society.[7]
Sa_{O_2}, arterial oxygen saturation.

Aetiology

- Bacteria*: S.pneumoniae*, *H.influenzae* type B and *Staph Aureus*
- *S.pneumoniae* important in HIV-infected and uninfected children
- Viruses: 30-40% of acute respiratory infections in hospitalised children. RSV predominates (20-25% of all viral resp infections)
- HIV: broader spectrum of pathogens including Gram-ves *E.Coli* and *Salmonella* spp. and *P.jirovecii*



Global Action Plan for Prevention and Control of Pneumonia (GAPP)



World Health Organization

unicef

Reducing the Burden of Childhood pneumonia

GAPP outlined a 6 year worldwide scale-up of a set of interventions to control pneumonia:

- **Protect** children by providing an environment where they are at low risk of pneumonia.
- **Prevent** children from developing disease
- **Treat** children who become ill

PROTECTION
Interventions

Breastfeeding

"Promote exclusive breastfeeding for 6 months"

•Protects against Pneumonia by passive protection (antibacterial and anti-viral substances such as IgA, lactoferrin and cells (lymphocytes and neutrophils).

	Country and reference		
	Brazil (65)	Philippines (66)	Tanzania (67)
Cause of death	ALRI	ALRI	ALRI
Age (mo)	0.25–11	0–23	0–59
Design	Case-control	Cohort	Case-control
Sample size			
Number of children	254[1]	9942	1160[1]
Number of deaths	127	39	39
Breast-feeding status			
Breast-fed	1.0	1.0	1.0
Breast-fed + non-breast-fed	1.6 (0.7, 3.6)[2]	—	—
Non-breast-fed	3.6 (1.7, 7.5)	1.05	1.7
Breast-fed compared with non-breast-fed	2.7	—	—
Comments	Adjusted for age and confounders	—	—

[1] Number of children in the control group.
[2] 95% CI in parentheses.

Victora et al. *Am J Clin Nutr* 1999

Nutrition

- Malnourished children have impaired immunologic response and consequently more severe infections.
- Protein-energy Malnutrition may affect nonspecific and antigen specific defence mechanisms. Thymic atrophy, T lymphocyte reduction.

Summary of community-based studies of mortality from acute lower respiratory infection (ALRI) and relative risks based on wieght-for-age *z* scores in children from Brazil, the Philippines, and the Gambia

	Country and reference		
	Brazil (49)	Philippines (41)	Gambia (50)
Cause of death	ALRI	ALRI	ALRI
Age (mo)	0.25–11	0–23	0–23
Design	Case-control	Cohort	Case-control
Sample size			
Number of children	254[1]	9942	270[1]
Number of deaths	127	39	129
Relative risk based on weight-for-age z scores			
>0	1.0	—	—
0 to −0.9	4.0 (1.8, 9.3)[2]	—	—
−1 to −1.9	5.5 (2.2, 13.8)	—	—
≤−2	21.5 (6.3, 73.6)	—	—
≥0	—	1.0	—
−1	—	1.9	—
−2	—	3.3	—
−3	—	5.9	—
≥0.75	—	—	1.5
−1.26 to 0.76	—	—	0.2
−1.87 to −1.27	—	—	0.8
≤1.88	—	—	1.0
Comments	Adjusted for confounders	Calculated from linear fit of *z* scores	—

[1] Number of children in the control group.
[2] 95% CI in parentheses.

Indoor air pollution and pneumonia

- Household use of solid fuels (wood, animal dung, crop wastes and coal) is a potential modifiable risk-factor for pneumonia

- Solid fuels are the principal household fuel for 3 billion people worldwide and use closely linked to poverty

- Dherani et al 2008: Meta-analysis- overall pooled odds ratio of 1.78 (1.45-2.18) increased risk of pneumonia associated with solid fuel use

Possible Interventions

- Use of cleaner liquid fuels (kerosene/ethanol/liquefied petroleum gas)

- Better combustion ventilation through high quality biomass stoves

Hand washing

- Handwashing may prevent the spread of acute respiratory infection – viruses are readily transmissible (pneumonia caused by viruses and secondary bacterial agents)

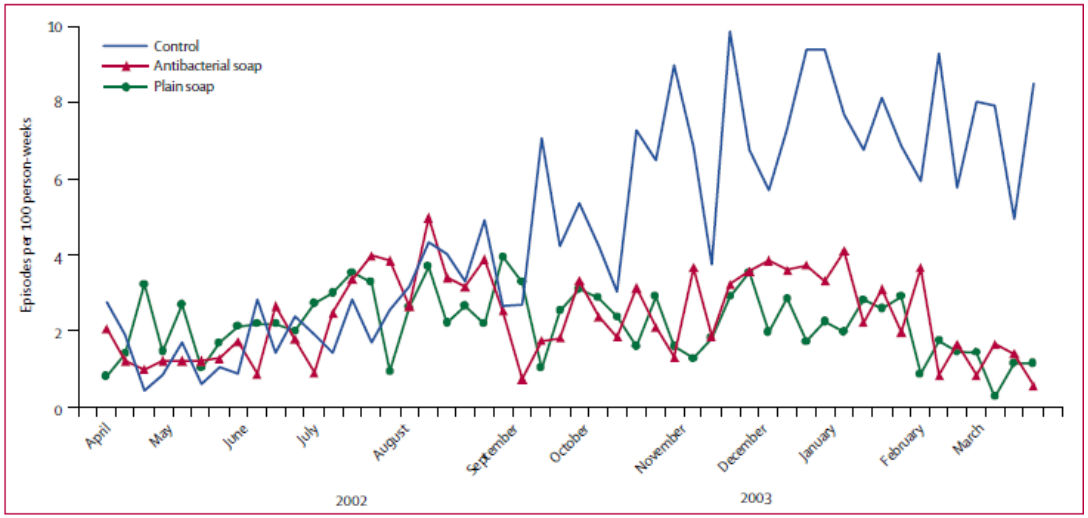


Figure 2: Incidence of pneumonia in children younger than 5 years

- 25 neighbourhoods in Karachi, Pakistan assigned to handwashing promotion; 11 neighbourhoods as controls.
- 300 households antibacterial soap, 300 plain soap.
- Fieldworkers visited households weekly for 1 year and encouraged handwashing

Luby SP et al. *Lancet* 2005

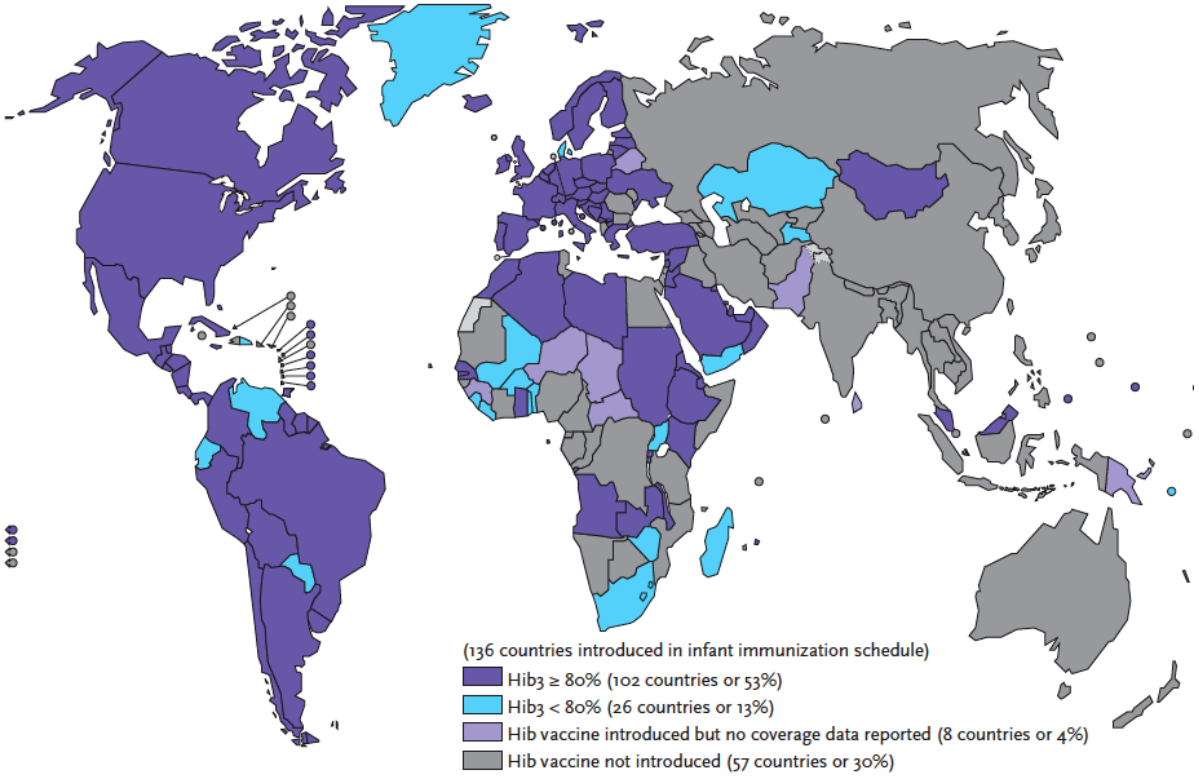
PREVENTION
strategies

Vaccination

- Global immunisation programmes have produced a decline in measles pneumonia and pertussis.
- Bacterial vaccines – H.influenzae type B (Hib) and pneumococcal conjugate vaccines have great potential to substantially reduce childhood pneumonia
- Hib conjugate vaccine reduces Hib invasive disease by 46-93%.
- Pneumococcal vaccines: polysaccharide or conjugate. Polysaccharide ineffective in children<5 yrs; Conjugate effective from 6 weeks of age onwards
- Expensive

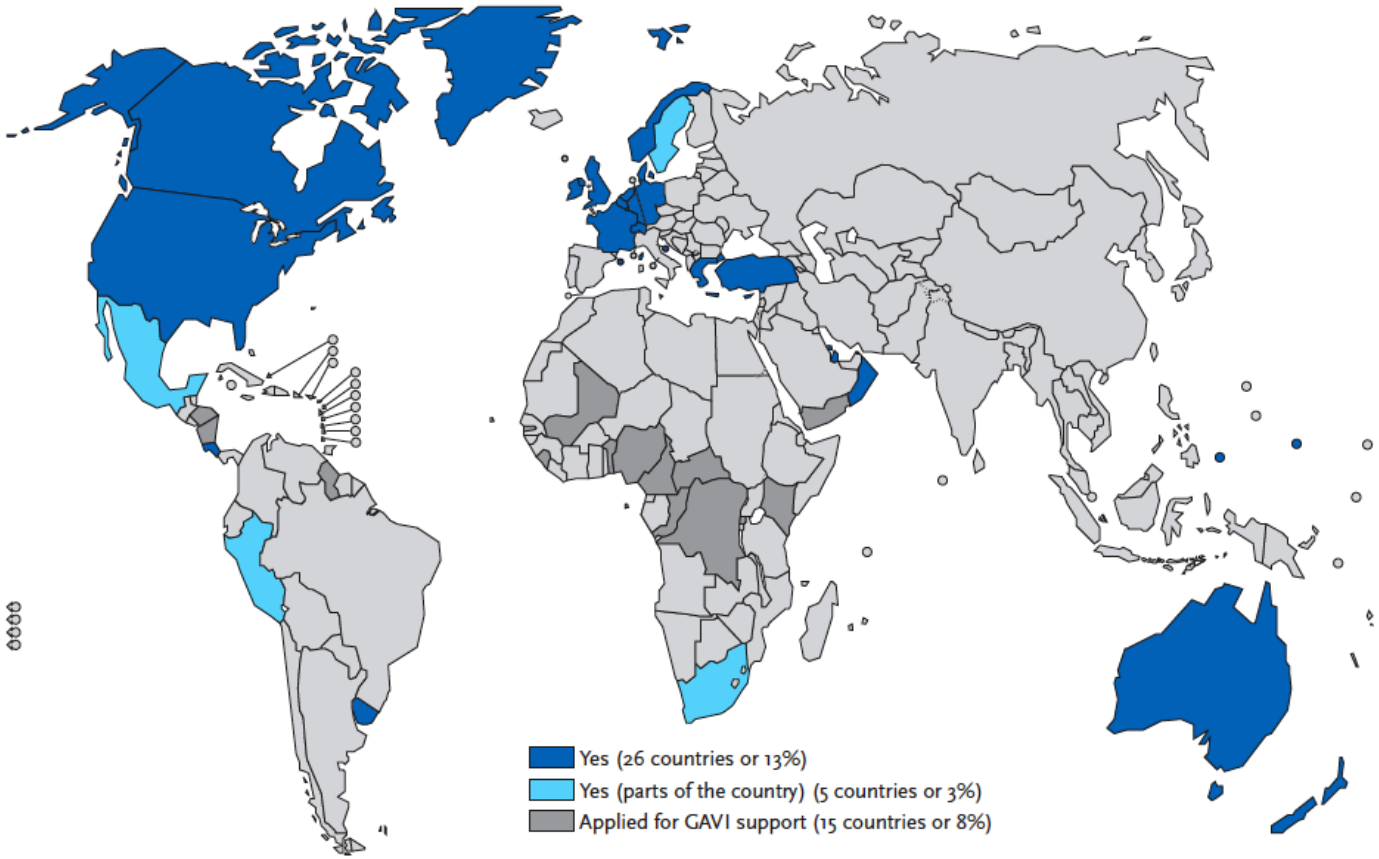
Worldwide HIB vaccine

FIG 7. COUNTRIES THAT HAVE INTRODUCED HIB VACCINE AND COVERAGE IN INFANTS (2008)



Worldwide pneumococcal vaccination

FIG 8. STATUS OF GLOBAL PNEUMOCOCCAL CONJUGATE VACCINE INTRODUCTION (2008)



HIB Vaccine

Doses	Pneumonia*		Meningitis		Other		All	
	PRP-T	Control	PRP-T	Control	PRP-T	Control	PRP-T	Control
0	0	1	3	1	0	0	3	2
1	2	4	3	4	0	1	5	9
2	0	5	0	4	1	1	1	10
3	0	5	1	12	0	2	1	19
Total	2	15	7	21	1	4	10	40
2 or 3	0	10	1	16	1	3	2	29

*Children with pneumonia which occurred in association with proven Hib meningitis were classified as meningitis.

Mulholland K et al. *Lancet* 1997

Pneumococcal vaccine

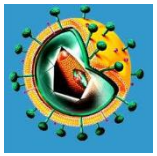
Table 4. Efficacy of the Vaccine against First Episodes of Radiologically Confirmed Pneumonia.*

Variable	Vaccinated Group	Control Group	P Value	Vaccine Efficacy (95% CI)
	no. of episodes			%
HIV-negative children	169	212	0.03	20 (2 to 35)
HIV-positive children	182	209	0.19	13 (–7 to 29)
All children	356	428	0.01	17 (4 to 28)

* CI denotes confidence interval, and HIV human immunodeficiency virus.

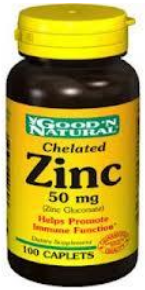
Klugman K et al *NEJM* 2003

HIV prevention and treatment



- HIV pandemic has resulted in a large increase in incidence, severity and outcome of childhood pneumonia
- Impact compounded by poor access and unavailability of HAART.
- Interventions such as Cotrimoxazole prophylaxis have been targeted by the WHO for HIV-infected children to reduce burden of pneumonia

Zinc Supplementation



- Zinc deficiency widely prevalent in the developing world
- Proposed by some authors to hold promise as an intervention to reduce incidence and mortality
- Three trials to date – all used daily dose 20mg zinc at onset of pneumonia.

Malhalanabus et al 2004: Zinc improved recovery from 'very ill' status and fever

Brooks et al 2004: Reduced duration of severe pneumonia and reduced hospitalisation

Bose et al 2006: Prolongation of pneumonia duration. No effect on severity parameters.

TREATMENT
strategies

Case management in community

- Major barrier in developing countries is lack of access to care.
- Improving management of suspected cases the community is an important objective
- Based on the premise that:

a) High proportion of pneumonia is bacterial
b) Timely antibiotic therapy reduces mortality
c) A simple algorithm based on counting respiratory rates is sensitive for identifying children with pneumonia
d) Health care workers can use this algorithm to provide antibiotics to children

SIGNS	CLASSIFY AS	TREATMENT
• Fast breathing (see below) • Lower chest wall indrawing • Stridor in calm child	Severe pneumonia	• Refer urgently to hospital for injectable antibiotics and oxygen if needed • Give first dose of appropriate antibiotic
• Fast breathing (see below)	Non-severe pneumonia	• Prescribe appropriate antibiotic • Advise mother on other supportive measures and when to return for a follow-up visit
• No fast breathing	Other respiratory illness	• Advise mother on other supportive measures and when to return if symptoms persist or get worse

WHAT IS FAST BREATHING?

If the child is...	The child has fast breathing if you count...
2 months to 12 months old	50 breaths or more per minute
12 months to 5 years old	40 breaths or more per minute

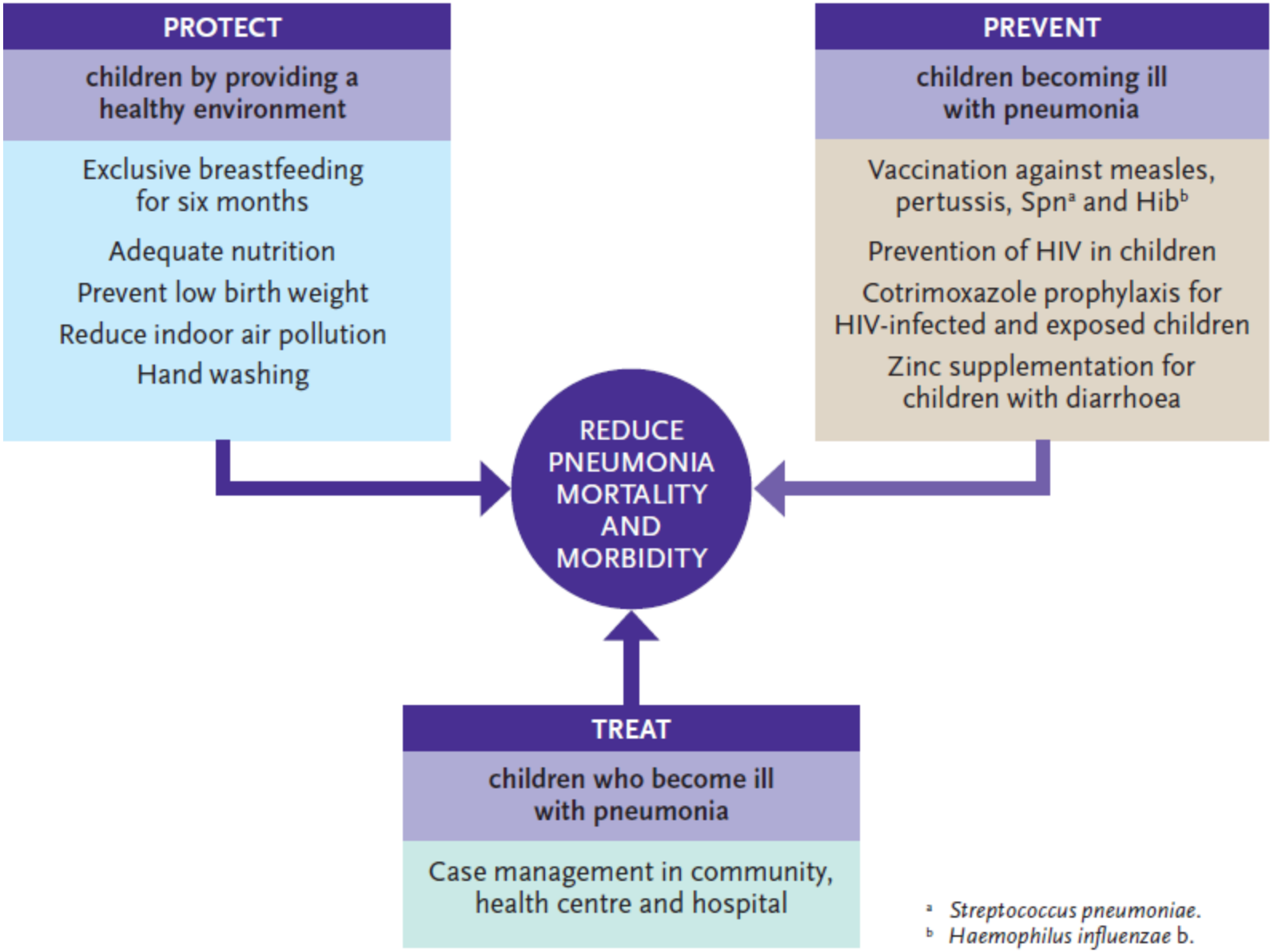
Effect of improved case management

- Meta-analysis of 10 studies evaluating the impact of case-management on mortality from pneumonia Sazawal et al. *Lancet Infect Dis* 2003.

- Reduction in total mortality of 27% in neonates, 20% in infants and 24% in children

Possible essay Question

“Outline reasons why childhood pneumonia kills more children in developing countries and discuss possible interventions/strategies that may address this health inequality”



[a] *Streptococcus pneumoniae.*
[b] *Haemophilus influenzae* b.