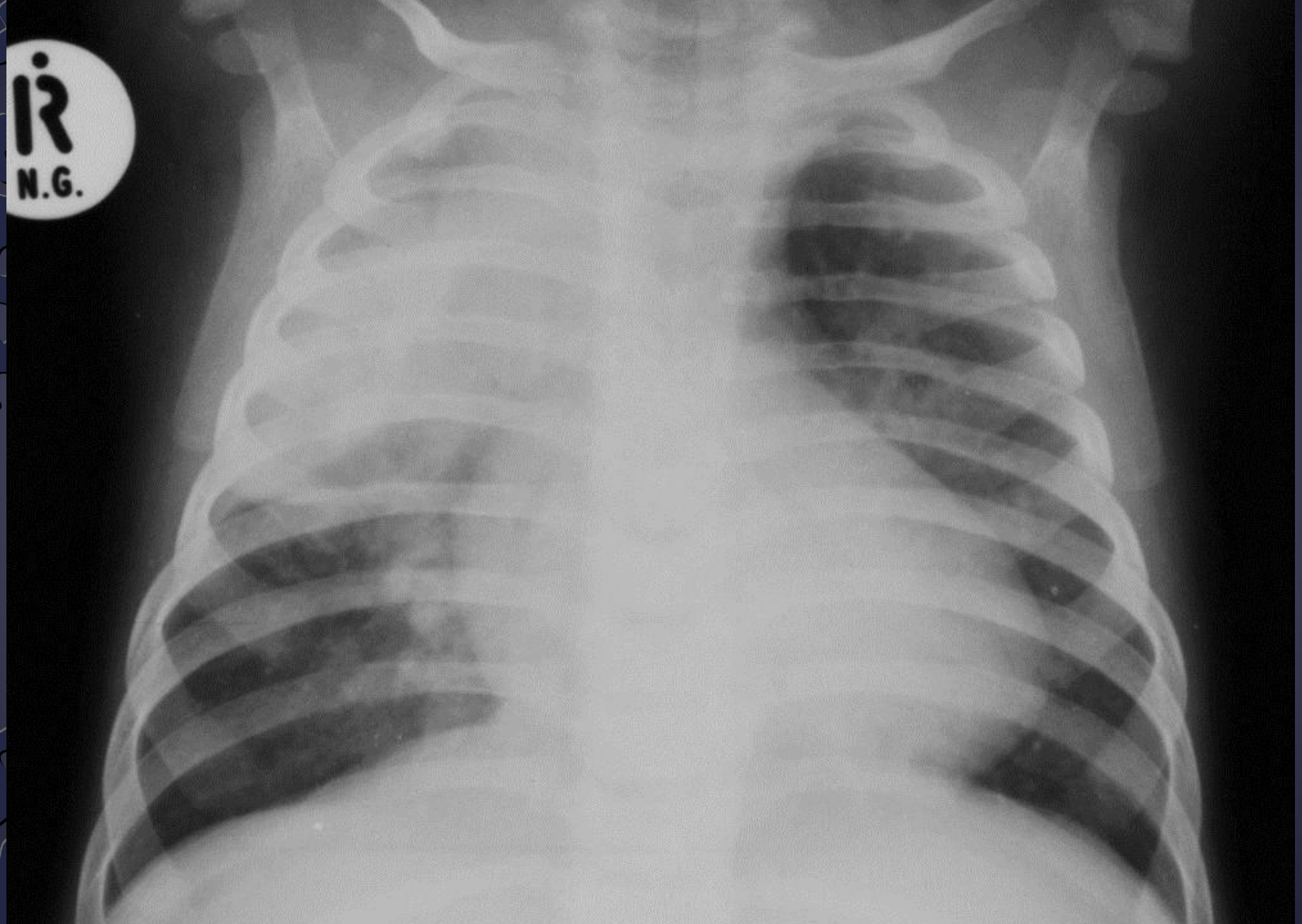
Childhood pneumonia

Kim Mulholland

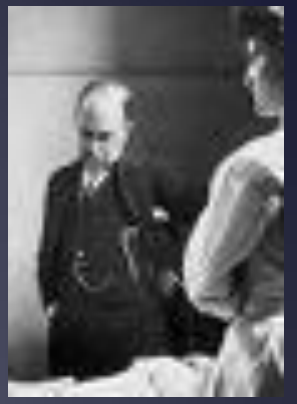
Murdoch Childrens Research Institute
University of Melbourne Department of Paediatrics
London School of Hygiene and Tropical Medicine, UK


R
N.G.

Pneumonia as a cause of mortality

- Historically:
  - regarded as "endogenous cause of mortality"
  - pneumonia death = debility, poverty, crowding
  - not seen as a specific cause of death
    - cf. Modern attitudes to pneumonia in the elderly
- Tended to be "left aside" as an important cause of child death

…but children usually survive pneumonia

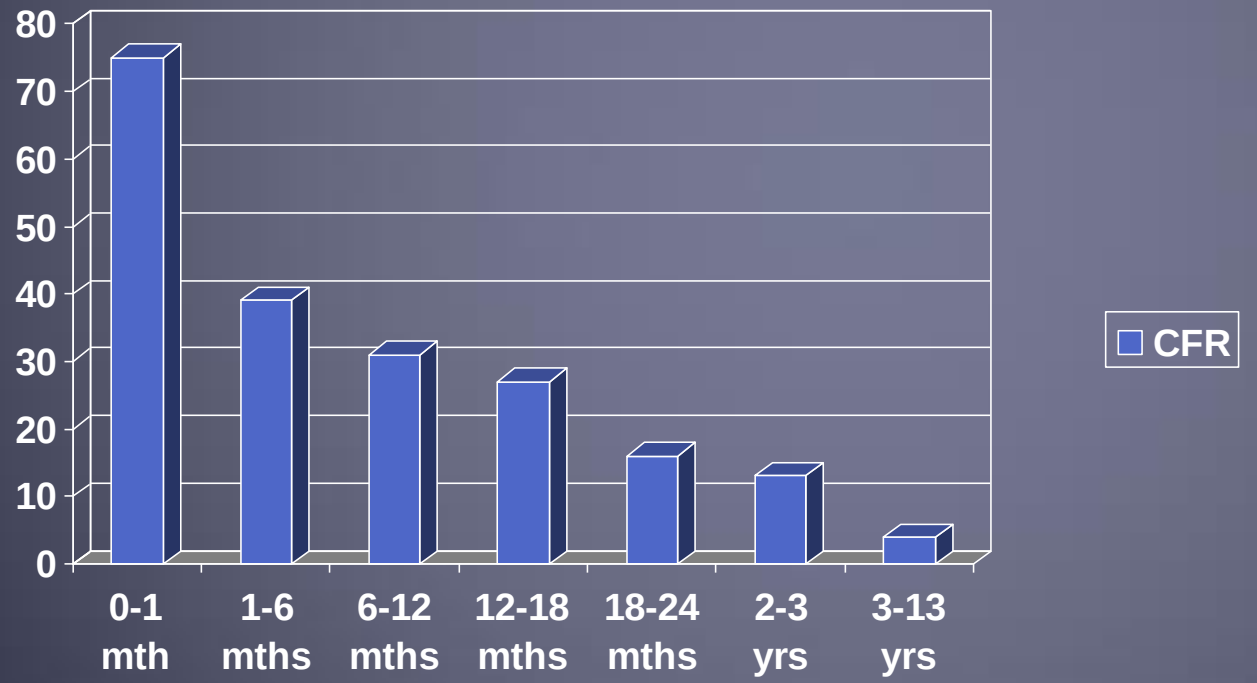


- William Osler on The prognosis of Pneumonia, 1897:

"The old are likely to die, the young to recover. Mortality in children has ranged from 1.9-3.3%. On the other hand , above 60 years of age the death rate is very high, reaching 50-60, or even 80%."

Amer J Med Sci 1897;113:1-10.

Case fatality rate of pneumonia by age, New York 1926-33

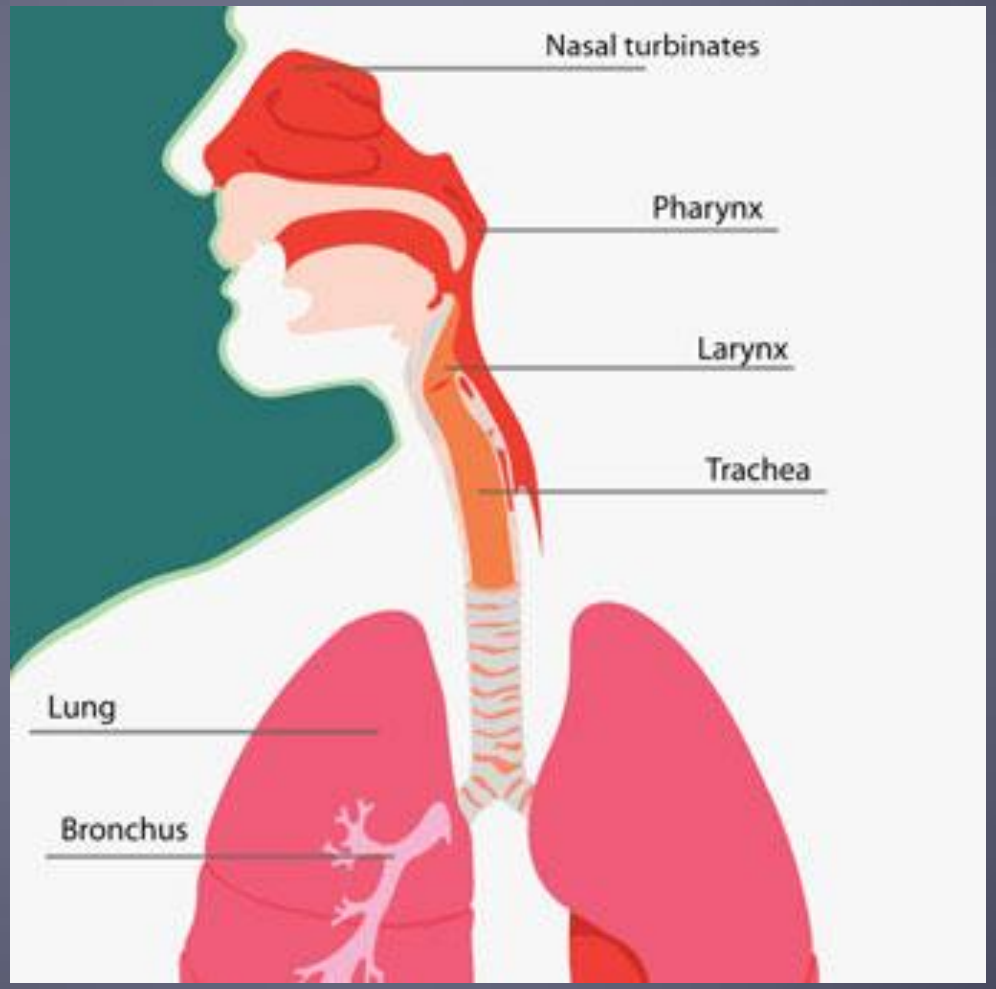


AJDC 1936;51:1095-1100

The problem

- Childhood pneumonia is:
  - The largest single cause of child death in the world
    - 920,000 deaths in 2015 (WHO estimate)
    - 16% of all child deaths
    - Where mortality is higher, the % of deaths due to pneumonia is higher
  - The most common cause for hospitalization of children in less developed countries
  - Responsible for unknown long term lung damage

The respiratory tract

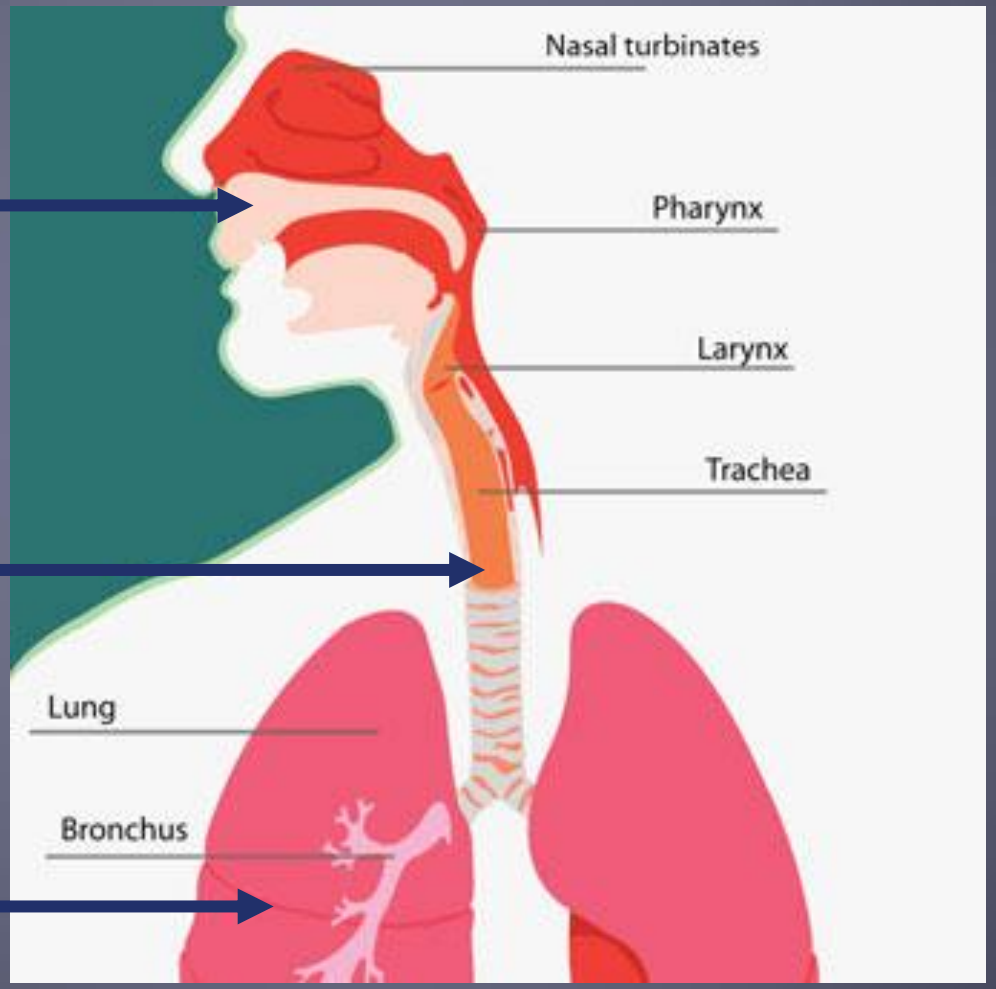


The respiratory tract

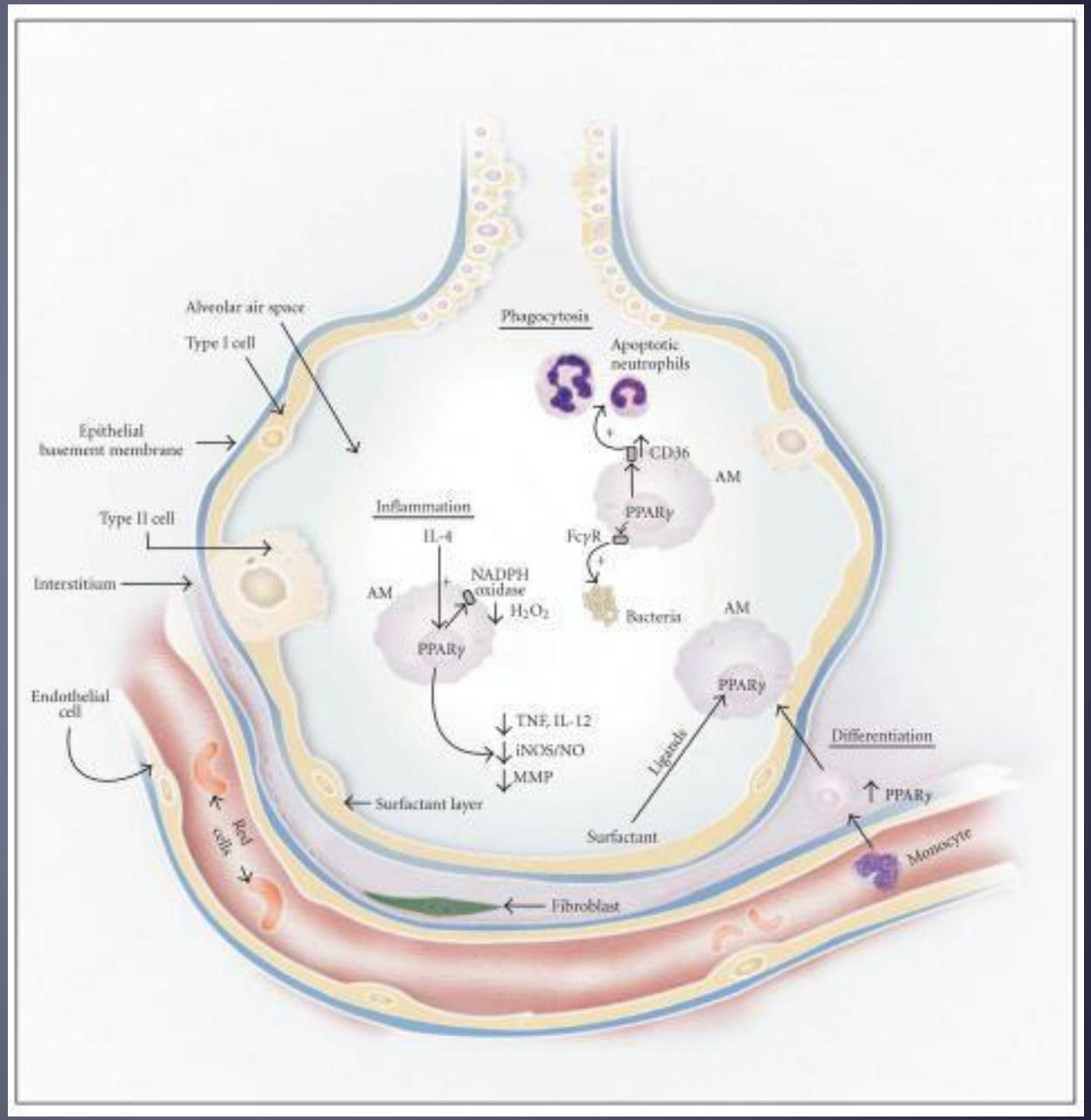
Bacteria ++

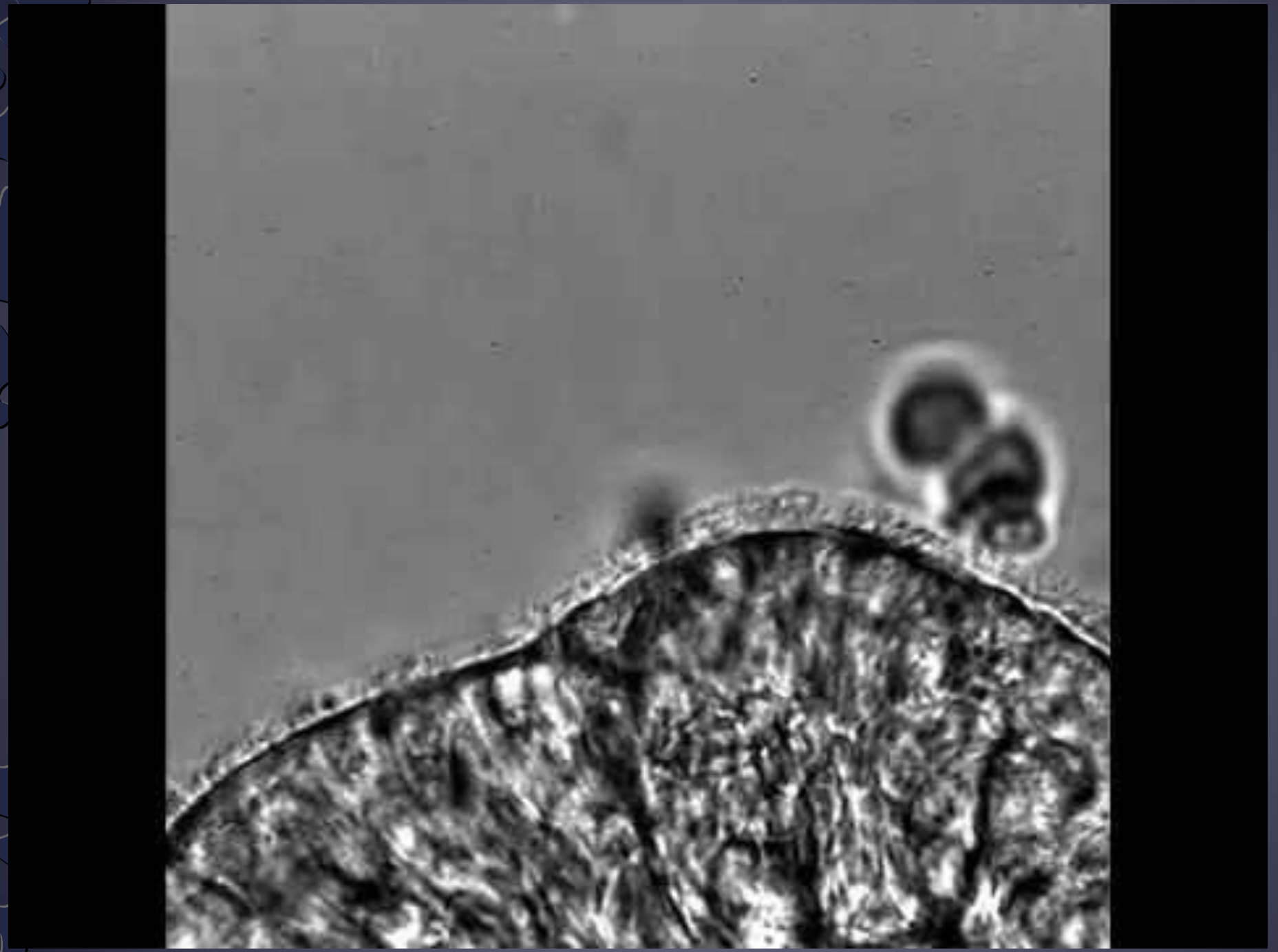
Bacteria +

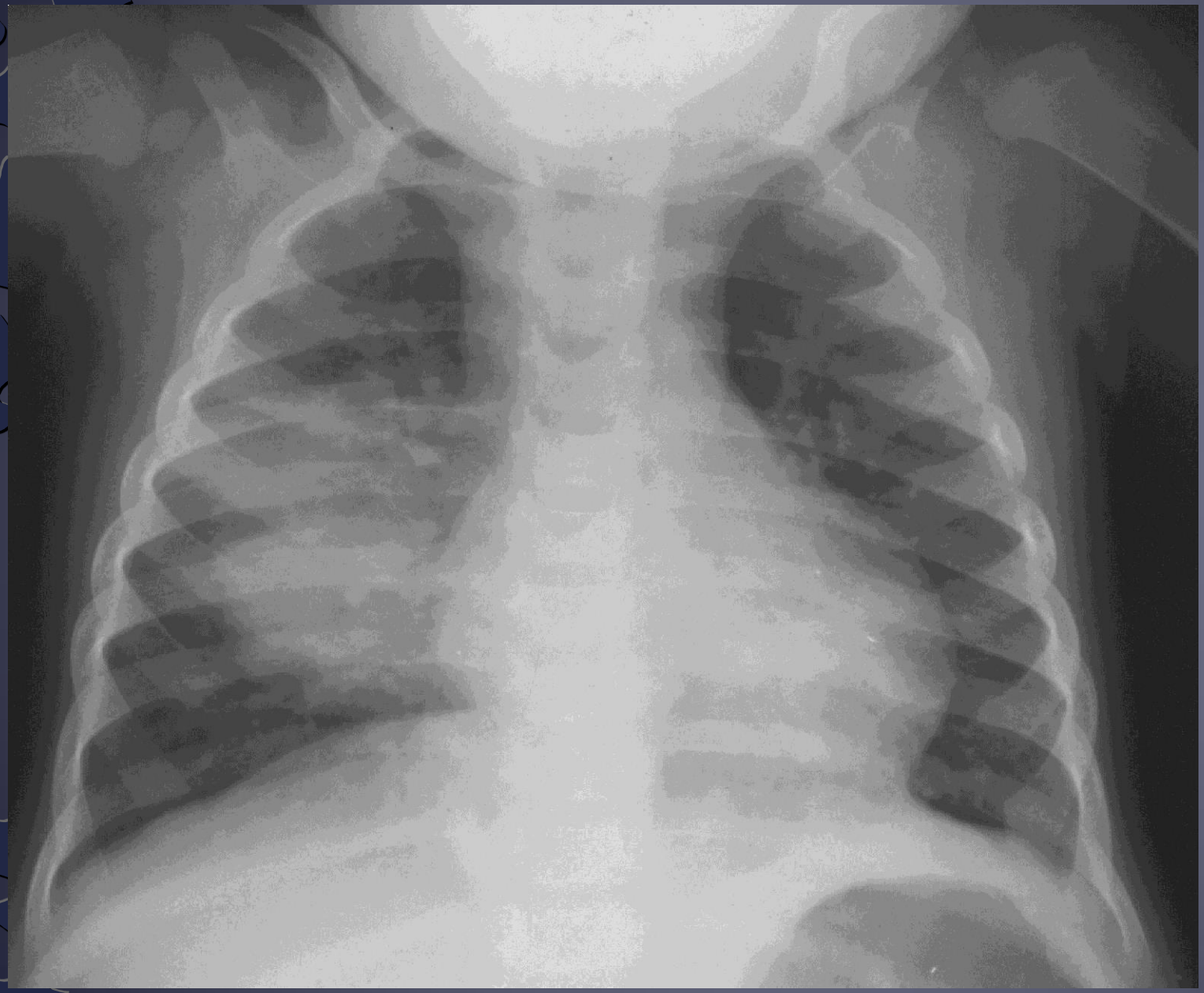
Bacteria +/-

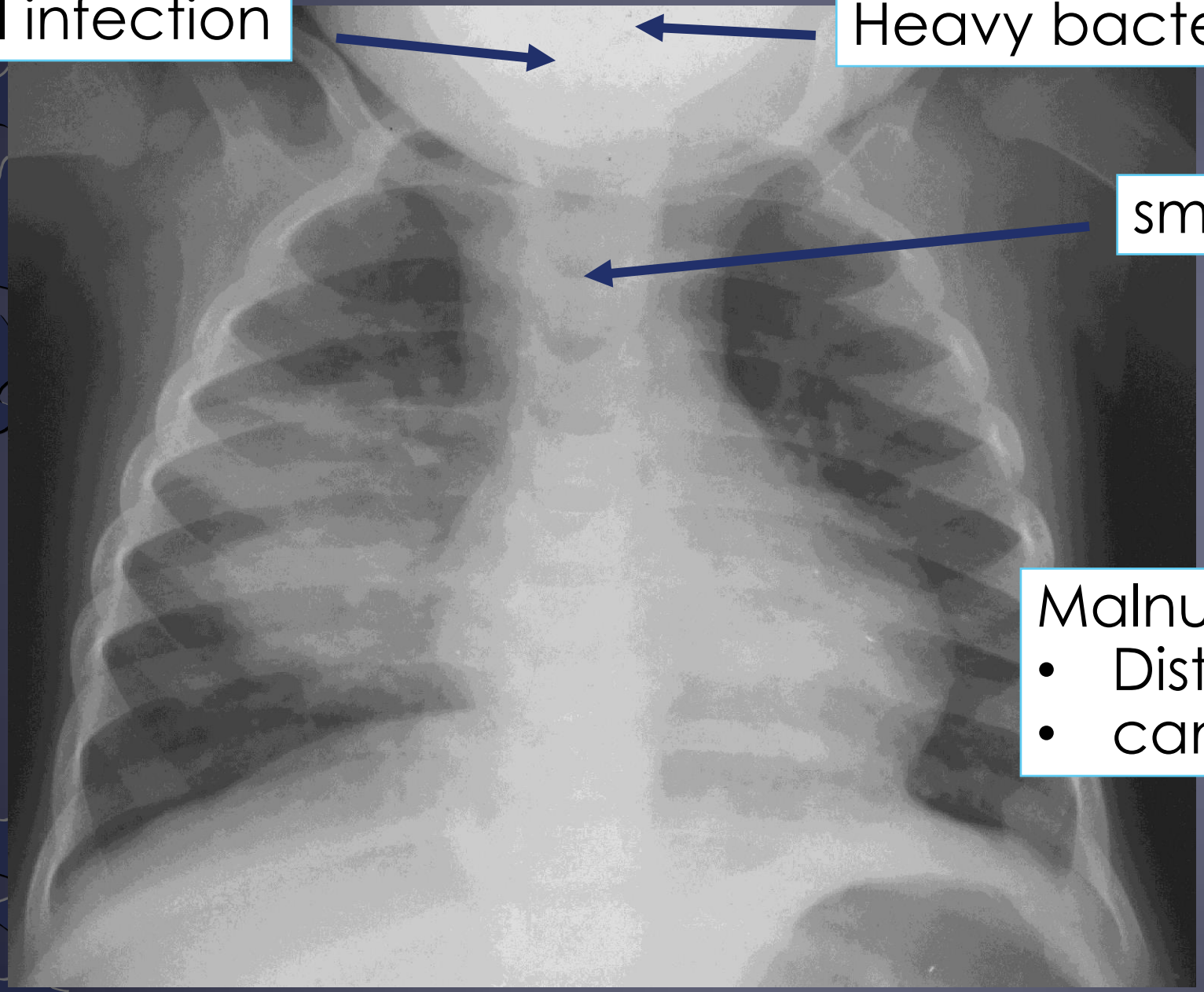


Alveolar immunity









Viral infection

Heavy bacterial colonization

smoke

Malnutrition –

- Disturbed immunity
- cannot cough

What causes pneumonia?

- Underlying causes
  - Poverty, crowding, malnutrition
  - Smoke
  - Chronic health problems, especially neurological
  - HIV
- Precipitating factors
  - Acute viral infection – measles, RSV
- Role of bacteria
  - Colonizing bacteria become invasive
    - Streptococcus pneumoniae (pneumococcus)
    - Haemophilus influenzae (type b or other types)
    - Staphylococcus aureus

What causes pneumonia?

- Underlying causes
  - Poverty, crowding, malnutrition ← preventable
  - Smoke ← preventable
  - Chronic health problems, especially neurological
  - HIV ← treatable
- Precipitating factors
  - Acute viral infection – measles, RSV ← Preventable
- Role of bacteria
  - Colonizing bacteria become invasive ← Treatable & Preventable
    - Streptococcus pneumoniae (pneumococcus)
    - Haemophilus influenzae (type b or other types)
    - Staphylococcus aureus

How to treat pneumonia

- Need:
  - Antibiotics
  - Oxygen (severe cases)
  - Supportive care, fluids, nutrition
- Can be in hospital or at home


DABAT
HEALTH CENTER

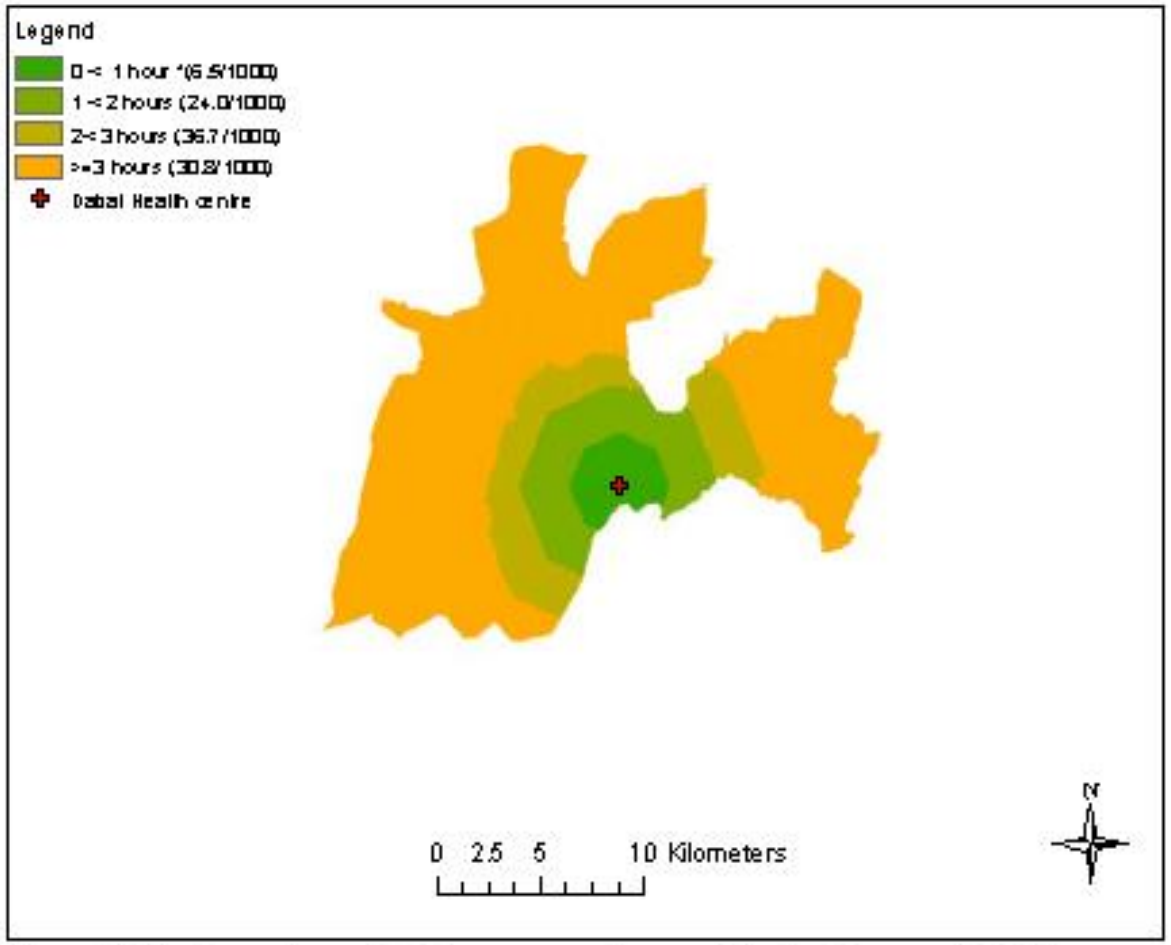


Figure 4 Under 5 mortality per 1,000 person years by travel time in Dabat, rural Ethiopia

*Under five mortality rate per 1000 person years

PLoS One. 2012; 7(3):e33564.

At the first level health facility

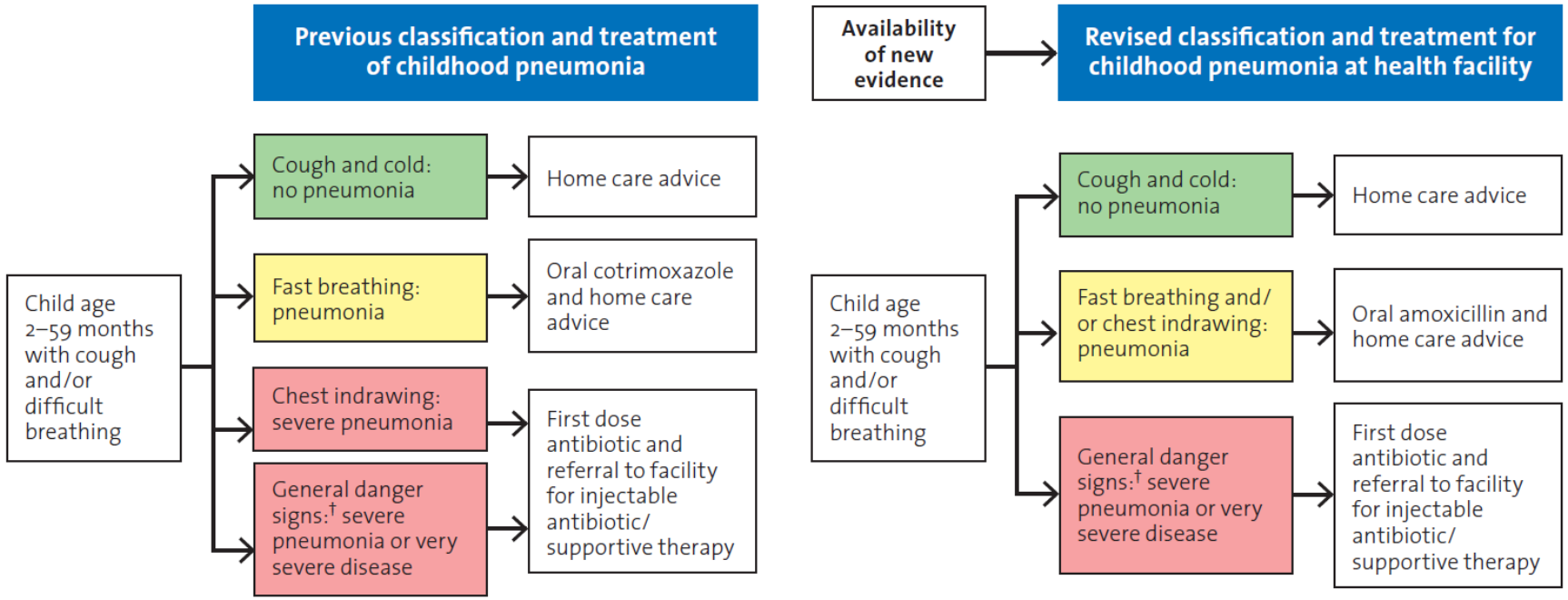
- Identify children with cough and fast breathing, chest wall indrawing or other signs of pneumonia
  - Home with antibiotics (usually amoxicillin)
- Identify children who need to be referred for admission to hospital
  - Very young
  - Malnutrition, poor conscious state, fitting, hypoxia (pulse oximetry)
  - *Lower chest wall indrawing*

Example: Gadi, 6 months (II)

▪ Danger signs ▪ ~~Chest wall indrawing~~ ▪ Stridor in calm child	**SEVERE PNEUMONIA OR VERY SEVERE DISEASE**
▪ Fast breathing ***Chest wall indrawing***	**PNEUMONIA**
▪ No signs of pneumonia or very severe disease	**NO PNEUMONIA: COUGH OR COLD**

Age of the child:	**Fast breathing:**
1 week to 2 months	RR $\geq$ 60/min
2 months to 12 months	RR $\geq$ 50/min
12 months to 5 years	RR $\geq$ 40/min

FIGURE. Comparison of previous and revised classification and treatment of childhood pneumonia at health facility



† Not able to drink, persistent vomiting, convulsions, lethargic or unconscious, stridor in a calm child or severe malnutrition.

At the first level health facility

- Identify children with cough and fast breathing, chest wall indrawing or other signs of pneumonia
  - Home with antibiotics (usually amoxicillin)
- Identify children who need to be referred for admission to hospital
  - Very young
  - Malnutrition, poor conscious state, fitting, hypoxia
  - Lower chest wall indrawing
  - Pulse oximetry (detect hypoxia)

At the first level health facility

- Identify children wit
  wall indrawing or ot
  - Home with antibiotic
- Identify children wh
  admission to hospit
  - Very young
  - Malnutrition, poor c
  - Lower chest wall ind
  - Pulse oximetry (dete

Problems with the WHO guidelines for management of childhood pneumonia

See Articles page e74

Global child mortality has fallen substantially in the past 25 years. Available data and modelled estimates indicate that pneumonia mortality has fallen to a greater extent.[1] Although improved community development and immunisation have no doubt contributed to this decline, improved management of cases is also a major factor. For virtually all high-mortality settings, the WHO case management strategy implemented as a component of the Integrated Management of Childhood Illness (IMCI) algorithm has formed the basis for pneumonia management. The algorithm for pneumonia management had not changed for 24 years until 2013 when the key physical sign previously used to identify severe pneumonia cases (lower chest wall indrawing) was downgraded to become a sign of non-severe pneumonia, to be managed with oral antibiotics at home.[2]

In *The Lancet Global Health*, Ambrose Agweyu and colleagues[3] report a large, retrospective study of pneumonia by the new definition, who had indrawing (and were admitted to hospital) had a case fatality rate of 3·2% (95% CI 2·7–3·7). Under the pre-2013 system these children would have been classified as having severe pneumonia in need of hospital care; under the current system they would have been sent home.

This study is not the only one to identify lower chest wall indrawing as an important sign of potentially fatal pneumonia. In South Africa, chest wall indrawing was a strong indicator of a fatal outcome in both HIV-positive and HIV-negative children with pneumonia.[4] However, lower chest wall indrawing is a confusing sign. Wheezing children will often demonstrate the sign with moderately severe illness due to the reduced lung compliance associated with wheezing, so in areas where asthma prevalence is increasing this has led to problems with over-referral of children not deemed to be severely ill.[5] Indrawing is also a sign that can be very subtle, and is easy to overcall. Not surprisingly then,

Mulholland K. Lancet Global Health, Jan 2018

In hospital

- Antibiotics
  - Ampicillin/Gentamicin
  - 3rd generation cephalosporins
- Monitor need for oxygen
  - Nasal prongs or nasopharyngeal catheter
- Nutrition
- Fluids and other supportive care

Prevention

- Reduce poverty, prevent malnutrition
- Improve indoor and outdoor air quality

Control and Intervention: RESPIRE Project Guatemalan Highlands

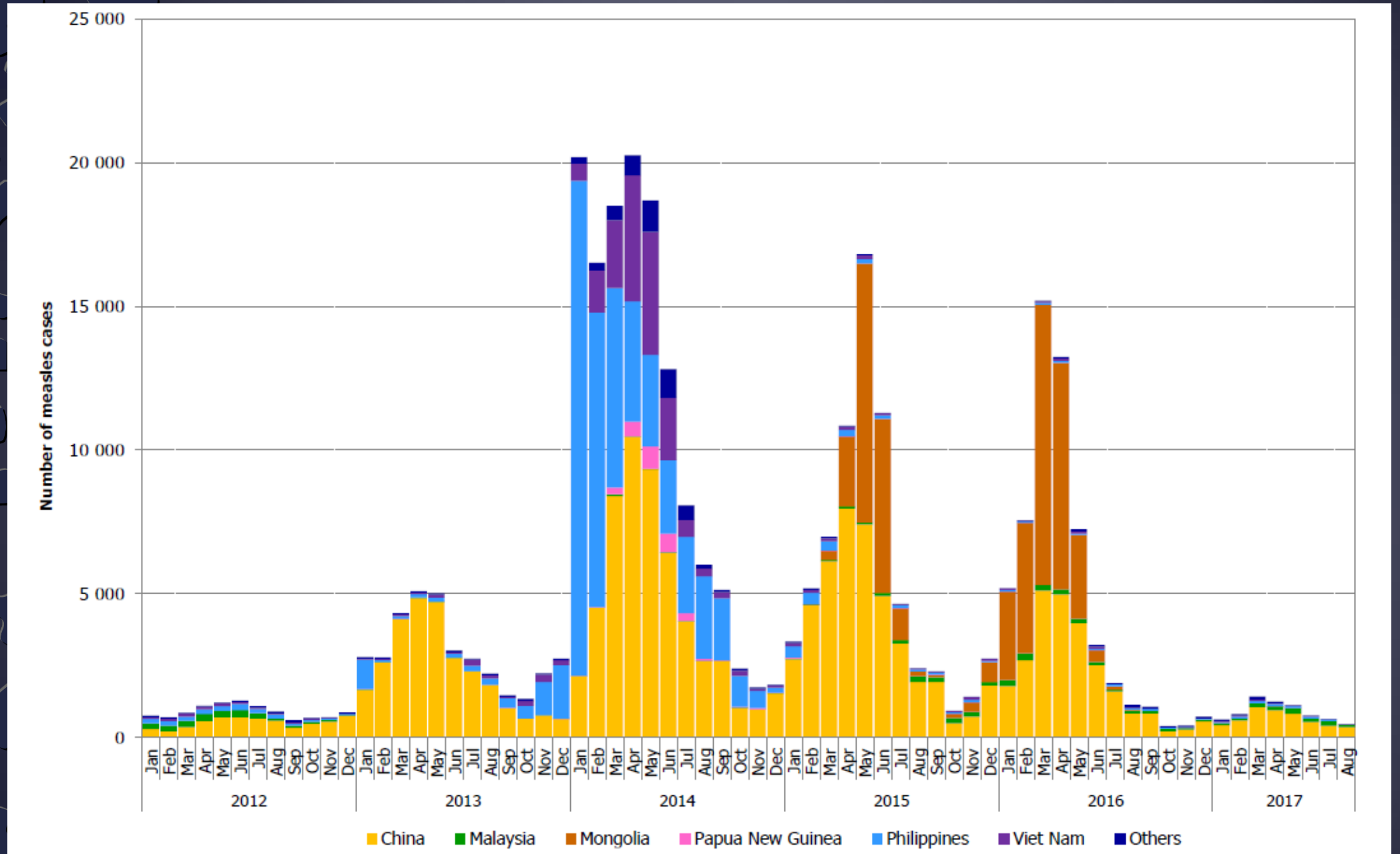
Traditional 3-stone open fire

Plancha chimney wood stove

(Photos courtesy of Kirk Smith)

Prevention

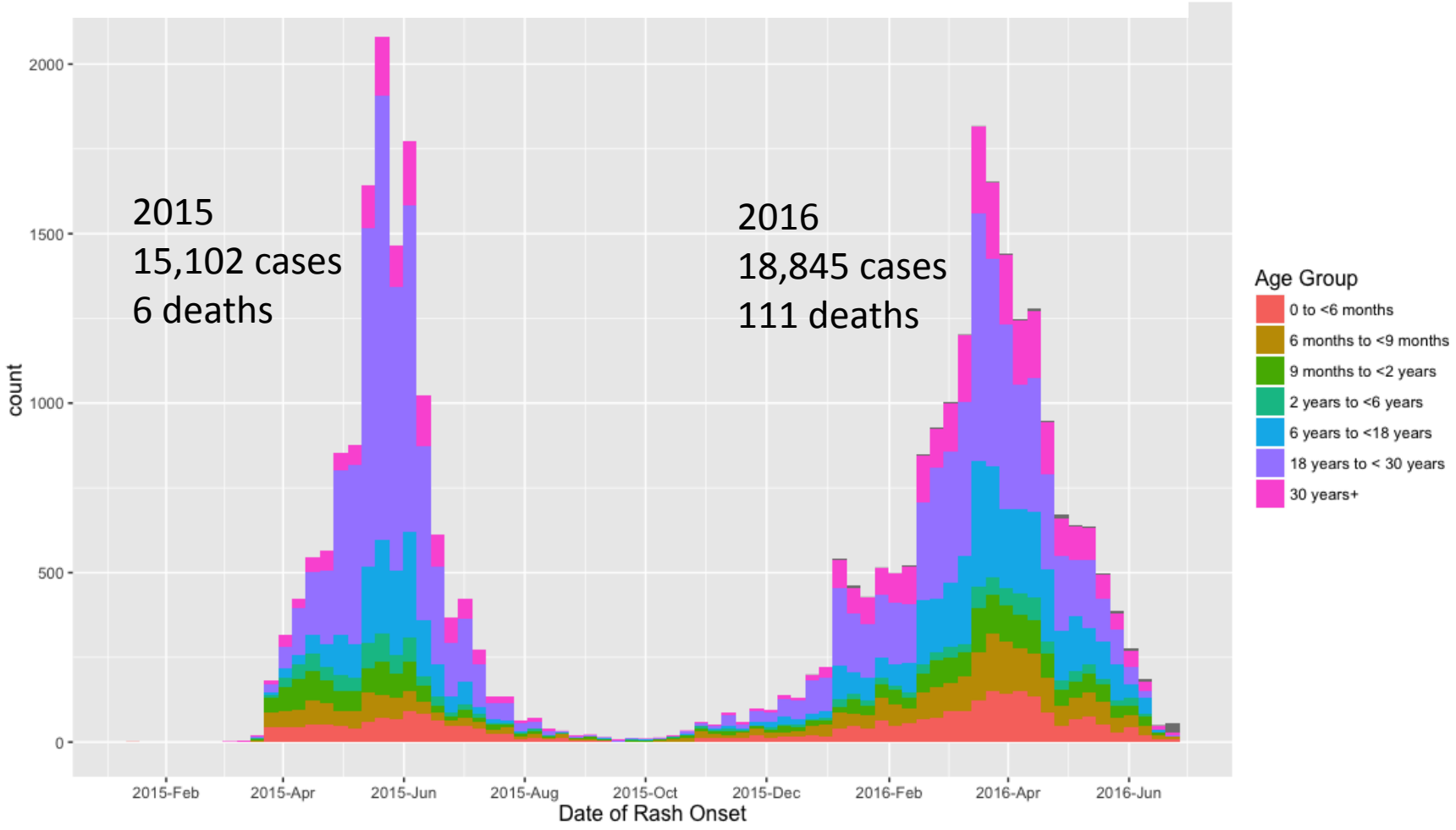
- Vaccination
  - Measles



Source: Measles and rubella monthly country reports to WHO by 20 September 2017
Includes laboratory confirmed, epi-linked and clinically confirmed cases for 2012

Mongolia measles — 2015–2016

Confirmed Measles Cases* — Mongolia, March 16 2015–June 27 2016



Mongolia population
3,121,772

Slide courtesy of Christopher Lee, CDC

Prevention

- Vaccination
  - Measles
  - Pertussis
    - Not controlled with primary vaccination alone
    - Increasing interest in acellular pertussis vaccines – although inferior protection
    - Infant disease → maternal immunization

Prevention

- Vaccination
  - Measles
  - Pertussis
  - Haemophilus influenzae type b (Hib)
    - 1st conjugate vaccine licensed December 1990
    - Prevents dominant cause of bacterial meningitis in all countries
    - Prevents up to 25% of severe pneumonia cases - variable

Hib vaccine in the national immunization programme, 2017

Introduced* to date *(191 countries or 98%)*

Not Available, Not Introduced/No Plans *(3 countries or 2%)*

Not applicable

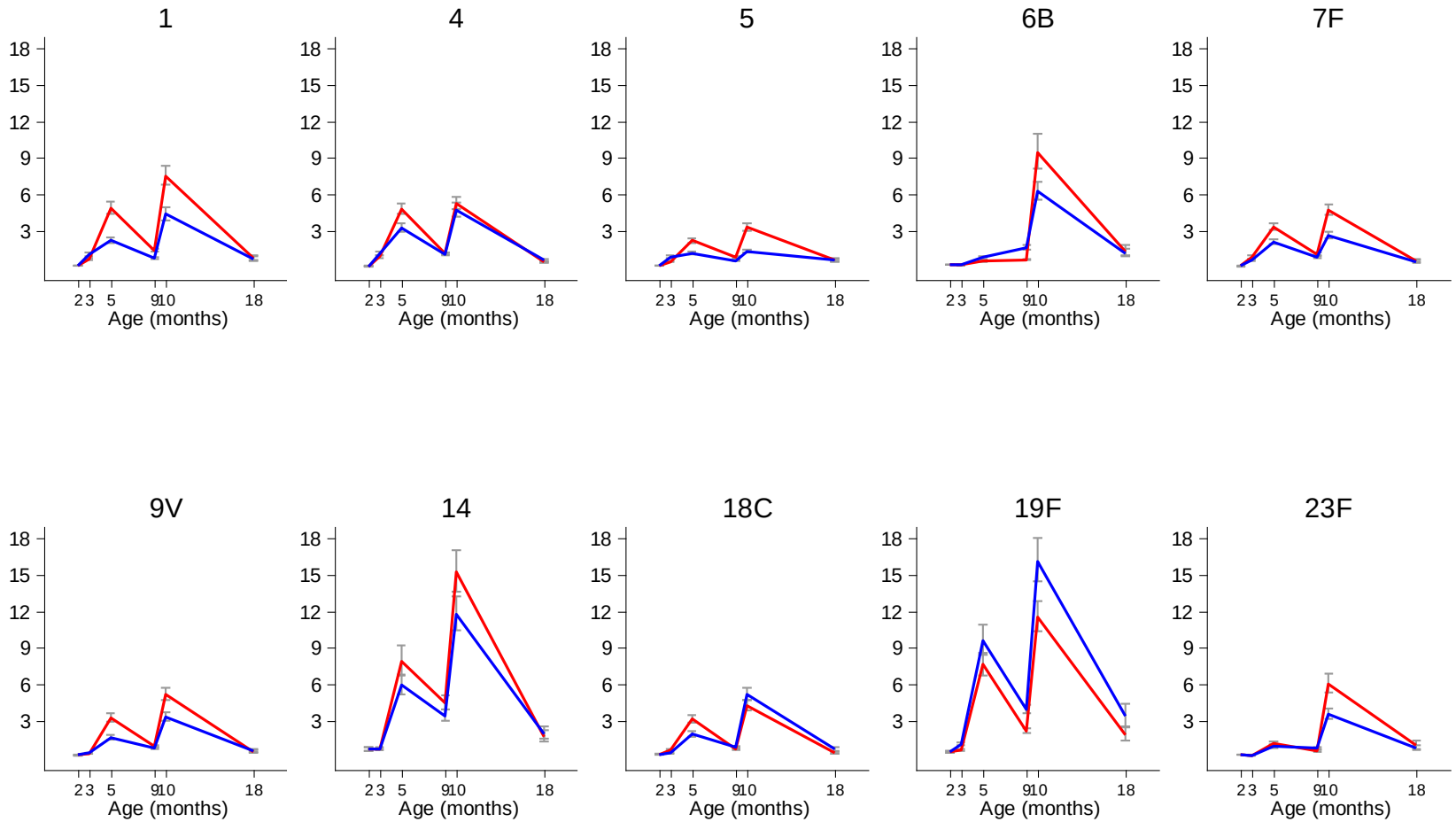
* Includes partial introduction

Data source: WHO/IVB Database, as of 14 April 2017
Map production Immunization Vaccines and Biologicals (IVB),
World Health Organization

Prevention

- Vaccination
  - Measles
  - Pertussis
  - Haemophilus influenzae type b (Hib)
  - Streptococcus pneumoniae (pneumococcus)
    - Over 90 serotypes
    - 1st pneumococcal conjugate vaccine (PCV) licensed February 2000
      - PCV7 - *Prevenar®*, Wyeth Vaccines
    - Second generation PCVs in use:
      - PCV10 – *Synflorix®*, GSK – licensed 2009
      - PCV13 – *Prevenar-13®*, Pfizer (formerly Wyeth) – licensed 2010

Vietnam pneumococcal vaccine trial I

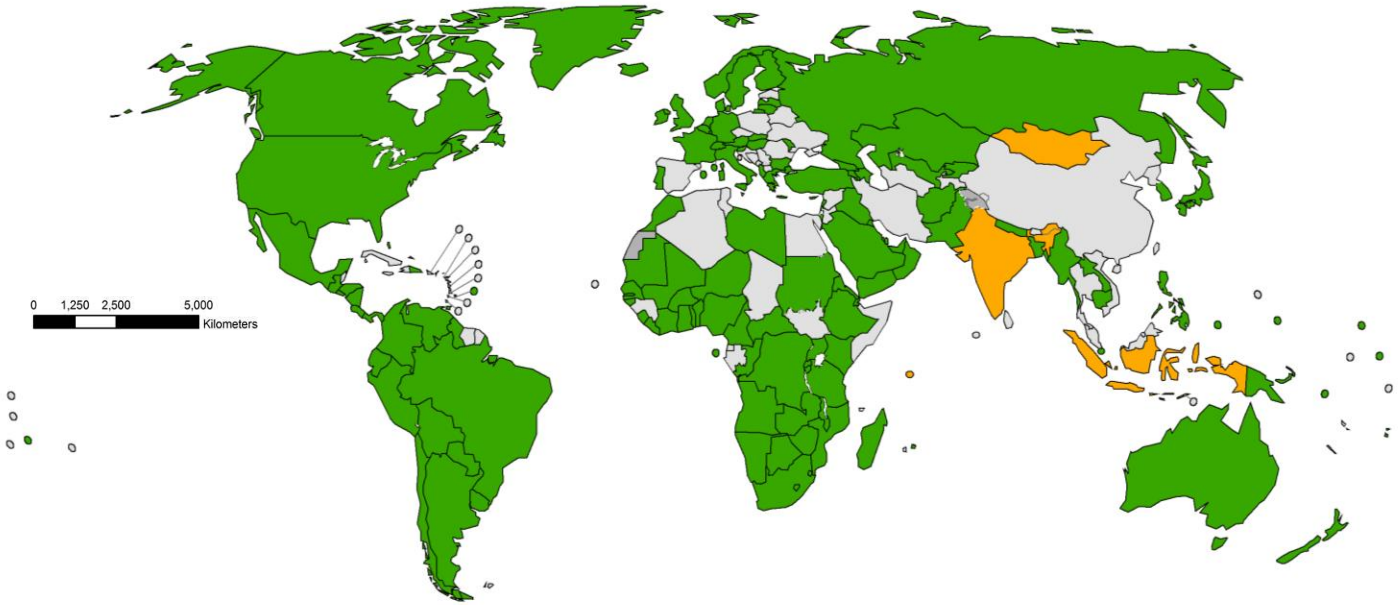


2m	pre-PCV
3m	post-1 dose
5m	post-primary
9m	pre-booster
10 m	post-booster
18 m	18m

PCV success – since licensed Feb 2000

- Individual protection against invasive pneumococcal disease >95%
- Protection of unvaccinated individuals (herd immunity) - variable
  - Impact on carriage
  - Unvaccinated children
  - Elderly
- Gavi estimates that 500,000 infant deaths have been averted

Pneumococcal Conjugate Vaccine national immunization programmes, 2017



* Includes partial introduction

Data source: WHO/IVB Database, as of 14 April 2017
Map production Immunization Vaccines and Biologicals (IVB), World Health Organization

WHO

IVAC
Evidence ➤ Policy ➤ Access

Issues

- Vaccine accessibility
  - Barely 40% of the world's infants get the vaccine
- Vaccine price
  - Private sector price remains prohibitive 18 years after PCV introduction
- Vaccine supply
  - Global production is stretched
  - India currently introducing PCV (birth cohort 26 million)
  - Pfizer fighting to prevent new producers entering the market
- Serotype replacement
  - Increase in carriage and disease due to serotypes not included in the vaccine

Introduction of new lifesaving vaccines for children

- Measles – 1965
  - By 1990 about 80% coverage globally
- Hib – 1990
  - By 2015 about 80% coverage globally
- Pneumococcal – 2000
  - By 2017 about 40% coverage globally

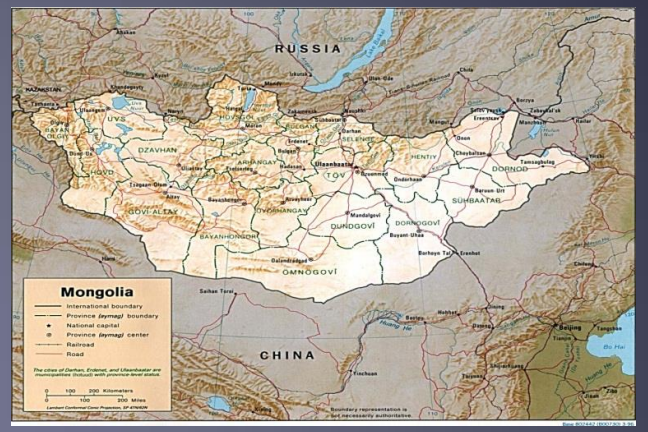
New vaccines on the way

- Pneumococcal
  - PCV10 – Serum Institute of India
  - PCV10 – Panacea Biotech
  - PCV15 – Merck
  - PCV20 – Pfizer
  - PCV? – SK-Sanofi
  - Non-polysaccharide based vaccines
    - Pneumococcal whole cell vaccine (BioFarma Indonesia/PATH)
    - Protein based vaccines
- Non-pneumococcal
  - RSV vaccines

Prevention - environment

- Indoor air pollution in poor rural communities
  - Mainly burning crop residues, dung, wood, coal
  - Improved fuels needed – eg gas in Indonesia
- External air pollution, especially in Asian mega-cities
  - Delhi, Beijing, north Asia
- Environmental tobacco smoke exposure

Mongolia



- 1.6 million sq km
- 3.1 million people
  - half in Ulaanbaatar
  - 32% live in poverty
- Extreme climate
- Extreme pollution (mainly coal)

Prevention – improve nutrition

- Reduce LBW
- Exclusive breast feeding
- Optimal weaning foods
- Prevention of malnutrition

Prevention – prevent wars

- High risk of pneumonia among children
  - War settings
    - Women and children increasingly targeted
    - Health facilities targeted
    - Loss of essential services
  - Refugee settings
    - Crowding, malnutrition, poor sanitation
- The cause
  - Arms industry
  - Sociopathic leaders waging proxy wars
  - Deranged, often elderly men running countries

Care of children with pneumonia

- WHO case management guidelines need to be independently revised
- Countries must learn to identify communities at high risk
  - Increasing inequity
- Focus on quality of care at primary care and district hospital level

Conclusion

- Children must be protected in all areas of civil conflict or refugee settings
- All children must have access to routine vaccines – Penta, measles, pneumococcal conjugate
  - Pricing/access issue for PCVs must be addressed
- Long term effects of air pollution (from pre-conception) must be documented and used to help improve the health of cities
- WHO case management guidelines must be sorted out and implemented in all communities currently lacking adequate care

ISPPD-11

11TH INTERNATIONAL SYMPOSIUM ON PNEUMOCOCCI & PNEUMOCOCCAL DISEASES

MELBOURNE 2018

15-19 APRIL

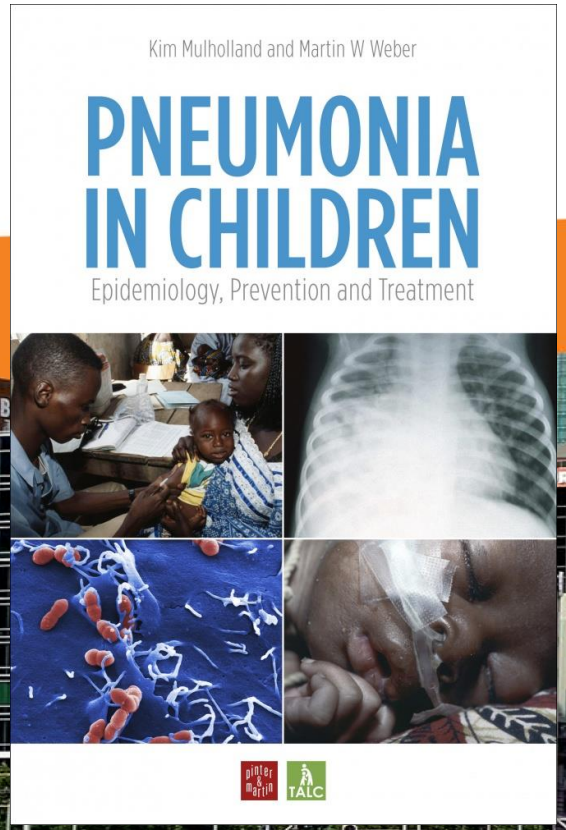
WWW.ISPPD.KENES.COM/2018

ISPPD-11

11TH INTERNATIONAL SYMPOSIUM ON PNEUMOCOCCI & PNEUMOCOCCAL DISEASES

MELBOURNE 2018

15-19 APRIL



WWW.ISPPD.KENES.COM/2018