

Global Burden of Pneumococcal Disease in Children under 5

Susan Wang, MD, MPH

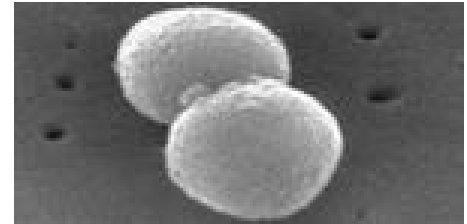
Expanded Programme on Immunization



**World Health
Organization**

Streptococcus pneumoniae

- Gram-positive encapsulated diplococcus
- Transmitted by direct contact with respiratory secretions from patients and healthy carriers
- Usual outcome of exposure is transient nasopharyngeal colonization, not disease
- Disease caused either by contiguous spread to sinuses or middle ear, aspiration into the lungs, or invasion of bloodstream with or without seeding of secondary sites



***Streptococcus pneumoniae* (cont'd)**

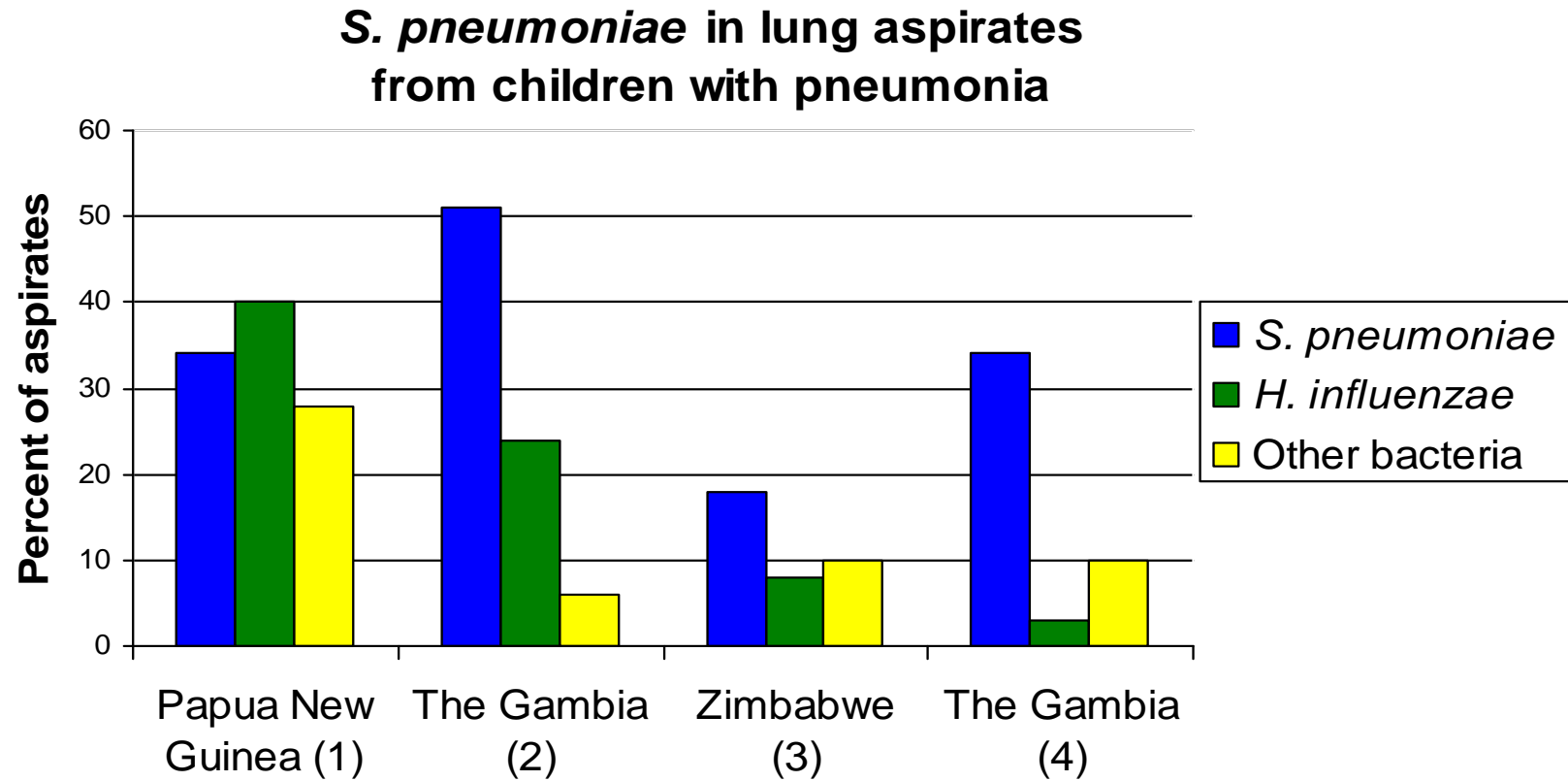
- Pneumococcal resistance to antimicrobials is a serious and growing problem (penicillins, cephalosporins, trimethoprim-sulfamethoxazole, macrolides, and fluoroquinolones)
- Laboratory diagnosis based on growth in culture media
- Failure to isolate the organism often occurs due to prior antibiotic treatment, improper handling and transport of specimens, use of inappropriate culture media

Diseases caused by *Streptococcus pneumoniae* (Pneumococcus)

- **Invasive pneumococcal disease (IPD):** infection of a normally sterile site
 - Pneumonia
 - Meningitis
 - Febrile bacteremia
 - Arthritis
 - Peritonitis
 - Osteomyelitis
- **Less serious, but more common pneumococcal disease**
 - Otitis media
 - Sinusitis
 - Bronchitis

Invasive pneumococcal disease (IPD)

S. pneumoniae is the most common cause of bacterial pneumonia



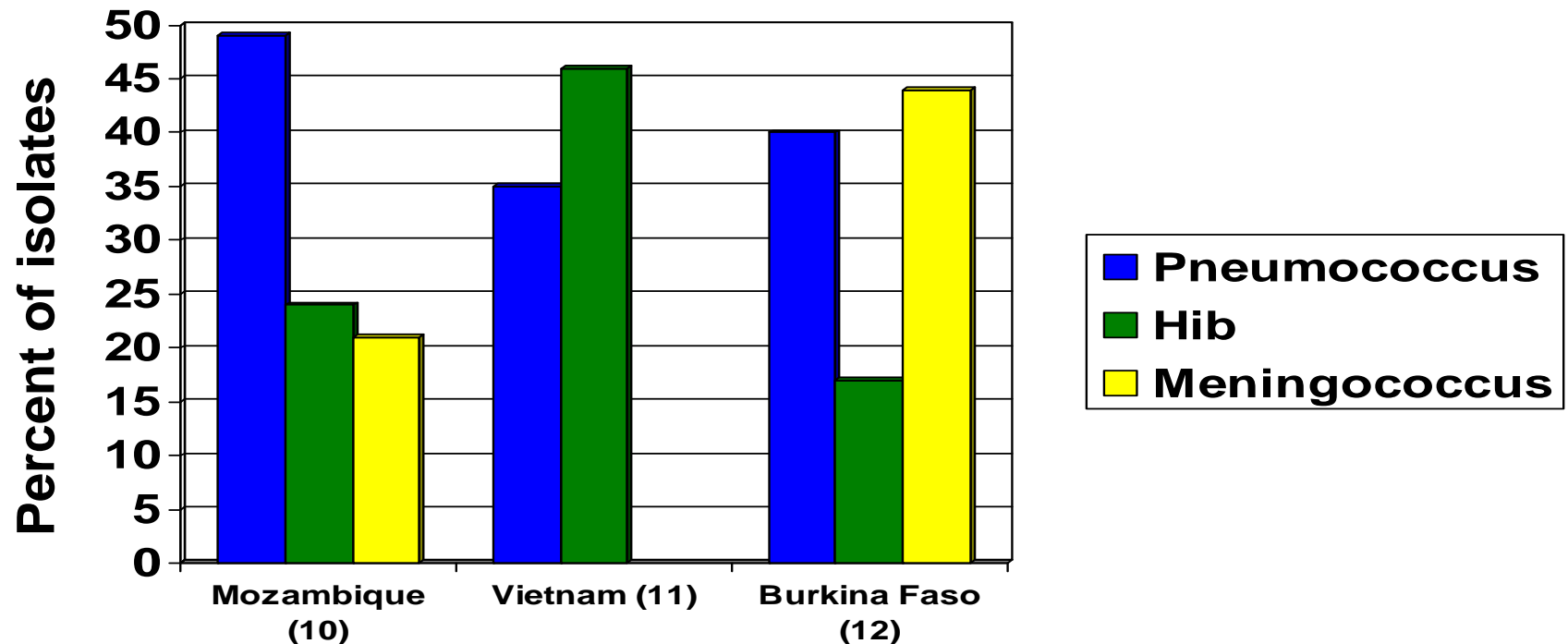
Shann F, Gratten M, Germer S, et al. *Lancet*. 1984; 2(8402):537-541.

Wall RA, Corrah PT, Mabey DC, Greenwood BM. *Bull World Health Org*. 1986; 64(4):553-558.

Ilkeogu MO. *Arch Dis Child*. 1989; 64(8):1207.

Forgie IM, Campbell H, Lloyd-Evans N, et al. *Pediatr Infect Dis J*. 1992; 11(6):466-473.

Pneumococcus is a significant cause of bacterial meningitis



In low-income countries, about 45% of people with pneumococcal meningitis die, compared to 29% with Hib meningitis and 8% with meningococcal meningitis

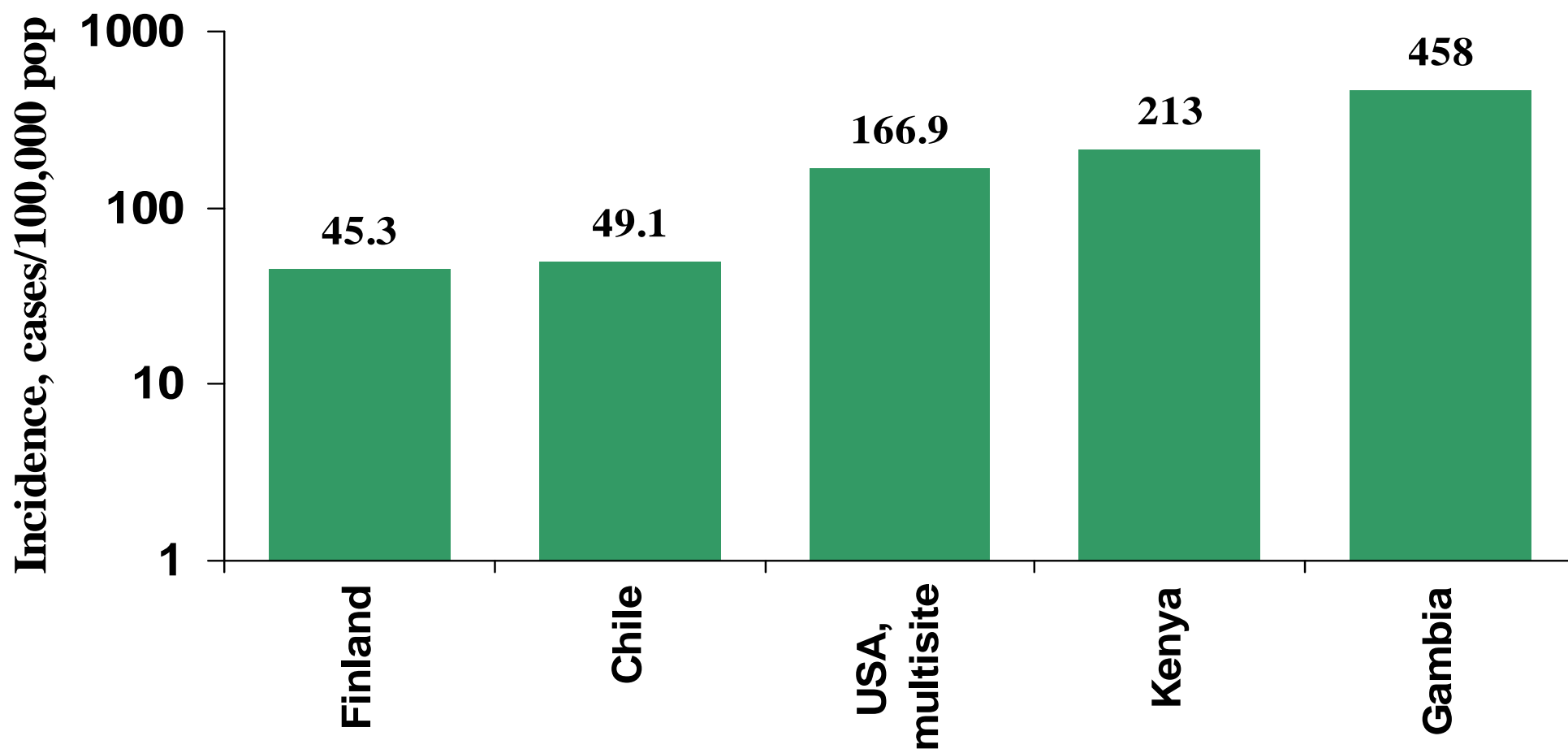
Itola H. Clin Inf Dis 2001; 32: 64-75.

ana G, Parmar N, et al. J Trop Pediatr 1995; 41: 164-8.

am TT, Thinh LQ, et al. Ped Inf Dis J 1998; 17(9 Suppl): S192-S194.

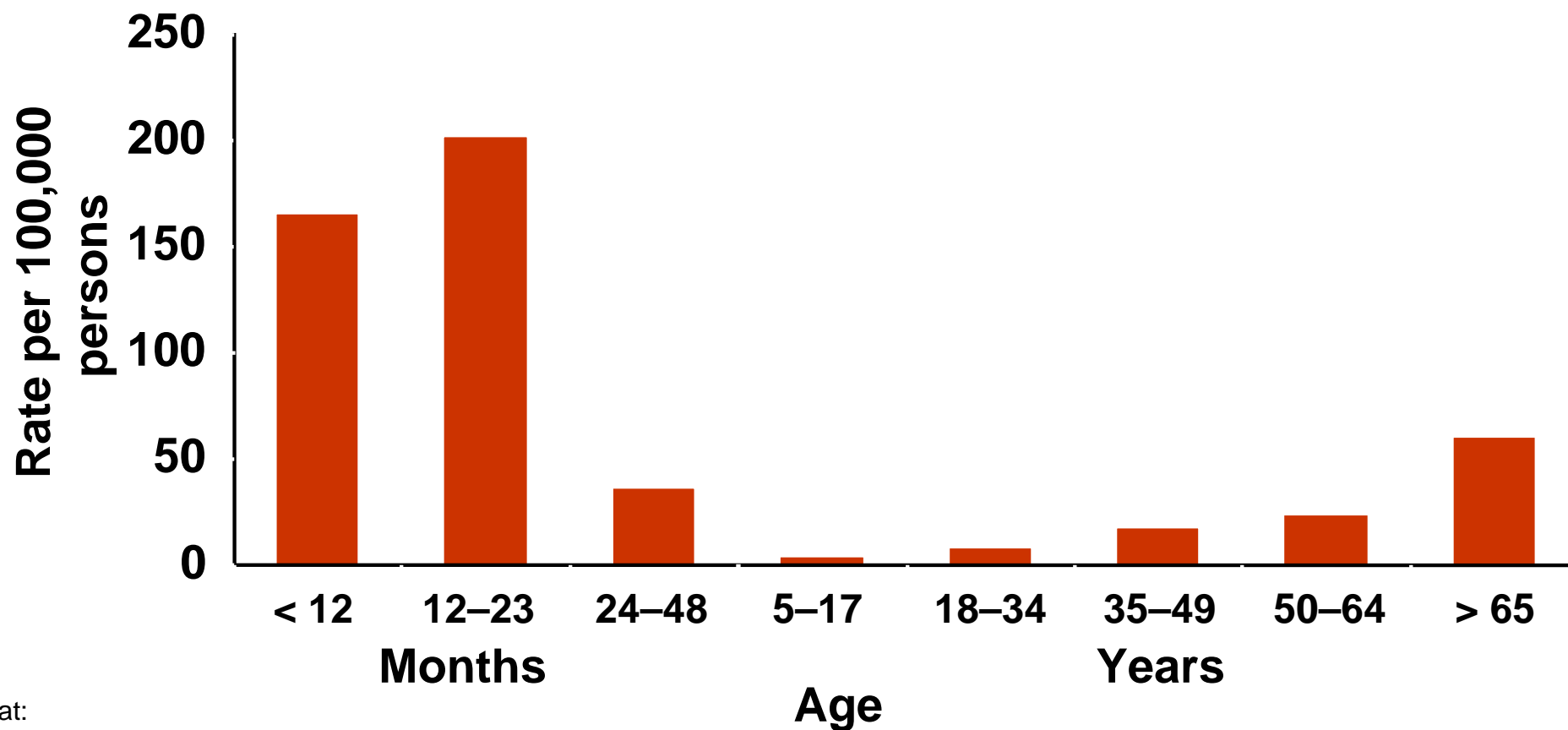
Chatelet IP, Traore Y, et al. Clin Inf Dis 2005; 40: 17-25.

Incidence of Invasive Pneumococcal Disease in Children <2 Years by Population



ources: Robinson KA JAMA 2001; Davidson M JID 1994; O'Dempsey TJ PIDJ 1996;
vine MM PIDJ 1998; Eskola J JAMA 1992; Berkley NEJM 2005

Invasive Pneumococcal Disease Incidence, by Age, USA, 1997



Available at:
www.cdc.gov/ncidod/dbmd/abcs/survreports/spneu98.pdf.



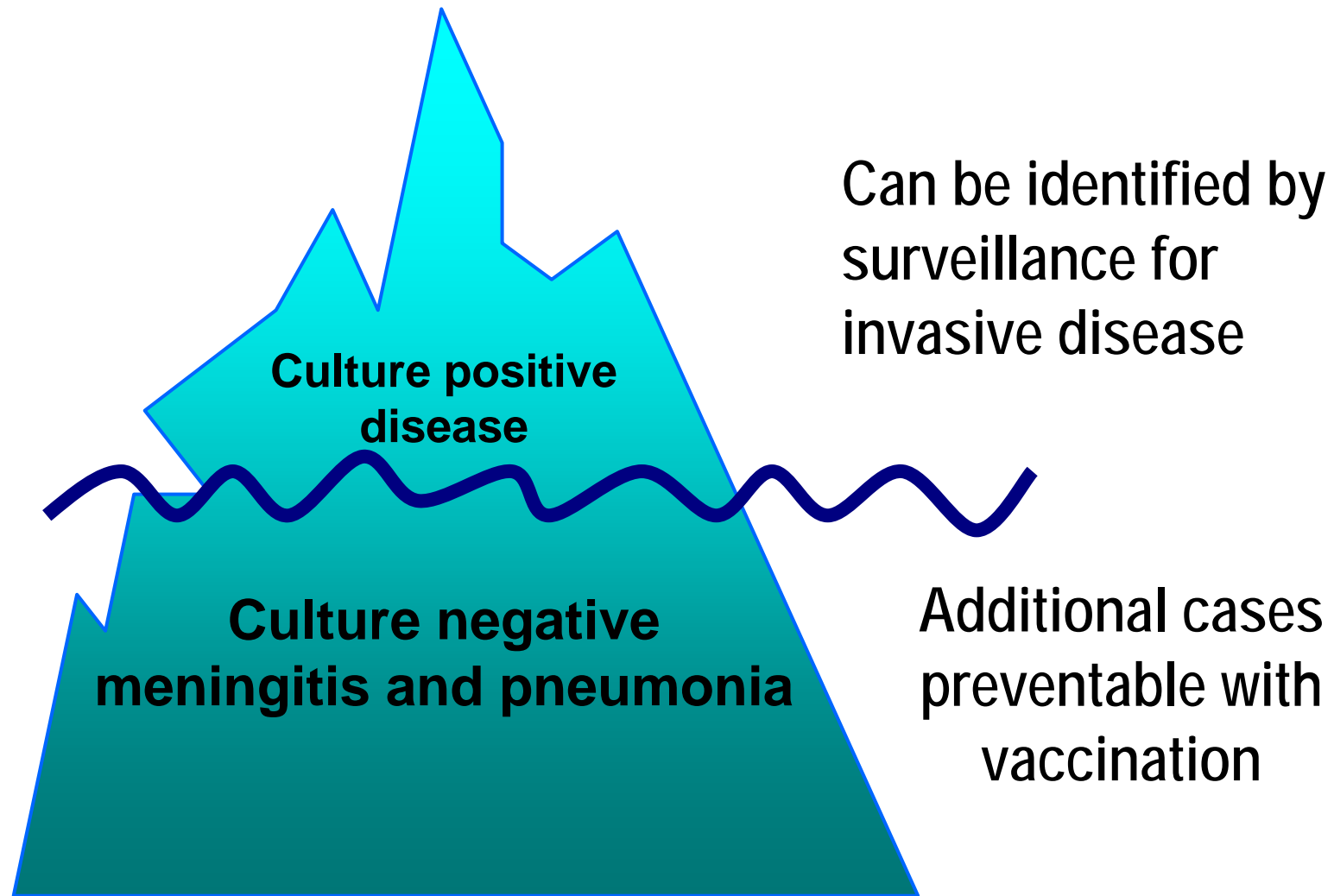
Children at increased risk for pneumococcal disease

- Children with anatomic or functional asplenia: sickle cell disease, other sickle hemoglobinopathies (hemoglobin S-C disease, S- β thalassemia)
- HIV-infected children have 2.8 and 12.6 times the rate of HIV uninfected children
- Children in out-of-home day care have 2 to 3 times the rate of disease compared to children at home



Burden of disease due to *S. pneumoniae*

Pneumococcal surveillance for laboratory confirmed disease only provides part of the picture



Role of Surveillance for Pneumococcus

- Surveillance data alone does not accurately measure burden of disease
 - Low sensitivity of culture based methods, esp for pneumonia
 - Low specificity of non-culture based methods (PCR, UAg)
 - Representativeness depends on many factors
 - Poor quality surveillance may hurt evidence-based policy making
- Surveillance is important for monitoring the impact of vaccination
 - Changes in disease pre- and post- vaccine introduction
- Modeling is essential to establish disease burden

WHO Disease Burden Estimation Process

- Goal: produce estimates of cases and deaths for global, regional, and country levels for children < 5 years of age with 2000 as base year
- Database of evidence
 - Systematically collected
 - Publicly available
- Methods for estimation
 - Transparent methods
 - Communication of uncertainty of estimates
 - Public dissemination
- Independent expert group
- Country consultation prior to release of country-level estimates
- Clearance through WHO-EIP
 - Compatibility with burden estimates for other diseases

Outline of General Analytic Methods

Literature

Incidence

CFR

VE

Meta-analyses

(country specific parameters)

Adjustments

Access to care, HIV, Hib vaccine use

Models

Meningitis

Invasive
NPNM

Pneumonia

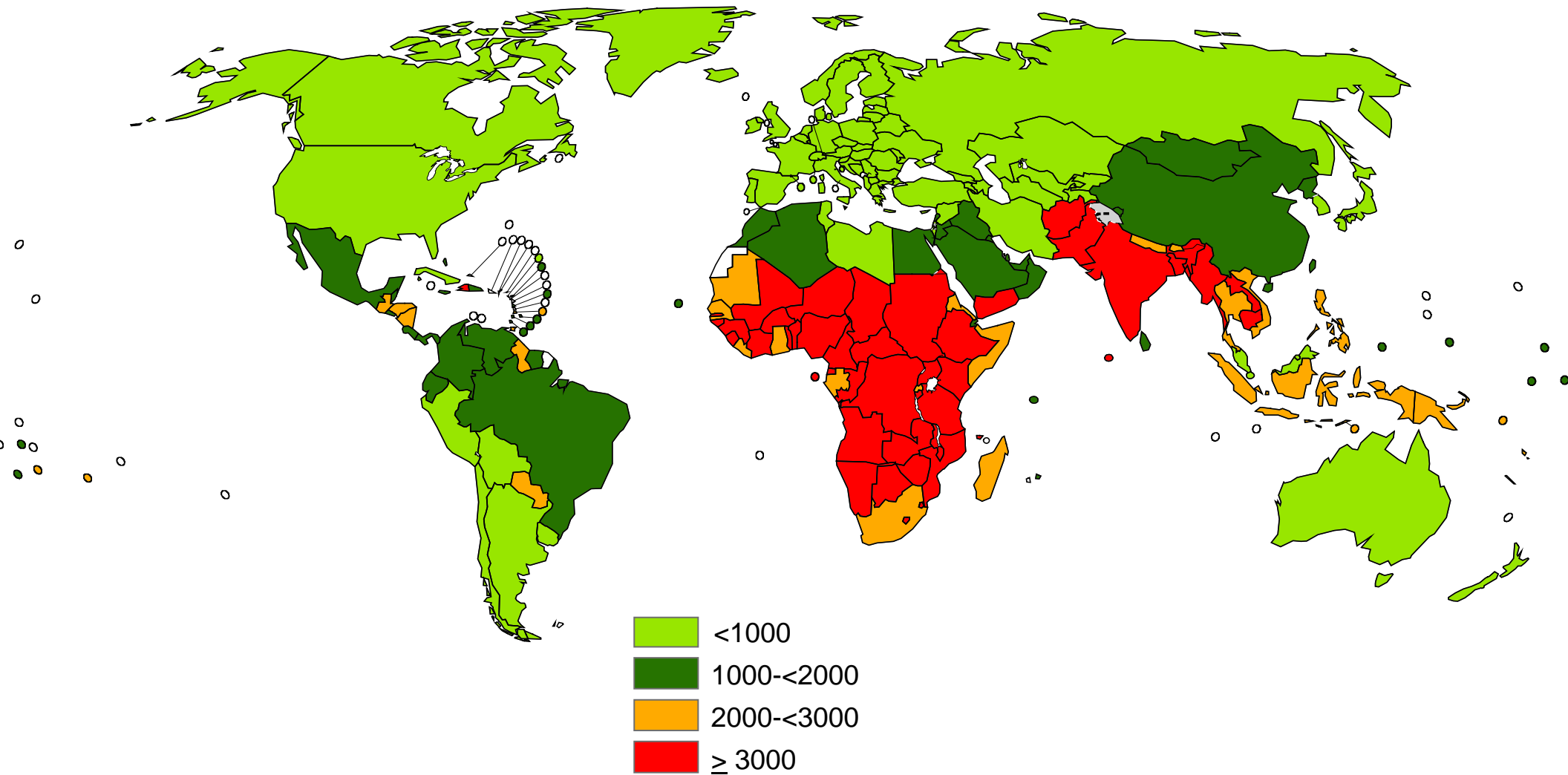
Global burden of disease due to *S. pneumoniae* in 2000 (children < 5 yrs)

- 14.5 million episodes (range, 11.1 – 18.0 million) of invasive pneumococcal disease
 - Americas: 713,000 (range, 551,000 – 950,000)
- About 826,000 (range, 582,000 – 926,000) deaths in children aged 1-59 months; of these, 90,000 (range, 60,000-100,00) among HIV+ children
 - Americas: 33,100 deaths (range, 23,600 – 39,500)
- *S. pneumoniae* causes around 11% (range, 8-12%) of all deaths in children aged 1-59 months (excluding pneumococcal deaths in HIV-positive children)

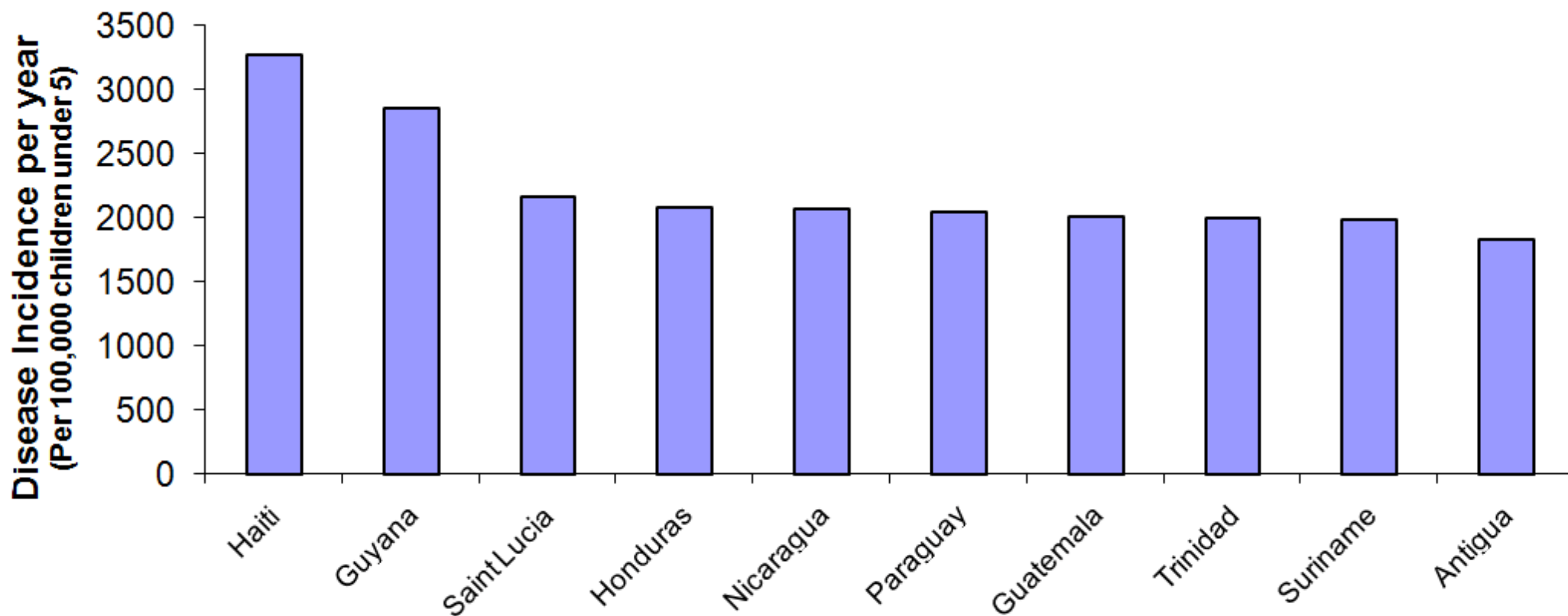
O'Brien K, Wolfson L, Watt JP, et al. Lancet, 2009; 374:893-902.

S. pneumoniae incidence rates globally

(per 100,000 children < 5 yrs)



10 Countries with Highest Incidence of Pneumococcal Disease in AMRO Region

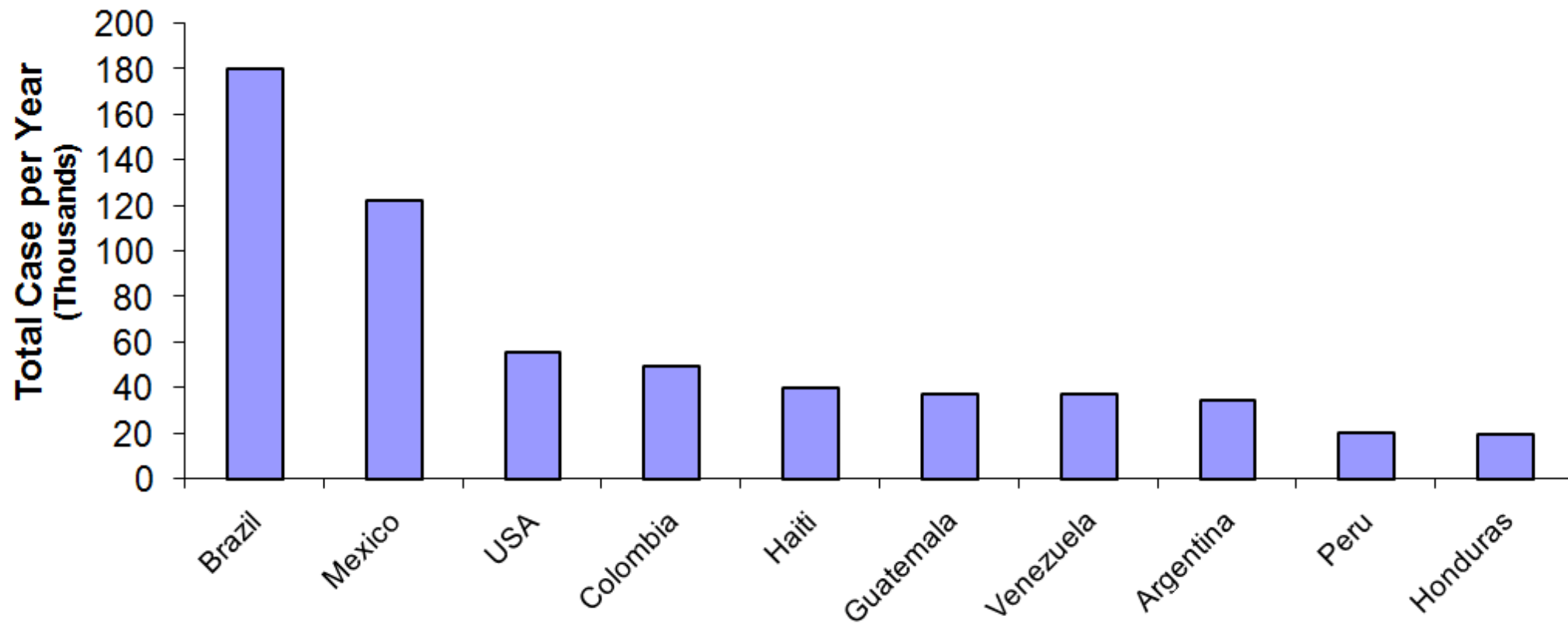


(+) deaths included

Source: Hib/SP GDB June 15, 2009 Final Analysis



10 Countries with Greatest Number of Pneumococcal Cases in AMRO Region

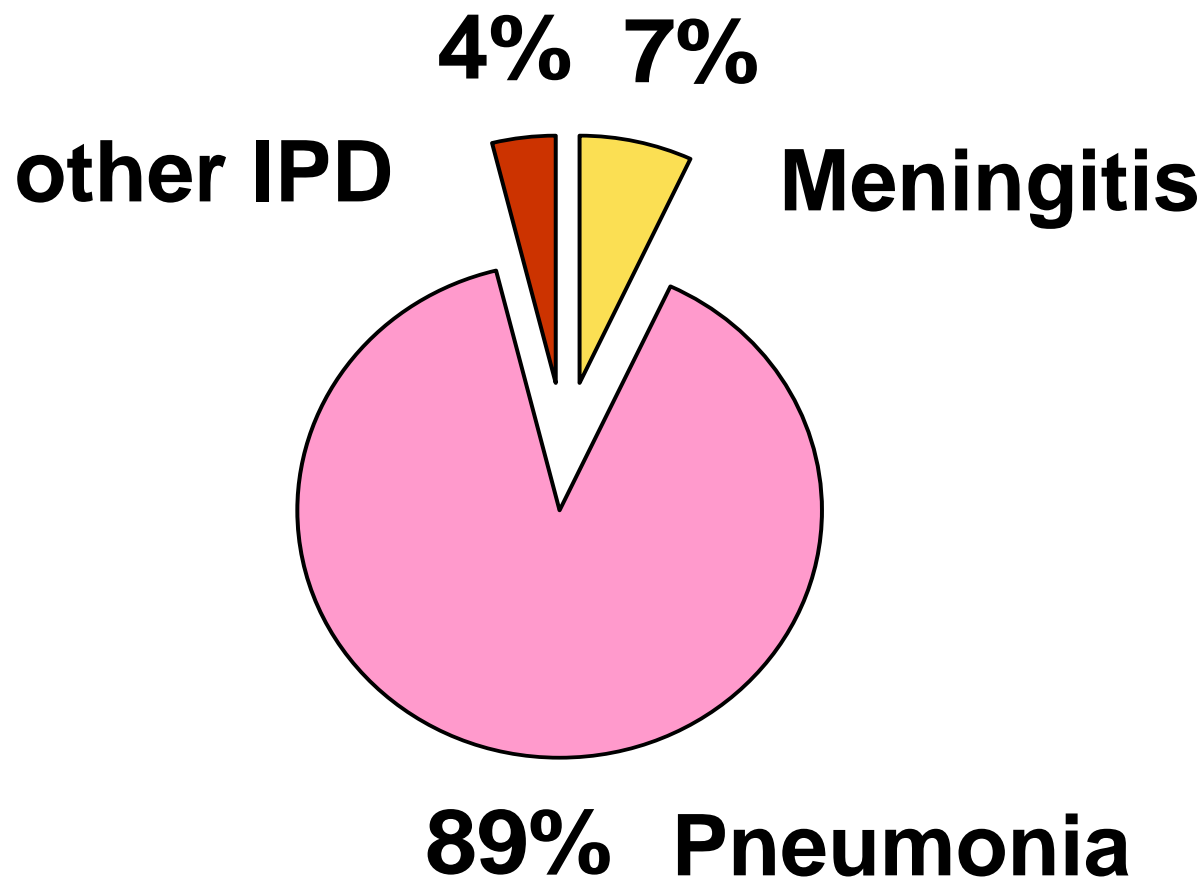


(+) deaths included

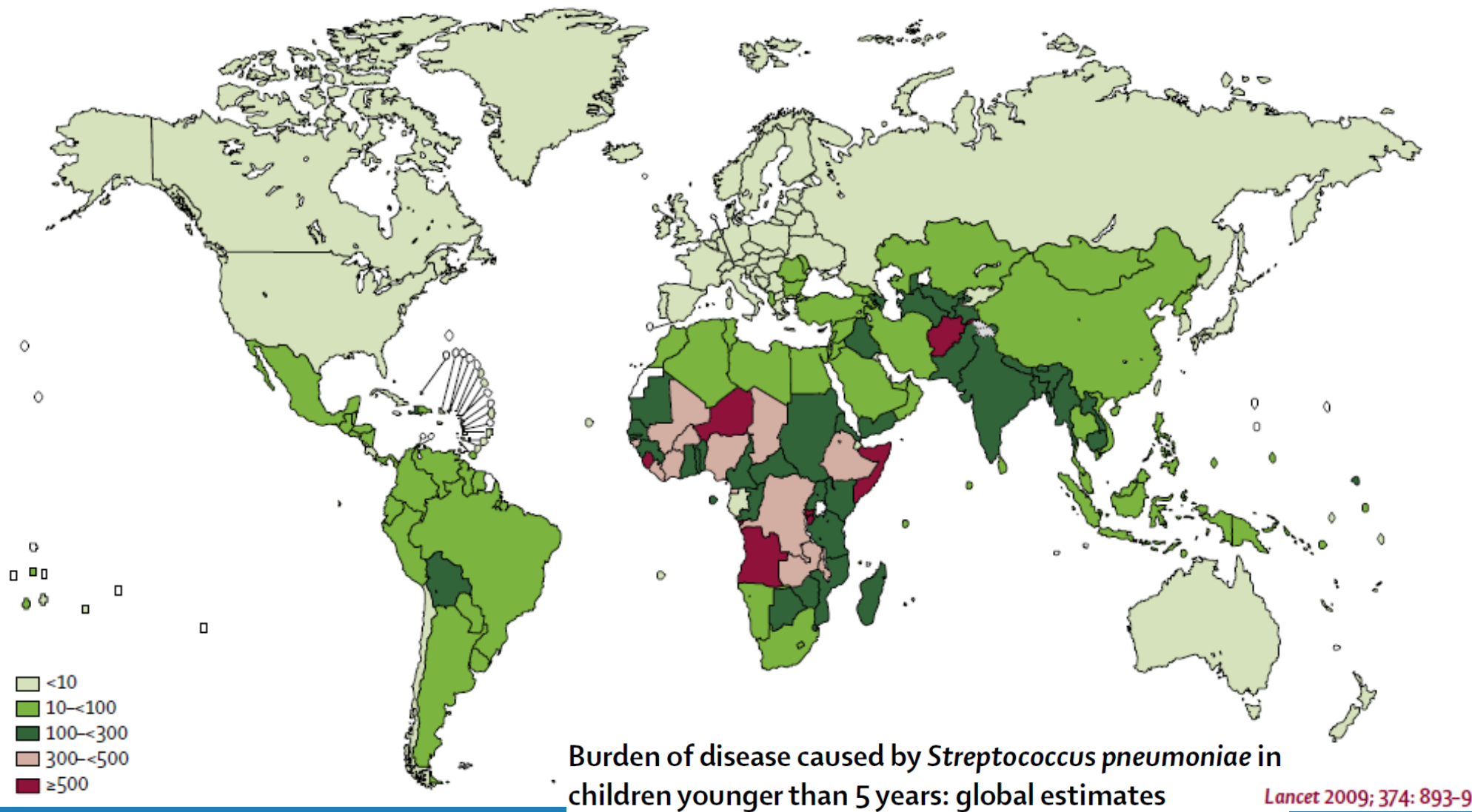
Source: Hib/SP GDB June 15, 2009 Final Analysis



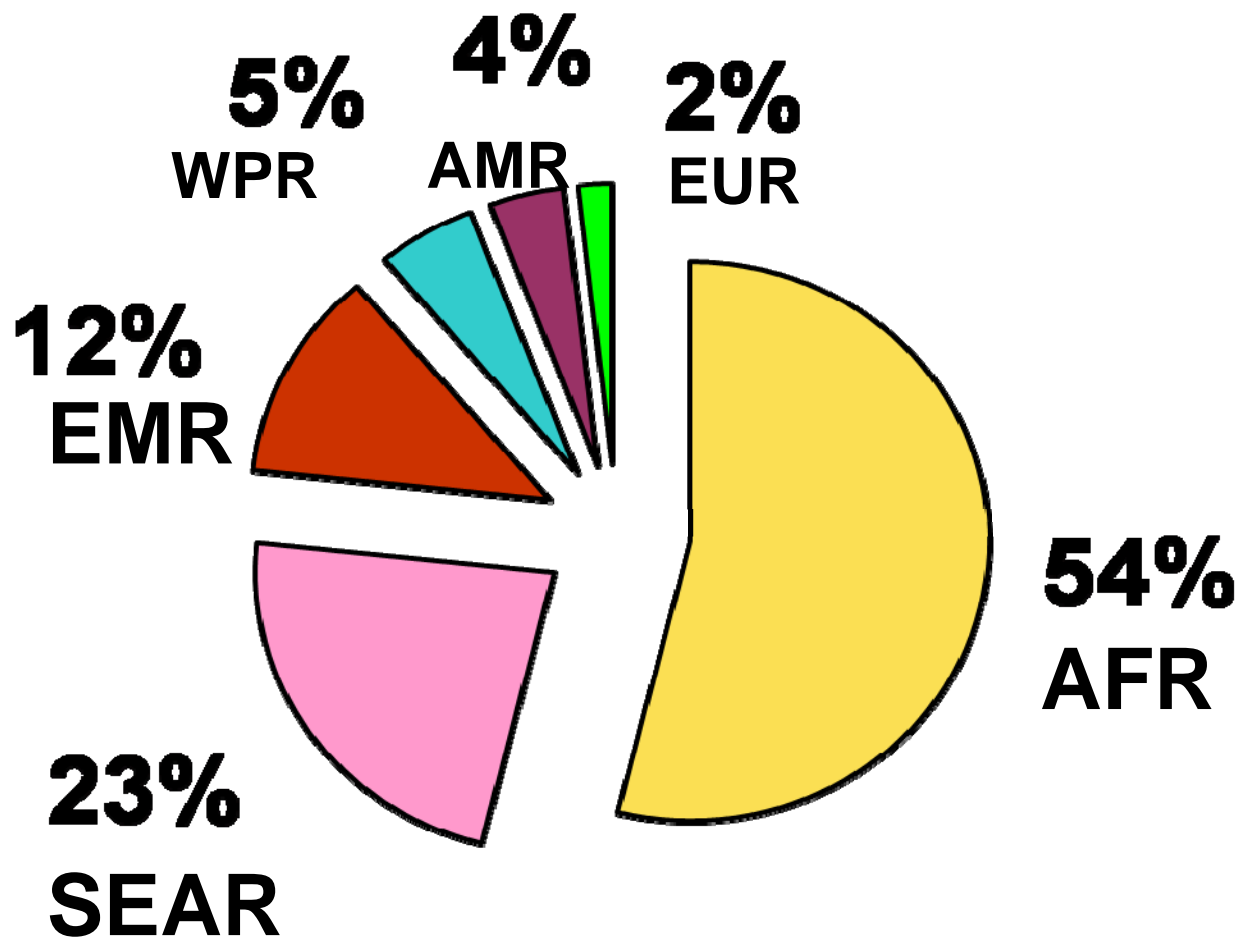
Distribution of *S. pneumoniae* Deaths by Syndrome, Globally



S. pneumoniae mortality rate (deaths per 100,000 children under age 5)



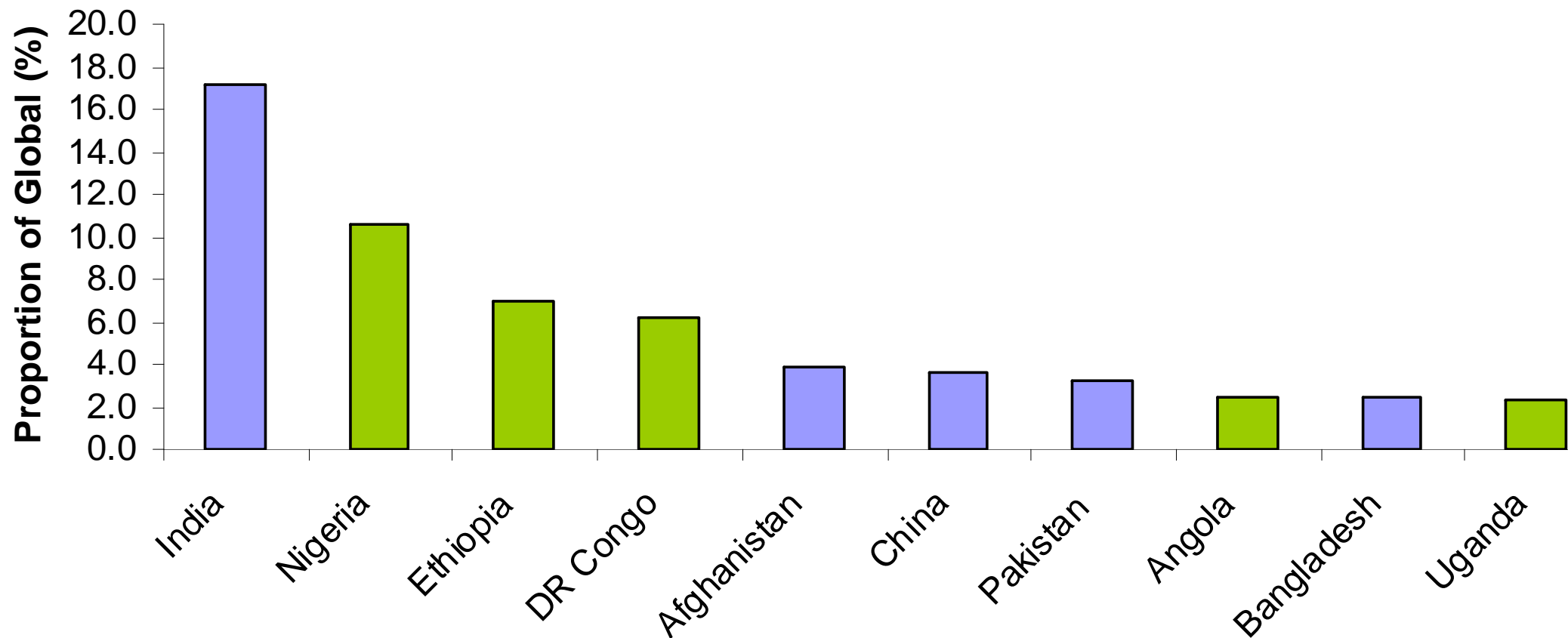
Greatest Proportion of Global Pneumococcal Deaths are in Africa and Asia



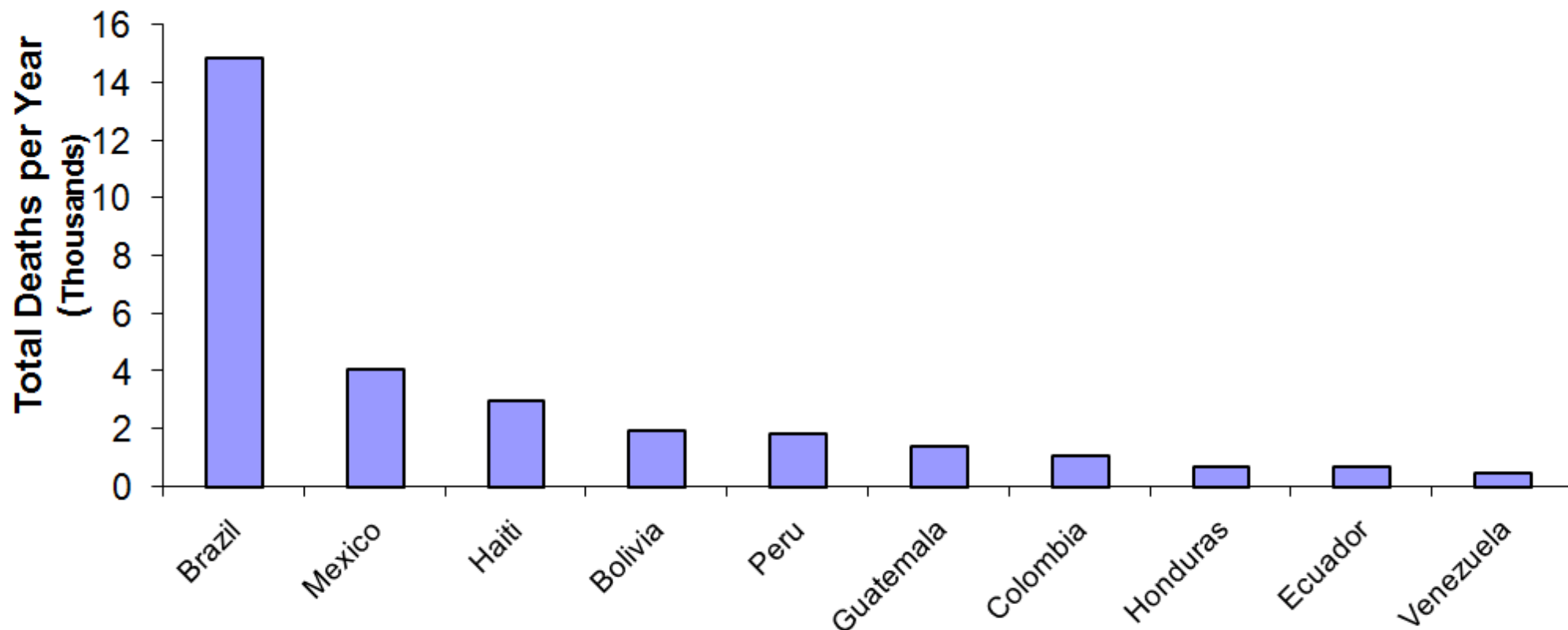
(+) deaths Included

Source: Hib/SP GDB June 15, 2009 Final Analysis

10 Countries with Greatest Pneumococcal Deaths are all in Africa and Asia



10 Countries with Greatest Number of Pneumococcal Deaths in AMRO Region



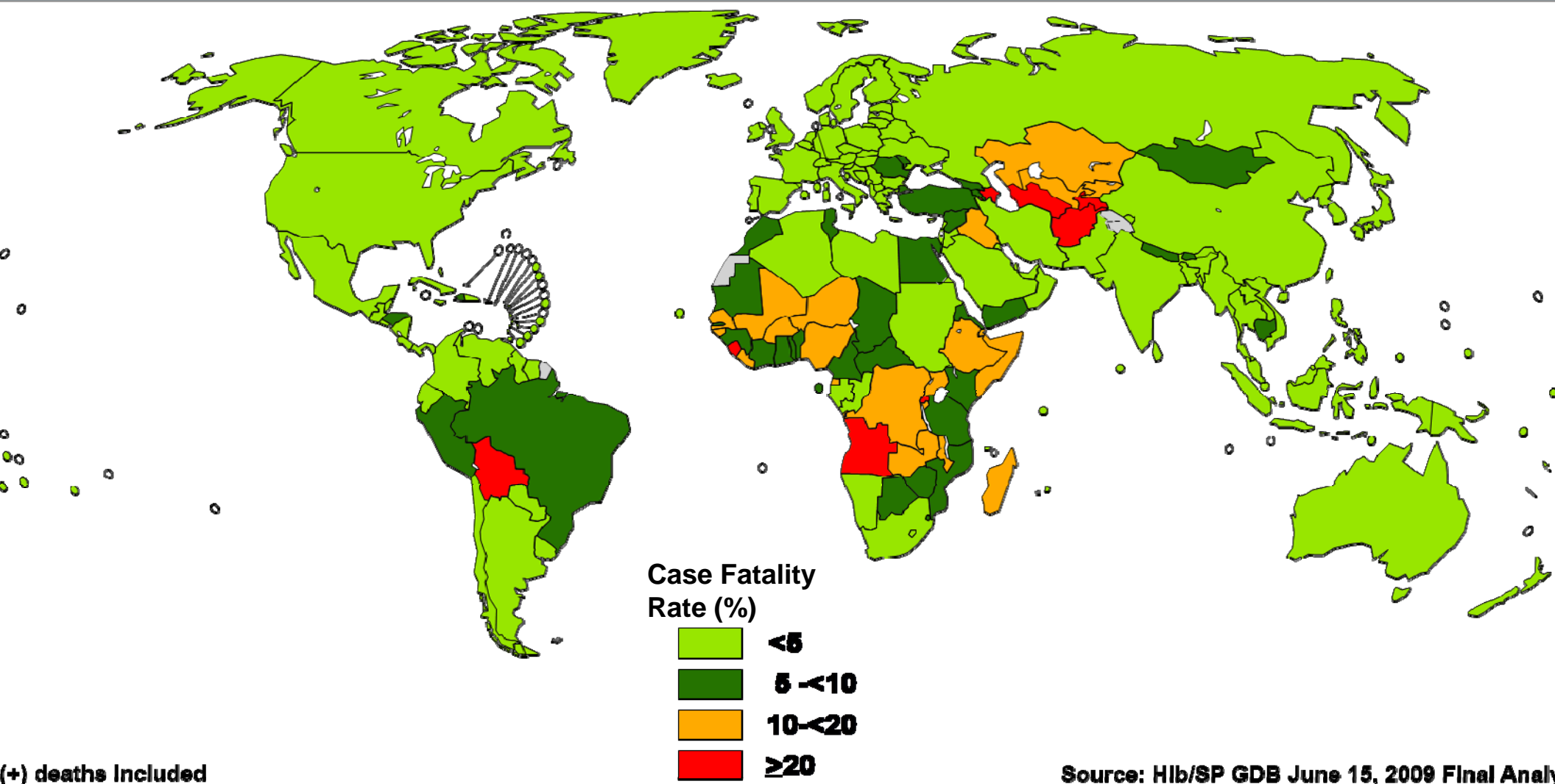
(+) deaths included

Source: Hib/SP GDB June 15, 2009 Final Analysis



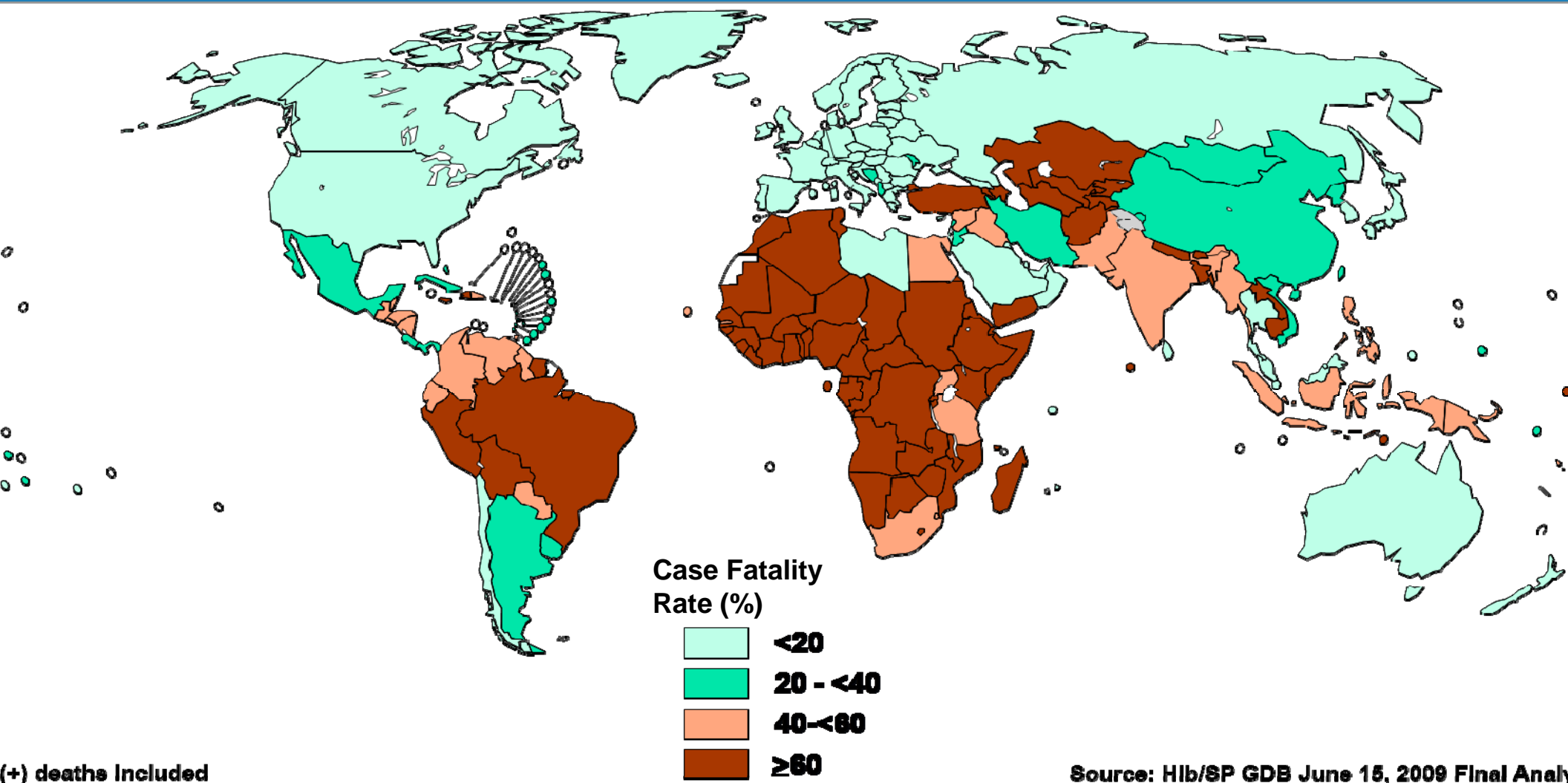
SP pneumonia case fatality rate

(Children under age 5)



SP meningitis case fatality rate

(Children under age 5)



Summary

- *Streptococcus pneumoniae* is a major cause of morbidity and mortality among children < 5 years in developing countries. Annually for this age group, the Americas are estimated to have
 - 713,000 invasive pneumococcal disease cases
 - 33,100 deaths
- 73% of deaths are due to pneumonia, 14% to meningitis, 13% to other invasive pneumococcal disease

Acknowledgements

Thomas Cherian

Hope Johnson

Kate O'Brien

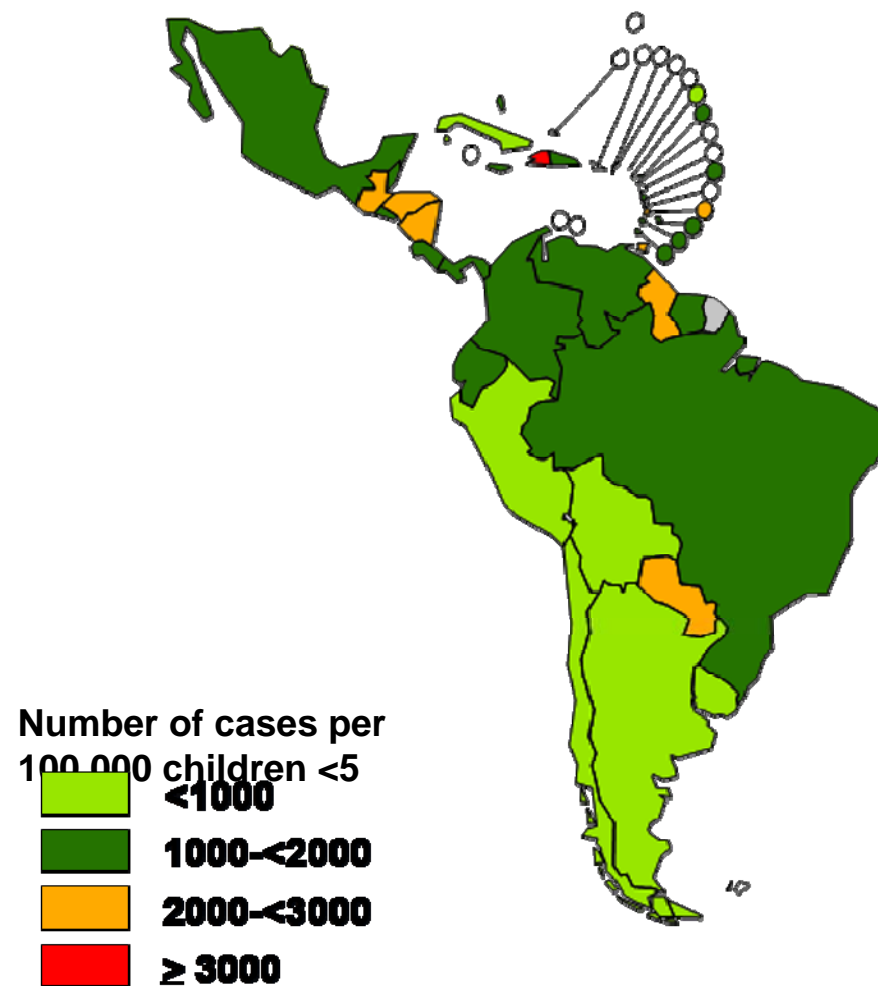
Carsten Mantel



Extra slides

SP incidence rate : PAHO region

(per 100,000 children under age 5)



(+) deaths Included

Source: Hlb/SP GDB June 15, 2009 Final Analysis

Comparison of *Streptococcus pneumoniae* disease burden estimates for PAHO using different models

	WHO	Sabin
Pneumonia	595,000 (463,000-741,000)	327,000
Meningitis	8,400 (6,000-11,500)	4000
Deaths	33,000 (23,000-39,000)	18,000

Comparison of Disease Burden Estimates

- Geographic scope: Sabin – limited to Latin America and Caribbean; WHO – included North America
- Literature reviews: Sabin – 1990-2006 and nonpublished data: WHO – 1980-2005 with global databases
- Diseases: WHO case definition included more NPNM while Sabin case definition included only sepsis for NPNM cases
- Modeling strategies: WHO – adjusted for access to care and HIV prevalence

SP mortality rate : PAHO region

(deaths per 100,000 children under age 5)

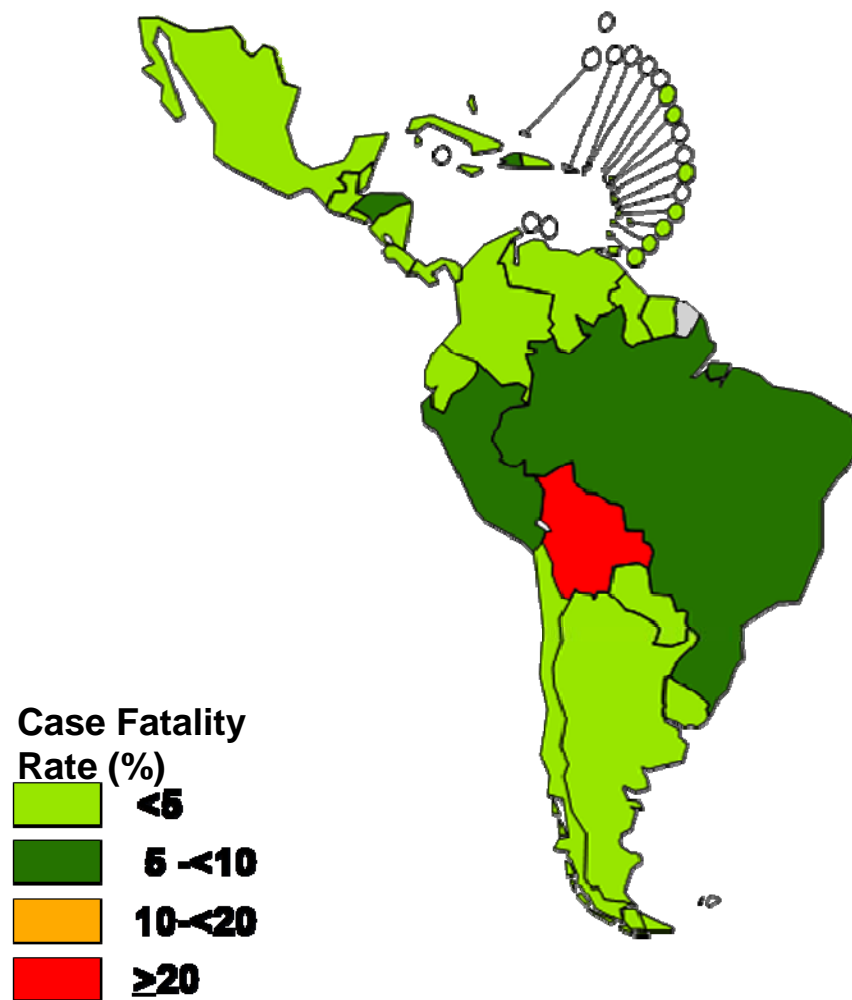


(+) deaths Included

Source: Hib/SP GDB June 15, 2009 Final Analysis

SP pneumonia case fatality rate : PAHO region

(Children under age 5)

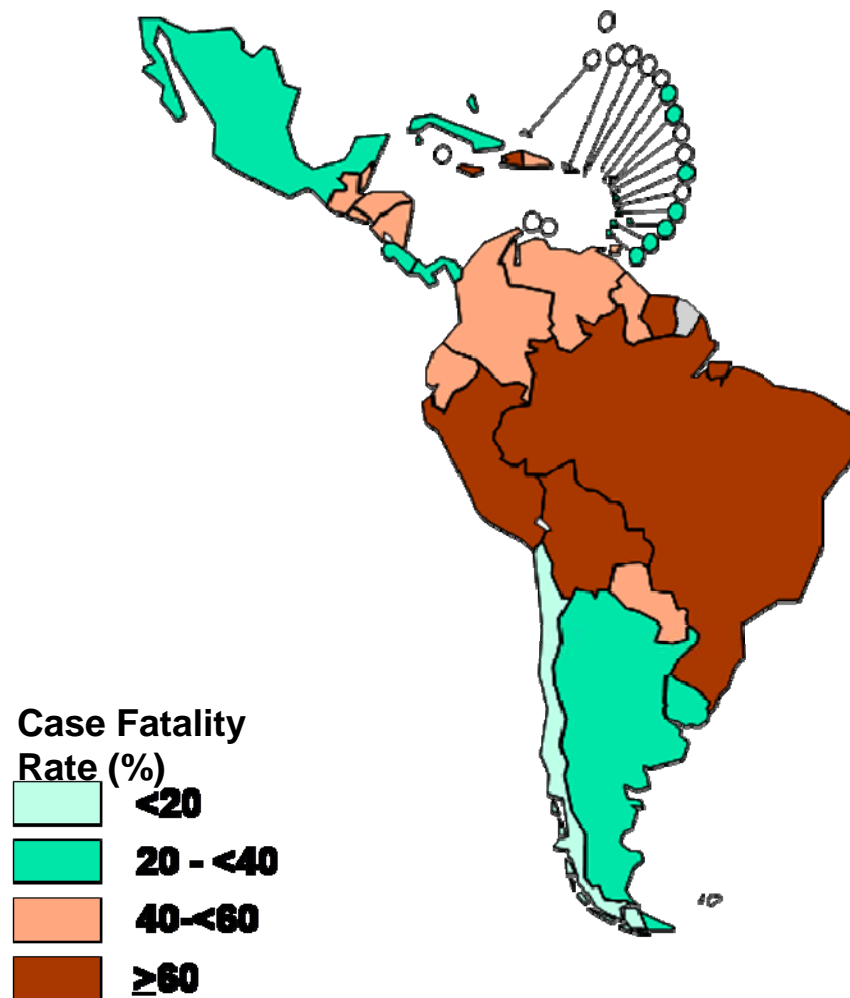


(+) deaths Included

Source: Hib/SP GDB June 15, 2009 Final Analysis

SP meningitis case fatality rate : PAHO region

(Children under age 5)



(+) deaths Included

Source: Hib/SP GDB June 15, 2009 Final Analysis

What drives pneumococcal deaths? Population size, or pneumococcal mortality?

