Epidemiology of community-acquired meningitis

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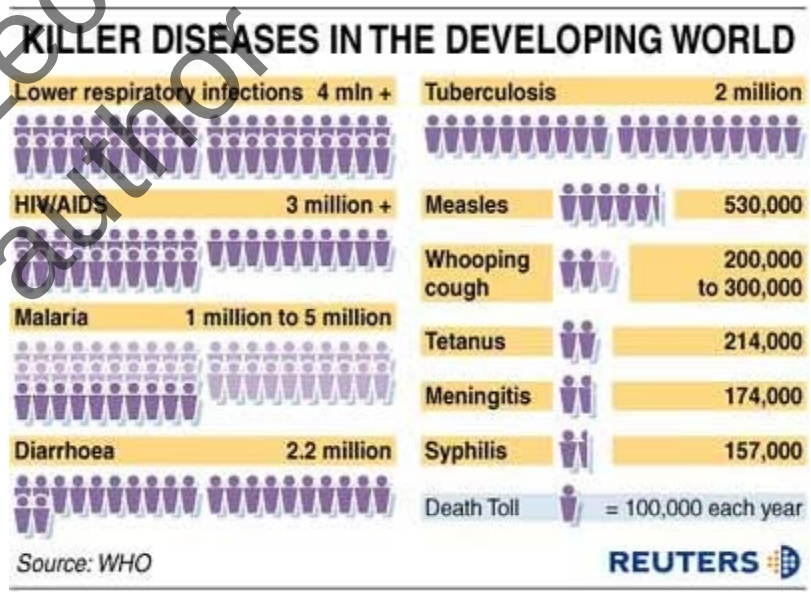
Presentation outline

- Epidemiology of meningitis
- Microorganisms
- Predisposing factors
- Effect of vaccination on epidemiology of meningitis

Epidemiology

- Medical emergency
- 1.2 million cases worldwide
- 0.6-1.3 cases/1000 live births
- 3-10 cases per 100,000 population
- Top 10 most common infections



Tunkel R. In: UpToDate, Basow, DS (Ed), UpToDate, Waltham, MA, 2010

Microorganisms

- Streptococcus pneumoniae
- Neisseria meningitidis
- Haemophilus influenzae type b [Hib]

} >% 80

- Group B streptococcus
- Listeria monocytogenes
- Escherichia coli

Nudelman Y, Tunkel AR. Drugs 2009;69:2577-96
Sim KS. Lancet Infect Dis 2010;10:32-42

Mortality

Microorganism	%
Streptococcus pneumoniae	19-26
Neisseria meningitidis	3-13
Haemophilus influenzae	3-42
Listeria monocyogenes	15-29
Group B streptococcus	7-27

Nudelman Y, Tunkel AR. Drugs 2009;69:2577-96
Sim KS. Lancet Infect Dis 2010;10:32-42

Epidemiology: Children

Newborn	Infants	Children
Group B strep	Group B strep	S. pneumoniae
E. coli	Gram -ve	N. meningitidis
Other Gram -ve	H. influenzae	H. influenzae
L. monocytogenes	S. pneumoniae	
S. pneumoniae	N. meningitidis	

Epidemiology: Adults

Adult	%	> 60 years	%
S. pneumoniae	60	S. pneumoniae	70
N. meningitidis	20	L. monocytogenes	20
H. influenzae	10	N. meningitidis	3-4
L. monocytogenes	6	Group B strep	3-4
		H. influenzae	3-4

Quagliarello V. In: UpToDate, Basow, DS (Ed), UpToDate, Waltham, MA, 2010

Etiology of childhood bacterial meningitis
Turkey

- N. meningitidis 56.5%
- S. pneumoniae 22.5%
- H. influenzae type b 20.5%

PCR-positive samples

Year 2005

Ceyhan M, et al. EID 2008;14:1089-96

Meningitis in elderly
Turkey

- Multi-center study
- >50 yrs
- 159 culture-positive cases
  - S. pneumoniae 69.2%
  - L. monocytogenes 8.8%
  - N. meningitidis 2.5%
  - H. influenzae 1.3%

Erdem H, et al. Clin Microbiol Infect 2010;16:1223-9

Purulent meningitis in Turkey
Pooled analysis

Pathogen	Number
Streptococcus pneumoniae	457
Neisseria meningitidis	251
Staphylococcus aureus	29
Enterobacteriacea (species not mentioned)	8
Coagulase-negative staphylococci	6
Listeria monocytogenes	6
Acinetobacter baumannii	5
Escherichia coli	4
Gram-negative bacilli (species not mentioned)	4
Klebsiella pneumoniae	3
Streptococcus pyogenes	3
Pseudomonas aeruginosa	3
Haemophilus influenzae	2
Branhamella catarrhalis	1
Proteus mirabilis	1
Enterococcus spp.	1
Total	784

Arda B, et al. Med Princ Pract 2008;17:76-79

Developing World

Pakistan http://new.com.au

http://gbgm-umc.org/health/

Zimbabwean currency

Malawi

Scarborough M, Thwaites GE. Lancet Neurol 2008;7:637-48

Pakistan - How to Help

Guide to Humanitarian Giving for the Pakistan flood emergency

The worst floods to hit Pakistan since 1929 have **affected** an estimated **15.4 million people** with **over 8 million in need of urgent life-saving humanitarian assistance** as of 16 August. Over 1,600 people have died and at least 893,000 homes are reported to have been destroyed or severely damaged, leaving **millions homeless**. In addition to a rising number of deaths, injuries and displacements, there is major damage to roads, bridges, infrastructure and livelihoods. Over the medium to long-term, the food security situation in the country is likely to be affected by the significant loss of crops and agricultural land.

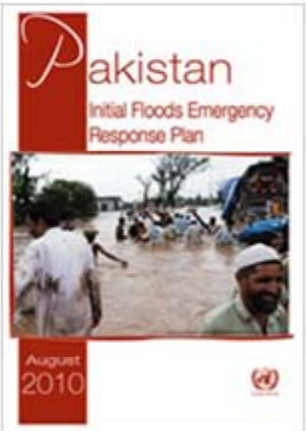
The most **urgent needs** of the population are **food, clean drinking water, emergency shelter, medical care and non-food-items**. Access continues to be a serious challenge hampering relief efforts. As such, there is urgent need to repair damaged roads and telecommunications networks.

The Government of Pakistan and the United Nations agencies, non-governmental organizations and the International Red Cross and Red Crescent Movement are working tirelessly to provide life-saving emergency assistance to the flood-affected communities. But much more needs to be done and **hundreds of millions of dollars will be required** to provide humanitarian assistance in the coming months. Unless response operations are rapidly scaled up to reach those who remain displaced and without immediate access to food and clean drinking water, **additional loss of human lives and further suffering will occur**.

Your support in meeting the immediate needs of the vulnerable people affected by this disaster is crucial!

How Can You Help?

Pakistan Appeal



UN Member State

Click here if you are a Donor from a UN Member State (guidance)

Common causes of meningitis in developing world

- N. meningitidis
  - Serogroups A, W-135, C, and X cause epidemics in Africa
- Streptococcus suis
  - Commonest cause of bacterial meningitis in southeast Asia, link to exposure to pigs or pork
- Non-typhi Salmonella sp
  - Patients in Africa who are infected with HIV
- Mycobacterium tuberculosis
  - More common with HIV infection
- Treponema pallidum
- Cryptococcus neoformans
  - HIV infection

Scarborough M, Thwaites GE. Lancet Neurol 2008;7:637-48

Partially treated meningitis

- Availability of antibiotics as over the counter drugs in developing countries
- Important clinical entity in resource-limited setting
- Difficult diagnostic dilemma

Scarborough M, Thwaites GE. Lancet Neurol 2008;7:637-48

Predisposing factors

Predisposing factors	Microorganisms
Open cranial trauma	coliforms, S. aureus, pseudomonads
Closed trauma	S. pneumoniae, H. influenzae, polymicrobial meningitis, with coliforms and non-sporing anaerobes.
Otitis media & sinusitis	S. pneumoniae, H. influenzae type b, coliforms, non-sporing anaerobes, other streptococ
Bacteremia & Endocarditis	S. aureus, Gram -ve

Wilks D, Farrington M, Rubenstein D. The Infectious Diseases Manual 2003

Predisposing factors

Predisposing factors	Microorganisms
Absence of opsonizing antibody	S. pneumoniae, N. meningitidis, H. influenzae
Complement deficiency	N. meningitidis
Asplenia	S. pneumoniae, N. meningitidis
Corticosteroid use	L. monocytogenes, C. neoformans
HIV infection	C. neoformans, S. pneumoniae, L. monocytogenes,

Kaplan LS. In: UpToDate, Basow, DS (Ed), UpToDate, Waltham, MA, 2010

Vaccines

- Streptococcus pneumoniae
- Neisseria meningitidis
- Haemophilus influenzae

Serotypes of S. pneumoniae

- Serotype 14 (19.47%)
- Serotype 6 (16.26%)
- Serotype 19 (15.14%)
- Serotype 23 (10.29%)
  - in 16 European countries

7-valent	4	6B	9V	14	18C	19F	23F						
13-valent	4	6B	9V	14	18C	19F	23F	1	5	7F	3	6A	19A

Jefferson T, et al. Lancet Infect Dis 2006;6:405–10.

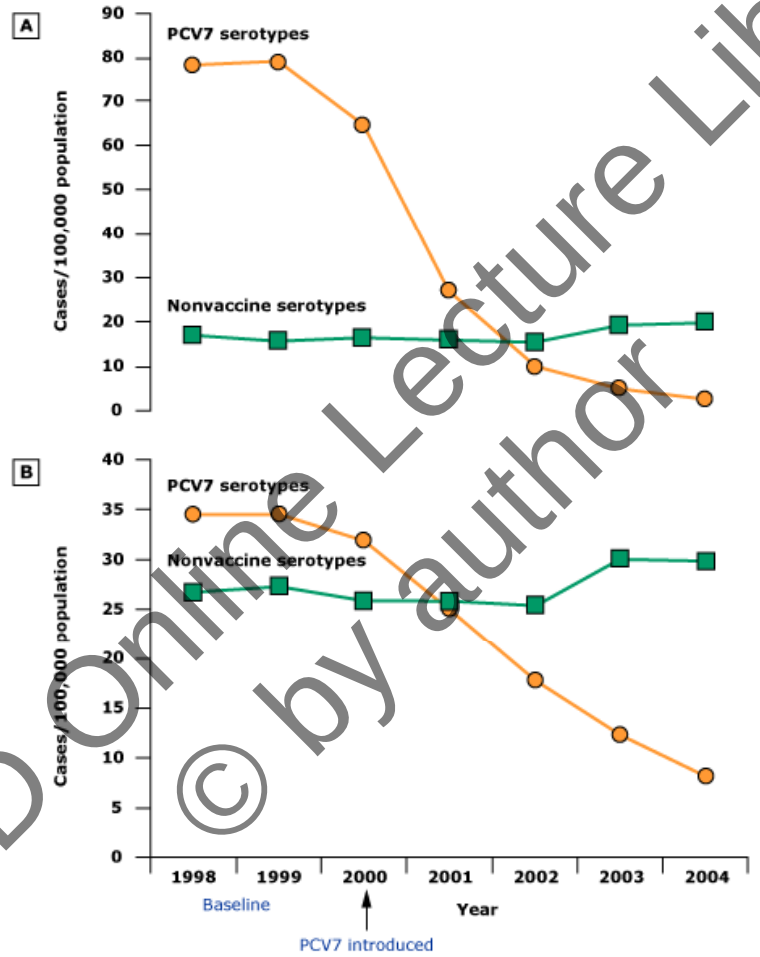
Pneumococcal meningitis in USA
Routine vaccination PCV7

Tsai CJ, et al.	<2 y	2-4 y	≥65 y
1994-1999	7.7/100.000	0.9/100.000	1.2/100.000
2001-2004	2.6/100.000	0.5/100.000	0.8/100.000
Change	**-66%**	**-51.5%**	**-33%**

Hsu HE, et al.	<2 y	2-4 y	≥65 y
1998-1999	10.16/100.000	0.95/100.000	1.9/100.000
2004-2005	3.66/100.000	0.87/100.000	0.87/100.000
Change	**-64%**	**-8.4%**	**-54%**

Tsai CJ, et al. Clin Infect Dis 2008; 46: 1664-72
Hsu HE, et al. N Engl J Med 2009; 360: 244-56

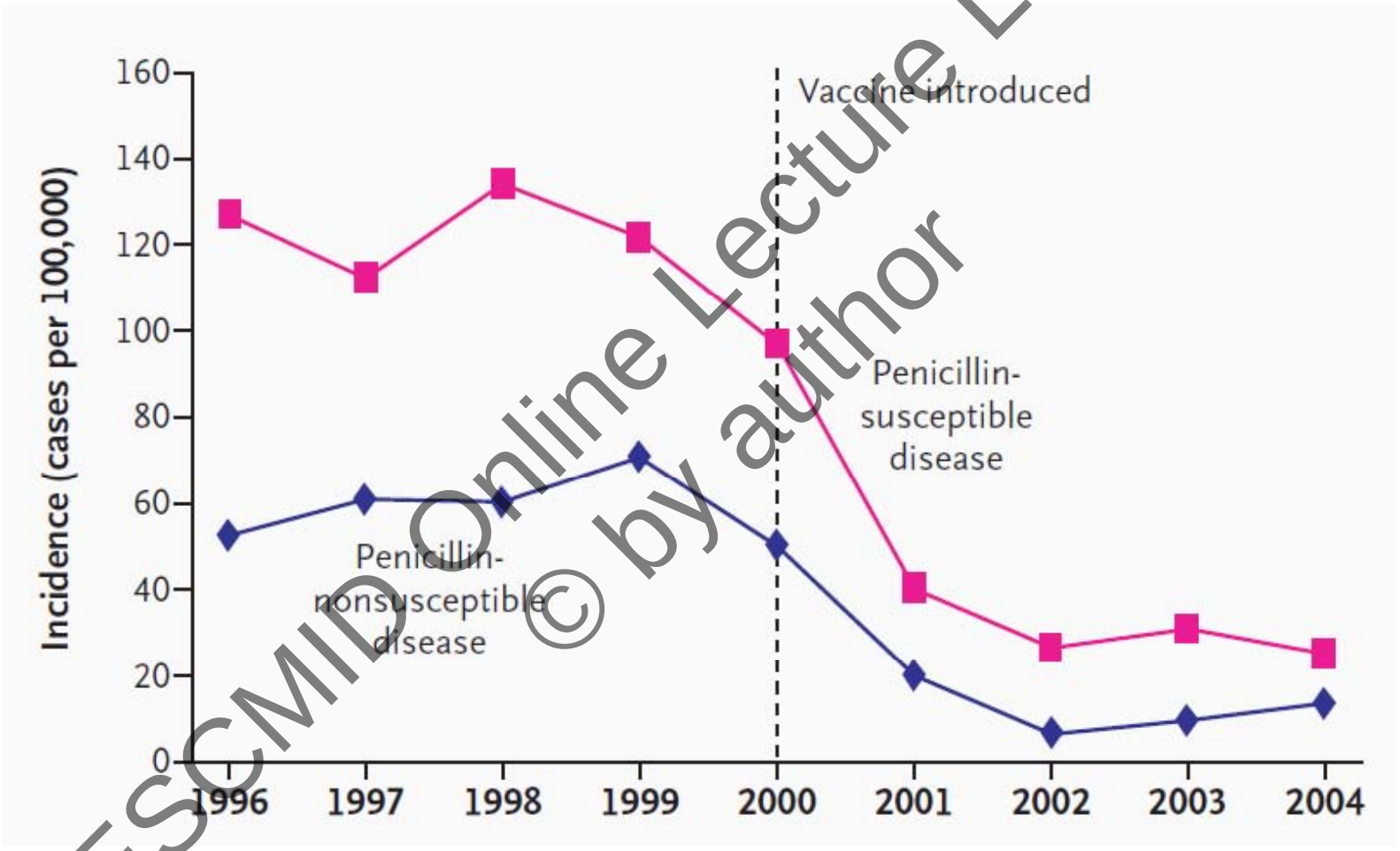
Rates of invasive pneumococcal disease among children <5 years and adults aged ≥65 years by serotype and year



Rates of invasive pneumococcal disease among children aged <5 years (A) and adults aged ≥65 years (B), by serotype and year. The 7-valent pneumococcal conjugate vaccine (PCV7) includes serotypes 4, 6B, 9V, 14, 18C, 19F, and 23F.

Reproduced with permission from: Hicks, LA, Harrison, LH, Flannery, B, et al. Incidence of Pneumococcal Disease Due to Non-Pneumococcal Conjugate Vaccine (PCV7) Serotypes in the United States during the Era of Widespread PCV7 Vaccination, 1998-2004. JID 2007; 196:1346.

Effect of vaccine on drug-resistant S. pneumoniae



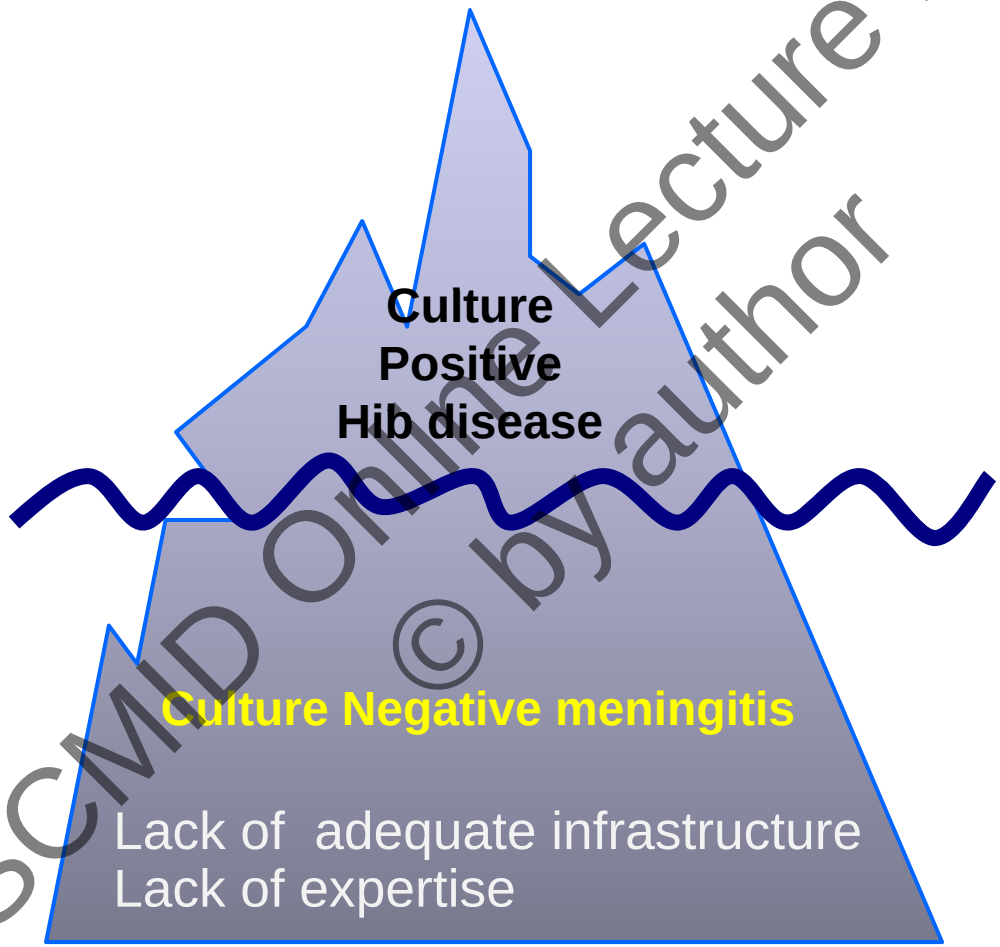
Kyaw M et al. NEJM 2006;354:1455-63

Serotype distribution of S. pneumoniae

- Routine use of PCV7 in Europe
- Decline in in IPD including meningitis
- Increase non-vaccine serotypes
  - Serotypes 1, 19A, 3, 6A, and 7F
- There is a need for inclusion of these serotypes in future vaccine formulations

Isaacman DJ, et al. Int J Infect Dis 2010;14(3):e197-209

Burden of Hib disease



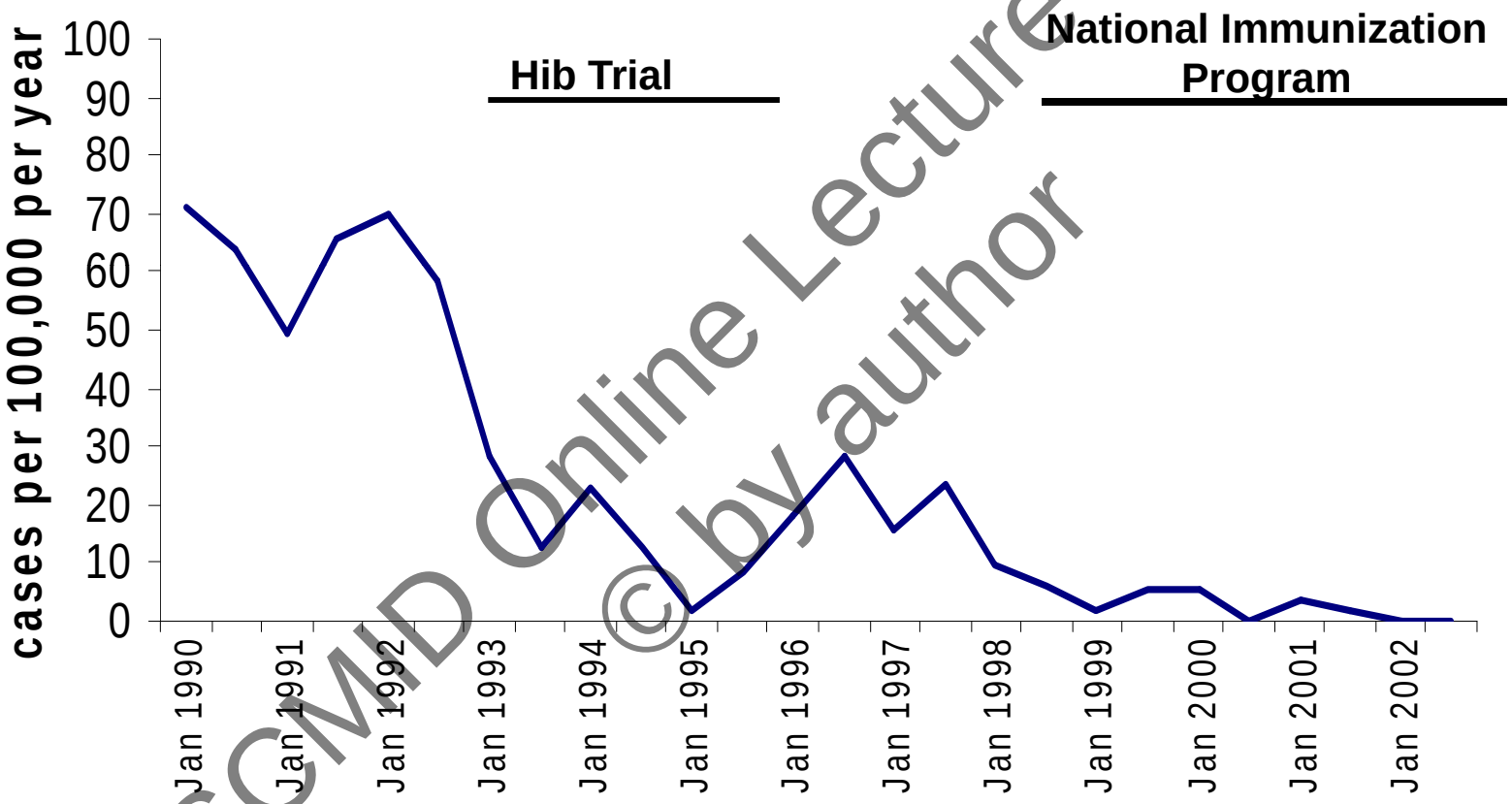
Updated from: the Hibinitiative

H. influenzae type b meningitis

Geographic area (yr of comparison)	No. of cases/100,000 population	
	Prevaccination	Postvaccination
United States (1987 vs 1995)	54	<1
Canada (1985 vs 1994)	~44	<1
Brazil (1988–1996 vs 1997)	22	10
Chile (1995 vs 1998)	40	<2
Uruguay (1992-1993 vs 1995)	17–22	1
Scandinavia (1970s vs 1995)	31	<1
Austria (1991 vs 1993–1996)	11	<1
Netherlands (1970s vs 1993-1994)	22–40	0.3
Spain (1993–1995 vs 1997)	14	~0
Switzerland (1976–1990 vs 1991–1993)	25	8
United Kingdom (1991–1992 vs 1993-1994)	15	0.6
Israel (1989–1992 vs 1995)	18	<1
Australia (1991-1992 vs 1993-1994)	21	6
The Gambia (1990–1993 vs 2002)	60	0
Kenya (2000-2001 vs 2004-2005)	66	7.6
Malawi (1997–2002 vs 2005)	20–40	0
Uganda (2001 vs 2003–2006)	42	<3

Brouwer MC. CMR 2010;23:467-92

Gambia: Incidence of Hib meningitis in children under 5 yrs of age



Source: the Hibinitiative

Adegbola et al. Lancet 2005; 366:144-150

Hib meningitis

- Routine immunization in children eliminated meningitis caused by vaccine serotypes in high income countries
  - Hib meningitis is seen primarily in children that are not vaccinated
- In developing countries, where routine vaccination program is not available, Hib remains a major cause of meningitis in children
  - South East Asia, Africa and in various other tropical regions

Maelej SM, et al. Med Mal Infect 2006;36(2):105-10.
ANH DD, et al. Am J Trop Med Hyg 2006;74:509-515
Sim KS. Lancet Infect Dis 2010;10: 32-42

H. influenzae meningitis: Serotypes

- H. influenzae type B meningitis decreased 69% after implementation of Hib vaccine in Brasil
- 8-fold increase in the incidence of meningitis caused by H. influenzae type A

Ribeiro GS, et al. J Infect Dis 2003;187:109-16

N. meningitidis

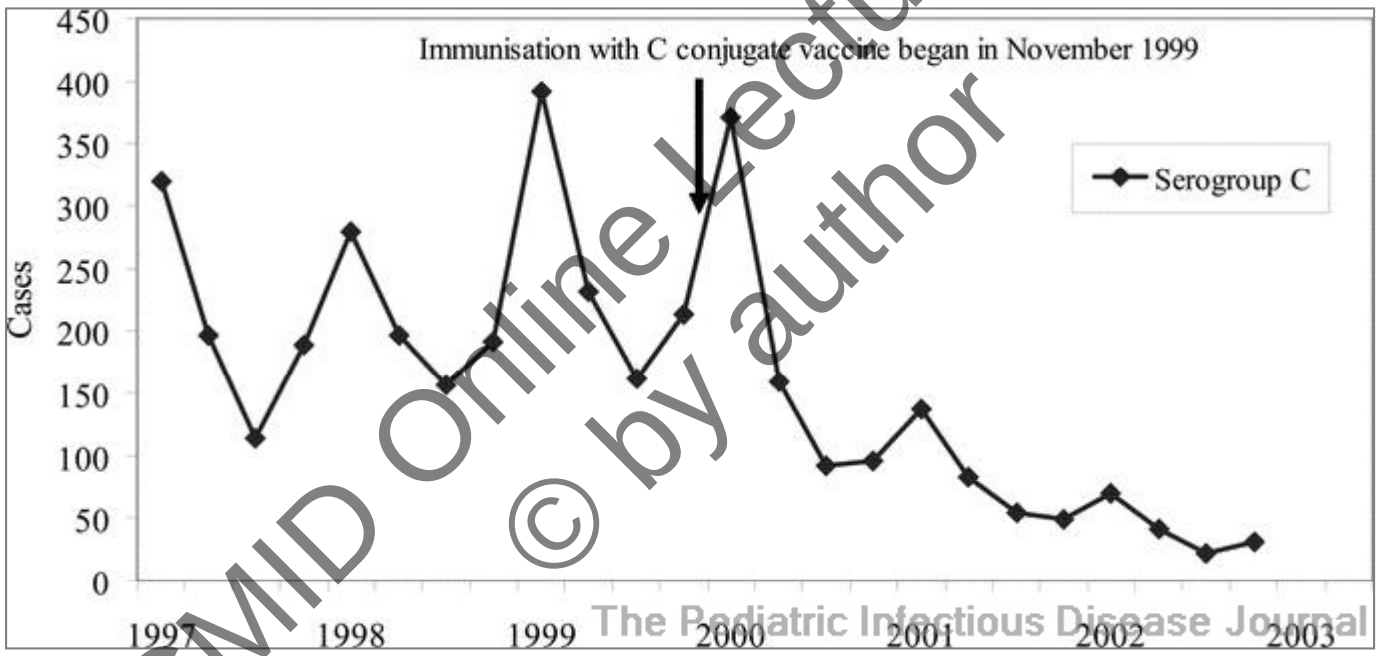
- Most infections (90%) are caused by organisms belonging to serogroups A, B, C, Y and W-135
- Types A, B and C account for most of the cases
- The predominant serogroup is B in most European countries
- Serogroup A is responsible for epidemic disease in sub-Saharan Africa
- In Saudi Arabia during the annual Hajj pilgrimage the prevelant serotype was W-135

Macwana N, Riordan FAI. CNS Drugs 2007;21:355-66
Tzanakaki G. Mastrantonio P. Int I Antimicrob Agents 2007;29:621-29

Meningitis belt

- Epidemics typically occur in the dry season (December to June)
- An epidemic wave can last two to three years

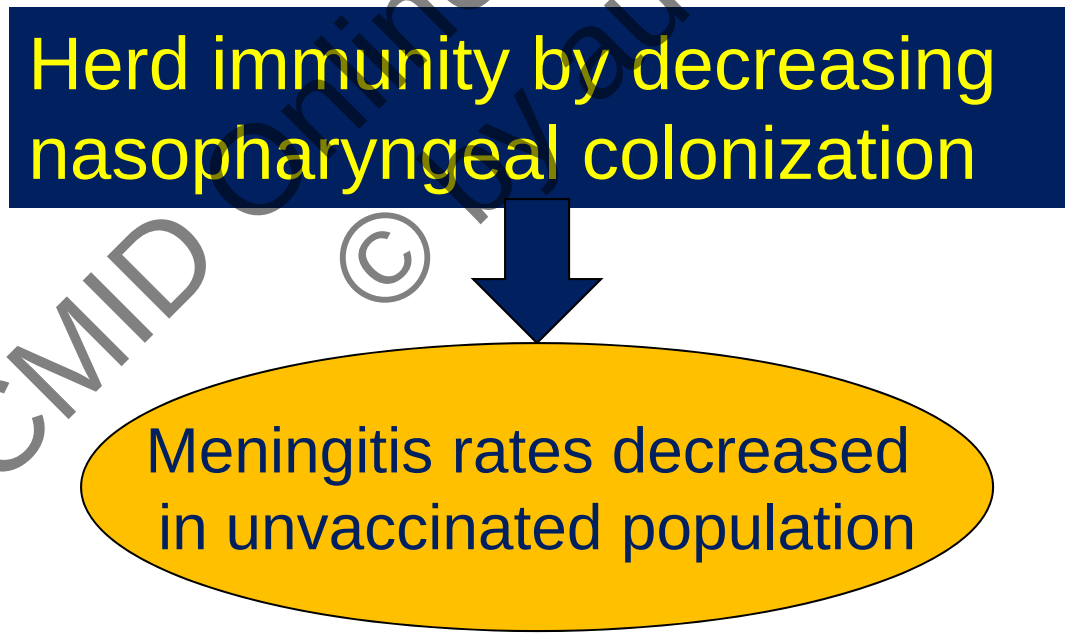
Serogroup C meningococcal disease England & Wales



Pollard, AJ. The Pediatric Infectious Disease Journal 2004;23(12):S274-S279

Herd immunity

- S. pneumoniae conjugate vaccine
- H. influenzae type B conjugate vaccine
- Meningococcal conjugate vaccine



Sim KS. Lancet Infect Dis 2010;10: 32-42

Conclusion

- Top three leading cause of meningitis
  - Streptococcus pneumoniae
  - Neisseria meningitidis
  - Haemophilus influenzae type b [Hib]
- Bacterial meningitis remains a life-threating infection in developing countries
- Following the institution of routine immunization with H. influenzae, S. pneumoniae and meningoccocal vaccines, bacterial meningitis has decreased in frequency in developed countries
- An increase in meningitis cases caused by serotypes not in the vaccines