

Epidemiology of community-acquired meningitis



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Hakan Leblebicioglu

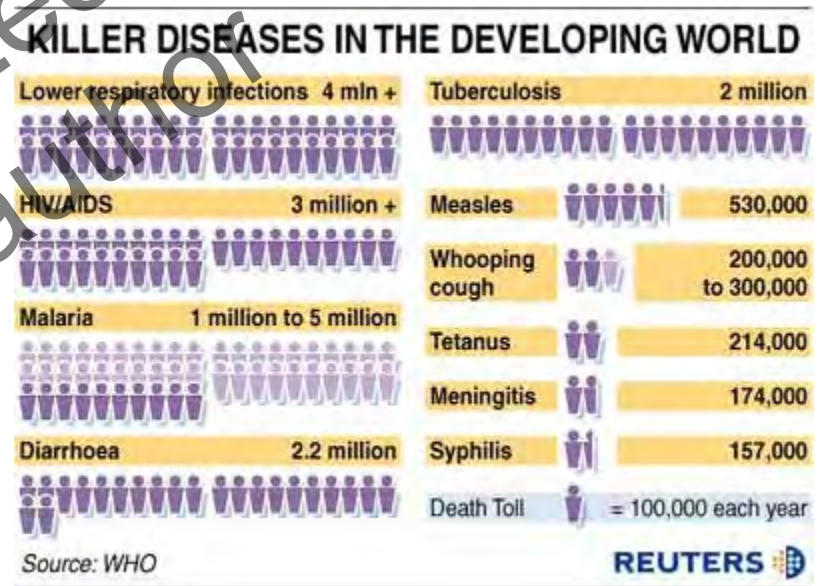
Presentation outline

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

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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



Microorganisms

- Streptococcus pneumoniae
- Neisseria meningitidis
- Haemophilus influenzae type b [Hib]
- Group B streptococcus
- Listeria monocytogenes
- Escherichia coli

} >% 80

Mortality

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

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

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

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%

Purulent meningitis in Turkey

Pooled analysis

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

Developing World



Pakistan <http://new.com.au>



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



Zimbabwean currency

Malawi



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

Partially treated meningitis

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

Predisposing factors

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

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,

Vaccines

- Streptococcus pneumoniae
- Neisseria meningitidis
- Haemophilus influenzae

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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

Pneumococcal meningitis in USA

Routine vaccination PCV7

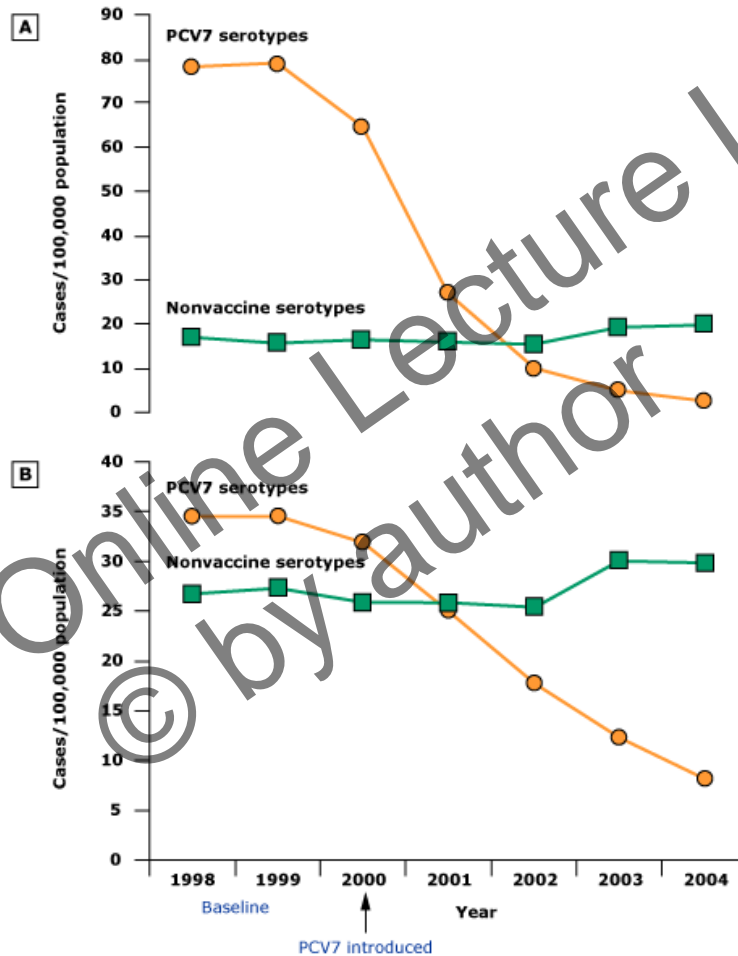
Tsai CJ, et al.	<2 y	2-4 y	≥65 y
1994-1999	7.7/100.000	0.9/100.000	1.2/100.000
2001-2004	2.6/100.000	0.5/100.000	0.8/100.000
Change	-66%	-51.5%	-33%

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

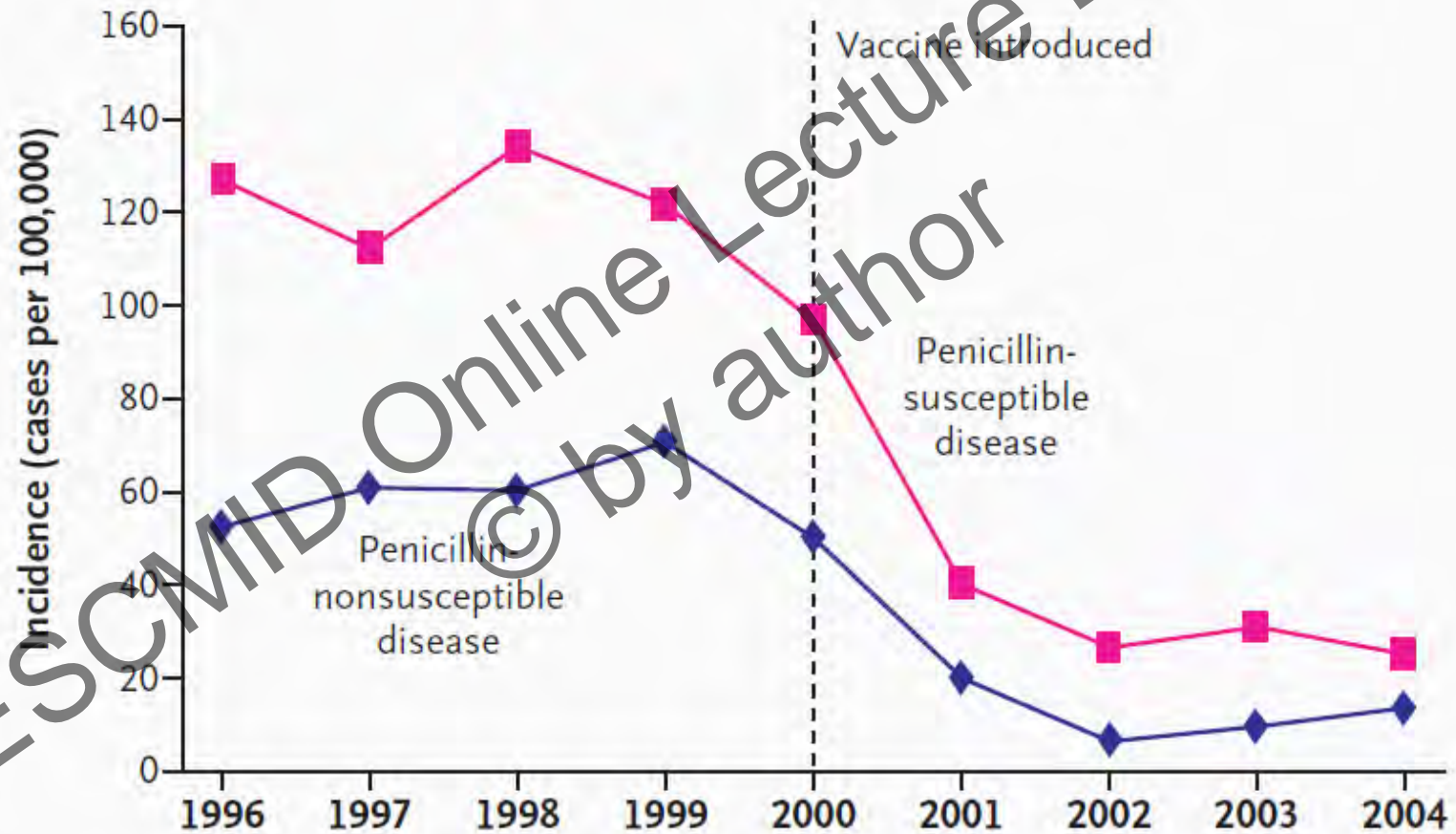


Rates of invasive pneumococcal disease among children aged <5 years (A) and adults aged ≥65 years (B), by serotype and year. The 7-valent pneumococcal conjugate vaccine (PCV7) includes serotypes 4, 6B, 9V, 14, 18C, 19F, and 23F.

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.

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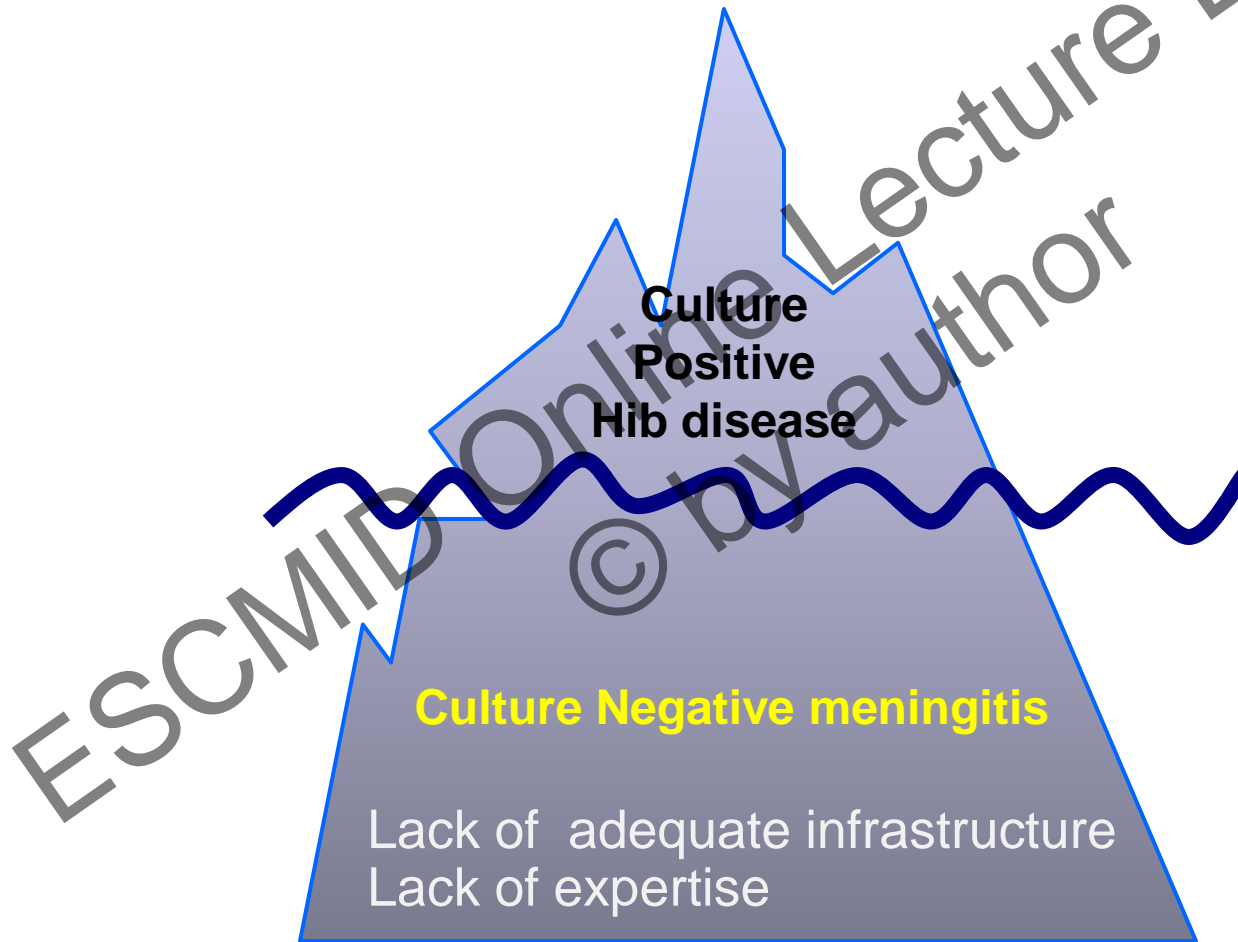
Effect of vaccine on drug-resistant *S. pneumoniae*



Serotype distribution of *S. pneumoniae*

- Routine use of PCV7 in Europe
- Decline 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

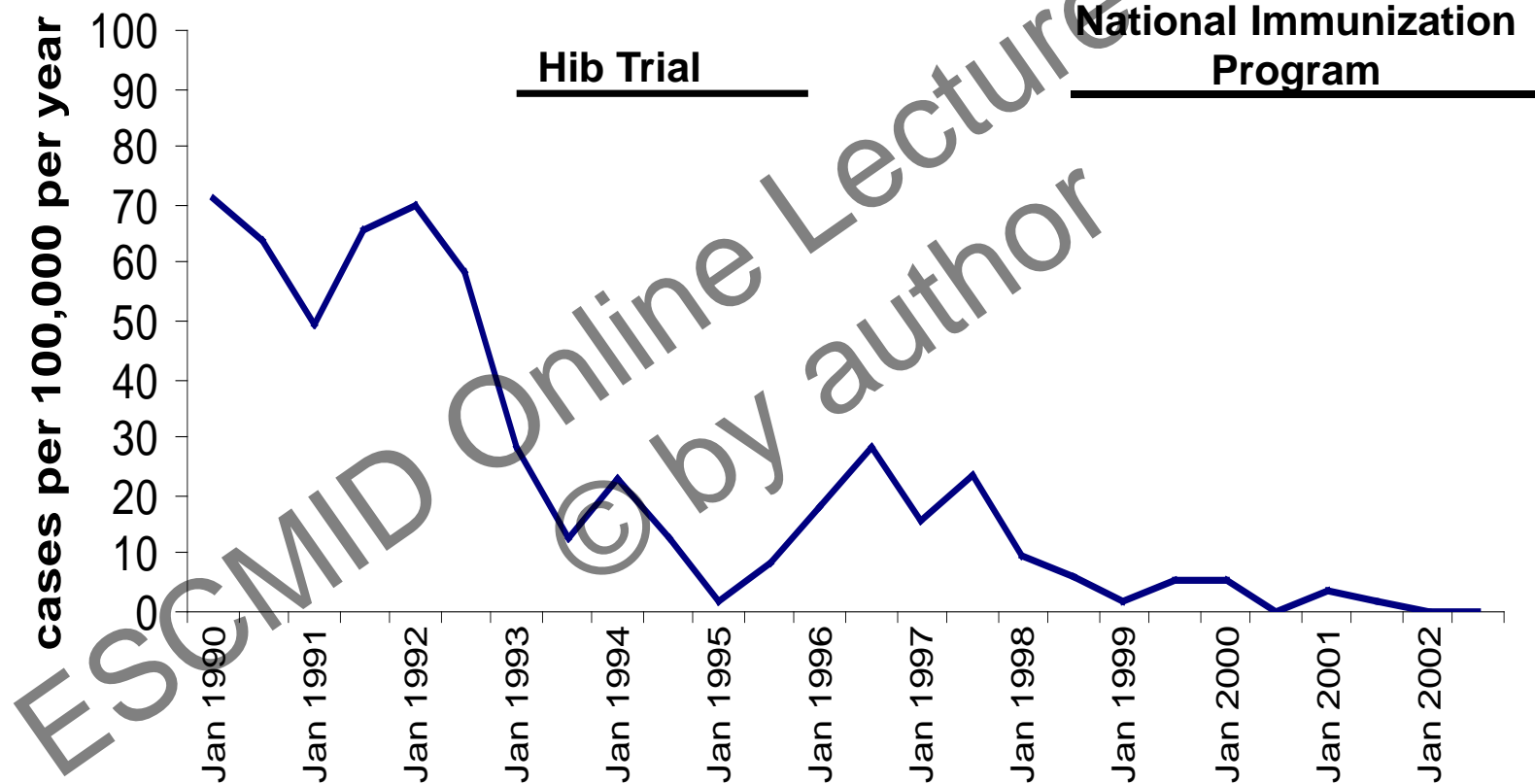
Burden of Hib disease



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)	23	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

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



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

N. meningitidis

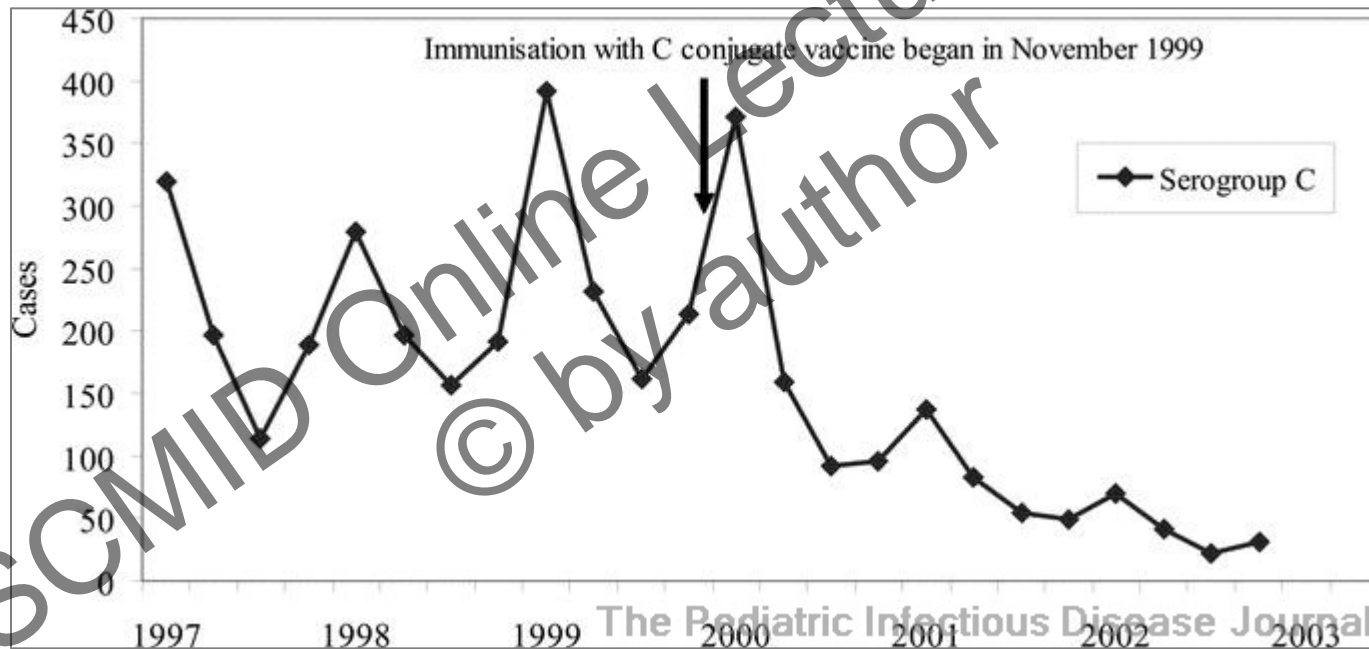
- Most infections (90%) are caused by organisms belonging to serogroups A, B, C, Y and W-135
- Types A, B and C account for most of the cases
- The predominant serogroup is B in most European countries
- Serogroup A is responsible for epidemic disease in sub-Saharan Africa
- In Saudi Arabia during the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

Meningitis belt

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



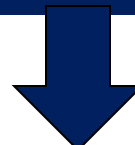
Serogroup C meningococcal disease England & Wales



Herd immunity

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

Herd immunity by decreasing
nasopharyngeal colonization



Meningitis rates decreased
in unvaccinated population

Conclusion

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