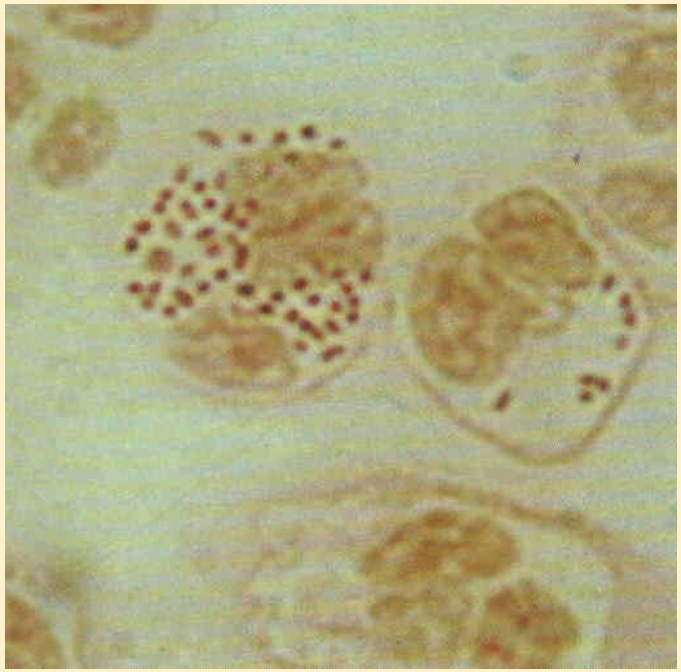
Meningococcal Infections

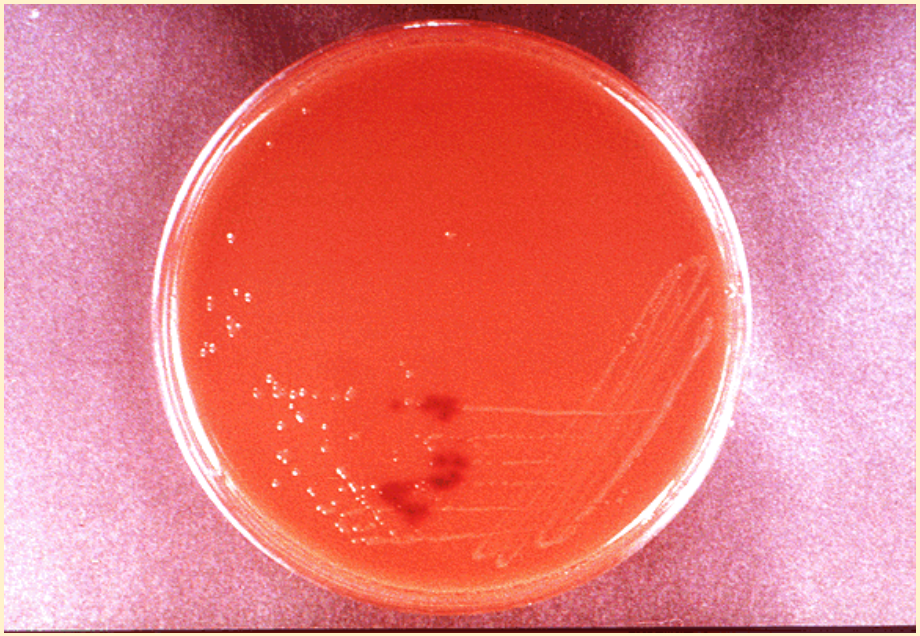
Infectious Disease Epidemiology Section
Office of Public Health
Louisiana Department of Health

800-256-2748
http://infectiousdisease.ldh.la.gov

Bacteriology

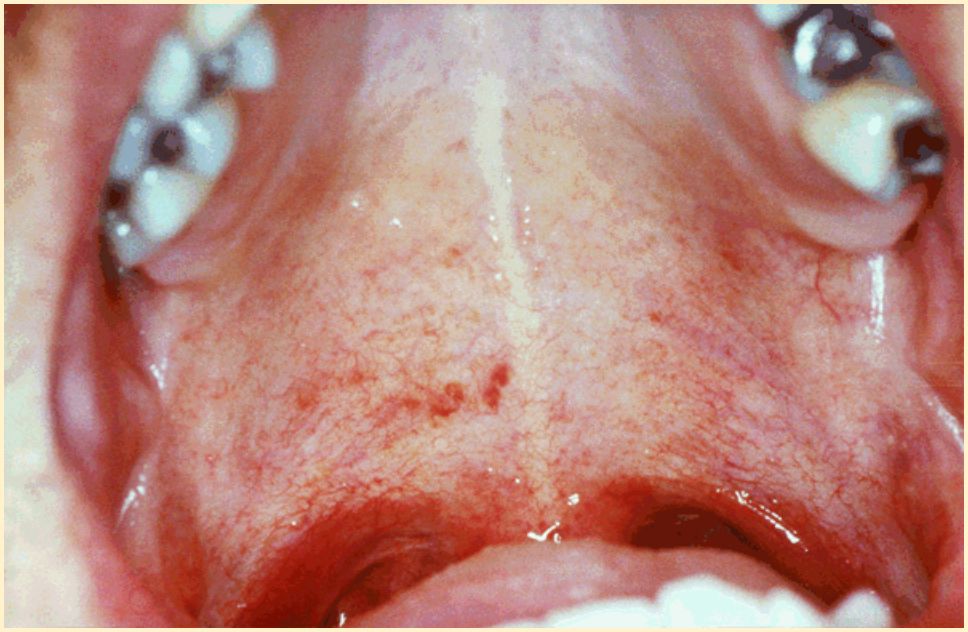
- *Neisseria meningitidis*, **meningococcus**
- **fastidious Gram negative diplococcus**
- **requires enriched media to grow: Thayer-Martin Chocolate agar**
- **37 °C asap in CO_2 atmosphere**
- **(candle jars or special incubators).**



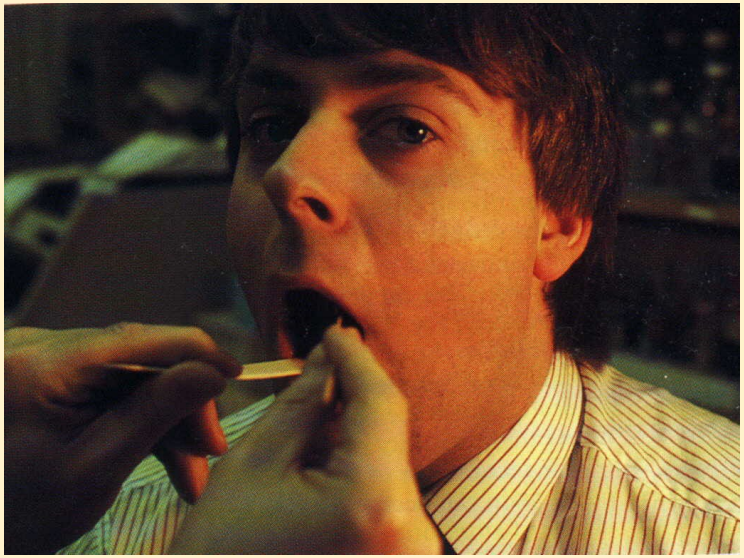


Transmission

- **Droplets**
- **Originate from posterior pharyngeal area**
- **Transmission usually requires close and prolonged contact and takes place slowly**
- **Transmission to medical and nursing personnel is very rare.**



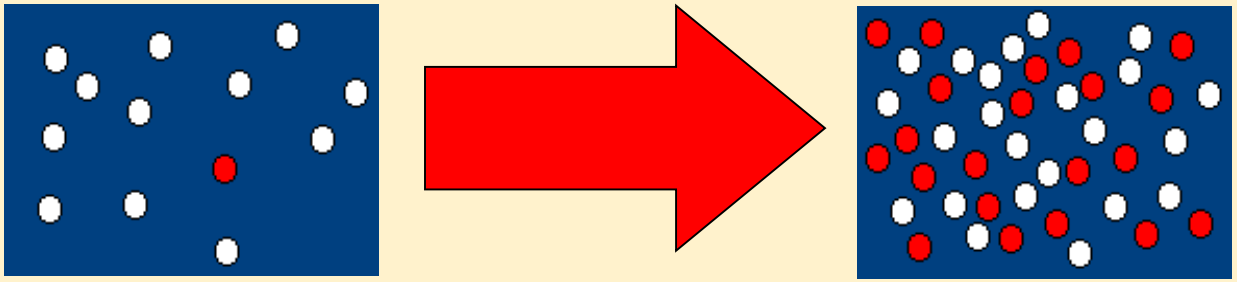
Carriers: prevalence



- All serotypes
- Highest rates among close contacts of index cases, particularly children and young adults
- High rates in crowded, close contact, low socio-economic conditions
- Carriage once well established provides some protection

- 2 to 10% of healthy persons carriers of meningococci
- Transient, intermittent, chronic (2years)
- To cultivate: reach out behind the uvula in the posterior nasopharynx and swipe with a swab or bent wire

Carriers: incidence



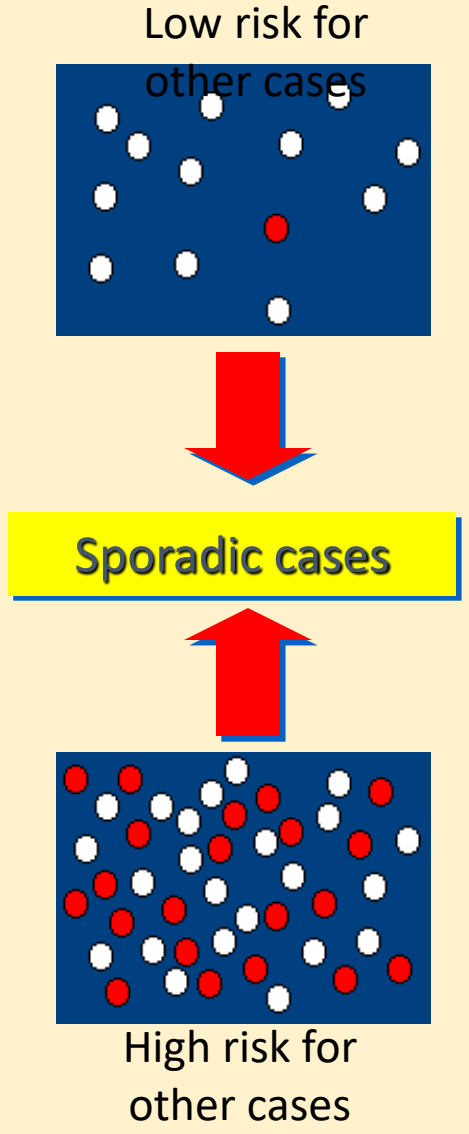
- Acquisition of carriage vary: high in outbreak situation, slow otherwise
- = 0.3% /month in US; estimated as 30% infected if in HH for 1 yr
  - = 1.6% in HH with carriers in Nigeria
  - = 0.7% /month in HH without carriers in Nigeria
- Carrier are highest risk in the days after acquisition of Nm

This explains why it is VERY important to give prophylaxis to close contacts if two cases appear connected. Remember close contact means DROPLET transmission, NOT airborne

Sporadic Cases

Sporadic cases occur throughout the world

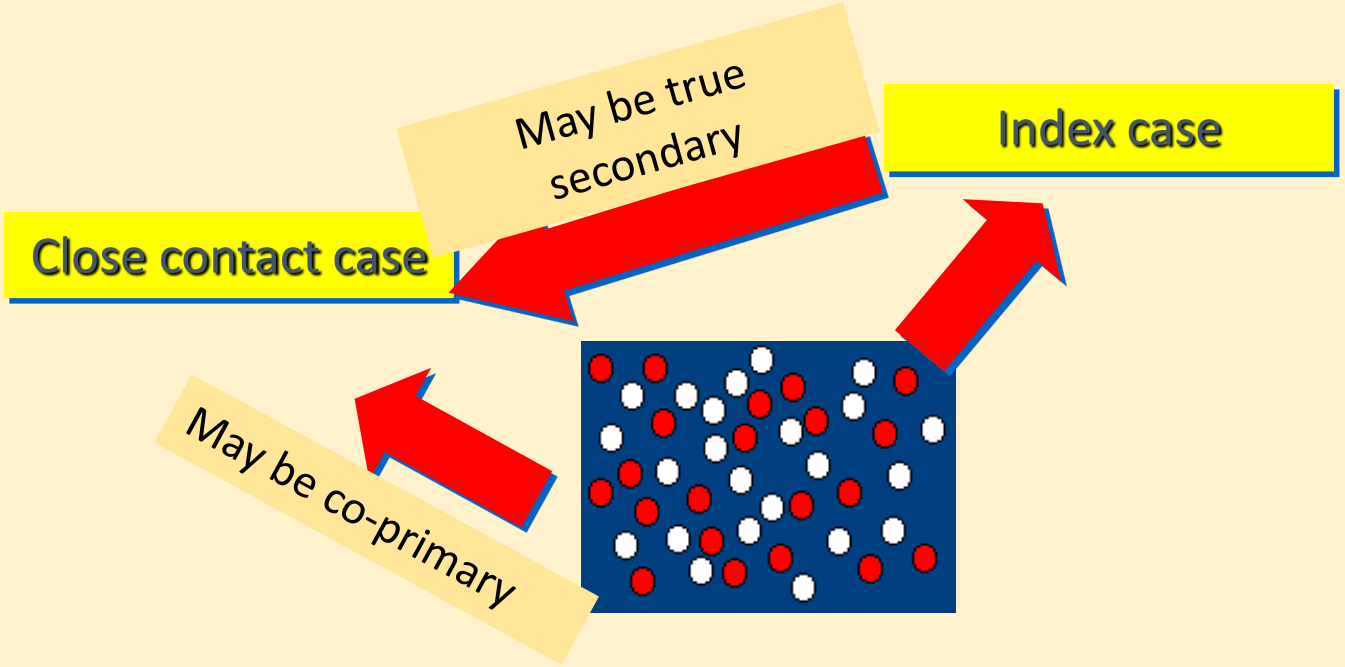
- **Incidence rates**
  - **1 /100,000 in western countries**
  - **15 to 25 /100,000 in developing countries**
- **majority caused by**
  - **serogroup B (46%)**
  - **serogroup C (45%)**
  - **other serogroups: W135, Y and non typable**
- **highest rates**
  - **in infants <1 year of age**
  - **peak incidence of 26 /100,000 among infants < 4 months**



Case among Close Contacts

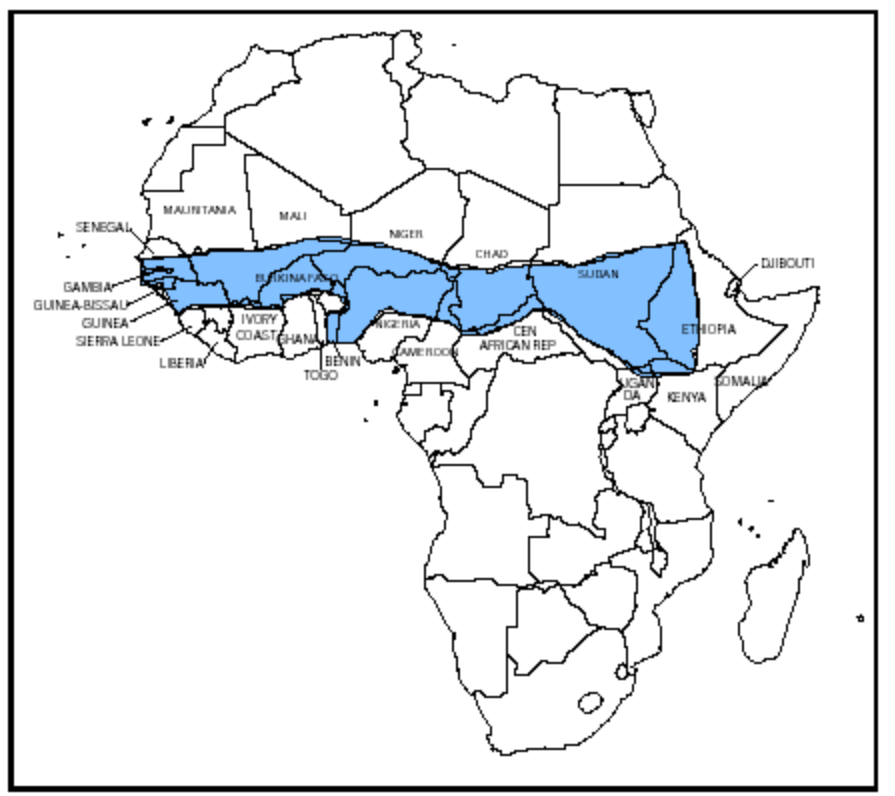
Close contacts of index case highest risk of invasive disease

- **Attack rate in HH contacts = 500 to 1000 x general pop**
- **2.2 /1,000 versus 0.2 /100,000 in general population**
- **Day-care contacts close contact risk = 75 x higher**
- **Rates do not make the distinction between secondary cases and co-primary cases**
- **Cases develop soon after acquisition of carriage, chiefly during high rate of transmission**



Epidemics

- **Epidemics unpredictable & infrequent**
- **Groups:**
  - **major epidemics caused by group A**
  - **localized outbreaks may be group B, C or Y**
- **Major epidemics with attack rates 1%**
  - **developing countries**
  - ***meningitis belt* of sub-Saharan Africa**
- **Mostly children 5-10 years**
- **More frequent in dry season**



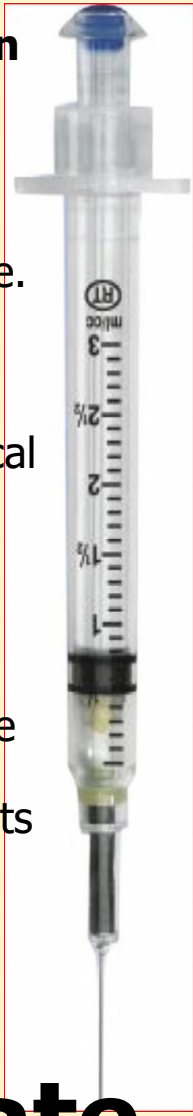
•Epidemic q10yrs: 1962, 1972-74, 1983 Grp A other

1988 Grp A Clone III-1

- **Inc/100,000: 10-50 endemic ® 1,000 epidemic**
- **End. carriers 5-10% , Epidem carriers 80%**

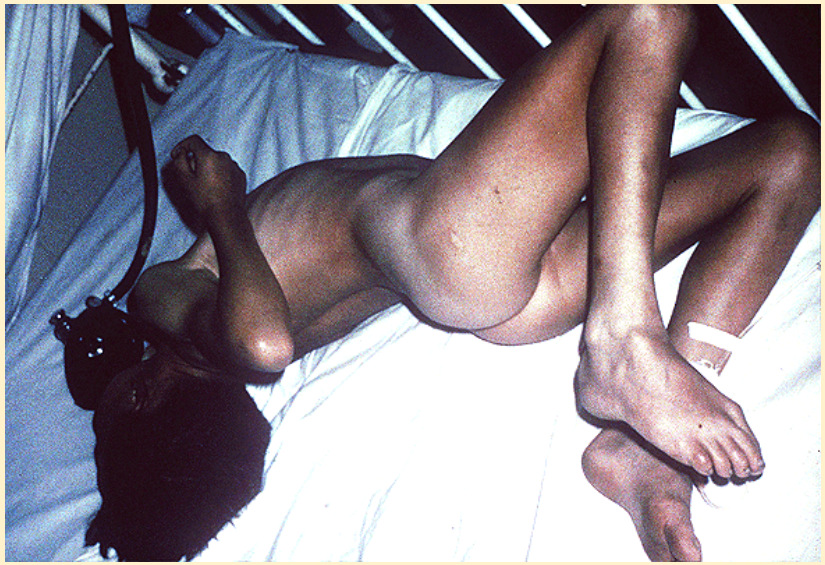
People at High Risk of Disease

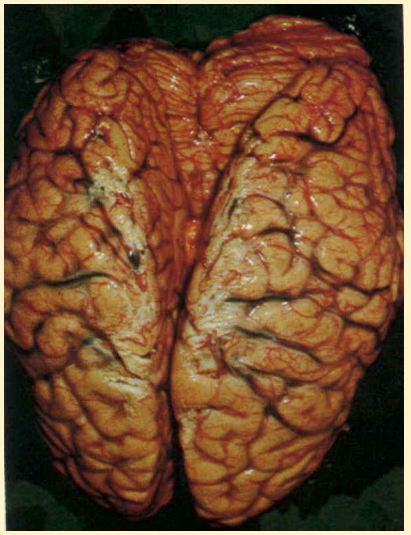
- **Component deficient (Hereditary) in terminal common complement pathway (C3, C5–C9) many experience multiple episodes of infection >Vaccinate**
- **Asplenic**
- **iPeople who take complement inhibitors** (e.g., eculizumab [Soliris®], ravulizumab [Ultomiris™]) are also at increased risk for meningococcal disease.
- **Immunosuppressed**
  - HIV (but not at substantially increased risk for epidemic serogroup A)
  - Streptococcus pneumoniae infection higher risk for acquiring meningococcal disease and for disease caused by some other encapsulated bacteria
  - Atypical hemolytic uremic syndrome (aHUS)
  - Paroxysmal nocturnal hemoglobinuria (PNH)
  - Generalized myasthenia gravis (MG)
  - Recent data suggest that meningococcal vaccines likely provide incomplete protection against invasive meningococcal disease in eculizumab patients. Experts believe this increased risk likely also applies to ravulizumab patients
  - **College students (First year, living in dormitories)**
  - **Military Recruits**
  - **Hajjis**
  - **Teens and preteens**



Vaccinate

Clinical Picture: Meningitis





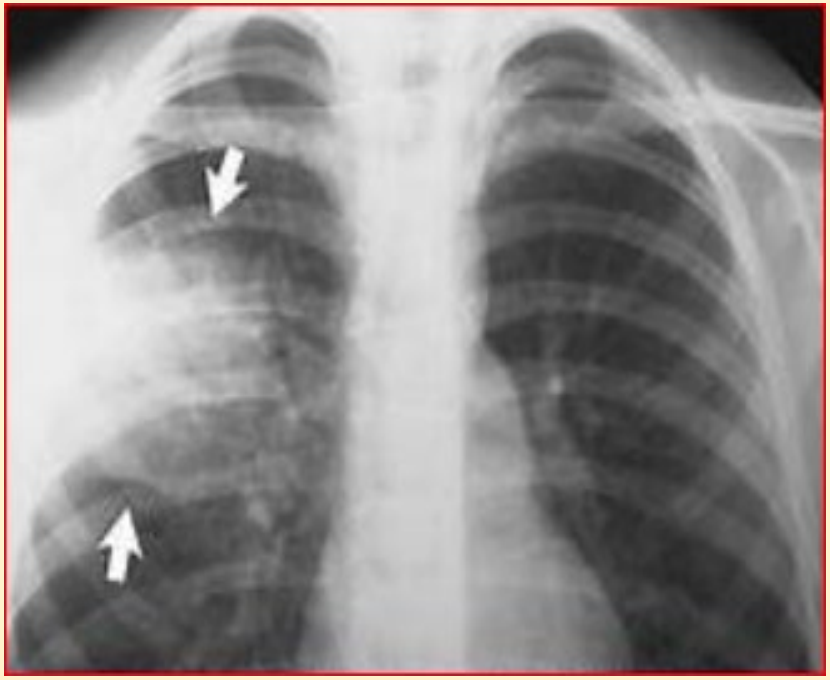
Sequelae:

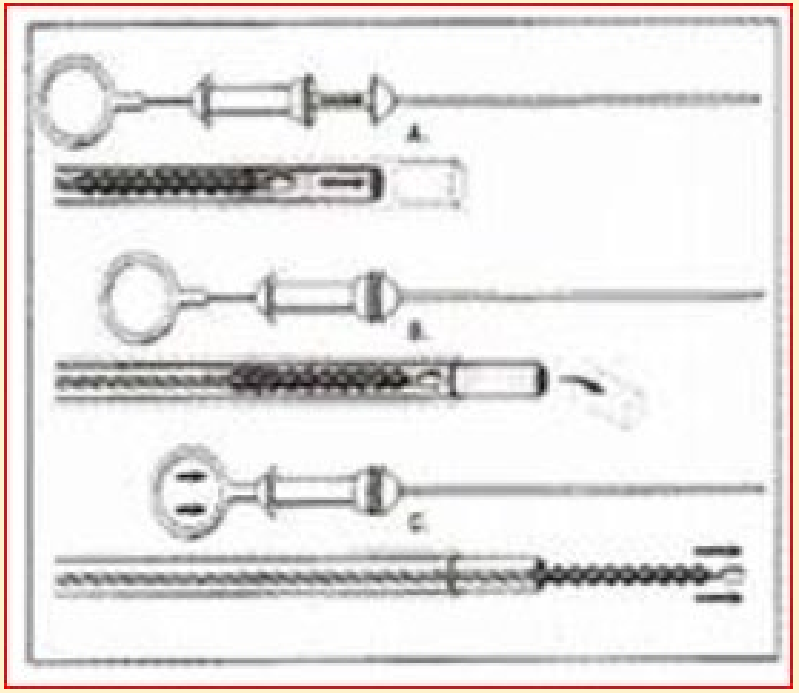
- Mortality: 10 to 15 percent infected with meningococcal disease.
- Long Term Disabilities: percent of
  - Loss of limb(s)
  - Deafness
  - Nervous system problems
  - Brain damage

Meningococcal Pneumonia

- There are no typical signs and symptoms for N.m pneumonia
- Fever, shortness of breath, cough, chest pain, fatigue, night sweats, chills,
- Consolidation on chest Xray

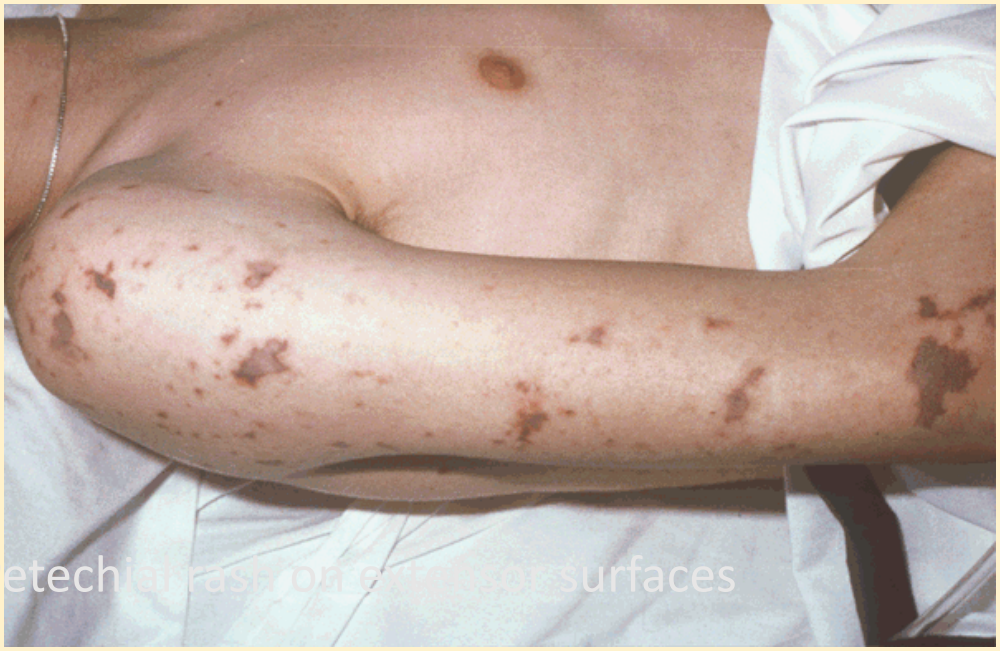
- N.m. on bronchoscopy specimens collected with a protected tip



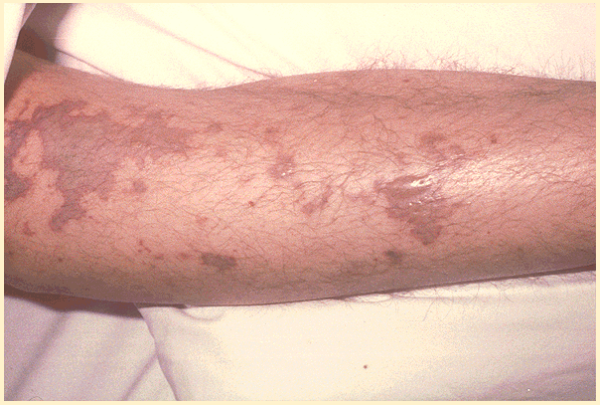


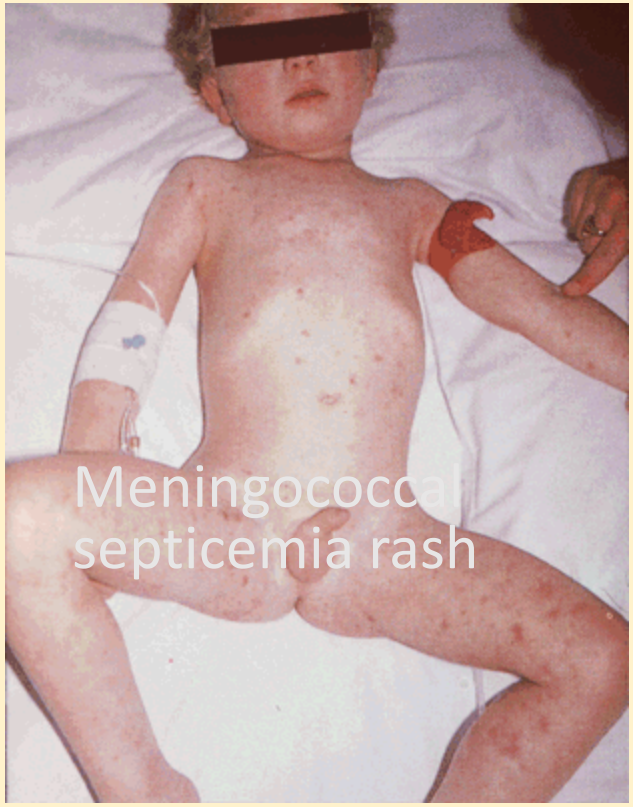
Clinical

- **Petechiae**
- **Signs of Sepsis if ony meningococcemia**



Petechial rash on extensor surfaces

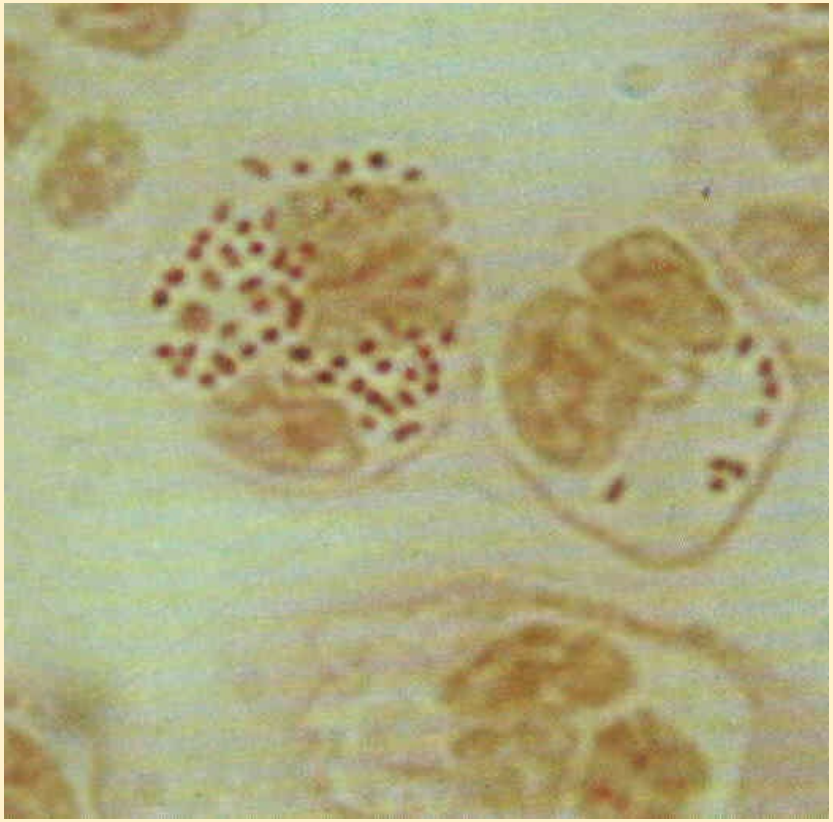


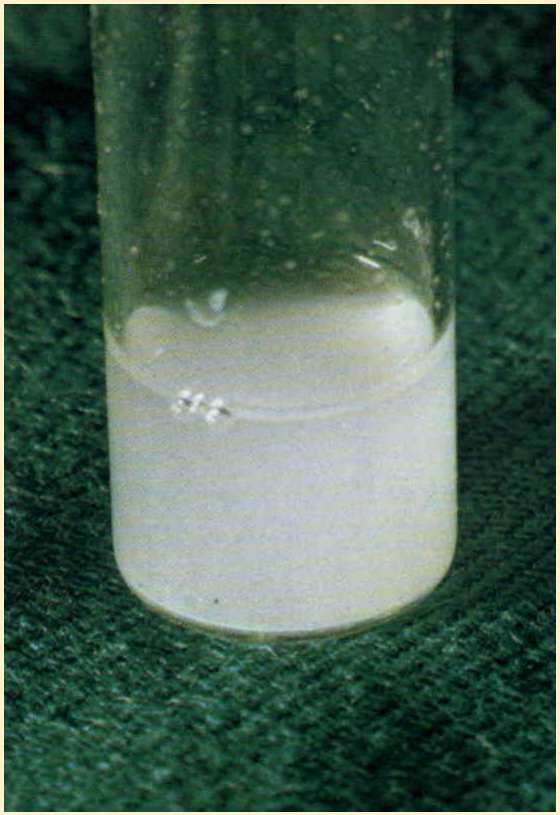


Meningococcal septicemia rash

Diagnosis

- **CSF examination**
- **Blood culture**
- **Phadebact ®**

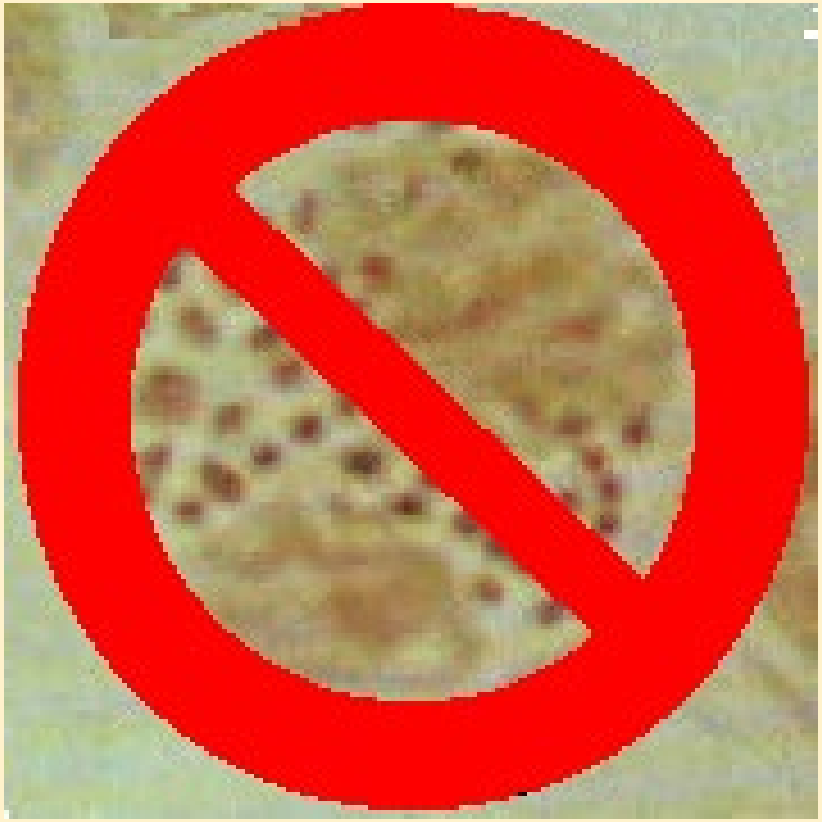




Meningitis Diagnosis by Spinal Tap of CSF

CSF	NORMAL	BACTERIAL	ASEPTIC
Opening Pressure	70-180mm H2O	N to ⇧	N to ⇧
Protein	15-45 mg/dL	Elevated	N to ⇧
Glucose	45-80 mg/dL	⇩	N to ⇩
WBC Count	0-10	25-10 ,000	5-2000
Cells	Mononuclear	Polynuclear	Lympho
Gram stain	Neg	Pos	Neg

Prevention

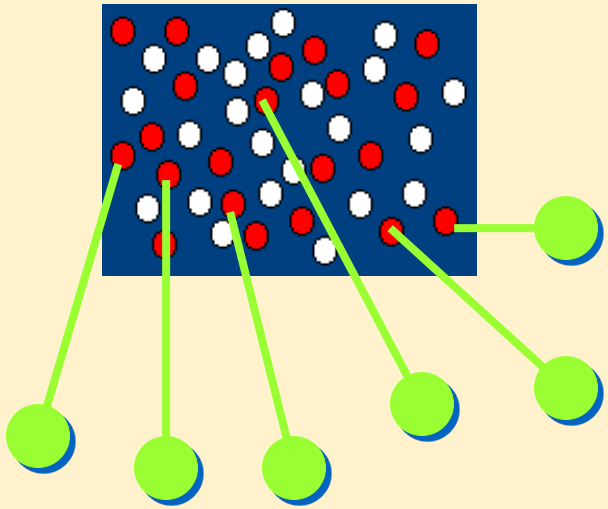


Chemoprophylaxis of Close Contacts

- Primary means for prevention in USA
- Close contacts include
  - household members,
  - day care center contacts,
  - anyone directly exposed to the patient's oral secretions (e.g., through kissing, mouth-to-mouth resuscitation, endotracheal intubation, or endotracheal tube management).
  - NOT CASUAL CONTACT
- Administer antimicrobial chemoprophylaxis ASAP (24 hrs after case identified)
- Administered >14 days: no value
- Oro/nasopharyngeal culture not helpful in determining need for chemoprophylaxis

Chemoprophylaxis

- DOES prevent carriers from developing disease
- DOES eliminate nasopharyngeal carriage of close contacts
- Does NOT prevent contacts from acquiring the infection
- Does NOT treat infection in those incubating disease



Chemoprophylaxis for Health Care Contacts

*Prophylaxis is **not routinely recommended for medical personnel** except those with intimate exposure (such as occurs with mouth to mouth resuscitation, intubation or suctioning). Respiratory tract cultures are of no value in deciding who should receive prophylaxis* (Red Book).

Epidemic Control

Not applicable in the USA

Chemoprophylaxis is not appropriate for epidemic control. *During the 1987 epidemic, carriage rates for those returning to the US were similar among those who did and did not report using rifampin prophylaxis (14% and 10%). A study of chemoprophylaxis during the same outbreak showed substantial acquisition of carriage in the control population, suggesting that a few of the prophylaxis failures were due to recolonization with epidemic strain* (Redbook).

Why Limit Prophylaxis to Close Contacts

JOHN is simply colonized,
Colonization will PROTECT HIM AGAINST ACQUIRING ANOTHER N.M STRAIN

You give him a prophylactic dose,
The N.M. colonizers are eradicated
John has become more susceptible to acquire the new pathogenic strain

You have put JOHN at higher risk of getting the disease

Rifampin for Prophylaxis

- **Rifampin** twice daily for 2 days
  - 600 mg every 12 hours for adults,
  - 10 mg/kg of body weight every 12 hours for children >1
  - 5 mg/kg every 12 hours for infants <1 month of age
- **Effective in eradicating nasopharyngeal carriage** of *N. meningitidis*
- Efficacy in reducing carriage rates has been established

- **Not for mass prophylaxis**: resistant strains quickly develop
- 10-25% of contacts treated with rifampin become recolonized with resistant strains
- Repeated & unjustified use of rifampin among medical personnel result in increasing in-hospital circulation of rifampin resistant meningococci

Alternatives for Prophylaxis

- **Ciprofloxaxin**
  - Single 500-mg oral dose of ciprofloxacin
  - 90% effective in eradicating nasopharyngeal carriage
  - Not generally recommended for persons <18 years or for pregnant and lactating women
  - Ciprofloxacin can be used for chemoprophylaxis of children when no acceptable alternative therapy is available (recent international consensus report)
- **Ceftriaxone**
  - Single parenteral dose (IM 125 mg for children and 250 mg for adults)
  - 97%-100% effective in eradicating pharyngeal carriage

Vaccine

- Quadrivalent A, C, Y, W-135 available in USA
- Single 0.5-mL SC injection
- Dose = 50 μg of purified bacterial capsular polysaccharides
- A polysaccharide response for children OK but comparable with adults after age 4
- C poorly immunogenic children <24 months of age
- A & C vaccines efficacy = 85%-100% in older children and adults
- Useful in controlling epidemics
- Y and W-135 polysaccharides immunogenic in adults and in children >2
- 3 year OK

Indications for Vaccine

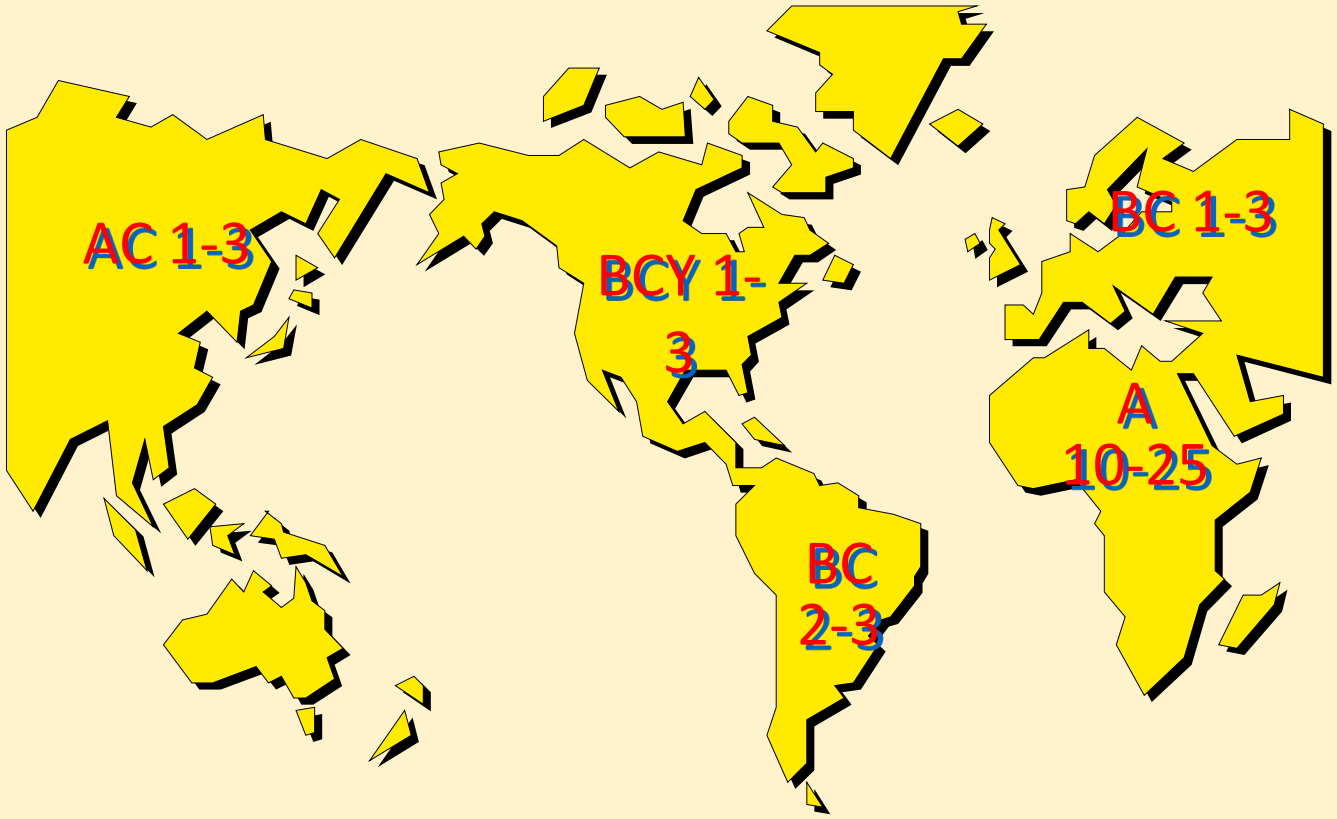
- High-risk groups,
  - **Terminal complement component deficiencies**
  - **Anatomic or functional asplenia.**
  - **Laboratory personnel exposed to *N. meningitidis***
- Travelers to and US citizens residing in countries in which *N. meningitidis* is hyperendemic or epidemic,

Mass Immunization

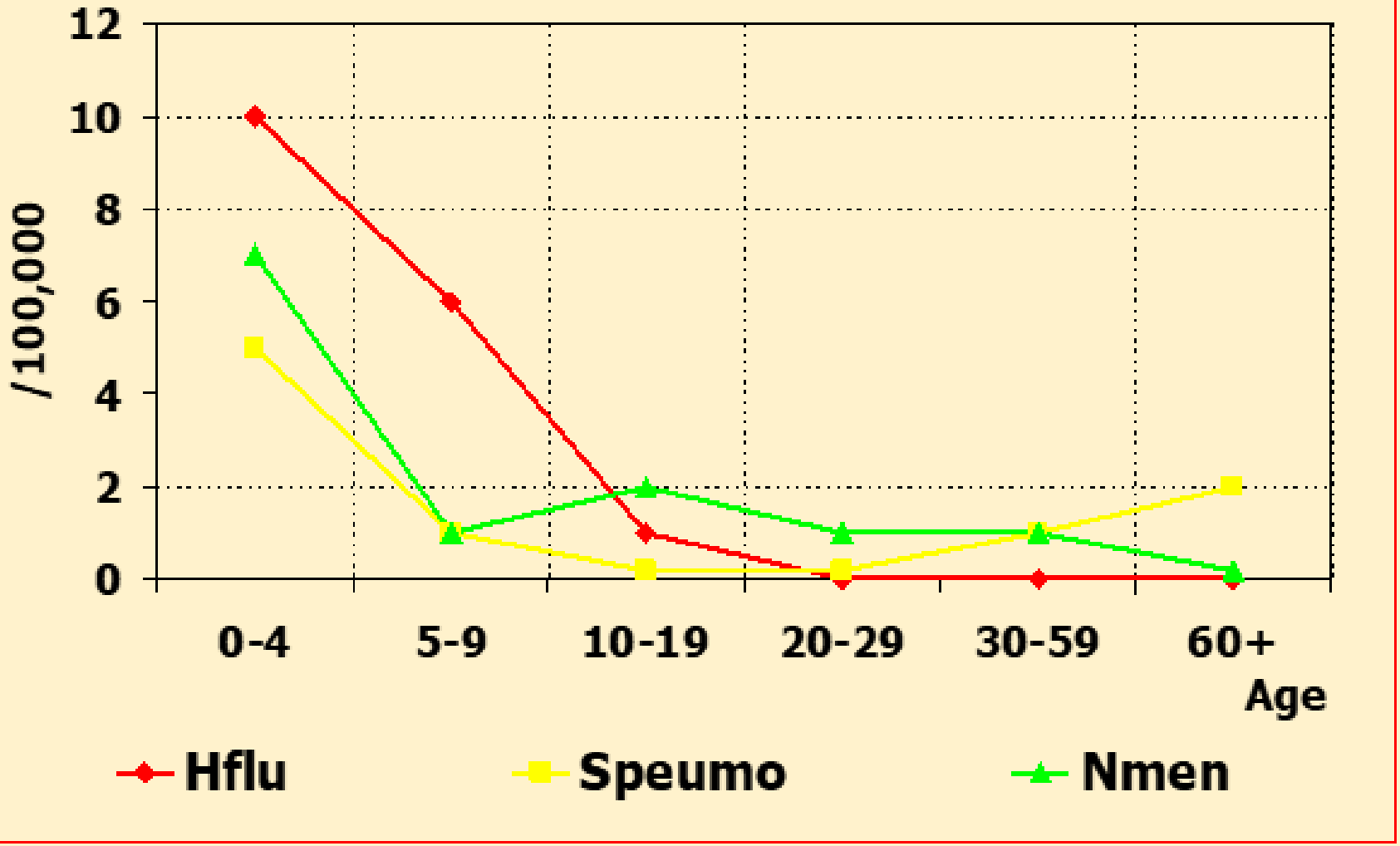
- Highly effective to control epidemics
- Start ASAP after initial cases
- Immunization with A antigen does not prevent carriage but it seems to reduce transmission.
- The decision to implement mass vaccination to prevent meningococcal disease depends on
  - Occurrence of >1 case =outbreak ?
  - Determination not easy without evaluation and analysis of the pattern of disease occurrence.

Meningococcal Meningitis in the World

Incidence /100,000



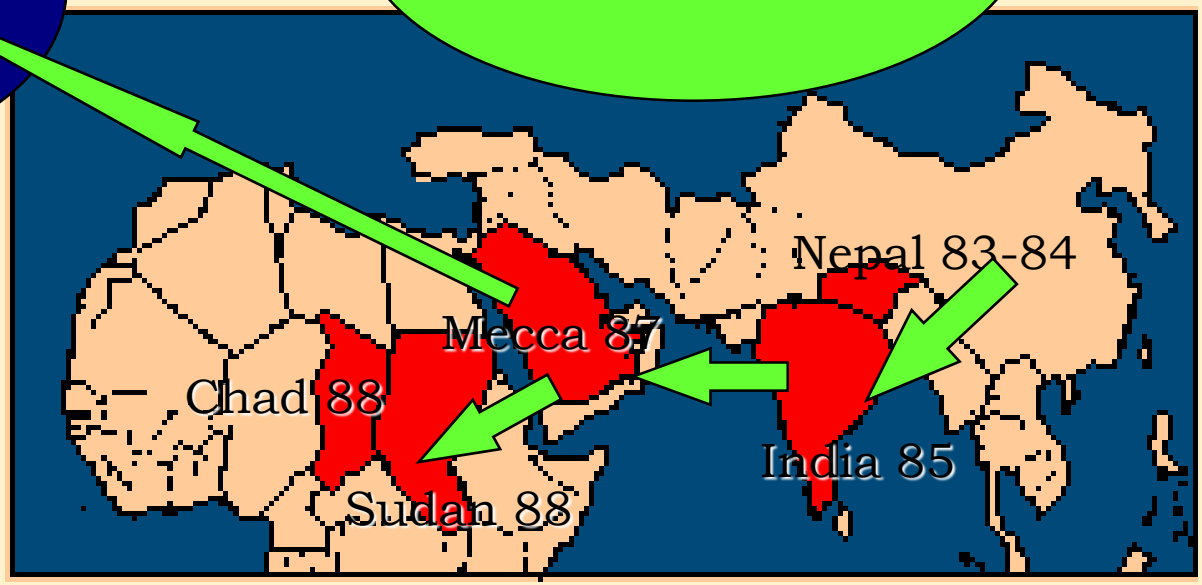
Age Group Incidence of Main Bacterial Meningitis in the World



1987 Epidemic

USA
1250 pilgrim
9 cases, 2 deaths
640E-5

1,620,000 Hajjis,
1841 cases
12% mortality



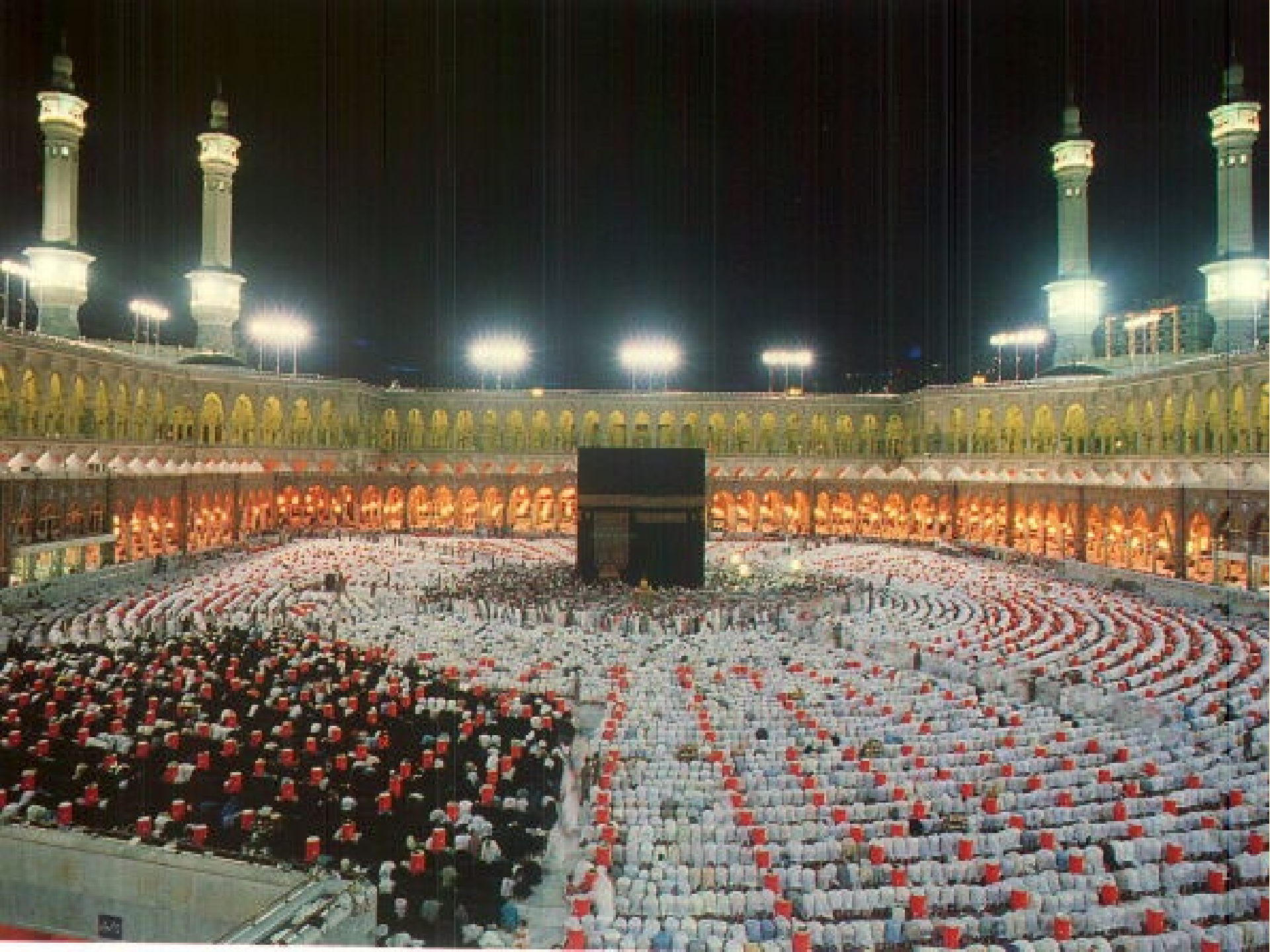
Moore PS 1988, JAMA 260:2687

Moore PS 1989 Lancet 7/29: 260

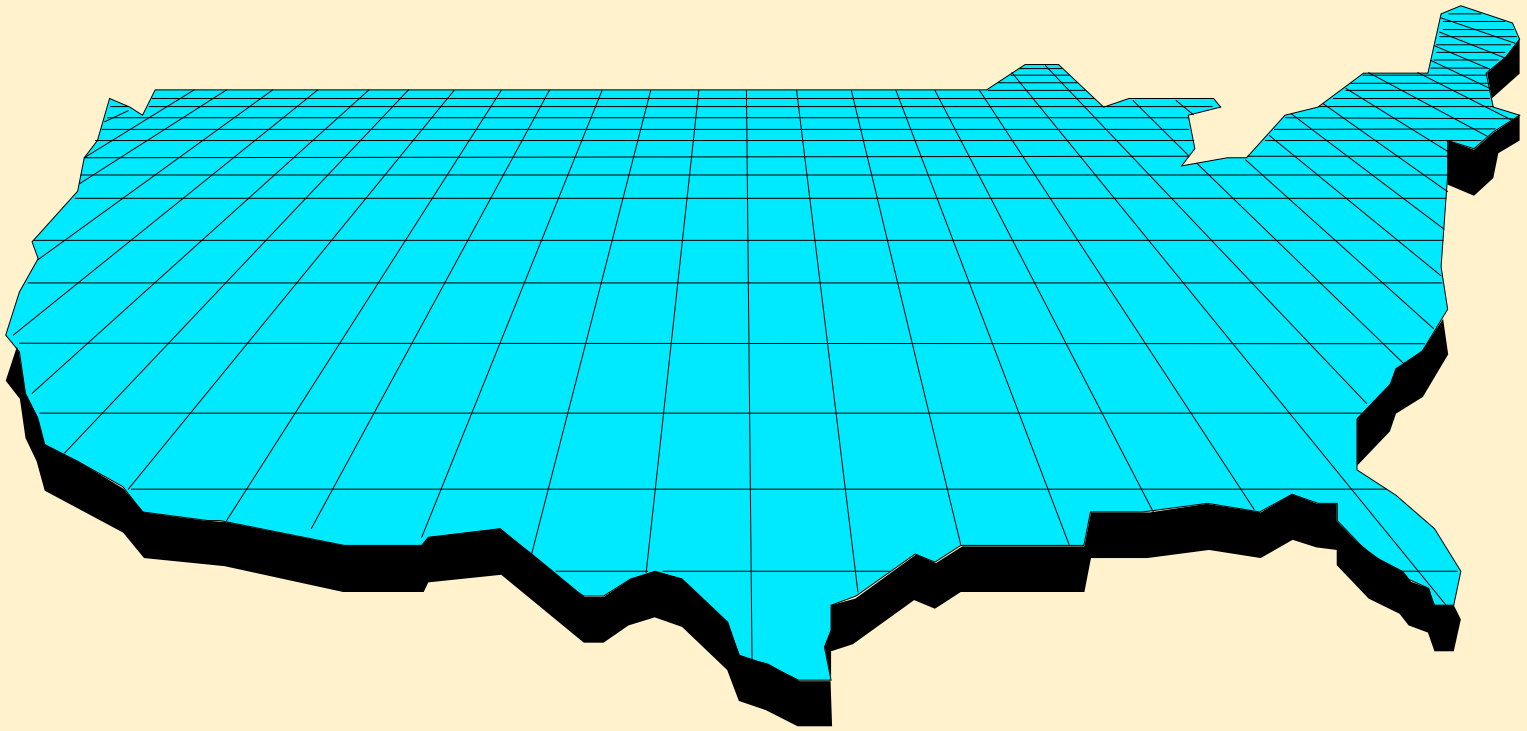
Neisseria meningitidis clonal complex III-1 by enzymatic electrophoretic typing

Africa
Low in African Hajjis because of vaccine requirements

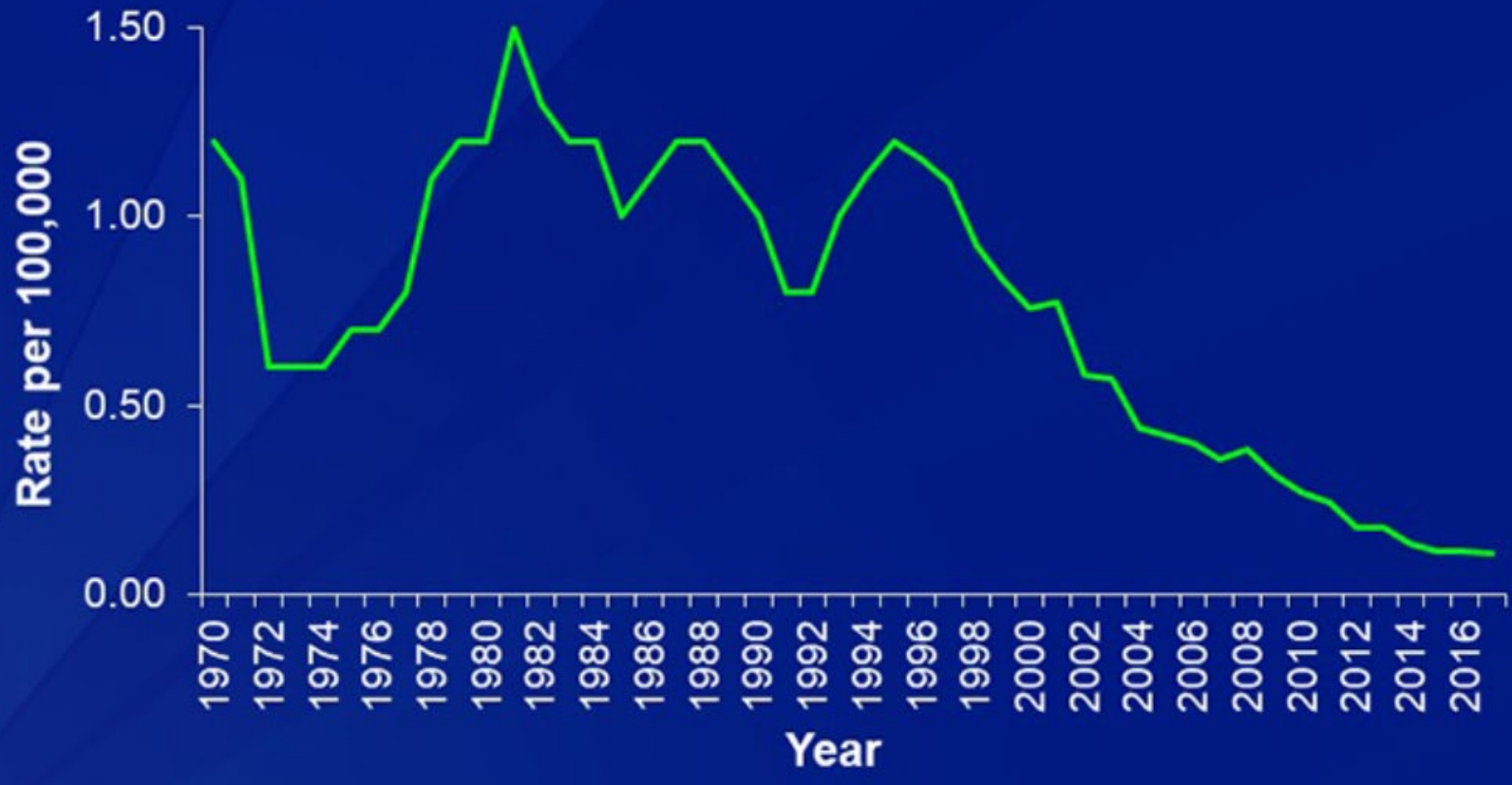
Saudi Pop<<< Other Hajji <<< Asian Hajjis



Meningococcal Meningitis in the USA

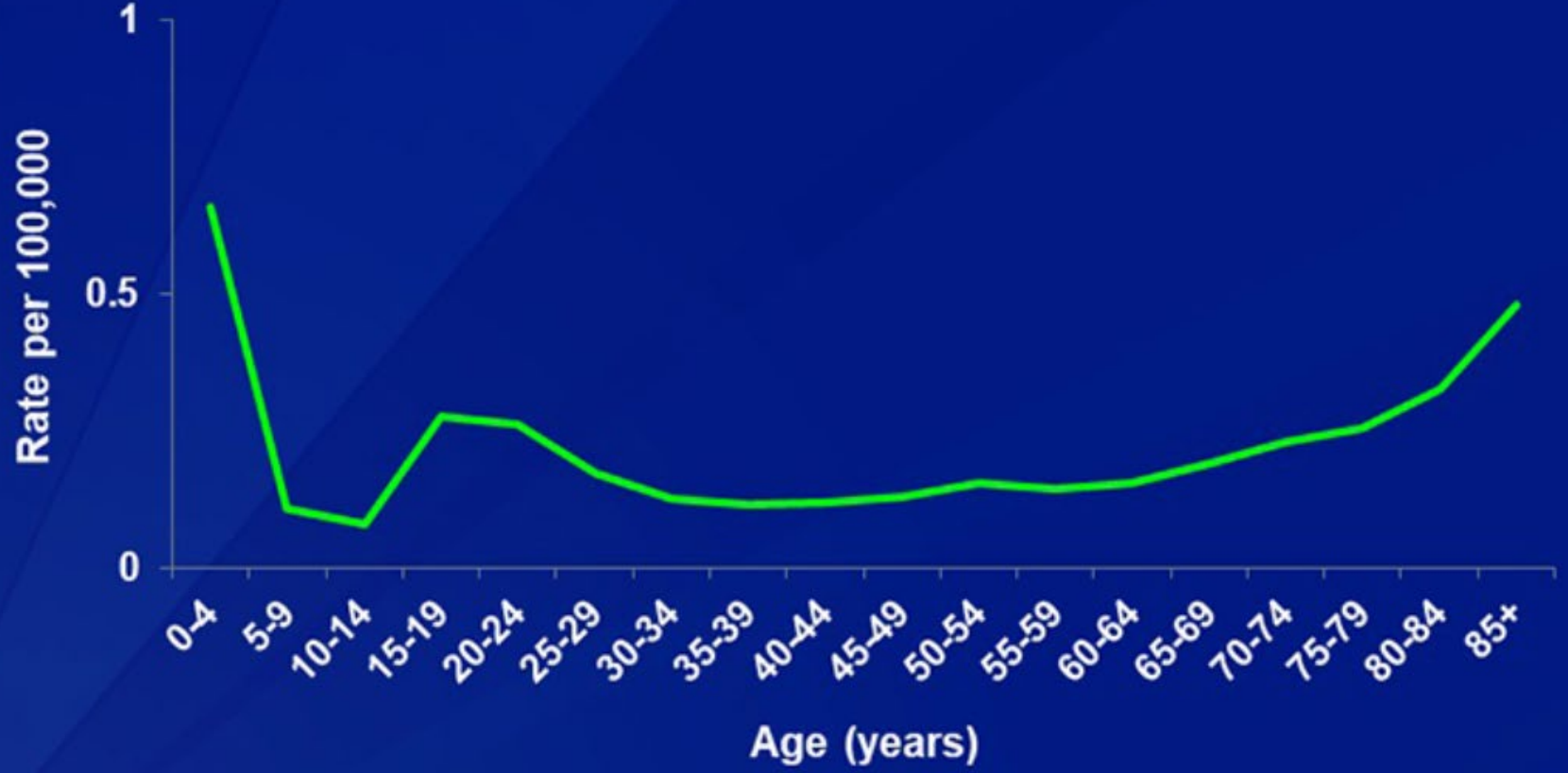


Meningococcal Disease Incidence, United States, 1970-2017



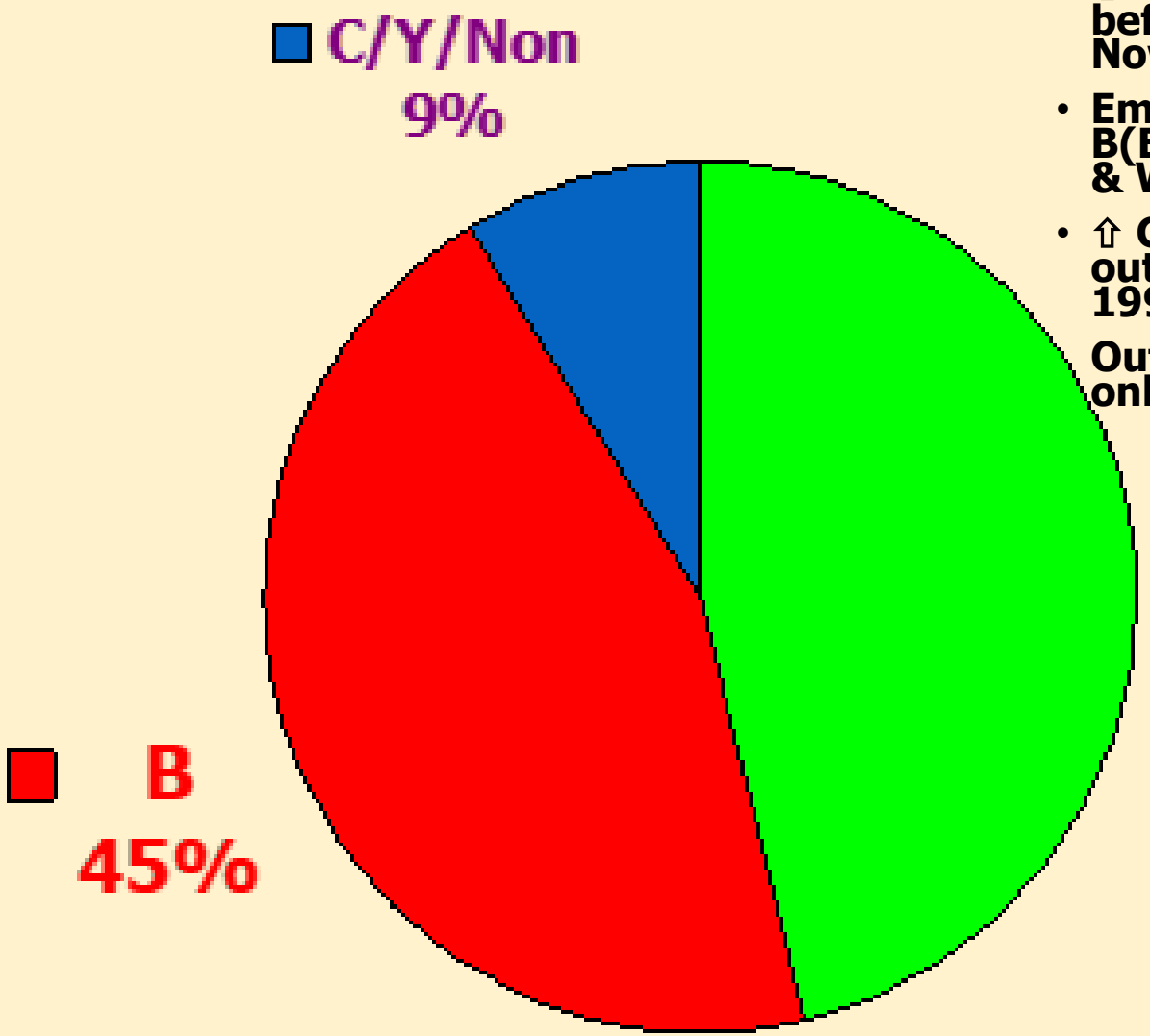
SOURCE: CDC; National Notifiable Diseases Surveillance System

Meningococcal Disease Incidence by Age 2008-2017



SOURCE: CDC; National Notifiable Diseases Surveillance System

Epidemiologic Situation in USA



- ⇧ Group Y: 2% before 1990, Now 33%
- Emergence of B(ET-5) in OR & WA
- ⇧ Group C outbreak after 1990

Outbreaks = only 2-3% of all cases

Epidemiologic Situation in USA

- Control of H.influenzae b infections
- Caused N.meningitidis to become the leading cause of bacterial meningitis in children & young adults in US
- 2,600 cases/year = 0.5 /100,000
- Case-fatality rate
  - = 13 % for meningitic disease (isolation of N.m from CSF)
  - = 11.5% for bacteremic (N.m from blood)
  - Despite rx with antimicrobial agents

https://www.cdc.gov/meningococcal/clinical-info.html October 2019

Outbreaks of Group C in USA

- Serogroup C meningococcal disease (SCMD) outbreaks
- More frequently since early 1990s
- Use of vaccine to control outbreaks increased
- 1980--1993: 21 outbreaks of SCMD
    - 8 during 1992--1993
    - Each from 3-45 cases
    - Most attack rates >10 /100,000
    - ≃20 x >endemic SCMD rates
    - 1981--1988: 7,600 doses of vaccine used for 4 outbreaks
    - Jan92-Jun93: 180,000 doses of vaccine used for 8 outbreaks