Update on Meningococcal Disease, Testing and Vaccines

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Neisseria meningitidis

- Gram-negative diplococci
- Humans are the only natural reservoir
- Bacteria attach to surface of mucosal cells of nasopharynx
- Approximately 10% of persons are colonized – can carry and transmit bacteria for months
- Transmitted by aerosols or secretions from the nasopharynx of colonized persons
- If infection occurs, it usually occurs within a few days of new colonization
Neisseria meningitidis

- Produces a polysaccharide capsule, which is the basis of serogroup typing
  - At least 13 serogroups have been identified
- Majority of disease worldwide is serogroup A, B, C, Y, and W
- Serogroups B, C and Y are the most common in the United States; B now causes all U.S. college outbreaks (outbreaks account for 2-3% of reported U.S. cases)
- Serogroup A is common in the “meningitis belt” of sub-Saharan Africa
Meningococcal Disease by Serogroup -- California, 2008-2014*

Serogroup W
6%
23% fatal
med age=50y

Serogroup Y
19%
10% fatal
med age=48y

Serogroup C
34%
19% fatal
med age=34.5y

Serogroup B
38%
11% fatal
med age=18y

Ungroupable
3%

Other
<1%

Of cases with known serogroup; 30 (4%) unknown
Infants <1 year of age have the highest incidence of disease; a second peak occurs in adolescence. In the United States, cases typically peak in January and February.
U.S. Incidence of Meningococcal Disease

- Incidence is cyclical and varies over time, by age, and location; rates have decreased in the U.S. since the late 1990s

- The decrease preceded the introduction of meningococcal conjugate vaccine, and includes serogroup B disease, for which there has been no vaccine until very recently
  - CA: 56 cases in 2014 (compared to 100-200 cases/year)
  - US: 564 cases in 2013 (compared to 1,200-2,800 cases/year)

- The reasons for this decrease are not known but may be related to:
  - Immunity of the population to circulating meningococcal strains
  - Changes in behavioral risk factors (e.g., less smoking and exposure to secondhand smoke among adolescents and young adults)
Incidence of invasive meningococcal disease - California 1993-2014

- MPSV4 College Recs
- MCV4 licensed

- All cases
- Serogroup B
- Serogroups A, C, Y, W135
- Unknown

Cases per 100,000 population

Year:
Risk Factors for Meningococcal Disease

• Host factors
  ▪ Deficiencies in the terminal common complement pathway
  ▪ Functional or anatomic asplenia
  ▪ Certain genetic factors

• Environmental factors
  ▪ Preceding or concurrent viral upper respiratory tract infection
  ▪ Crowded living/social situations
  ▪ Active and passive smoking
  ▪ Occupational risk (microbiologists)
Meningococcal Disease

- Meningococcal disease can present as meningococcal meningitis (50%) and/or meningococcemia (35-40%)
  - *N. meningitidis* is just one cause of bacterial meningitis or sepsis; since the introduction of vaccines for Hib and *S. pneumoniae* it is the leading cause of bacterial meningitis
  - Even with prompt treatment, it may result in death
    - Meningitis case-fatality rate 9-12%
    - Meningococcemia case-fatality rate ≤40%
    - 10-20% survivors have sequelae (neurologic deficits, limb or digit loss, hearing loss, skin scarring)
## Meningococcal Disease Symptoms

### Meningitis
- **Primary symptoms** are sudden onset of fever, headache and stiff neck
  - In infants, fever, headache or stiff neck may be absent or difficult to notice
  - Infants may be inactive, irritable, vomiting or feeding poorly
- **Other symptoms**
  - Nausea
  - Vomiting
  - Photophobia
  - Altered mental status

### Meningococcemia
- Fatigue
- Vomiting
- Cold hands and feet
- Chills
- Severe aches or pain in muscles, joints, chest or abdomen
- Rapid breathing
- Diarrhea
- In the later stages, petechia or purpura may occur
The “Glass Test”

• A person with meningococcemia may have a petechial rash that later develops into purpura.
• For patients with a fever and a rash, a clear glass or glass slide can be pressed firmly against the skin.
• If the rash doesn't fade under pressure is a sign of meningococccemia, and indicates a medical emergency.
• The rash can be harder to see on dark skin – areas on paler areas like the palms of the hands, soles of the feet, the abdomen, inside the eyelids and on the roof of the mouth can be checked.
• The rash may fade under pressure at first so should be checked at least every hour.
Laboratory Diagnosis

• Bacterial culture (blood, CSF)
• Gram stain (gram negative diplococci)
  ▪ Note: Gram stains can be misidentified
  ▪ If patient’s symptoms are compatible with meningococcal disease treat as such regardless of test results
• Non-culture methods
  ▪ PCR (preferred non-culture method)
    ✓ Can detect *N. meningitidis* DNA in culture negative cases; CDPH lab can perform
    ✓ Important when patient pretreated with antibiotics
  ▪ Antigen detection in CSF
    ✓ False negative results common
  ▪ Serology
    ✓ Should not be used for diagnosis
• Clinicians should report cases to public health as soon as meningococcal disease is suspected, and not wait for confirmation
Falsely Negative Gram Stains

• CDPH became aware of a number of falsely negative Gram stains in patients with meningococcal disease.

• Initially incorrect Gram stain results can delay appropriate patient treatment AND delay notification of public health and the implementation of control measures.
  - Performing and reading Gram stains is quite subjective and dependent on laboratorian skill and experience.

• To determine the extent of this problem, CDPH reviewed Gram stain results for 156 meningococcal disease cases from Jan 2013-Feb 2015 for any indication that a correction was made in the results; all specimens were tested in hospital laboratories.
### Gram Stain Results Summary

<table>
<thead>
<tr>
<th>Type of Specimen</th>
<th>Number of Specimen</th>
<th>Misidentified</th>
<th>Correct</th>
<th>Inconclusive</th>
<th>Negative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blood</td>
<td>156</td>
<td>17 (11%)</td>
<td>83 (53%)</td>
<td>56 (36%)</td>
<td>N/A</td>
</tr>
<tr>
<td>CSF</td>
<td>97</td>
<td>4 (4%)</td>
<td>39 (40%)</td>
<td>5 (5%)</td>
<td>49 (50%)</td>
</tr>
</tbody>
</table>

- 13.5% of specimens had a misidentified Gram stain result
- Most incorrect results were initially reported as Gram positive cocci
- Most errors were in blood specimens
- These were errors that were caught and corrected – we don’t know about errors that weren’t identified
## Impact on Public Health Action

<table>
<thead>
<tr>
<th>Initial Result Notification (hrs)</th>
<th>Corrected Result Notification (hrs)</th>
<th>Approximate Notification Delay (hrs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>52</td>
<td>5</td>
<td>47</td>
</tr>
<tr>
<td>51</td>
<td>14</td>
<td>37</td>
</tr>
<tr>
<td>47</td>
<td>15</td>
<td>32</td>
</tr>
<tr>
<td>25</td>
<td>24</td>
<td>1</td>
</tr>
<tr>
<td>18</td>
<td>2</td>
<td>16</td>
</tr>
<tr>
<td>17</td>
<td>6</td>
<td>11</td>
</tr>
<tr>
<td>16</td>
<td>8</td>
<td>8</td>
</tr>
</tbody>
</table>
Future Actions

- Determine if Gram stain misidentifications are associated with level of experience of those performing and reading Gram stains.
- Determine protocols used by hospital laboratories in performing, reading and reporting Gram stains to reduce the number of Gram stain misidentifications.
- Determine if lab personnel are at risk for exposure to *Neisseria meningitidis* because of failure to properly identify organism as Gram negative diplococci.
Medical Management

• Empiric therapy should include an extended-spectrum cephalosporin, such as cefotaxime or ceftriaxone

• Once the microbiologic diagnosis is established, definitive treatment with penicillin G, ampicillin, or an extended-spectrum cephalosporin (cefotaxime or ceftriaxone) is recommended.

• Some experts recommend susceptibility testing before switching to penicillin, however:
  ▪ Susceptibility testing is not standardized, and the significance of intermediate resistance is not known.

• In fulminant cases death can occur within hours.
Public Health Actions

- Persons with meningococcal disease are considered infectious <7 days before onset until >24 hours after initiation of antibiotic therapy

- Persons who had close contact with the case while they were infectious should be identified as soon as possible; postexposure prophylaxis (PEP) is more effective the sooner it is given after an exposure
  - Examples: household members, intimate contacts, some healthcare personnel, first responders (expanded PEP for college contacts)
  - For most contacts, PEP is one dose of ciprofloxacin

- Bacterial isolates should be submitted to CDPH for serogroup identification and molecular typing

- Clinical samples (e.g., CSF or blood) should be submitted to CDPH for PCR testing when cultures negative
CDPH and CDC Information

Meningococcal Disease Quicksheet

**Infectious Agent**
*Neisseria meningitidis*, a gram-negative diplococcus bacterium carried by 5-10% of the population.

**Clinical Description**
Invasive disease manifests most commonly as meningitis and/or meningococcaemia and may progress to purpuric ulcers, shock, and death within hours of onset. Other manifestations, such as septic arthritis or orbital cellulitis, may be observed. The case fatality rate is 10% and 11-19% of surviving patients have sequelae (e.g., neurologic disability, limb loss, and hearing loss).

**Mode of Transmission**
Transmission occurs through contact with aerosols from the nose, throat, and mouth of colonized or infected persons. *N. meningitidis* may be carried in the nasopharynx of otherwise healthy individuals. Invasive meningococcal disease occurs primarily in individuals who are newly colonized with the organism, usually Morbidity and Mortality Weekly Report (MMWR)

**Suscept:**
- Clinical purpuric ulcers in the affected blood culture; or
- Gram-negative diplococci, not yet isolated from a normally sterile (b)lood or CSF.

**Culture-negative suspect cases**
If antibiotics have been given prior to collection, cultures may be negative. Cultures from non-sterile site specimens should be submitted to Microbial Diseases Laboratory (MDL) which can confirm the diagnosis. See "Testing for Meningococcal Disease".

A primary case of meningococcal disease occurs in the absence of previous know with another case. A secondary case is...  

Laboratory Testing for Meningococcal Disease

The California Department of Public Health (CDPH) Immunization Branch and Microbial Diseases Laboratory (MDL) request submission of all *Neisseria meningitidis* isolates obtained from normally sterile sites for confirmation and serogrouping. In addition, culture-negative specimens from patients for whom there is a high clinical suspicion of meningococcal disease should be submitted for PCR testing.

**Criteria for high clinical suspicion**

- Appropriate samples for testing:
  - Bacterial isolates of *N. meningitidis* from a normally sterile site: or
  - 0.5 ml of EDTA-treated blood (purple top); and/or
  - 0.5 ml of CSF
- Please send both blood and CSF, if available.

**Emergency testing**
Please contact CDPH IZB and MDL if urgent PCR testing or serogroup identification is needed to assist in public health follow-up.

Prevention and Control of Meningococcal Disease: Recommendations of the Advisory Committee on Immunization Practices (ACIP)

**Recommendations and Reports**
March 22, 2013 / 62(RR02):1-22

https://www.cdph.ca.gov/HealthInfo/discond/Pages/MeningococcalDisease.aspx
http://www.cdc.gov/mmwr/preview/mmwrhtml/mm6202a1.htm

California Department of Public Health, Immunization Branch
Postexposure Prophylaxis for Meningococcal Disease

- PEP is now one 500 mg dose of cipro for most nonpregnant people

## Table 3.41. Recommended Chemoprophylaxis Regimens for High-Risk Contacts and People With Invasive Meningococcal Disease

<table>
<thead>
<tr>
<th>Age of Infants, Children, and Adults</th>
<th>Rifampin</th>
<th>Ceftriaxone</th>
<th>Ciprofloxacin</th>
<th>Azithromycin</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;1 mo</td>
<td>5 mg/kg, orally, every 12 h</td>
<td>125 mg, intramuscularly</td>
<td>Not recommended for use in pregnant women</td>
<td>10 mg/kg (maximum 500 mg), orally</td>
</tr>
<tr>
<td>≥1 mo</td>
<td>10 mg/kg (maximum 600 mg), orally, every 12 h</td>
<td>250 mg, intramuscularly</td>
<td>Use only if fluoroquinolone-resistant strains of <em>Neisseria meningitidis</em> have not been identified in the community</td>
<td>10 mg/kg (maximum 500 mg)</td>
</tr>
<tr>
<td></td>
<td>2 days</td>
<td>Single dose</td>
<td>Single dose</td>
<td>Single dose</td>
</tr>
<tr>
<td></td>
<td>90–95</td>
<td>90–95</td>
<td>90</td>
<td>90–95</td>
</tr>
<tr>
<td></td>
<td>Can interfere with efficacy of oral contraceptives and some seizure and anticoagulant medications; can stain soft contact lenses</td>
<td>To decrease pain at injection site, dilute with 1% lidocaine</td>
<td>Not recommended routinely; equivalent to rifampin for eradication of <em>Neisseria meningitidis</em> from nasopharynx in one study</td>
<td></td>
</tr>
</tbody>
</table>

2015 AAP Red Book
Definition of HCP exposure to meningococcal disease

• CDC: Direct exposure to an infectious patient’s oral secretions, e.g., performing mouth-to-mouth resuscitation, or contact during endotracheal intubation or management without the use of a surgical mask.

• CDPH: May also be transmitted by infectious aerosols.

http://www.cdc.gov/mmwr/preview/mmwrhtml/mm6335a2.htm
http://www.cdc.gov/mmwr/preview/mmwrhtml/mm5945a2.htm
What happens in the “real world”

- Many more people typically receive PEP than those recommended by CDC, irrespective of whether they are community or HCP contacts.
- Occupationally-acquired infection is rare, but it happens:
  - In 2010, a California police officer and respiratory therapist were infected via contact with a patient.
  - The respiratory therapist assisted with intubation and was not wearing a surgical mask – he would have been recommended to receive PEP but did not receive it.
  - The unmasked police officer’s only contact with the patient was very brief - turning him from his back to his side; persons with such contact would not typically be recommended to receive PEP.
- My personal opinion: a rigid interpretation of the CDC recommendations and denial of PEP to HCP who are concerned about their exposure is probably not warranted.
Current Meningococcal Vaccines in the United States

• Quadrivalent (ACWY) polysaccharide vaccine (MPSV4)
  ▪ First licensed in 1974
  ▪ Menomune® licensed in 1981
  ▪ Only licensed vaccine for adults ≥56 years of age; however, mainly used for meningococcal vaccine naïve persons who anticipate only needing a single dose of vaccine, i.e., travelers

• Quadrivalent (ACWY) conjugate vaccines (MenACWY)
  ▪ Menactra® licensed in 2005
  ▪ Menveo® licensed in 2010

• Meningococcal serogroup B vaccines (MenB)
  ▪ Trumenba® licensed in 2014
  ▪ Bexsero® licensed in 2015
Meningococcal Vaccines: Men-ACWY

- Quadrivalent conjugate vaccine, contains capsular polysaccharide antigens to serogroups A, C, Y and W
  - Menactra® licensed 2005 (9 months through 55 years of age)
  - Menveo® licensed in 2010 (2 months through 55 years of age)

- Recommended for all persons aged 11-18 years and high risk persons 2 months-55 years with a booster at age 16 or 5 years after prior dose
  - High risk includes persons with complement component deficiencies or asplenia, laboratory workers, travelers to meningitis belt or Hajj, MSM with multiple sex partners in certain geographic areas
Meningococcal Vaccines: MenB

- Outer polysaccharide capsule mimics the polysaccharide in human neurologic tissue; poorly immunogenic

- Two Men B vaccines are now licensed by FDA (both granted breakthrough therapy status to expedite approval)

- **Trumenba® (Pfizer):** 3 dose series
  - Licensed in October 2014 for use in individuals 10-25 years of age
  - 2 recombinant factor H binding protein (fHBP) variants

- **Bexsero® (GSK):** 2 dose series
  - Licensed in US in January 2015 for use in persons 10-25 years of age
  - Licensed in Europe, Australia and Canada starting at 2 months of age
  - Recommended for routine use in infants in the UK
  - 4 distinct antigens including factor H binding protein (fHbp), Neisserial adhesin A (NadA), Neisserial heparin-binding antigen (NHBA), and PorA antigen of OMV NZ
MenB Vaccines in the U.S.

• In Feb 2015, the Advisory Committee on Immunization Practices (ACIP) recommended MenB vaccines for high risk persons
  ▪ Persons with persistent complement component deficiencies
  ▪ Persons with anatomic or functional asplenia
  ▪ Microbiologists routinely exposed to isolates of *N. meningitidis*
  ▪ Persons identified to be at increased risk because of a serogroup B meningococcal disease outbreak

• In June 2015, ACIP made a “category B” (permissive) recommendation for MenB vaccine for healthy adolescents and young adults aged 16-23 years

• Under the Affordable Care Act, insurance companies must cover vaccines with category A (routine) or B (permissive) recommendations
# Current ACIP Recommendations for Meningococcal Vaccines

All ACIP recommendations are available at: [http://www.cdc.gov/vaccines/hcp/acip-recs/](http://www.cdc.gov/vaccines/hcp/acip-recs/)

## Table 3.42. Recommended Meningococcal Vaccines for Immunocompetent Children and Adults

<table>
<thead>
<tr>
<th>Age</th>
<th>Vaccine</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 mo through 10 y</td>
<td>MenACWY-D*&lt;br&gt;(Menactra, Sanofi Pasteur; Swiftwater, PA)&lt;br&gt;MenACWY-CRM*&lt;br&gt;(Menveo, Novartis; Cambridge, MA)&lt;br&gt;HibMenACWY-TTM*&lt;br&gt;(MenHibTM, GlaxoSmithKline; Research Triangle Park, NC)</td>
<td>Not routinely recommended; see Table 3.43 (p 555) for recommendations for people at increased risk</td>
</tr>
<tr>
<td>10 through 25 y</td>
<td>rLP2006 serogroup B&lt;br&gt;(Trumembis, Pfizer Inc; Philadelphia, PA) or 4CRM serogroup B&lt;br&gt;(Bozzaro, Novartis Vaccines and Diagnostics; Siena, Italy)</td>
<td>Not routinely recommended; see text of 4th bullet (below) for recommendations for people at increased risk</td>
</tr>
<tr>
<td>11 through 21 y</td>
<td>MenACWY-D&lt;br&gt;or&lt;br&gt;MenACWY-CRM</td>
<td>Primary:&lt;br&gt;• 11 through 12 y of age, 1 dose&lt;br&gt;• 13 through 18 y of age, 1 dose if not previously immunized&lt;br&gt;• 19 through 21 y of age, not routinely recommended but may be given as catch-up immunization for those who have not received a dose after their 16th birthday&lt;br&gt;Booster:&lt;br&gt;• 1 dose recommended for adolescents if first dose administered prior to 16th birthday</td>
</tr>
<tr>
<td>22 through 55 y</td>
<td>MenACWY-D&lt;br&gt;or&lt;br&gt;MenACWY-CRM</td>
<td>Not recommended routinely; see Table 3.43 (p 555) for people at increased risk</td>
</tr>
<tr>
<td>≥56 y</td>
<td>MPSV4, MenACWY-D, or MenACWY-CRM</td>
<td>Not routinely; see Table 3.43 for people at increased risk</td>
</tr>
</tbody>
</table>

*Licensed only for people 6 months through 55 years.<br>**Licensed only for people 6 months through 55 years.<br>***Licensed only for children aged 6 weeks through 18 months of age.
Meningococcal vaccines for HCP

- Microbiologists routinely exposed to *N. meningitidis* isolates are recommended to receive quadrivalent meningococcal conjugate vaccine (MenACWY), which protects against A, C, Y and W disease AND meningococcal B (MenB) vaccine.

- A booster dose of MenACWY should be administered every 5 years if exposure is ongoing (a booster recommendation has not yet been made for MenB vaccine, but likely will be).

- Although MenACWY is licensed for persons 2 months through 55 years of age, it is recommended for persons ≥56 years of age who previously received MenACWY and are recommended for revaccination or for whom multiple doses are anticipated (e.g., microbiologists, asplenics).

- Although MenB vaccines are licensed for persons aged 10-25 years, they can be given to older people (e.g., microbiologists).

http://www.cdc.gov/mmwr/preview/mmwrhtml/rr6202a1.htm?s_cid=rr6202a1_e
http://www.cdc.gov/mmwr/preview/mmwrhtml/mm6422a3.htm
Meningococcal Disease and College Students

- College aged persons, whether or not they’re attending college, are at increased risk of meningococcal disease.
- Many colleges and universities require meningococcal conjugate vaccine and other vaccines, but there has not been such a requirement for the UC/CSU systems.
  - However, students entering the UC system in fall 2017 will be required to show proof of immunization against hepatitis B, measles, mumps and rubella; varicella; tetanus, diphtheria and pertussis; and meningococcal disease.
  - MenACWY vaccine will be required, and there will be a recommendation but not a requirement for MenB vaccine.
  - There is an existing rule in California that institutions with on-campus housing must inform students about meningococcal disease and vaccine (Health and Safety Code, Sections 120395-120399).
Meningococcal Disease and College Students

- Prior to the introduction of conjugate vaccines, serogroup C caused most outbreaks - because most college students are immunized against serogroup C disease, serogroup B outbreaks now occur.
- Meningococcal conjugate vaccines (MenACWY) prevent carriage with vaccine serogroups and since most college students have received this vaccine, serogroup replacement has occurred.
- Since 2009, 41 cases have been identified in California college students – 73% of those with known serogroups were B.
- Most cases are not associated with other cases, however even one case can trigger public anxiety.
- Expanded postexposure prophylaxis recommendations may be indicated.
Recent U.S. College Outbreaks

- **Ohio University: 2008 – 2010**
  - 10 cases serogroup B; 3 unknown serogroup
  - MenB vaccine not yet available

- **Princeton University: March 2013 – late 2014**
  - 8 cases serogroup B in Princeton students
  - 1 outbreak-associated case in a Drexel student
  - Bexsero administered

- **UC Santa Barbara: Nov 2013 (prior case in March 2013)**
  - 5 cases serogroup B
  - Bexsero administered

- **University of Oregon: late Jan 2015 – May 2015**
  - 7 cases serogroup B
  - Trumenba administered

- **Providence College: Feb 2015**
  - 2 cases serogroup B
  - Trumenba administered

- **There is 200-1400 fold increased risk during outbreaks**
Meningococcal Disease Among MSM

- Outbreaks and clusters of serogroup C meningococcal disease have occurred among MSM in since 2001
  - Toronto (2001)
  - Chicago (2003 and 2015)
  - NYC (2010-13, 2014)
  - Los Angeles (2014)
  - In addition, Belgium, Germany and France reported clusters in 2012-2014
- MSM who are HIV+ are more likely to be cases and more likely to be fatal cases than HIV- MSM
- CDPH has routinely attempted to collect MSM status on male cases since April 2013 and is also attempting to obtain it for earlier cases; however, this information is not available for all cases and there is likely to be under-reporting of MSM status
CA Meningococcal Disease Cases Among MSM Since 2013

- Since 2013, when collection of MSM status on meningococcal disease cases began:
  - 77 cases were reported in males aged 18-64 years
    - 15 (19%) were known to be MSM; 7 (47%) were also HIV+
      - 10 were serogroup C (4 HIV+)
      - 1 was serogroup Y (HIV+)
      - 4 were serogroup B (2 HIV+)
    - 11/15 (73%) cases covered by MenACWY vaccine
    - An additional 3 cases were HIV+ males who either denied MSM status or for whom MSM status is unknown
  - 2 additional MSM cases occurred in CA among non-CA residents (not included in numbers above)
Vaccination Recommendations

- There is no ACIP recommendation to routinely vaccinate MSM or HIV+ people with meningococcal vaccine.
  - ACIP reviewed data in Feb 2014; the overall rate among U.S. MSM in 2012-2013 was 4.0 per 100,000 population.
    - NYC=59.8 and LAC=14.1 per 100,000 population, respectively.
    - The rate of sporadic cases in MSM was 1.6 per 100,000.
    - Under-reporting of MSM status is likely.
- ACIP did not make any changes in the recommendations at that time, but supports vaccination during outbreaks.
- In 2005, when the recommendation was made to vaccinate adolescents, the rate for 11-19 year olds was 1.9/100,000 (the rate in those <1 year was 9.2/100,000).
Outbreak Response

• Generally, outbreaks have resulted in local immunization recommendations/campaigns targeting high risk MSMs
  ▪ After a great deal of effort, NYC estimated vaccinating 25,000 (~24% of the MSM population); vaccine costs were primarily covered by private insurance, CDC free vaccine, and Ryan White funds
  ▪ The targeted vaccination campaign averted an estimated 2.7 cases and 1.0 deaths with an ICER of $66,000/QALY when herd immunity was assumed; without herd immunity, vaccination prevented 1.1 cases and 0.4 deaths with an ICER of $177,000/QALY

• Some jurisdictions (including Los Angeles, Orange, San Diego, and San Francisco Counties) issued travel-related immunization recommendations for residents traveling to outbreak areas

• Minnesota made a statewide recommendation after one MSM case in July 2015

• Should California consider such a recommendation?

Potential Cost to Vaccinate CA MSM Against Serogroup C Disease

- In the 2014 California Health Interview Survey, 2.9% of CA men aged 18-64 years identified as gay; 1.4% as bisexual
- Using these data, there are an estimated 347,000 gay men and 165,000 bisexual men in CA for a total of 512,000 MSM
  - This population is not evenly distributed throughout CA
  - It’s unclear how many would be considered “high-risk”, eg, many close contacts (sexual and otherwise) in the MSM community
  - Some of the younger men will have received MenACWY in the past five years and would not need vaccine at this time
- A 5% vaccination rate of all MSM (based on NYC’s rate after extreme efforts in a single city) could result in ~25,000 men (25,600) receiving vaccine (not all MSM would be targeted)
- ~10% of men 19-64 years have been eligible for Medi-Cal
- The public sector price for MenACWY vaccine is $85
<table>
<thead>
<tr>
<th>Country</th>
<th>Vaccination Schedule</th>
</tr>
</thead>
<tbody>
<tr>
<td>Andorra</td>
<td>C at 2m, 4m, 18m</td>
</tr>
<tr>
<td>Australia</td>
<td>C at 12m</td>
</tr>
<tr>
<td>Austria</td>
<td>C at 12-14m, ACWY at 12y</td>
</tr>
<tr>
<td>Bahrain</td>
<td>ACWY at 2y for risk groups</td>
</tr>
<tr>
<td>Belgium</td>
<td>C at 15m</td>
</tr>
<tr>
<td>Brazil</td>
<td>C at 3m, 5m, 15m and AC at &gt;2y for risk groups</td>
</tr>
<tr>
<td>Canada</td>
<td>varies by province; all 13 provinces have 1-3 infant C doses (9 have 1 dose at 12m) and 11 provinces have additional C doses at 9-15y</td>
</tr>
<tr>
<td>Chile</td>
<td>ACWY at 12m</td>
</tr>
<tr>
<td>China</td>
<td>AC at 3y, 6y and A at 6-18m + 3m</td>
</tr>
<tr>
<td>Cuba</td>
<td>BC at 3m, 5m</td>
</tr>
<tr>
<td>Cyprus</td>
<td>C at 12-15m, ACWY (MPSV) at &gt;2y for risk groups</td>
</tr>
<tr>
<td>Czech Republic</td>
<td>B at 2-11 months, B and ACWY at 12m-5y, 12-19 years</td>
</tr>
<tr>
<td>Ecuador</td>
<td>B and C for risk groups</td>
</tr>
<tr>
<td>Egypt</td>
<td>AC at 3m, 6m, 12m, 15y</td>
</tr>
<tr>
<td>France</td>
<td>C at 12-23m, catch-up 2-24y</td>
</tr>
<tr>
<td>Germany</td>
<td>C at 11-23m, catch-up 2-17y</td>
</tr>
<tr>
<td>Greece</td>
<td>C at 2m, 4m, 6m-6y, ACWY at 11y</td>
</tr>
<tr>
<td>Guyana</td>
<td>ACWY for risk groups</td>
</tr>
<tr>
<td>Iceland</td>
<td>C at 6m, 8m and ACWY for travelers</td>
</tr>
<tr>
<td>Ireland</td>
<td>C at 4m, 6m, 13m</td>
</tr>
<tr>
<td>Israel</td>
<td>ACWY for risk groups</td>
</tr>
<tr>
<td>Italy</td>
<td>C at 13-15m, catch-up 11-18y</td>
</tr>
<tr>
<td>Jordan</td>
<td>ACWY at &gt;2y for contacts, pilgrims</td>
</tr>
<tr>
<td>Kuwait</td>
<td>ACWY at 2y, AC for expatriot risk groups</td>
</tr>
<tr>
<td>Kazakhstan</td>
<td>ACWY at 15y for travelers</td>
</tr>
<tr>
<td>Libya</td>
<td>ACWY at 6y for pilgrims</td>
</tr>
<tr>
<td>Liechtenstein</td>
<td>C at 12-15m, catch-up 11-15y</td>
</tr>
<tr>
<td>Luxembourg</td>
<td>C at 13m</td>
</tr>
<tr>
<td>Malaysia</td>
<td>ACWY for pilgrims</td>
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<tr>
<td>Maldives</td>
<td>ACWY at &gt;15y for pilgrims</td>
</tr>
<tr>
<td>Marshall Islands</td>
<td>C at 11-12y</td>
</tr>
<tr>
<td>Mauritius</td>
<td>ACWY for travelers</td>
</tr>
<tr>
<td>Monaco</td>
<td>C at 12m</td>
</tr>
<tr>
<td>Netherlands</td>
<td>C at 14m</td>
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<tr>
<td>New Zealand</td>
<td>C at &lt;2y and ACWY at &gt;2y for risk groups, contacts of cases, those living in close quarters</td>
</tr>
<tr>
<td>Oman</td>
<td>ACWY at 2y</td>
</tr>
<tr>
<td>Palau</td>
<td>C at 11-18y</td>
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<tr>
<td>Paraguay</td>
<td>ACWY for risk groups</td>
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<tr>
<td>Poland</td>
<td>C at 2-6m, 8m-19y</td>
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<tr>
<td>Portugal</td>
<td>C at 12m</td>
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<td>ACWY for risk groups</td>
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<tr>
<td>Saudi Arabia</td>
<td>ACWY at &gt;2y</td>
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<tr>
<td>Serbia</td>
<td>AC for risk groups</td>
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<td>Slovenia</td>
<td>C and ACWY for risk groups</td>
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<tr>
<td>Spain</td>
<td>C at 2m, 12m, 12y</td>
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<tr>
<td>Switzerland</td>
<td>C at 12-15m, 11-15y</td>
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<tr>
<td>Suriname</td>
<td>ACWY for travelers</td>
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<tr>
<td>Syria</td>
<td>ACWY at 6y</td>
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<td>Togo</td>
<td>A at 1-29y</td>
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<td>Trinidad/Tobago</td>
<td>AC at &gt;2y mainly for travelers</td>
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<tr>
<td>United Arab Emirates</td>
<td>risk groups, pilgrims</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>B at 2m, 4m, 12m, C at 3m, 12-13m, ACWY at 14-15y</td>
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<tr>
<td>Venezuela</td>
<td>B and C at days 1 and 2 of life for risk groups</td>
</tr>
</tbody>
</table>

*Meningococcal Vaccine Recommendations* for Civilian Populations Around the World

*Routine vaccination unless otherwise specified; as of 4/6/2015*