Meningococcal Disease and Meningococcal Vaccine

Chapter 14

May 2019
Disease
Neisseria meningitidis

- Aerobic gram-negative bacteria
- At least 13 serogroups based polysaccharide capsule
- Most invasive disease caused by serogroups A, B, C, Y, and W
- Relative importance of serogroups depends on geographic location and other factors (e.g., age)
Meningococcal Disease Pathogenesis

- Organism colonizes nasopharynx
- In some persons organism enters the bloodstream and causes infection at distant site
- Antecedent URI may be a contributing factor
Neisseria meningitidis
Clinical Features

- Incubation period 3-4 days (range 2-10 days)
- Abrupt onset of fever, meningeal symptoms, hypotension, and rash
- Fatality rate 10%-15%, up to 40% in meningococcemia
Meningococcal Meningitis

- Most common presentation of invasive disease
- Results from hematogenous dissemination
- Clinical findings
  - fever
  - headache
  - stiff neck
Meningococcal Sepsis

- Meningococcemia
- Bloodstream infection
- May occur with or without meningitis
- Clinical findings
  - fever
  - petechial or purpuric rash
  - hypotension
  - shock
  - acute adrenal hemorrhage
  - multi-organ failure
Meningococcal Disease
Meningococcal Disease
Neisseria meningitidis
Risk Factors for Invasive Disease

- **Host Factors**
  - Deficiencies in the terminal common complement pathways
  - Functional or anatomic asplenia
  - Chronic underlying disease
  - Certain genetic factors (altered genes: mannose-binding lectin and tumor necrosis factor)

- **Environmental factors**
  - Household crowding
  - Active and passive smoking
  - Antecedent viral infection

- **Occupational (microbiologists)**
Neisseria meningitidis
Risk Factors for Invasive Disease

- College Students
  - Studies in 1990s – overall incidence similar to or lower than their counterparts in general population*
  
  - Case control study of 50 cases and other studies in the 1990s#
    * First-year college students living in residence halls at higher risk

*JAMA 1999;281:1906-10
#Abstracts of the 39th Meeting of the IDSA. Philadelphia, PA: IDSA; 1999:276
Meningococcal Disease Incidence – United States, 1996–2015

Abbreviations: MenACWY = quadrivalent meningococcal conjugate vaccine; MenB vaccine = serogroup B meningococcal vaccines
Source: 1996-2015 NNDSS Data

Source: National Notifiable Diseases Surveillance System (NNDSS) data with additional serogroup data from Active Bacterial Core surveillance (ABCs) and state health departments
Meningococcal Disease by Serogroup, All Ages – United States, 2006-2015

Source: National Notifiable Diseases Surveillance System (NNDSS) data with additional serogroup data from Active Bacterial Core surveillance (ABCs) and state health departments
Excludes 20% with unknown serogroup
Rates of Meningococcal Disease (C and Y) by Age, 1999–2008

Option 1
Dose at 11–12 years and booster at 16 years

Option 2
Single dose at 16 years

Active Bacterial Core surveillance (ABCs), 1998–2008
Meningococcal Outbreaks in the United States

- Outbreaks account for 2%-3% of reported cases
- Most recent outbreaks caused by serogroup C and B

Serogroup B meningococcal disease outbreaks on college campuses†, 2013–2018

<table>
<thead>
<tr>
<th>State of University</th>
<th>Year started</th>
<th>Cases (deaths)</th>
<th>Undergraduate population</th>
</tr>
</thead>
<tbody>
<tr>
<td>New Jersey</td>
<td>2013</td>
<td>9 (1)</td>
<td>5,000</td>
</tr>
<tr>
<td>California</td>
<td>2013</td>
<td>4*</td>
<td>19,000</td>
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<tr>
<td>Rhode Island</td>
<td>2015</td>
<td>2</td>
<td>4,000</td>
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<tr>
<td>Oregon</td>
<td>2015</td>
<td>7 (1)</td>
<td>20,000</td>
</tr>
<tr>
<td>California</td>
<td>2016</td>
<td>2**</td>
<td>5,000</td>
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<tr>
<td>New Jersey</td>
<td>2016</td>
<td>2</td>
<td>35,000</td>
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<tr>
<td>Wisconsin</td>
<td>2016</td>
<td>3</td>
<td>30,000</td>
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<tr>
<td>Oregon</td>
<td>2016</td>
<td>5</td>
<td>25,000</td>
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<tr>
<td>Massachusetts</td>
<td>2017</td>
<td>3</td>
<td>30,000</td>
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<tr>
<td>Pennsylvania</td>
<td>2017</td>
<td>2</td>
<td>3,600</td>
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</tbody>
</table>

During 2014–2016, 31.7% of serogroup B cases in college students were outbreak-related.

†Where CDC consulted; *1 additional associated case identified after retrospective case review; **1 additional patient with inconclusive laboratory results
2 Vaccine
<table>
<thead>
<tr>
<th>Vaccine product</th>
<th>Age indications</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MenACWY Vaccines</strong></td>
<td></td>
</tr>
<tr>
<td>Menactra</td>
<td></td>
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<tr>
<td>MenACWY-D</td>
<td>9 months-55 years</td>
</tr>
<tr>
<td>Menveo</td>
<td></td>
</tr>
<tr>
<td>MenACWY-CRM</td>
<td>2 months–55 years</td>
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<tr>
<td><strong>MenB Vaccines</strong></td>
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<tr>
<td>Trumemba</td>
<td></td>
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<tr>
<td>MenB-FHbp</td>
<td>10-25 years</td>
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<tr>
<td>Bexsero</td>
<td></td>
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<tr>
<td>Men B-4C</td>
<td>10-25 years</td>
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</tbody>
</table>
Meningococcal Conjugate Vaccines

- Meningococcal polysaccharide conjugated to protein carrier

- Elicit both T- and B-cell immunity (T-cell dependent immunity)

- 2 brands currently licensed in the United States
  - Menactra = MenACWY-D (Sanofi Pasteur)
  - Menveo = MenACWY-CRM (Novartis)
Menactra MenACWY Vaccine

- Licensed by FDA in January 2005
- Quadrivalent polysaccharide vaccine conjugated to diphtheria toxoid (MenACWY-D)
- Approved for persons 9 months through 55 years of age
- Intramuscular injection
- Single dose vials
Menveo MenACWY Vaccine

- Licensed by FDA in February 2010
- Lyophilized serogroup A vaccine reconstituted with liquid containing serogroups C, Y, and W135 (MenACWY-CRM)
- May be used for any person 2 months through 55 years of age for whom MCV4 is indicated, including revaccination
- Intermuscular injection
- Single dose vials
Interchangeability of Conjugate Vaccine Brands

- Limited data suggest that different conjugate vaccine products can be used interchangeably.

- Whenever feasible, the same brand of vaccine should be used for all doses of the vaccination series.

- If vaccination providers do not know or have available the type of vaccine product previously administered, any product should be used to continue or complete the series.
Clinical Considerations
# MenACWY Recommendations

- **Child and adolescent immunization schedule**

<table>
<thead>
<tr>
<th>Vaccine</th>
<th>Birth</th>
<th>1 mo</th>
<th>2 mos</th>
<th>4 mos</th>
<th>6 mos</th>
<th>9 mos</th>
<th>12 mos</th>
<th>15 mos</th>
<th>18 mos</th>
<th>19-23 mos</th>
<th>2-3 yrs</th>
<th>4-6 yrs</th>
<th>7-10 yrs</th>
<th>11-12 yrs</th>
<th>13-15 yrs</th>
<th>16 yrs</th>
<th>17-18 yrs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meningococcal (MenACWY-D ≥9 mos; MenACWY-CRM ≥2 mos)</td>
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</table>

- **Adult immunization schedule**

<table>
<thead>
<tr>
<th>Vaccine</th>
<th>19–21 years</th>
<th>22–26 years</th>
<th>27–49 years</th>
<th>50–64 years</th>
<th>≥65 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meningococcal A, C, W, Y (MenACWY)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1 or 2 doses depending on indication, then booster every 5 yrs if risk remains</td>
</tr>
</tbody>
</table>
Administer MenACWY at age 11 or 12 years with a booster dose at 16 years of age

Administer 1 dose at age 13 through 15 years if not previously vaccinated

For persons vaccinated at age 13 through 15 years, administer a one-time booster dose, preferably at or after 16 through 18 years of age
  - The minimum interval between doses is 8 weeks
MenACWY Adolescent Vaccination Recommendations

- A booster dose is not recommended for healthy persons if the first dose is administered at or after 16 years of age.

- A booster dose is not recommended for healthy persons after 21 years of age who are not at increased risk of exposure.
  - A booster dose is not recommended for healthy persons 22 years of age and older even if the first dose was administered at 11-15 years of age.
MenACWY Vaccine Recommendations for Persons at Increased Risk for Meningococcal Disease
High-risk Groups: Functional or Anatomic Asplenia or HIV Infection*

- Younger than 19 months
  - Infant series at 2, 4, 6, and 12-15 months with MenACWY-CRM

- 19-23 months who have not received a complete series
  - 2-dose primary series of MenACWY-CRM 12 weeks**

- 24 months or older who have not received a complete series
  - 2-dose primary series of either MenACWY 8-12 weeks apart

*Including sickle-cell disease
** Doses valid if 8 weeks apart
High-risk Groups: Persistent Complement Component Deficiency*

- Children 2-18 months
  - Infant series at 2, 4, 6, and 12-15 months with MenACWY-CRM; OR
  - 2-dose primary series of MenACWY-D starting at 9 months at least 12 weeks apart**

- 19-23 months without complete series of either MenACWY
  - 2-dose primary series of either MenACWY at least 12 weeks apart**

- 24 months or older who have not received a complete series of either MenACWY
  - 2-dose primary series of either MenACWY at least 12 weeks apart**

* Including persons taking Soliris (eculizumab)
** Doses valid if 8 weeks apart
Meningococcal Vaccine Recommendations for Persons 2 through 55 years at High Risk

- Persons who:
  - Are first-year college students aged ≤21 years living in residential housing
  - Travel to, or are residents of, countries where meningococcal disease is hyperendemic or epidemic
  - Are microbiologists routinely exposed to isolates of Neisseria meningitidis
  - Military recruits

- Administer: 1 dose of MenACWY
Meningococcal ACWY Vaccine Booster Doses

- Person who receive primary immunization and remain at increased risk should receive booster doses
  - If primary immunization complete **before** 7 years of age:
    • first booster should be 3 years after primary immunization and every 5 years thereafter if at continued risk
  - If primary immunization complete **on or after** 7 years of age
    • first booster should be 5 years after primary immunization and every 5 years thereafter if at continued risk
MenACWY Revaccination Recommendations

- Other high-risk persons recommended for boosters:
  - Microbiologists with prolonged exposure to Neisseria meningitidis
  - Frequent travelers to or persons living in areas with high rates of meningococcal disease (see next slide)

- Revaccinate every 5 years as long as the person remains at increased risk
  - MenACWY for persons 2 through 55 years of age
  - MenACWY for persons 56 years and older also (off-label recommendation) if repeated vaccination anticipated
International Travelers and Revaccination*

- International travelers should receive a booster dose of MenACWY if the last dose was administered 5 or more years previously.
  - Vaccination in the 3 years before the date of travel is required by the government of Saudi Arabia for all travelers to Mecca during the annual Hajj.

*CDC Travelers Health website at http://www.cdc.gov/travel
Updated Guidance for Use of Meningococcal Vaccines in Persons Aged ≥56 Years

- Meningococcal vaccines that are licensed for use in person aged ≥56 year are not currently available in the United States

- Persons aged ≥56 years who are recommended meningococcal vaccination because they are at increased risk for meningococcal disease should receive MenACWY conjugate vaccine
  - This includes, meningococcal vaccine-naïve persons aged ≥56 years who anticipate requiring only a single dose of meningococcal vaccine (e.g. travelers and persons at risk as a risk of a community outbreak)
  - And persons who were vaccinated previously with MenACWY conjugate vaccine and are recommended for revaccination or for whom multiple doses are anticipated (e.g., person with asplenia, HIV, and microbiologists)
Meningococcal ACWY Adverse Reactions

<table>
<thead>
<tr>
<th></th>
<th>MenACWY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local reactions</td>
<td>11%-59%</td>
</tr>
<tr>
<td>Low-grade fever</td>
<td>5%-17%</td>
</tr>
<tr>
<td>Systemic reactions</td>
<td>4%-54%</td>
</tr>
<tr>
<td>(headache, malaise,</td>
<td></td>
</tr>
<tr>
<td>fatigue)</td>
<td></td>
</tr>
</tbody>
</table>
MenB Vaccine Recommendations
# Meningococcal B Vaccines

<table>
<thead>
<tr>
<th>Product Name (ACIP Abbreviation)</th>
<th>FDA Age Indications</th>
<th>Schedule/Dosage/Route</th>
</tr>
</thead>
</table>
| Trumenba® (MenB-FHbp)           | 10 through 25 years of age | • 3-dose series  
- 0, 1–2, and 6-month  
OR  
- 2-dose series  
- 0, 6 month  
• 0.5 mL dose  
• IM injection |
| Bexsero® (MenB-4C)              | 10 through 25 years of age | • 2-dose  
- 0, 1–6 month  
• 0.5 mL dose  
• IM injection |
Meningococcal B Recommendations

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<tbody>
<tr>
<td>Meningococcal B</td>
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</tbody>
</table>

- Recommendation for use in individuals ≥10 years of age at increased risk of disease
- Recommendation for use in adolescents and young adults not at increased risk for disease

2 or 3 doses depending on vaccine and Indication
ACIP MenB Recommendations

- Certain persons aged ≥10 years* who are at increased risk for meningococcal disease **should** receive MenB vaccine. These persons include:
  - Persons with persistent complement component deficiencies
  - Persons with anatomic or functional asplenia**
  - Microbiologists routinely exposed to isolates of Neisseria meningitides
  - Persons identified as at increased risk because of a serogroup B meningococcal disease outbreak

*ACIP off-label recommendation
**Including sickle cell disease

http://www.cdc.gov/mmwr/preview/mmwrhtml/mm6422a3.htm?s_cid=mm6422a3_w
ACIP MenB Recommendations

- Certain other groups included in MenACWY (MCV4) recommendations for persons at increased risk, are not in this recommendation

- MenB – **NOT currently recommended for:**
  - Children aged 2 months – 9 years of age
  - Persons who travel to or reside in countries where meningococcal disease is hyperendemic or epidemic because risk is generally not caused by serogroup B
  - Routine use in first-year college students living in residence halls, military recruits, or all adolescents

http://www.cdc.gov/mmwr/preview/mmwrhtml/mm6422a3.htm?s_cid=mm6422a3_w
Use of 2- and 3-Dose Schedules of MenB-FHbp (Trumenba) Meningococcal Serogroup B Vaccine

- For persons at increased risk for meningococcal disease and for use during serogroup B outbreaks, 3 doses of MenB-FHbp should be administered at 0, 1-2, 6 months

- When given to healthy adolescents who are not at increased risk for meningococcal disease, 2 doses of MenB-FHbp should be administered at 0 and 6 months
If a patient is recommended for 3 doses of Trumenba, but the second dose is delayed beyond a 6-month interval, a third dose is NOT necessary.

If a patient is recommended for 2 doses of Trumenba, and the second dose is given less than 6 months after the first dose, then a repeat (3rd) dose must be administered 4 months after the second dose.
Voted upon at the June 2019 ACIP meeting

Will become official policy when published in MMWR

Sign-up for email alerts!
MenB for Adolescents and Young Adults

- A MenB vaccine series *may* be administered to adolescents and young adults aged 16–23 years to provide short-term protection against most strains of serogroup B meningococcal disease*

- The preferred age for MenB vaccination is 16–18 years

* Permissive recommendation (Category B)
MMWR October 23, 2015 / 64(41);1171-6
ACIP MenB Recommendations

- MenB should be administered as either a 2-dose series of MenB-4C or a 2-dose or 3-dose series of MenB-FHbp

- The same vaccine product should be used for all doses

- MenB-4C and MenB-FHbp may be administered concomitantly with other vaccines indicated for this age, but at a different anatomic site, if feasible

- No product preference to be stated
MenB Vaccine Brand Error

- If a dose of MenB vaccine is administered and found to be a different brand from a dose previously administered:
  - Pick the brand with which you want to continue the series
  - Invalidate the dose of the other brand
  - Continue the series
  - Need a 4 week minimum interval from any invalid doses
  - Need to follow the minimum intervals between doses of the chosen brand
# Meningococcal B Adverse Reactions

<table>
<thead>
<tr>
<th>Adverse Reactions</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pain at injection site, injection site reactions, erythema</td>
<td>28%-85%</td>
</tr>
<tr>
<td>fatigue, headache, chills, nausea, arthralgia</td>
<td>13%-60%</td>
</tr>
</tbody>
</table>
Meningococcal Vaccine
Contraindications and Precautions

- Severe allergic reaction to vaccine component or following prior dose

- Moderate or severe acute illness
Meningococcal Vaccine Use in Outbreaks

- MenACWY and MenB recommended for use in control of outbreaks caused by A, C, W, Y, or B

- Outbreak definition:
  - at least 3 confirmed or probable primary cases of the same serogroup
  - period of 3 months or less
  - primary attack rate of more than 10 cases per 100,000 population
Meningococcal Resources

- ACIP’s Meningococcal Recommendations web page
  www.cdc.gov/vaccines/hcp/acip-recs/vacc-specific/mening.html
- CDC’s Meningococcal Infection web page
  www.cdc.gov/meningococcal/index.html
- CDC’s Meningococcal Vaccination web page
  www.cdc.gov/vaccines/vpd-vac/mening/default.htm
- Immunization Action Coalition Meningococcal web page
  www.immunize.org/meningococcal/
- Children’s Hospital of Philadelphia Vaccine Education Center Meningococcal web page
  http://www.chop.edu/centers-programs/vaccine-education-center/vaccine-details/meningococcal-vaccine