Disclosure: Session G2

In compliance with continuing education requirements, all presenters must disclose any financial or other associations with the manufacturers of commercial products, suppliers of commercial services, or commercial supporters as well as any use of unlabeled product(s) or product(s) under investigational use.

CDC, our planners, content experts, and their spouses/partners wish to disclose they have no financial interests or other relationships with the manufacturers of commercial products, suppliers of commercial services, or commercial supporters.

Planning committee discussed conflict of interest with each presenter to ensure there is no bias.

Content will not include any discussion of the unlabeled use of a product or a product under investigational use.

CDC did not accept commercial support for this continuing education activity.
The spatiotemporal evolution of vaccine refusal in California, 2000-2013

Paul L. Delamater
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pld@email.unc.edu
May 16\textsuperscript{th} 2018 | National Immunization Conference
Vaccination in the US/CA

• Childhood vaccination in US
  - Historically, high levels of uptake
    • Recently, increases in hesitancy and refusal, nonmedical exemptions (NME)

• California
  - Pre-2014, highly relaxed NME policy
    • Increase in parents obtaining NMEs for their children
      - 0.46% of all kindergarteners in 1996
      - 3.15% of all kindergarteners in 2013
California

• Disease outbreaks
  - Statewide Pertussis epidemics
    • > 9,000 cases (2010), > 10,000 cases (2014)
  - Measles at Disneyland in 2014 (147 cases)

• New laws
  - AB 2109 (2014-15)
    • Required proof of counseling from a health care provider to obtain an NME
  - SB 277 (2017-17)
    • Removed NME provision
Evolution of Refusal

• Spatiotemporal evolution of NME use from 2000 to 2013
  - Change over time in the geographic patterns of NME use
  - Prior to new laws, changes in behavior
    • Nature of geographic clustering
    • Location of geographic clusters
    • General temporal patterns
  - Spatial diffusion of vaccine refusal
Data

• California elementary schools
  - 2000-01 to 2013-14
  - Kindergartens with ≥ 10 students
    • Roughly 7,000 schools and 500,000 kindergarteners per year
    • Enrollment and NME counts
    • Geocoded using school address
    • Linked via unique school identifier
  - Levels of aggregation
    • School, Census Block Group, Census Tract
Methods

• Spatial autocorrelation over time
  - Global
    • Overall clustering in data
  - Local
    • Location of clusters and outliers
      - e.g., High NME rate with geographic neighbors having High NME rates
    • Percent of years located in a High NME or Low NME local cluster
Methods

- K-means clustering
  - Group observations with similar NME use over time
    - Input data: NME rates over time
    - Output: Group membership
  - Interpret “mean” of groups
    - General temporal patterns of NME use
  - Map group membership
The spatiotemporal evolution of vaccine refusal in California, 2000-2013

<table>
<thead>
<tr>
<th>Gr</th>
<th>N</th>
<th>N(%)</th>
<th>2000</th>
<th>2013</th>
<th>CHG</th>
<th>Line Color</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2,113</td>
<td>50.6</td>
<td>0.2</td>
<td>0.6</td>
<td>0.4</td>
<td>Blue</td>
<td>Near 0% throughout</td>
</tr>
<tr>
<td>2</td>
<td>1,017</td>
<td>24.3</td>
<td>0.7</td>
<td>3</td>
<td>2.3</td>
<td>Blue</td>
<td>Starts low, moderate increase (similar to CA)</td>
</tr>
<tr>
<td>3</td>
<td>453</td>
<td>10.8</td>
<td>1.6</td>
<td>3.8</td>
<td>2.2</td>
<td>Blue</td>
<td>Starts low, moderate increase (similar to CA)</td>
</tr>
<tr>
<td>4</td>
<td>287</td>
<td>6.9</td>
<td>1.2</td>
<td>10.3</td>
<td>9.1</td>
<td>Orange</td>
<td>Starts low, large increase</td>
</tr>
<tr>
<td>5</td>
<td>94</td>
<td>2.3</td>
<td>2.5</td>
<td>16.5</td>
<td>14.5</td>
<td>Orange</td>
<td>Starts low, large increase</td>
</tr>
<tr>
<td>6</td>
<td>137</td>
<td>3.3</td>
<td>2.9</td>
<td>7.8</td>
<td>4.9</td>
<td>Orange</td>
<td>Starts low, large increase</td>
</tr>
<tr>
<td>7</td>
<td>52</td>
<td>1.2</td>
<td>6.1</td>
<td>19.5</td>
<td>13.4</td>
<td>Red</td>
<td>Starts high, large increase</td>
</tr>
<tr>
<td>8</td>
<td>20</td>
<td>0.5</td>
<td>11.5</td>
<td>29.9</td>
<td>18.4</td>
<td>Red</td>
<td>Starts high, large increase</td>
</tr>
<tr>
<td>9</td>
<td>4</td>
<td>0.1</td>
<td>31.1</td>
<td>59.4</td>
<td>28.3</td>
<td>Red</td>
<td>Starts high, large increase</td>
</tr>
</tbody>
</table>
The spatiotemporal evolution of vaccine refusal in California, 2000-2013

Group Membership, NME %
- Groups 1, 2, 4: Near 0% throughout or Starts low with moderate increase
- Groups 3, 5, 6: Starts low with large increase
- Groups 7, 8, 9: Starts high with large increase

Less than 14 years of data
Evolution of Refusal

• Findings
  - Geographic clustering of NME use increased over this time period
  - Geographic clusters of high NME use expanded over this time period
    • Geographic clusters of low NME use contracted
  - Regions that began with low NME use and had high increases located near regions with high initial use
Evolution of Refusal

• Findings
  – Refusal as a self-reinforcing process
    • Increases in NME use in the “seed” regions
  – Refusal as a spatially diffusive process
    • Increases in NME use in regions near the “seed” regions
Examining the spatiotemporal evolution of vaccine refusal: nonmedical exemptions from vaccination in California, 2000–2013

The spatiotemporal evolution of vaccine refusal in California, 2000-2013

Thank You!

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May 16th 2018 | National Immunization Conference
ASSESSMENT OF MMR VACCINATION STATUS AMONG CHILDREN WITH AND WITHOUT EXEMPTIONS TO SCHOOL IMMUNIZATION REQUIREMENTS

National Immunization Conference
May 16th, 2018
Topics

• Background
  • School exemption reporting
  • Measles in WA
  • Exemption rates and School Module
• Objectives of the study
• Methods used
• Results
• Next steps
Definitions

- **Complete**: The student has been fully immunized for their age or has provided proof of acquired immunity
- **Exempt**: The student has a signed Certificate of Exemption on file at the school excusing the student from one or more vaccinations due to medical, personal, or religious beliefs
- **Conditional**: A temporary status for children lacking immunization against one or more of the required vaccine-preventable diseases who are working towards compliance.
- **Out-of-compliance**: Conditional status has ended, but the student has not been fully immunized, does not have an exemption on file, or lacks appropriate documentation
**SCHOOL IMMUNIZATION STATUS REPORT FOR SCHOOL YEAR 2017-2018**

**How to Report:**
1. Use your school’s electronic Student Information System to generate a data file (csv or xls). Email the file to [otc@washington.gov](mailto:otc@washington.gov)
2. Report online using the state Immunization Information System ([www.wa immunization.gov](http://www.wa immunization.gov)) if you don’t use a Student Information System or can’t generate a data file from your school system.
3. Complete this form and email or mail to the department ONLY IF you don’t have computer access.

**PART A: All schools must complete.**

<table>
<thead>
<tr>
<th>School Name:</th>
<th>School Building Code:</th>
<th>Completed by:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**PART B: All schools must complete. This section counts all your students in all the grades in your school from kindergarten through 12th (K-12).**

<table>
<thead>
<tr>
<th>Number of Students Enrolled In All Grades (K-12)</th>
<th>Number of Students Complete/Immune In All Grades (K-12)</th>
<th>Number of Students Exempt In All Grades (K-12)</th>
<th>Number of Students Exempt By Category</th>
<th>Total Number of Students Exempt For Each Vaccine In All Grades (K-12)</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>90</td>
<td>10</td>
<td>4 (Medical)</td>
<td>3 (Personal)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2 (Religious)</td>
<td>1 (Religious Membership)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1 (Diphtheria)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1 (Tetanus)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1 (Petsuis)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1 (Poliomyelitis)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1 (MMR)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1 (Hepatitis B)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1 (Varicella)</td>
</tr>
</tbody>
</table>

**PART C: Please complete only for kindergarten and 6th grade.**

<table>
<thead>
<tr>
<th>Grade Level</th>
<th>Number of Students Enrolled</th>
<th>Number of Students Complete/Immune</th>
<th>Number of Students Exempt</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kindergarten</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>6th Grade</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
</tbody>
</table>

**NOTE:** Box 1 must equal the sum of boxes 1-5. The sum of boxes 3a + 3b + 3c + 3d must be greater or equal to Box 3. The sum of boxes A + B + C + D + E + F must be greater or equal to the sum of 3 + 4 + 5.

See additional instructions on back on how to complete this report.
School immunization exemptions among kindergarteners, 2005 - 2018

Any kind of exemption
4.6% (-0.1% change from last year)

Exemption type data were not collected for kindergartners prior to 2012-13.
Certificate of Exemption - Personal/Religious

Child’s Last Name: ____________________  First Name: ____________________  Middle Initial: ____________________  Birthday (mm/dd/yyyy): ___________  Gender: ___________  

NOTICE: A parent or guardian may exempt their child from some or all vaccinations listed below by submitting this completed form to the child’s school and/or child care. A person who has been exempted from a vaccination is considered at risk for the disease or diseases for which the vaccination offers protection. Exempted children/students may be excluded from school or child care settings and activities during an outbreak of the disease that they have not been fully vaccinated against. The diseases vaccines can protect against still exist, and can spread quickly in school and child care settings. Immunizations are one of the best ways to protect people from getting and spreading diseases that may result in serious illness, disability, or death.

Personal/Philosophical or Religious Exemption

Exemption Type:  □ Personal/Philosophical  □ Religious

I am exempting my child from the requirement that my child be vaccinated against the following diseases to attend school or child care:

□ Diphtheria  □ Hepatitis B  □ Hib  □ Measles  □ Mumps  □ Pertussis (whooping cough)
□ Pneumococcal  □ Polio  □ Rubella  □ Tetanus  □ Varicella (chickenpox)

Parent/Guardian Declaration

One or more of the required vaccines are in conflict with my personal, philosophical or religious beliefs. I have discussed the benefits and risks of immunizations with the health care practitioner below. I have received notice that an outbreak of vaccine-preventable disease for which my child is exempted occurs, my child may be excluded from the school or child care center for the duration of the outbreak. The information on this form is complete and correct.

Parent/Guardian Signature ____________________  Date ___________

Health Care Practitioner Declaration

I have discussed the benefits and risks of immunizations with the parent/legal guardian as a condition for exempting their child. I am a qualified MD, ND, DO, ARNP or PA licensed under Title 18 RCW, and the information provided on this form is complete and correct.

□ MD  □ ND  □ DO  □ ARNP  □ PA

Licensed Health Care Practitioner Name (print) ____________________  
Licensed Health Care Practitioner Signature ____________________  Date ___________
# Measles activity Washington State 2014 (32 cases)

<table>
<thead>
<tr>
<th>Cluster</th>
<th>Index Case Onset Date</th>
<th>Number of cases</th>
<th>Travel History/Exposure</th>
<th>Genotype</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whatcom County</td>
<td>March 15</td>
<td>6</td>
<td>Linked to outbreak in British Columbia, Canada</td>
<td>D8 “Netherlands”</td>
</tr>
<tr>
<td>San Juan/Kitsap</td>
<td>March 25</td>
<td>8</td>
<td>Unimmunized index case traveled to the Philippines</td>
<td>B3 “Philippines”</td>
</tr>
<tr>
<td>King/Pierce Micronesian</td>
<td>May 30</td>
<td>16</td>
<td>Unimmunized index case traveled to Micronesia</td>
<td>B3 Similar but distinct from Philippines</td>
</tr>
<tr>
<td>Single Case Skagit County</td>
<td>April 9</td>
<td>1</td>
<td>Unknown source. Did not leave Washington.</td>
<td>B3 “Iran”</td>
</tr>
<tr>
<td>Single Case Snohomish County</td>
<td>May 17</td>
<td>1</td>
<td>Travel to Indonesia</td>
<td>D8 “France”</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Total cases</strong></td>
<td><strong>32</strong></td>
</tr>
</tbody>
</table>
Immunization Status of Kindergartners 2017-2018

- 85.6% complete for all immunizations or proof of immunity
- 4.6% exempt for one or more vaccines
  - Non-medical: 3.9%
    - Personal: 3.7%
    - Religious: 0.2%
    - Religious Membership: 0.1%
  - Medical: 0.7%
- 1.6% conditional status
- 8.2% out-of-compliance
Kindergarteners with school immunization exemptions by Washington county, school year 2017-2018

Kindergarten: Percent with any exemptions

0% - 1.7%
1.8% - 3.6%
3.7% - 4.5%
4.6% - 5.6%
5.7% - 8.5%
8.6% - 13.4%

Kindergarteners with school immunization exemptions by school district, Washington, school year 2017-2018

School Module Background

• In the 2015-2016 school year, only 85% of kindergarteners were complete for all vaccines, well below the Healthy People 2020 goal of 95%.

• Students often lack proper immunization documentation and are “out-of-compliance” with school immunization requirements, even though they may have been immunized.
School Module Background

• In 2016 WA received legislative funding to:
  
  • Expand the use of the School Module statewide to all school districts
  
  • The School Module is a portal into the Washington Immunization Information System (IIS).
RELATIONSHIP OF THE SCHOOL MODULE TO THE IIS

Healthcare Provider Access
- View Records
- Print CIS
- Add/Edit records & contraindications
- Run clinic & patient reports

School (View Only Access)
- View Records
- Print CIS
RELATIONSHIP OF THE SCHOOL MODULE TO THE IIS

Healthcare Provider Access
- View Records
- Print CIS
- Add/Edit records & contraindications
- Run clinic & patient reports

School (View Only Access)
- View Records
- Print CIS

School Module Access
- View Records
- Print CIS
- Add records
- Run school-specific reports & parent letters

Patient Records

IMMUNIZATION INFORMATION SYSTEM

WA State DOH | 14
Objectives

• School exemption rates are used to assess vulnerability to measles outbreaks in school settings, but is this an appropriate marker?

• Our objective was to assess the true MMR vaccination status for school aged students to provide a clearer understanding of student vulnerability of a measles outbreak in schools.
Methods

- Obtained exemption information for students documented in the School Module
- Merged data on student ID to students’ WIIS record
- Calculated number of MMR doses for each student
  - Exempted from any vaccine
  - Exempted specifically MMR
  - Listed as in compliance
- Observed vaccine and MMR specific exemptions by grade
Original analysis:

Study involved **2130 students**
- All students with an exemption  714
- Matched ~2 compliant students  1416 for each exempt student

Matched by WA IIS ID to IIS data
- No IIS data  151

Analysis done on **1979 students***
- Students with exemption and IIS data  565
- Students compliant and IIS data  1414

*Includes 50 pre-school students
MMR doses for 2016-2017 students in any grade with exemptions on file in the School Module (N = 1979)

<table>
<thead>
<tr>
<th>Nature of Exemption:</th>
<th>Number of students</th>
<th>Number of MMR doses shown in WIIS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Exemption for any vaccine</td>
<td>565</td>
<td>132 (23%) 129 (23%) 292 (52%) 12 (2%)</td>
</tr>
<tr>
<td>Students compliant with school entry requirements</td>
<td>1414</td>
<td>1 7 1329 (94%) 77</td>
</tr>
</tbody>
</table>
### MMR doses for 2016-2017 students in any grade with an MMR exemption on file in the School Module (N = 1747)

<table>
<thead>
<tr>
<th>Nature of Exemption:</th>
<th>Number of students</th>
<th>Number of MMR doses shown in WIIS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>Specific Exemption for MMR</td>
<td>333</td>
<td>126 (38%)</td>
</tr>
<tr>
<td>Students compliant with school entry requirements</td>
<td>1414</td>
<td>1</td>
</tr>
</tbody>
</table>
Date of MMR vaccination vs. date MMR exemption was claimed for 333 students with MMR specific exemption

126 students (38%) received no MMR doses
207 students (62%) had received 1 or more MMR doses
For 173 of 207 (84%) the date that the exemption was requested was available

<table>
<thead>
<tr>
<th>Number of doses students received</th>
<th>Proportion that received all doses before claiming exemption</th>
<th>Proportion that received doses before and after claiming exemption</th>
<th>Proportion that received all doses after claiming exemption</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 (n=91)</td>
<td>84%</td>
<td>0%</td>
<td>16%</td>
</tr>
<tr>
<td>2 (n=78)</td>
<td>35%</td>
<td>41%</td>
<td>24%</td>
</tr>
<tr>
<td>≥3 (n=4)</td>
<td>50%</td>
<td>50%</td>
<td>0%</td>
</tr>
</tbody>
</table>
Students with exemptions from any vaccine on file in School Module 2016-2017 (N=695)

<table>
<thead>
<tr>
<th>School Grade</th>
<th>Number of Students</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kindergarten</td>
<td>158</td>
</tr>
<tr>
<td>1st</td>
<td>93</td>
</tr>
<tr>
<td>2nd</td>
<td>61</td>
</tr>
<tr>
<td>3rd</td>
<td>79</td>
</tr>
<tr>
<td>4th</td>
<td>55</td>
</tr>
<tr>
<td>5th</td>
<td>54</td>
</tr>
<tr>
<td>6th</td>
<td>43</td>
</tr>
<tr>
<td>7th</td>
<td>28</td>
</tr>
<tr>
<td>8th</td>
<td>24</td>
</tr>
<tr>
<td>9th</td>
<td>35</td>
</tr>
<tr>
<td>10th</td>
<td>25</td>
</tr>
<tr>
<td>11th</td>
<td>24</td>
</tr>
<tr>
<td>12th</td>
<td>16</td>
</tr>
</tbody>
</table>
Students with exemptions from MMR on file in School Module 2016-2017 (N = 461)

Number of Students

<table>
<thead>
<tr>
<th>School Grade</th>
<th>Number of Students</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kindergarten</td>
<td>104</td>
</tr>
<tr>
<td>1st</td>
<td>55</td>
</tr>
<tr>
<td>2nd</td>
<td>44</td>
</tr>
<tr>
<td>3rd</td>
<td>53</td>
</tr>
<tr>
<td>4th</td>
<td>37</td>
</tr>
<tr>
<td>5th</td>
<td>42</td>
</tr>
<tr>
<td>6th</td>
<td>32</td>
</tr>
<tr>
<td>7th</td>
<td>17</td>
</tr>
<tr>
<td>8th</td>
<td>17</td>
</tr>
<tr>
<td>9th</td>
<td>23</td>
</tr>
<tr>
<td>10th</td>
<td>13</td>
</tr>
<tr>
<td>11th</td>
<td>14</td>
</tr>
<tr>
<td>12th</td>
<td>10</td>
</tr>
</tbody>
</table>
Conclusion

- School exemption rates do not equate to school vulnerability to a measles outbreak
- School exemption rates = exemption with any vaccine
- MMR exemptions may portray a more accurate exemption but 62% of students had one or more doses of MMR
- Almost 40% of children received MMR doses after they have requested an exemption
Next steps

- Create code that allows analysis to be repeatable for future years

<table>
<thead>
<tr>
<th></th>
<th>Enrolled ('17 - ’18)</th>
<th>Onboarding</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public School Districts</td>
<td>25 (200 schools)</td>
<td>32</td>
</tr>
<tr>
<td>Private Schools</td>
<td>6</td>
<td>12</td>
</tr>
<tr>
<td>Charter Schools</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Tribal Schools</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>ECEAP or head start programs</td>
<td></td>
<td>4</td>
</tr>
</tbody>
</table>
Acknowledgements

Natalie Linton, MPH  
Epidemiologist  
Washington State Department of Health

Teal Bell, MPH  
Epidemiologist  
Washington State Department of Health

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Nursing Consultant  
Washington State Department of Health

Chas DeBolt RN, MPH  
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Office of Communicable Disease Epidemiology
Washington State Department of Health
1610 NE 150th Street
Shoreline, WA 98155

Nhan.Le@DOH.WA.gov
(206) 418-5594
Extra slides
WAC 246-105 Immunization of child care and school children against certain vaccine-preventable diseases

(1) Before a child may attend a school or child care center, a parent must provide proof of immunization status using the following documentation:

   (a) A department approved CIS form signed by the parent
   (b) If applicable, a department-approved COE form signed by a parent

   (A) A statement signed and dated by a health care practitioner stating that he or she has provided the parent information about the benefits and risks of immunization to the child as a condition of obtaining a medical, religious, personal, or philosophical exemption

(1) Chickenpox (Varicella);
(2) Diphtheria;
(3) German measles (Rubella);
(4) Haemophilus influenzae type B disease;
(5) Hepatitis B;
(6) Measles (Rubeola);
(7) Mumps;
(8) Pneumococcal disease;
(9) Polio (Poliomyelitis);
(10) Tetanus; and
(11) Whooping cough (Pertussis).
<table>
<thead>
<tr>
<th>Nature of Exemption:</th>
<th>Number of students</th>
<th>Number of MMR doses shown in WIIS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>Exemption for any MMR</td>
<td>565</td>
<td>132 (23%)</td>
</tr>
<tr>
<td>Specific Exemption for MMR</td>
<td>333</td>
<td>126 (38%)</td>
</tr>
<tr>
<td>County</td>
<td>Onset Date</td>
<td>Age</td>
</tr>
<tr>
<td>-------------------</td>
<td>------------</td>
<td>------</td>
</tr>
<tr>
<td>Grays Harbor #1</td>
<td>Jan 3</td>
<td>10-19</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grays Harbor #2</td>
<td>Jan 13</td>
<td>10-19</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clallam #1</td>
<td>Jan 30</td>
<td>50-59</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clallam #2</td>
<td>Feb 11</td>
<td>5-9</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clallam #3</td>
<td>Feb 14</td>
<td>40-49</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clallam #4</td>
<td>Feb 19</td>
<td>10-19</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Whatcom</td>
<td>Feb 24</td>
<td>30-39</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clallam #5</td>
<td>Mar 4</td>
<td>40-49</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spokane #1</td>
<td>April 15</td>
<td>20-29</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spokane #2</td>
<td>April 27</td>
<td>20-29</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clallam #6</td>
<td>No rash</td>
<td>Adult</td>
</tr>
<tr>
<td></td>
<td>Expired Spring ’15</td>
<td></td>
</tr>
</tbody>
</table>
### MMR doses for 2016-2017 P3/P4 students with any exemptions on file in the School Modules (N=50)

<table>
<thead>
<tr>
<th></th>
<th>Number</th>
<th>0 MMR</th>
<th>1 MMR</th>
<th>2 MMR</th>
<th>3+ MMR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Any</td>
<td>14</td>
<td>6</td>
<td>3</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>Comp</td>
<td>36</td>
<td>0</td>
<td>6</td>
<td>30</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Number</td>
<td>0 MMR</td>
<td>1 MMR</td>
<td>2 MMR</td>
<td>3+ MMR</td>
</tr>
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<td>----------</td>
<td>--------</td>
<td>-------</td>
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<td>-------</td>
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</tr>
<tr>
<td>MMR</td>
<td>11</td>
<td>6</td>
<td>1</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>Comp</td>
<td>36</td>
<td>0</td>
<td>6</td>
<td>30</td>
<td>0</td>
</tr>
<tr>
<td>Any Exempt</td>
<td>Number</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3+</td>
</tr>
<tr>
<td>------------</td>
<td>--------</td>
<td>---</td>
<td>---</td>
<td>---</td>
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<tr>
<td>Kindergarten</td>
<td>124</td>
<td>27</td>
<td>34</td>
<td>59</td>
<td>4</td>
</tr>
<tr>
<td>1st - 5th</td>
<td>278</td>
<td>68</td>
<td>63</td>
<td>141</td>
<td>6</td>
</tr>
<tr>
<td>6th</td>
<td>39</td>
<td>11</td>
<td>8</td>
<td>18</td>
<td>2</td>
</tr>
<tr>
<td>7th - 12th</td>
<td>110</td>
<td>20</td>
<td>21</td>
<td>69</td>
<td>0</td>
</tr>
<tr>
<td>MMR Exempt</td>
<td>Number</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3+</td>
</tr>
<tr>
<td>------------</td>
<td>--------</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>----</td>
</tr>
<tr>
<td>Kindergarten</td>
<td>71</td>
<td>26</td>
<td>26</td>
<td>18</td>
<td>1</td>
</tr>
<tr>
<td>1st - 5th</td>
<td>169</td>
<td>64</td>
<td>56</td>
<td>48</td>
<td>1</td>
</tr>
<tr>
<td>6th</td>
<td>28</td>
<td>10</td>
<td>8</td>
<td>8</td>
<td>2</td>
</tr>
<tr>
<td>7th - 12th</td>
<td>54</td>
<td>20</td>
<td>20</td>
<td>14</td>
<td>0</td>
</tr>
</tbody>
</table>
School Module Data Limitations

- Missing immunization data in the IIS causes functionality issues
  - Historical immunization dates
  - Titers and contraindications
- Parent reported immunizations
  - Requests for medically verified records
Comparison of MMR vaccination date and date MMR exemption was claimed for 173 students with MMR specific exemption

126 students (38%) received no MMR doses
207 students (62%) had received 1 or more MMR doses
For 173 of 207 (84%) the date that the exemption was requested was available

<table>
<thead>
<tr>
<th>Number of total doses student received</th>
<th>Total</th>
<th>3+ Before</th>
<th>2 Before</th>
<th>1 Before</th>
<th>1 on or after</th>
<th>2 on or after</th>
<th>3 on or after</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>91-</td>
<td>-</td>
<td>76</td>
<td>15-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>78-</td>
<td>27</td>
<td>32</td>
<td>32</td>
<td>19-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3+</td>
<td>4</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Comparison of vaccination date with Date exemption was claimed (n=364)

565 with vaccine exemptions
232 with doses they are exempted to
??? with date requested available

| Number of total doses | Total | 3+ Before 1 Before 2 Before 1 on or after 2 on or after 3 on or after |
|-----------------------|-------|------------------------|-----------------|-----------------|-------------------|-------------------|-------------------|
| 1                     | 109   | 91                     | 18              | -               | -                 | -                 |
| 2                     | 243   | 137                    | 76              | 76              | 30                | -                 |
| 3+                    | 12    | 8                      | 0               | 4               | 1                 | 4                 | 0                 |

WA State DOH | 37
Kindergartners complete for required immunizations, 2010-2018

The percentage of kindergartners complete for required immunizations stayed the same as last school year. Students with completed immunizations are better protected from getting and spreading vaccine-preventable diseases.

HP2020 goal*: 95%

*HP2020: Healthy People 2020, ten-year national goal for kindergarten immunization completeness.
Influence of parental attitudes towards vaccination on not achieving pneumococcal conjugate vaccine (PCV) series completion among children 19-35 months in the United States

Zhen Zhao, PhD; Holly A. Hill, MD, PhD

2018 National Immunization Conference

May 15, 2018 – May 17, 2018
1. Background

- Vaccine hesitancy is believed to have a negative impact on vaccination coverage and to contribute to the occurrence of vaccine-preventable disease outbreaks and epidemics.

- Experts worldwide acknowledge that there is an increasing trend toward vaccine hesitancy.

- Vaccine hesitancy is complex and context specific, varying across time, place and type of vaccines. It is influenced by factors such as complacency, convenience and confidence [1].
1. Background (continued-1)

- It has been reported that vaccination confidence is associated with early childhood vaccination for some vaccines: MMR (measles, mumps, and rubella), DTaP (diphtheria, tetanus, and acellular pertussis), and HepB (Hepatitis B) [2-3]

- The association of parental attitudes towards vaccines with not achieving pneumococcal conjugate vaccine (PCV) series completion has not been fully investigated
1. Background (continued-2)

- By 2016, vaccination coverage for ≥1 MMR, ≥1 Varicella, and ≥3 HepB had reached the Healthy People 2020 target of 90% in the United States.

- But, as of 2016, vaccination coverage for ≥4 PCV was 8 percentage points below the 90% target.

- On average during 2011-2016, 17.2% (15.1% to 19.2%) of young children in the United States were at risk since they had not completed the four-dose series of PCV.
2. Objectives

- Determine vaccination status for the 1st through the 4th dose of PCV among children 19-35 months in the US

- Evaluate the prevalence of not achieving PCV series completion by parental attitudes towards vaccines among children 19-35 months in the US

- Identify parental attitudes associated with not achieving PCV series completion
3. Methods

- National Immunization Survey-Child (NIS-Child) data for 2011 in the United States include the latest available data for parental attitudes towards vaccines and are analyzed in this study.

- Children who were missing any of the 4 doses of PCV were defined as not achieving pneumococcal conjugate vaccine (PCV) series completion.
3. Methods (continued-1)

- Parents were asked to indicate their level of agreement with 10 statements about vaccines on a scale of 0 to 10.

- Agreement was defined as a response \( \geq 7 \). Thus, 10 binary response variables (agreement/disagreement) for parental attitudes towards vaccines were created.
3. Methods (continued-2)

Parental attitudes towards vaccines:

- (1). Vaccines are necessary.
- (2). Vaccines do a good job.
- (3). Children not vaccinated may get disease.
- (4). Worry less about children’s health if vaccinated.
- (5). Vaccines are safe.
- (6). Vaccination may have serious side effects.
- (7). Children receive too many vaccines.
- (8). Vaccination may cause autism.
- (9). Have good relationship with provider.
- (10). Providers have my child’s best interest at heart.
3. Methods (continued-3)

- Includes 3 other child and parental characteristic in multivariable logistic regression:
  
  - (1). Health insurance status of children
  - (2). Vaccination decision influenced by doctor
  - (3). Vaccination decision influenced by nurse
3. Methods (continued-4)

- Weighted proportion of child vaccination status for the 1st through the 4th dose of PCV was estimated with one-way categorical data analysis.

- Prevalence and risk factor analysis for not achieving PCV series completion were conducted by two-way and multivariable logistic regression data analyses.
4. Results
Vaccines are Necessary
Vaccines do a good job
Children not vaccinated may get diseases
Worry less about children's health if vaccinated
Vaccines are safe

Figure 1. Percentage of negative response for health insurance and the first 5 parental attitudes towards vaccines among children.
Figure 2. Percentage of negative response to the last 5 parental attitudes towards vaccines among children.

- Vaccination may have serious side effects: 27%
- Children receive too many vaccines: 30.7%
- Vaccination may cause Autism: 10.7%
- Have good relationship with provider: 6.2%
- Providers have my child’s best interest at heart: 5.9%
4.1. Weighted percentage of children with no health insurance and negative response by parental attitudes towards vaccines among children, Figure 1 – Figure 2

- The percentage of children with no health insurance is 4.7% (95% CI, 4.1 – 5.4%)
- The negative ‘NO’ response of parental attitudes towards vaccines ranged between 5.9% and 25.8%, with the maximum occurring for attitude of “Worry Less about Children’s Health if Children Vaccinated”
- The negative ‘YES’ response varied from 10.7% to 30.7% with the maximum occurring for attitude of “Children Received Too Many Vaccines”
Figure 3. Weighted proportion of vaccination status for the 1st through the 4th dose of Pneumococcal Conjugate Vaccine for children 19-35 months in the US

- On time
- Late
- Missing transition from 1st dose
- Missing transition from 2nd dose
- Missing transition from 3rd dose
- New missing at this dose
Vaccines are Necessary

Vaccines do a good job

Children not vaccinated may get diseases

Worry less about children's health if vaccinated

Vaccines are safe

Figure 4. Prevalence of not achieving PCV series completion by the first 5 parental attitudes towards vaccine.
Figure 5. Prevalence of not achieving PCV series completion by the last 5 parental attitudes towards vaccine.

- Vaccination may have serious side effects: 13.1% No, 21% Yes
- Children receive too many vaccines: 13.4% No, 19.5% Yes
- Vaccination may cause Autism: 14.1% No, 23.3% Yes
- Have good relationship with provider: 30.2% No, 14.2% Yes
- Providers have my child’s best interest at heart: 30.9% No, 14.3% Yes
4.2. Weighted prevalence by parental attitudes towards vaccines for not achieving PCV series completion in Figure 4 and Figure 5

- The weighted prevalence rates ranged from 12.7% to 37.0%, with mean of 18.9% and median of 15.1%, across the 10 parental attitudes.

- The difference between the 2 categories is significant at level of P-value < 0.001 for all of the 10 parental attitudes towards vaccines.
Table 1. Unadjusted and adjusted prevalence ratios for not achieving PCV series completion by parental attitudes towards vaccines among children 19-35 months in the United States.

<table>
<thead>
<tr>
<th>Factors</th>
<th>Comparison</th>
<th>Unadjusted prevalence ratio (95%CI)</th>
<th>Adjusted prevalence ratio (95%CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vaccines are Necessary</td>
<td>No vs. yes</td>
<td>2.7 (2.2, 3.2)</td>
<td>1.4 (1.01, 1.8)</td>
</tr>
<tr>
<td>Vaccines do a good job</td>
<td>No vs. Yes</td>
<td>2.2 (1.8, 2.7)</td>
<td>1.1 (0.9, 1.5)</td>
</tr>
<tr>
<td>Children not vaccinated may get diseases</td>
<td>No vs. Yes</td>
<td>1.5 (1.2, 1.8)</td>
<td>1.1 (0.9, 1.3)</td>
</tr>
<tr>
<td>Worry less about children’s health if vaccinated</td>
<td>No vs. Yes</td>
<td>1.8 (1.5, 2.1)</td>
<td>1.4 (1.1, 1.6)</td>
</tr>
<tr>
<td>Vaccines are safe</td>
<td>No vs. Yes</td>
<td>2.0 (1.7, 2.3)</td>
<td>1.4 (1.1, 1.7)</td>
</tr>
<tr>
<td>Vaccination may have serious side effects</td>
<td>Yes vs. No</td>
<td>1.6 (1.4, 1.9)</td>
<td>1.3 (1.1, 1.6)</td>
</tr>
<tr>
<td>Children receive too many vaccines</td>
<td>Yes vs. No</td>
<td>1.5 (1.3, 1.7)</td>
<td>1.2 (0.99, 1.4)</td>
</tr>
<tr>
<td>Vaccination may cause Autism</td>
<td>Yes vs. No</td>
<td>1.7 (1.4, 2.0)</td>
<td>1.0 (0.8, 1.3)</td>
</tr>
<tr>
<td>Have good relationship with provider</td>
<td>No vs. Yes</td>
<td>2.1 (1.7, 2.7)</td>
<td>1.5 (1.2, 2.0)</td>
</tr>
<tr>
<td>Provider have my child’s best interest at heart</td>
<td>No vs. Yes</td>
<td>2.2 (1.7, 2.7)</td>
<td>1.1 (0.8, 1.5)</td>
</tr>
</tbody>
</table>
4.3. Five parental attitudes were significantly associated with not achieving PCV series completion.

- Disagreeing that vaccines are necessary, vaccines are safe, and worry less about child’s health if he/she is vaccinated
- Agreeing that vaccination may have serious side effects
- Not having good relationship with provider
- The corresponding 5 adjusted PRs for not achieving PCV series completion ranged from 1.3 (95% confidence interval CI: 1.1, 1.6) to 1.5 (95% CI: 1.2, 2.0)
5. Discussion – Summary of Findings

- Our analysis suggests that 5 out of the 10 parental attitudes towards vaccines are significantly independently associated with not achieving PCV series completion. However, we can make no causal inferences from these data.

- **Vaccines are necessary**
- **Worry less about children’s health if vaccinated**
- **Vaccines are safe**
- **Vaccination may have serious side effects**
- **Have good relationship with provider**
5. Discussion - Limitation

- NIS uses a list-assisted random-digit-dialing (RDD) dual-frame design in household survey which could result in bias in evaluation of not achieving PCV series completion due to nonresponse and phoneless households.

- This study provided the most currently available information about association of parental attitudes toward vaccines and provider-reported vaccinations in the United States, but data from 2011 may not reflect the current situation.
5. Discussion – Future Work (1)

- Consider creating an index or scale of vaccine hesitancy
- Describe characteristics of vaccine hesitant parents and/or prevalence of vaccine hesitancy stratified by characteristics
- Use Classification and Regression Trees (CART) analysis to identify complex interactions between parental attitudes and vaccination status
5. Discussion – Future Work (2)

- CDC/NCIRD and CDC/NCHS have developed a 1-minute vaccine hesitancy module that will be fielded in NIS April-June 2018. This will provide more recent information related to vaccine hesitancy for children 6 months-17 years.
5. Discussion - Resources

- The vaccine hesitancy questions developed by CDC/NCIRD and CDC/NCHS can be used by awardees and researchers - contact Allison M Fisher (ark2@cdc.gov), if interested.

- Resources for providers regarding parents who question vaccines is available online at:
  https://www.cdc.gov/vaccines/hcp/patient-ed/parents-questions.html
References:


