When Mumps Takes Over Your Program
The 2016-17 Mumps Epidemic in Arkansas:

Why did it happen and what can we do to prevent it from happening again?

Presented by
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Immunization Section Chief

Special thanks to: Dirk Haselow, MD, PhD
State Epidemiologist,
Medical Director for Outbreak Response,
Arkansas Department of Health
Mumps

- Major cause of outbreaks in pre-vaccine era
- Vaccination has reduced mumps by 99% in the US
- Recently, a few outbreaks have centered around colleges and schools
Mumps Virus

- Paramyxovirus
- 13 genotypes
  - Considered antigenically monotypic
  *MUVS/Arkansas.USA/35.16/7
- Transmitted via respiratory droplets
- Reservoir is man
Mumps Clinical Features

- Incubation period usually 14-18d (but can be 12-26d)
- Often starts with 2-3d of nonspecific symptoms
  - Preschool-aged kids may present with lower respiratory illness
- Classic parotitis in 30%-40%
- Up to 20% of infections asymptomatic
  - Higher proportion seen among vaccinated persons
  - Can still transmit
Classic Swelling of Cheek and Neck (Parotitis) Seen with Mumps
Other Causes of Parotitis

- **Viruses**
  - Epstein Barr virus
  - Parainfluenza viruses types 1 and 3
  - Influenza A viruses
  - Coxsackievirus
  - Adenovirus
  - Parvovirus B19
  - Human Herpes virus 6
  - Lymphocytic choriomeningitis virus
  - HIV

- **Bacteria**
  - Staphylococcal infections
  - Atypical mycobacteria

- **Salivary stones**
- **Cysts**

- **Drugs**
  - Thiouracil
  - Iodides
  - Phenothiazines

- **Starch ingestion**
- **Malnutrition**
- **Tumors**
- **Diabetes**
- **Cirrhosis**
- **Uremia**

- **Rare genetic disorders**: Mikulicz’s, Parinaud’s and Sjögren’s syndromes
Potentially Serious Complications

- Inflammation of the:
  - Testicles
  - Pancreas
  - Ovaries
  - Breast
  - Encephalitis or Meningitis

- Deafness

- Male infertility
Mumps – United States, 1968-2005
Mumps Cases, United States, 1983-2016*

*2015 cases as of Jan 2, 2016. 2016 case count preliminary as of June 6, 2016 and subject to change.
Mumps Cases and Outbreaks 2017

Mumps Cases as of May 1, 2017

Legend:
- 0 Cases
- 1-2 Cases
- 3-19 Cases
- 20-49 Cases
- 50-99 Cases
- 100-299 Cases
- 300+ Cases
Epidemiological Characteristics

- **Persistence in Environment:**
  - Readily inactivated by UV light, formalin, heat, acid
  - If wet can persist several days at 4°C

- **Epidemic Potential:**
  - High – epidemic parotitis
  - $R_0=7.1$

- **Challenges**
  - Imported cases
  - Immunity may not be lifelong
Mumps Laboratory Diagnosis

• Isolation of mumps virus

• Detection of RNA via PCR

• Serologic testing
  – Positive IgM antibody
    • At least 6 months since vaccination
  – 4 fold increase in IgG antibody between acute and convalescent specimens
Correlates of Immunity

- Antibodies to surface proteins are protective
  - Haemagglutinin-neuraminidase protein
  - Fusion protein

- Between 70-99% of individuals had detectable anti-mumps IgG antibodies 10 years after vaccination

- But antibodies are not the whole story
  - 41/43 recruits who developed mumps 3mo-5yrs after joining the military were positive for anti-mumps IgG at entry (Eick et al. 2008)
Mumps Vaccine

- Effectiveness 88% after two doses
- Duration of Immunity Generally lifelong
- Schedule 1st dose at 12-15 months, 2nd after age 4 and for adults at higher risk
- Administered with measles and rubella (MMR)
- Developed from the Jeryl Lynn strain (genotype A)
- Every dollar spent on mumps vaccination saves $13.2 in direct and $24.9 in indirect costs. (Zhou et al. 2004)
Current Status of the Outbreak
(as of May 25, 2017)

Reported Cases of Mumps, Arkansas 2016-17

n=2,946 as of 5/25/17

* Numbers for most recent week are provisional
Marshall Islanders:
A primer on their history and unique cultural considerations

Many slides and advice kindly provided by
Mrs. Sandy Hainline, RN
Republic of the Marshall Islands

- 5 Coral Islands
- 29 Atolls
  - 1,156 islets
  - 750K square miles
  - Only 70 sq mi land, average elevation 7 feet
- About 85K people with per capita income ~ $2,900/yr

Majuro Atoll (capital) consists of 25,000 people and only 3.5 square miles of land
Marshall Islanders in NW Arkansas

- ~10,000 Marshallese in NW AR
- Largest number in continental US
Medicine and Health Care in the RMI

• Two hospitals
  – Majuro
  – Kwajalein

• Challenge to get any care to the outer islands
• Concept of preventive health care is limited
• National Health Insurance
  – Cost to the client for a clinic visit in the RMI ~ $5.00
Why Leave Paradise?

- Physical lack of land
- Population increase
- Economy: Poor
  - Unemployment rate is 35%
  - Minimum wage: $2.00
  - No industry
- Out migration started mid 1990
  - 30% migrate to the USA
  - 50% of the population < 25
- Out migration accelerating
  - Islands being reclaimed by the sea
‘Cold War’ Nuclear Legacy

• Between 1946 and 1958
  – 64 above ground detonations
  – 3 underwater

• Several islands uninhabitable

• Nuclear Claims Tribunal Findings
  – Over 7,200 fold the yield of Hiroshima and Nagasaki bombs
  – Over $2B judgement, but approximately 1/3rd paid in 60 years. Only $4M to individuals

  – “Most contaminated place in the world”
Compact of Free Association

- 1983 Legal agreement between the USA and the Republic of the Marshall Islands
  - May enter USA with passport only
  - Obtain a US social security number
  - Allows the Marshallese to work, attend school, and serve in the US military
  - Does not provide a pathway to citizenship
  - Prohibits most state or federal funding
Disproportionate Burden of Disease

• They bring the health issues of the islands with them
  – VPDs, TB, STDs, HIV, IPD, Hansen’s, nutritional deficiencies
  – Rapidly incorporate American diet
    • Huge increase in diabetes, obesity, HTN
• Pristine immune system?
• Genetic damage from radiation
  – Increased burden of cancers
Why They Do Not Seek Care

- Do not recognize seriousness of disease or significance of symptoms
- Language barriers
- Little or no concept of our medical system
- Difficulty navigating a phone menu
- Lack of reliable transportation
- Cost of health care
- Mistrust of providers and government
- Afraid to seek care
Traditional Healing

- **Riuno**: person who gives medicine
- **Ribitbit**: person who attends to musculoskeletal systems
- **Rikapal**: person who makes magic
- **Roro**: chants done to help the sick
- **Uno**: plants, soil, water, moon light, magic
Clan / Household Structure

- Matrilineal
- Decisions that effect the house and children are made by oldest women in the house
- Large families
  - 8-12 in the islands
  - 6-8 in the US
  - Single house may have 3 families
  - Sister mothers
- \( \frac{1}{2} \) of the population is under 25
Communication

- 30,000 word vocabulary, largely contextual
  - 250,000 word in English vocabulary
- Minimal English comprehension skills
- No written language prior to the arrival of British missionaries (approximately 100 years ago)
- Body language key
- Contact investigations enormous challenge
Barriers to Health Care Access

• Medical Insurance
  – Unable to make co-payments

• Arkansas does not extend Medicaid to foreign born Marshallese except for pregnant women and TB

• Arkids 1st only for American born
  – Application process

• Care is obtained mostly in the emergency room
How To Interact Effectively

• Negativity will cause them to ‘shut down’
  – Emphasize health promotion, not illness prevention
• Eye contact is considered aggressive
• Gain trust
• Deal holistically
• Take time to explain
• They live in an immediate world
• You must show interest
Adjusting to Life in America

- Faster pace of life
  - “Island Time”
- Money management problems
- Culture shock
  - Many have never previously spent a night alone
  - Concept of individual ownership
- Transportation
  - Family member dedicated to shuttle rest of family
  - Night shift workers
  - Balancing priorities
Throughout the Outbreak, 90% to 95% of school-aged children and 30% to 40% of adults involved were fully vaccinated.
Vaccination Status Among Those Who Have Been Investigated

<table>
<thead>
<tr>
<th>Vaccination Status of Cases</th>
<th>&lt;1</th>
<th>1 - 4</th>
<th>5 - 17</th>
<th>18+</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 MMR</td>
<td>10</td>
<td>36</td>
<td>88</td>
<td>726</td>
<td>860</td>
</tr>
<tr>
<td>1 MMR</td>
<td>0</td>
<td>39</td>
<td>48</td>
<td>134</td>
<td>221</td>
</tr>
<tr>
<td>2+ MMR</td>
<td>0</td>
<td>24</td>
<td>1,535</td>
<td>293</td>
<td>1,852</td>
</tr>
<tr>
<td>Total</td>
<td>10</td>
<td>99</td>
<td>1,671</td>
<td>1,153</td>
<td>2,933</td>
</tr>
<tr>
<td>Total Up-to-date</td>
<td>0</td>
<td>63</td>
<td>1,535</td>
<td>427</td>
<td>2,025</td>
</tr>
<tr>
<td>% Up-to-date</td>
<td>N/A</td>
<td>63.6%</td>
<td>91.9%</td>
<td>37.0%</td>
<td>69.0%</td>
</tr>
</tbody>
</table>

There are 8 more cases under investigation whose vaccine status is not known.
Weekly Mumps Cases by Race

![Graph showing weekly mumps cases by race from 2016 to 2018. The x-axis represents the year and week, while the y-axis represents the number of cases. The graph includes lines for Native Hawaiian or Other Pacific Islander, Asian, Black or African American, White, and Other races, with peaks and troughs indicating variations in case numbers over time.](image)
Primary Places Where Transmission Was Occurring

- Churches
- Homes
- Birthday Parties
- Employer Settings
- Schools
Numerous Challenges Forced us to Adapt our Response

• Initially, we were not welcomed into churches
• Many community members considered this a low priority
• Others ‘pushed back’ due to perceptions of stigma

• Engaged the community
  – Identified community champions
  – Had medical mission from RMI
  – Set up a Marshallese Task Force
  – Partnered with UAMS, ARCOM, RMI Consulate, RMI MOH, CDC, Walmart
  – Pastors and pastors wives
• Medical anthropologist
• Interpreters
• Marshallese messaging
• Presented on Marshallese radio stations
• Brought vaccine to worksites, homes, apartments, and grocery stores
## Observed vs. Expected Complications of Mumps

<table>
<thead>
<tr>
<th>Complication</th>
<th>% Pre vaccination</th>
<th>% Post-vaccination</th>
<th>Approximate Number Expected with 3,000 cases</th>
<th>Number Observed as of 5/10/17</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meningitis</td>
<td>1-10%</td>
<td>&lt;1%</td>
<td>30-300</td>
<td>0</td>
</tr>
<tr>
<td>Encephalitis</td>
<td>0.5%</td>
<td>&lt;1%</td>
<td>15-30</td>
<td>0</td>
</tr>
<tr>
<td>Orchitis</td>
<td>12-66% of men</td>
<td>~10%</td>
<td>180-990</td>
<td>18</td>
</tr>
<tr>
<td>Oophoritis</td>
<td>5% of women</td>
<td>&lt;1%</td>
<td>75</td>
<td>0</td>
</tr>
<tr>
<td>Pancreatitis</td>
<td>2-5%</td>
<td>&lt;1%</td>
<td>60-150</td>
<td>1</td>
</tr>
<tr>
<td>Deafness</td>
<td>0.005%</td>
<td>rare</td>
<td>0-1</td>
<td>0</td>
</tr>
<tr>
<td>Infertility</td>
<td>4% of men</td>
<td>rare</td>
<td>60</td>
<td>0</td>
</tr>
<tr>
<td>Hospitalization</td>
<td>10%</td>
<td>2%</td>
<td>60-300</td>
<td>6</td>
</tr>
</tbody>
</table>
Duration of Mumps Positivity Relative to Parotitis Onset (Kutty et. al 2010)

Eight Studies: Johnson et al. [36], Leymaster et al. [34], Henle et al. [3], Ennis et al. [38], Brunell et al. [26], Shope et al. [31], Knowles et al. [35], Uchida et al. [30]
Number of PCR-Positive Cases and Proportion Positive by Days After Parotitis Onset
Prolonged PCR Positivity

- 75 cases confirmed by PCR greater than 5 days after parotitis onset
- Age range 2-46 years
- 65% Marshallese
- 57% Female

- PCR positivity ≠ infectious
  - 10 samples sent to CDC and all had live virus
Recurrent Disease

- 28 cases with recurrent onset of clinical parotitis
  - 7 days to 161 days after first episode, average 71 days, median 69 days
  - Age range 5 months - 52 years
  - 79% Marshallese
  - 57% female

- Vaccination history
  - 68% had at least 2 doses of MMR, 14% had 1 dose, and 18% had none
Arkansas Mumps Cases and MMR Clinics as of May 10, 2017

Arrows represent dates of 71 clinics. Numbers represent # of persons immunized. Total of 8,709 MMRs provided as of 5/10/17
Rates of Mumps in 21 Schools Before and After Clinics

Pre-Clinic Period
Attack Rate = 16.7/1,000

Peri-Clinic Period
Attack Rate = 8.1/1,000

Post-Clinic Period
Attack Rate = 2.5/1,000

Days Relative to the Date of Clinic
Salary Hours and Cost by Category Number Of Hours Worked

NURSE Total 51%

EHS Total 0.001%

LAB Total 12%

MED Total 1%
Expense Category

- Mumps ACAS0017: 34%
- 317 Ops AIMG0016: 3%
- State General Revenue ASGR00XX: 63%
Does the Booster help?

Note: This analysis is restricted only to students in the 21 schools who already had two MMR doses

<table>
<thead>
<tr>
<th>Pre-Clinic Rate of Mumps</th>
<th>Results of Clinic</th>
<th>Rate (Count) of Mumps From 1-26d After Clinic</th>
<th>Rate (Count) of Mumps From 27-52d After Clinic</th>
</tr>
</thead>
<tbody>
<tr>
<td>16.7 (278)</td>
<td>1,916 Students Received 3rd Dose Booster</td>
<td>13.0 (25)</td>
<td>1.0 (2)</td>
</tr>
<tr>
<td></td>
<td>14,397 Did Not Receive 3rd Dose Booster</td>
<td>7.4 (107)</td>
<td>2.6 (38)</td>
</tr>
</tbody>
</table>

Crude 3rd dose Vaccine Effectiveness = \frac{(2.6-1.0)}{2.6} = 61\%
Communication Challenges

• Massive outreach effort

• Different messages worked for different audiences

• Stakeholders have varied perspectives, goals, and needs

• Multipronged and repetitive approach needed
What is ADH Doing about Mumps?

- Using the best evidence available
- Interviewing suspect cases and contacts
- Excluding undervaccinated kids from school
- Performing vaccination clinics in many settings
- Providing advice to providers, schools, employers, and parents
- Evaluating our control efforts and contributing to the understanding of mumps
- Communicating to many audiences
What Should We Be Doing to Optimize the Health of the Marshallese?

- Improved preventive care in the RMI
- Appropriate distribution of Compact funding
- Eligibility for federal healthcare benefits
  - Some recent progress here for kids…
- Marshall Islanders should undergo infection screening similar to immigrants
- Pathway to citizenship
Acknowledgements

• Thanks to all that have been involved in the outbreak response!
  – ADH staff, CDC staff, RMI Ministry of Health, Marshallese Task Force, ARCOM, UAMS, community leaders, and more

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Collaboration
Pastor’s Wives
Questions / Comments

Janell Routh MD, MHS
Medical Officer
CDR, USPHS
MMRHP Team
Division of Viral Diseases/NCIRD/CDC
Links

http://www.aetn.org/programs/aneisland

https://www.facebook.com/SpringdaleSchools/videos/10154122261092931/

http://www.healthy.arkansas.gov/programsServices/infectiousDisease/CommunicableDisease/Documents/041217ADHMumpsQA.pdf

https://www.historyofvaccines.org/content/mumps-jeryl-lynn-story