Disclosure: Session B2

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Economic Burden of the 2017 University of Washington Mumps Outbreak: A Prospective Analysis

Jamison Pike PhD, Sheryl Schwartz MPA, Meagan Kay DVM, Ailyn Perez-Osorio PhD, Mona Marin MD, Mark Jenkins MD, Janell Routh MD, Jeff Duchin MD, Chas DeBolt RN, MPH, Fangjun Zhou PhD

48th National Immunization Conference

May 15, 2018
2017 University of Washington Mumps Outbreak

- February 8, 2017 – first suspected case of mumps reported in a member of a sorority at University of Washington’s (UW) Seattle campus.
- By June 6, 2017 – 42 mumps cases were identified among UW students, staff, and associated community members.
- UW collaborated with Public Health—Seattle & King County (PHSKC) and Washington State Department of Health (WADOH) to rapidly respond to and contain the outbreak.
- This study reports the economic impact of the 2017 UW mumps outbreak to UW and the state and local health departments.
Methods
Setting

- UW’s Seattle campus encompasses 703 acres.
  ≈ 51,000 students.
  ≈ 32,000 are undergraduates.
  ≈ 3,900 students reside in fraternity and sorority housing
  ≈ 700 additional fraternity and sorority members live in other accommodations.

- UW reported >99% coverage with 2-doses of MMR among all students.
Outbreak and Public Health Response

- UW worked with PHSKC to investigate suspected cases and identify contacts.

- All clinical specimens were sent to WADOH for laboratory testing and a subset were also sent to the Minnesota Department of Health (MNDOH).

- Of the 42 total cases, 32 were among fraternity and sorority members, 2 cases resided in UW dormitories, 7 were socially linked to UW, and remaining case was in a UW faculty member.
Outbreak and Public Health Response

- By March 6th, the attack rate in the fraternities and sororities of 6/1,000 in a close contact setting supported the consideration for use of an additional dose of MMR vaccine for outbreak control according to CDC guidance at that time.

- 7 MMR vaccination clinics offered at sororities and fraternities.
  - PHSKC provided 406 doses of MMR vaccine.
  - UW provided 538 doses of MMR vaccine that UW privately purchased.

- 43 more privately purchased doses of MMR vaccine provided by UW at the student health center.
Cases over the duration of the 2017 UW Mumps Outbreak.
Data collection

- Public health and university perspective.
- Labor and material costs collected from the start of the outbreak on February 8th and categorized by payer and activity.
- Labor costs, which included fringe benefits and department overhead, were collected from UW, PHSKC, and WADOH.
- Laboratory hours and material costs collected from WADOH and MNDOH.
- Vaccine and vaccine supply costs were collected from UW and PHSKC.
- All expenses are in 2017 U.S. dollars.
Results
Results

- Total Labor and Material Costs accrued responding to the outbreak
  - $282,761 (or $6,732 per case) including 2,692h

- University of Washington
  - $160,664 ($3,825 per case) including 1,495h
  - UW bore 57% of costs

- Public Health (PHSKC, WADOH, and MNDOH combined)
  - $122,098 ($2,907 per case) including 1,197h
  - PH bore 43% of costs
Table 1

Estimated resources and costs of the containment for the University of Washington mumps outbreak, February 8 – June 23, 2017.

<table>
<thead>
<tr>
<th>Variable</th>
<th>University</th>
<th>Public Health</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Approximate personnel hours</td>
<td>1,495</td>
<td>1,197</td>
<td>2,692</td>
</tr>
<tr>
<td>Vaccine doses</td>
<td>581</td>
<td>406</td>
<td>987</td>
</tr>
<tr>
<td>Laboratory Tests</td>
<td>0</td>
<td>142</td>
<td>142</td>
</tr>
<tr>
<td>Estimated costs (% of total costs)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Labor</td>
<td>$117,990 (73)</td>
<td>$98,767 (81)</td>
<td>$216,757 (77)</td>
</tr>
<tr>
<td>Materials</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vaccines</td>
<td>$40,424</td>
<td>$13,058</td>
<td>$53,482</td>
</tr>
<tr>
<td>Vaccination Contractor</td>
<td>$2,250</td>
<td>N/A</td>
<td>$2,250</td>
</tr>
<tr>
<td>Vaccination and lab</td>
<td>N/A</td>
<td>$10,273</td>
<td>$10,273</td>
</tr>
<tr>
<td>Total Costs</td>
<td>$160,664</td>
<td>$122,098</td>
<td>$282,762</td>
</tr>
</tbody>
</table>
Table 2: Estimated labor costs (hours) by select type and payer for the University of Washington mumps outbreak, February 8–June 23, 2017.

<table>
<thead>
<tr>
<th>Type</th>
<th>University</th>
<th>Public Health</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>cost (%)</td>
<td>hours (%)</td>
<td>cost (%)</td>
</tr>
<tr>
<td>Containment</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Communication/education/media</td>
<td>$11,351 (10)</td>
<td>196 (13)</td>
<td>$11,411 (12)</td>
</tr>
<tr>
<td>Case and contact investigation</td>
<td>$3,377 (3)</td>
<td>38 (3)</td>
<td>$24,256 (25)</td>
</tr>
<tr>
<td>Response planning/coordination</td>
<td>$75,493 (64)</td>
<td>850 (57)</td>
<td>$19,183 (19)</td>
</tr>
<tr>
<td>Prepare reports</td>
<td>$1,286 (1)</td>
<td>13 (1)</td>
<td>$0 (0)</td>
</tr>
<tr>
<td>Lab</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>$20,445 (21)</td>
</tr>
<tr>
<td>Subtotal</td>
<td>$91,507 (78)</td>
<td>1,096 (73)</td>
<td>$75,295 (76)</td>
</tr>
<tr>
<td>Vaccination</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vaccination Clinic Planning</td>
<td>$22,613 (19)</td>
<td>312 (21)</td>
<td>$12,433 (13)</td>
</tr>
<tr>
<td>Vaccination Clinic</td>
<td>$3,870 (3)</td>
<td>88 (6)</td>
<td>$11,039 (11)</td>
</tr>
<tr>
<td>Subtotal</td>
<td>$26,483 (22)</td>
<td>400 (27)</td>
<td>$23,472 (24)</td>
</tr>
<tr>
<td>Total</td>
<td>$117,990</td>
<td>1,495</td>
<td>$98,767</td>
</tr>
</tbody>
</table>
Results

- Comparing outbreak containment versus vaccination-related activities, containment-related hours and labor costs were three-fold higher than vaccination-related activities.
- Overall, labor accounted for 77% of total outbreak costs.
- 23% of labor costs were spent on vaccination.
- Examined seven categories of labor activities: vaccination clinic planning; vaccination clinic; communication; case and contact investigation; response planning and coordination; preparing reports; and laboratory testing.
Discussion
Discussion

- UW the majority of their hours in (1) planning how to respond to the outbreak and (2) preparing for the vaccination clinics, and (3) outreach and education campaign.
  - Might be a result of UW’s limited experience with mumps or other infectious disease outbreaks, which is likely true for most universities in the United States.
  - Universities with a history of outbreaks might not incur a portion of the costs required to respond to the current outbreak if previously incurred during a prior outbreak (i.e., sunk costs).
Discussion

- Context of UW mumps outbreak – Washington State was in the midst of its largest mumps outbreak since the late 1970’s, accounting for 16% of the cases occurring nationally during January–September 2017.
  - Although the mumps cases at UW represented only 6% of the total cases reported by the entire state, PHSKC allocated important resources to assist UW in responding to the outbreak while also responding to the larger Washington State outbreak.
  - All of PHSKC involved staff either delayed or reduced the amount of time necessary to complete regular duties.
Discussion

- UW’s outbreak resulted in a relatively small number of cases compared to other recent mumps outbreaks at large universities.
  - Although no direct causation can be drawn, the rapid response by UW and public health agencies and the robust amount of labor allocated to planning and coordination of the outreach and education campaign and vaccination clinics likely have contributed to containment of the outbreak.
  - Because local health departments have been experiencing shrinking resources and do not have "outbreak" budget reserves, even relatively small outbreaks might represent real fiscal challenges.
Public Health Implications

- Mumps outbreaks in highly 2-dose vaccinated populations have been increasing across the United States, triggering discussion of outbreak prevention versus control strategies subject to the competing demands on public health agencies and affected institutions.

- In October 2017, ACIP recommended a third dose of MMR vaccine for individual protection for persons who are part of a group or population at increased risk for acquiring mumps as determined by public health authorities during an outbreak.
Public Health Implications

1. A mumps outbreak can economically burden an affected institution and public health department.

2. Using early intervention to target an outbreak with the potential to grow rapidly might limit the burden mumps outbreaks pose on community/public health burden although the resources used might be substantial.

3. The importance of public health department planning for adequate financial reserves to manage the cost of responding to even modest outbreaks.

4. The importance of the economics component in determining optimal response strategies to future mumps outbreaks.
Investigation of an Increase in Mumps in New York City, 2016-2017

Beth Isaac
New York City Department of Health and Mental Hygiene

48th National Immunization Conference
May 15, 2018
Mumps Surveillance

- New York City (NYC) Department of Health and Mental Hygiene (DOHMH) investigates and manages all reported suspect mumps infections
- Providers are required to report cases to DOHMH*
- Mandatory electronic laboratory reporting of positive mumps tests†

* NYC Health Code Section 11.03, New York State Sanitary Code 10NYCRR 2.10
† NYC Health Code Section 11.03, New York State Sanitary Code PHL 2102
Diagnostic Testing

• Polymerase Chain Reaction (PCR)
  – Buccal swab specimen
  – Collected through 6 days post-symptom onset
  – Earlier collection more likely to detect mumps

• Immunoglobulin M (IgM) Serology
  – IgM may not be detectable in vaccinated individuals
Classification of Mumps Reports*

- **Confirmed Case**
  - Parotitis, orchitis, oophoritis, aseptic meningitis, encephalitis, hearing loss, mastitis, or pancreatitis
  - Positive PCR

- **Probable Case**
  - Parotitis, orchitis, or oophoritis
  - Positive IgM, or
  - Epidemiologic link to a confirmed/probable case or outbreak location

- **Discarded (Not a case)**
  - Reports without symptoms, or
  - Reports without a positive lab (PCR/IgM) nor epidemiologic linkage

*Classification according to the Council of State and Territorial Epidemiologists (CSTE) case definition
Mumps Outbreak?

- Continued thorough investigations of all cases/settings
  - Workplaces
  - Schools, daycares, extra curricular activities, sports teams
  - Social settings
  - Travel history
  - Known exposure to another person with symptoms

- Post-incubation follow-up of exposed household members to identify additional cases

- No widespread epidemiological linkages identified during case investigations
Mumps Reports by Month of Onset

- **Period of Increase**: Jul 2016 – Dec 2017

- University Outbreak
- NHL Outbreak
- Community Outbreak
- Not a Case
- Case

# Mumps Reports by Month of Symptom Onset
Mumps Reports by Month of Onset

- **Period of Increase**: Jul 2016 – Dec 2017

### NHL Outbreak Attention

- **NHL Outbreak**: Jul 2016 – Dec 2017

- **Community Outbreak**: Jul 2014 – Jun 2016
Mumps Reports by Month of Onset

Excluded cases/reports associated with an outbreak of 20 or more cases

Not a Case
Case

Month of Symptom Onset

NHL Outbreak
Attention

Community Outbreak
Mumps Reports by Month of Onset

Not a Case
Case

Baseline Reports (18 reports per month)
Baseline Cases (4 cases per month)

Mumps Reports by Month of Onset

Period of Increase
62 reports per month (244% increase)
22 cases per month (476% increase)
What Changed?
Factors Examined for Period of Increase

- Patient age and geographic distribution of residence
- Type of facilities visited by patients
- Changes in reporting practices
- Changes in laboratory testing practices
Incidence by Age and Symptom Onset

Mumps Incidence per 100,000 NYC Residents

- 0 to 4 yrs
- 5 to 17 yrs
- 18 to 24 yrs
- 25 to 34 yrs
- 35 yrs and older

Symptom Onset

- 2014
- 2015
- 2016
- 2017

Community Outbreak
Incidence by Borough of Residence and Symptom Onset

Mumps Incidence per 100,000 NYC Residents

- Bronx
- Brooklyn
- Manhattan
- Queens
- Staten Island

Community Outbreak

Symptom Onset
Mumps Reports: Urgent Care Chain (UCC) vs Non-UCC

[Bar chart showing the number of mumps reports by month of symptom onset from July 2014 to November 2017. The chart compares reports from Urgent Care Chain (UCC) and non-UCC settings.]
Mumps Reports: Urgent Care Chain (UCC) vs Non-UCC

Period of Increase
60% of reports visited UCC
Mumps Cases: Urgent Care Chain (UCC) vs Non-UCC

Period of Increase
53% of cases visited UCC
UCC Checklists Implemented July 2016

- DOHMH asked UCC about any changes in practices
- UCC implemented checklists for suspected mumps cases in July 2016 in response to mumps outbreak in Long Beach, NY
UCC Checklist Guidance

• Collect appropriate specimens for mumps testing
  – Using standardized specimen collection/storage protocols
  – Specifies both serologic and PCR testing
UCC Checklist Guidance

• Collect appropriate specimens for mumps testing
  – Using standardized specimen collection/storage protocols
  – Specifies both serologic and PCR testing

• Report case to DOHMH
UCC Checklist Guidance

• Collect appropriate specimens for mumps testing
  – Using standardized specimen collection/storage protocols
  – Specifies both serologic and PCR testing

• Report case to DOHMH

• Implement droplet precautions: mask and gloves
UCC Checklist Guidance

• Collect appropriate specimens for mumps testing
  – Using standardized specimen collection/storage protocols
  – Specifies both serologic and PCR testing

• Report case to DOHMH

• Implement droplet precautions: mask and gloves

• Obtain pertinent historical information: vaccination, place of employment, sick contacts, travel history
UCC Checklist Guidance

• Collect appropriate specimens for mumps testing
  – Using standardized specimen collection/storage protocols
  – Specifies both serologic and PCR testing

• Report case to DOHMH

• Implement droplet precautions: mask and gloves

• Obtain pertinent historical information: vaccination, place of employment, sick contacts, travel history

• Advise social isolation: stay home for 5 days after symptom onset and inform contacts about suspected mumps infection
Did PCR Testing Practices Change?

- % of reports with PCR testing of those eligible*
  - Compared between baseline and period of increase
  - Stratified by facility visited (UCC vs non-UCC)

*Sought medical care within 6 days of symptom onset and were not tested for immunity only
Percent of Reports with PCR Testing

<table>
<thead>
<tr>
<th>Timeframe</th>
<th>% of Reports with PCR Testing Done</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Non-UCC</td>
</tr>
<tr>
<td>Baseline</td>
<td>58</td>
</tr>
<tr>
<td>Increase</td>
<td>60</td>
</tr>
</tbody>
</table>
### Percent of Reports with PCR Testing

<table>
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<th>Timeframe</th>
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<td>58</td>
</tr>
<tr>
<td>Increase</td>
<td>60</td>
</tr>
</tbody>
</table>
Mumps Cases: Urgent Care Chain (UCC) vs Non-UCC

Month of Symptom Onset

# Mumps Cases

Non-UCC
UCC
Mumps Cases: Urgent Care Chain (UCC) vs Non-UCC

- **Non-UCC**
- **Baseline**

![Graph showing Mumps Cases over time](image)

**Month of Symptom Onset**

- Jul-14 to Nov-17

**# Mumps Cases**

- The graph compares the number of mumps cases between patients seen in Urgent Care Chain (UCC) and Non-UCC settings over the specified months.
Other Factors to Consider for Increase

• No changes in DOHMH investigation procedures

• No changes in DOHMH Public Health Laboratory (PHL) testing protocol

• Increased media attention
  – College outbreaks in NY State\(^1,\,^2\)
  – Large outbreaks nationally\(^3\)
  – Possible increased awareness among providers and patients

1. NYS DOH. https://www.health.ny.gov/press/releases/2016/2016-09-15_mumps_cases_reported.htm
2. NYS DOH. https://www.health.ny.gov/press/releases/2016/2016-12-09_mumps.htm
3. CDC. https://www.cdc.gov/mumps/outbreaks.html
Summary

• Dramatic increase in mumps reports and cases mostly among 18-34 year olds and Manhattan residents
  – Increase is persisting
  – Does not appear to be associated with an outbreak
  – May reflect population served by urgent care centers
Why Did Mumps Reports and Cases Increase?

• No major changes in laboratory testing practices or protocols, or case investigation procedures

• Media attention
  – Increased awareness among providers and patients

• Implementation of checklists by large UCC
  – Increased clinical suspicion and case reporting to DOHMH
  – During increase, majority of reports and cases visited UCC

• Possible true increase in disease
Limitations

• True incidence of mumps not fully captured
  – Asymptomatic infection
  – Lab negative suspected cases not reported by provider

• Impacts both incidence estimates and epidemiological links between cases
Conclusions

• During the baseline, mumps had been underreported

• Increase in cases and reports due to increased awareness, clinical suspicion, and reporting to DOHMH

• Urgent care centers can be valuable partner in public health
  – Centralized structure of the UCC enabled them to implement rapid and widespread changes across many facilities
Acknowledgements

- NYC DOHMH Bureau of Immunization
  - Rob Arciuolo
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  - Eugene Lam
  - Mohammed Mannan
  - Francis Megafu
  - Chloé Peters
  - Jennifer Rosen
  - Gamal Sihly
Thank you

• Questions?

• Contact email: bisaac@health.nyc.gov
An unprecedented mumps outbreak among men-who-have-sex-with-men (MSM) or persons associated with MSM in Los Angeles County (LAC)

Emmanuel Mendoza, MPH

48th National Immunization Conference
Hilton Atlanta
May 15, 2018
<table>
<thead>
<tr>
<th>Lessons learned through the outbreak</th>
<th>LAC interventions during the outbreak</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Notify and work with medical providers and community</td>
<td>• Use any communication method (HANs, calls, visits) for educating providers about identification/testing, avoiding misdiagnosis. Recommend MMR</td>
</tr>
<tr>
<td>• Recommend additional dose of MMR</td>
<td></td>
</tr>
<tr>
<td>• Reach out early to venues that were possible sources of exposure and transmission</td>
<td>• Conducted exposure notification but should have visited highly congregated venues early to start partnerships</td>
</tr>
<tr>
<td>Lessons learned through the outbreak</td>
<td>LAC interventions during the outbreak</td>
</tr>
<tr>
<td>--------------------------------------</td>
<td>--------------------------------------</td>
</tr>
<tr>
<td>• Use of genotyping and nucleotide status</td>
<td>• Start early with genotyping and nucleotide sequencing - would have been useful to have earlier in the outbreak</td>
</tr>
<tr>
<td>• Know details of case HIV status</td>
<td>• HIV positive status did not mean that a case was necessarily immunosuppressed so additional data collected</td>
</tr>
<tr>
<td>• Collect detailed risk factor data about cases and contacts including being MSM or associating with MSM</td>
<td>• Standardization of MSM-associated risk factors</td>
</tr>
</tbody>
</table>
LAC MSM Associated Mumps Outbreak Summary

- January 10, 2017 to December 6, 2017
  - Number of reports: 76
  - Number of cases: 56
    - First reported case had onset on January 7
    - Last reported case had onset on August 27
    - Median age: 33 years old
    - Age range: 19 – 60 years old
    - Gender: 86% males
Mumps Case Residence and MSM Status

Residence
- 91% LA County
- 9% Out of Jurisdiction

MSM Status
- 80% MSM
- 20% Non-MSM
LAC MSM Associated Mumps Outbreak Location
Possible Exposure Sources/Sites

Percentage of Cases

Bars/Clubs/Gyms
Worksite
Household
Health Care Facility
Other /Unknown

0 10 20 30 40 50 60 70 80 90 100
March 9
Health alert sent out to providers in regards to two clusters of mumps cases in MSM in LAC

January - February
Communications with medical providers who serve MSM community, West Hollywood city officials, and HIV Commission

June 1
Second health alert sent out declaring a mumps outbreak among MSM population in LAC
Laboratory Confirmation

• Number of Lab Confirmed Cases: 43 (77%)
  – Confirmed by PCR: 28
  – Confirmed by IgM: 20

• Concerted efforts to test each suspect case by PCR
  – 50% of the cases confirmed by PCR were IgM negative
Genotyping and Nucleotide Sequencing

- Number of cases with genotype G
  - N=24 (86% of the PCR+ cases)

- Nucleotide Sequencing and Comparison to CDC database
  - 16 of the cases in the MSM-associated cluster had a strain that was not seen globally!
    - New York had 6 cases that also had this unique strain
      - Two had travel history or address in Los Angeles
      - Four had unknown connection to Los Angeles
Complications and HIV Status

• Number of cases with complications: 9 (16%)
  – Orchitis: N=8
    • Number HIV positive: N=3
  – Oophoritis: N=1

• Number of HIV positive cases: 13 (23%)
  – CD4+ T-lymphocyte counts were reviewed: N=6
  – 0% immunosuppressed cases based upon collected data
Previous Mumps Outbreaks in LA County

2010

- 11 cases - cultural-religious community
  - March - August
  - adolescent males
  - Vaccination clinics

2015

- 6 cases - sports-recreation venue
  - Feb – March
  - Five cases facility staff
  - 22 – 46 years old
  - Clinics for immunity testing and vaccination
What can you do as a public health practitioner as soon as you get home???

• Be prepared early!
  – Update your data collection instruments before an outbreak or case is identified in an unprecedented population
  – Collect social networking, venue and co-morbidity data no matter where you live and whether you have an MSM population or not. *This is NOT only an urban issue*
  – Fine tune and modify your tools as more risk factor information is learned through the outbreak

• Visit venues where high density congregation of individuals occurs to develop relationships before case development
What can you do as a public health practitioner as soon as you get home???

• Make a concentrated effort to collect specimens for testing and nucleotide sequencing – it will make your life easier in the long run!

• Make partnerships with medical providers that have not been traditional reporters but provide services to key sub-populations

• Utilize trusted community partners and established HIV/STI community relationships (e.g., city officials, HIV commissions, etc.)

• Recommend MMR as part of other existing disease outbreak interventions (piggy-back activities)
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