MUMPS & MEASLES: WHAT WE'VE LEARNED FROM RECENT OUTBREAKS

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LEARNING OBJECTIVES

By the end of this session, you should be able to:

- 1. Explain epidemiology and vaccinology of recent outbreaks of measles and mumps
- Identify effective public health intervention methods for dealing with outbreaks of theses diseases



IF VACCINES WORK, WHY ARE WE STILL HAVING OUTBREAKS?

CONTROLLING DISEASE OR AN OUTBREAK STARTS WITH SURVEILLANCE

- Surveillance of Vaccine Preventable Diseases (VPD's)
- Surveillance of complication rates
- Surveillance of vaccination rates
- Surveillance of school exemption rates

ROLE OF COMMUNICABLE DISEASE EPIDEMIOLOGY

DOH conducts statewide surveillance and investigation of more than 70 notifiable conditions

- Not all are 'communicable diseases' (e.g., blood lead levels)
- Collect, analyze, and disseminate information about notifiable conditions such as incidence of communicable diseases
- Educate and train public health and healthcare professionals on communicable disease prevention and control
- Plan for and respond to public health emergencies
- Provide data to support policy decisions

Support local public health with case and outbreak investigations

 35 local health jurisdictions, "Home rule", local health officer has legal responsibility and authority



ROLE OF VACCINATION

- Vaccination greatly reduces disease, disability, death and inequity worldwide.
- Vaccination has greatly reduced the burden of infectious diseases. Only clean water, also considered to be a basic human right, performs better.

http://www.who.int/bulletin/volumes/86/2/07-040089/en/

RECENT OUTBREAKS IN WASHINGTON STATE

Pertussis: 2012

Nearly 5000 cases

Measles: 2014-2015

• Disneyland outbreak, several Washington State outbreaks

Mumps: 2016-2017

Marshallese, school aged kids, and university students



Time to review R naught (R₀)

In epidemiology, the basic reproduction number of an infection can be thought of as the number of cases one case generates on average over the course of its infectious period, in an otherwise uninfected population.

■ For simple models and a 100%-effective vaccine, the proportion of the population that needs to be vaccinated to prevent sustained spread of the infection is given by 1 – 1/R₀.



RECENT OUTBREAKS

Pertussis $R_0 = 5.5$: 2012

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How Much of the population needs to be vaccinated to prevent the spread of Pertussis?

 Assuming a 100% effective vaccine
1-1/R₀ = Percent needed
1-1/5.5 = 0.82 OR 82% OF THE POPULATION!



WA State Pertussis Cases Reported by Month and Year with Projected Baseline and Epidemic Thresholds, 2007-2016 and 2017 (YTD)



^{*}Monthly data values from the 2012 epidemic period were not used to project the baseline and epidemic threshold



Pediatric Pertussis Cases by Age 2012



Pediatric Pertussis Cases by Age 2013



Pediatric Pertussis Cases by Age 2014



Cases per 100,000 population

Pediatric Pertussis Cases by Age 2015 YTD



RECENT OUTBREAKS

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Measles R₀ = 18: 2014-2015

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MEASLES $R_0 = 18$

The number of **people** that **one sick person** will infect (on average) is called R_0 . Here are the maximum R_0 values for a few viruses.



Measles is so contagious that "if one person has it, 90% of the people close to them <u>who are</u> <u>not immune</u> will get it."

HOW MUCH OF THE POPULATION NEEDS TO BE VACCINATED TO PREVENT THE SPREAD OF MEASLES?

- Assuming a 100% effective vaccine
- 1-1/R₀ = Percent needed
- 1-1/18 = 0.94 OR 94% OF THE POPULATION!

Measles cases Washington State 2015

County	Onset	Age	Immunization	Travel	Lab	Genotype
	Date		Status	History/Exposure	Confirmation?	
Grays Harbor #1	Jan 3	10-19	0 doses	Travel to Disneyland	Yes. PCR positive.	B3 Disneyland
Grays Harbor #2	Jan 13	10-19	0 doses	Household contact of Grays Harbor #1	Yes. PCR positive.	B3 Disneyland
Clallam #1	Jan 30	50-59	Unknown	<mark>Unknown</mark>	Yes. PCR positive.	D9
Clallam #2	Feb 11	5-9	0 doses	Present at clinic 1 hour after measles case left	Yes. PCR positive.	D9
Clallam #3	Feb 14	40-49	Unknown (IgG negative)	Community contact of Clallam #1	Yes. PCR positive.	D9
Clallam #4	Feb 19	10-19	0 doses	Household contact of Clallam #2	Epi-link to lab + case IgM positive.	D9 link. (No specimen for virus isolation)
Whatcom	Feb 24	30-39	Unknown (IgG negative)	Household visitor to CA PCR+ case.	Yes. PCR positive	B3 Disneyland
Clallam #5	Mar 4	40-49	MMR x 1 (1971)	Visited Clallam #4 during quarantine.	Epi-link to lab + case IgM positive.	D9 link. (No specimen for virus isolation)
Spokane #1	April 15	20-29	Unimmunized	Unknown	Yes. PCR positive	H1
Spokane #2	April 27	20-29	Unimmunized	Household contact of Spokane #1	Yes. PCR positive	H1
Clallam #6	No rash Expired Spring '15	Adult	Unknown	Present at clinic with measles case	Yes. PCR positive Histopathology	D9

Rate of Nonmedical Vaccine Exemptions By State

Percentage of kindergartners with nonmedical exemptions, 2012-13 school year



Mother Jones

Note: Children with exemptions may still be vaccinated. Source: Centers for Disease Control

Vaccine exemptions vary by county

Vaccine-exemption rates for Washington state kindergartners range widely by county, from a high of 22.3 percent in Ferry County to a low of 1 percent in Yakima County. In King County, 4.8 percent of kindergartners were exempt in 2013-2014; in Snohomish County, it was 6 percent.



GARLAND POTTS / THE SEATTLE TIMES

Exemption rates by county for incoming kindergartners 2013-2014

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Mumps R₀=4-7: 2016-2017

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2016-2017 Mumps Outbreak Washington Cases by county as of 8/9/2017

County	Number of cases						
Benton	6						
Ferry	3						
Grant	45						
King	312						
Kitsap	2						
Okanogan	3						
Pend Oreille	3						
Pierce	62						
Skagit	17						
Snohomish	87						
Spokane	333						
Stevens	1						
Thurston	6						
Whatcom	4						
Yakima	5						
Total	889						





Mumps outbreak cases by outbreak name and date of symptom onset December 2016 – August 2017





Mumps in Washington, 1920 – August 9, 2017





Mumps does not appear to be equitable...





Onset date

Vaccination status of cases

October 2016 – August 2017

Category	Total number of cases	Cases with unknown vaccination status	Cases with vaccine information available	Number with 2+ doses	Number with 1 dose	Number with 0 doses	Total number UTD*	% of cases with available vaccine information UTD
School-aged (5-19 years)	516	35 (7%)	481 (93%)	438	27	16	438	91%
School-aged Marshallese (5-19 years)	304	29 (10%)	275 (90%)	255	12	8	255	93%
Marshallese	465	125 (27%)	340 (73%)	268	32	40	288	85%
Entire outbreak	889	229 (26%)	660 (74%)	510	82	68	574	87%



MMR Vaccine has Reduced Severity of Symptoms

Complications	Unvaccinated (%)*	Vaccine era (%)†
Orchitis‡	up to 30%	3-11
Mastitis‡	up to 30%	≤1
Hearing loss	4	≤1
Pancreatitis	4	≤0.1
Aseptic meningitis	1-15	0.2-0.5
Encephalitis	0.03-0.5	0-0.3
Hospitalizations	5.5	<1-2

*McLean HQ et al. MMWR 2013; †Data from US outbreak investigations 2006-2015; ‡Assessed in postpubertal male/female patients

Complication rates and vaccination status among 840 confirmed and probable Washington State mumps cases related to a multistate outbreak, October 30, 2016 – August 31, 2017

Complication	Number of	Rate per	Rate per 1,000	Cases (%) with vaccine	Number of doses			Number (%) with	Number (%) with	
reported	complication	1,000 cases	postpubertal cases	information available	2+	1	0	who are UTD†	and evidence of immunity ^{††}	
Orchitis*	26	65.5	85.2	14 (54%)	10	0	4	10 (71%)	16 (62%)	
Oophoritis**	1	2.3	2.7	1 (100%)	0	1	0	1 (100%)	1 (100%)	
Hearing loss	10	11.9		9 (90%)	9	0	0	9 (100%)	9 (90%)	
Mastitis	5	6.0		2 (40%)	2	0	0	2 (100%)	2 (40%)	
Meningitis	2	2.4		1 (50%)	1	0	0	1 (100%)	1 (50%)	
Encephalitis	1	1.2		0 (0%)	-	-	-	-	0 (0%)	
Hospitalized	4	4.8		2 (50%)	2	0	0	2 (100%)	3 (75%)	

* Among cases (n=397) and postpubertal (≥11) cases (n=305) with reported male sex

** Among cases (n=433) and postpubertal (≥10) cases (n=371) with reported female sex

+ UTD (up to date): 2 doses of MMR for children (5-19), 1 dose for children ages 1-5, 1 dose for adults (20+), and excludes those with unknown immunization status

⁺⁺ Evidence of immunity: documentation of adequate vaccination (UTD), lab evidence of immunity prior to onset (n=0), birth before 1957, or documentation of physician-diagnosed mumps



Orchitis rates among unvaccinated vs. vaccinated males with mumps in Washington State

October 2016 – August 2017

	Unvaccinated			v	accinated±		Unknown vaccination status			
Confirmed and probable mumps outbreak cases (n=889)	Total cases	No. of cases	Cases reporting orchitis	Rate per 1,000 cases	No. of cases	Cases reporting orchitis	Rate per 1,000 cases	No. of cases	Cases reporting orchitis	Rate per 1,000 cases
Male cases	417	31	4	129.0	286**	11	38.5	100	12	120.0
Postpubertal males*	324	24	4	166.7	205***	10	48.8	95	12	126.3

* Age 11 and over

± Documentation of one or more doses of mumps-containing vaccine

** Includes 251 cases with 2 doses, 35 cases with 1 dose

***Includes 181 cases with 2 doses, 24 cases with 1 dose



Exclusion as a contact management strategy for controlling the spread of mumps in WA

- Exclusion, as a surveillance strategy for controlling the spread of mumps, is discussed in of the <u>WA DOH Mumps Surveillance</u> <u>Guideline</u> (Section 6. C. 2.)
- Follows CDC recommendations
- "Susceptible asymptomatic contacts other than health care workers should be excluded from school, workplace, and child care from the 12th day after the first exposure through 25 days after the last exposure."
- WA's first outbreak with a majority of cases in highly vaccinated persons
- This experience has lead to questions about the appropriateness and feasibility of current mumps exclusion recommendations, since the outbreak continued in these settings after exclusion was implemented – sometimes for many incubation periods.
- Should the mumps strategy be more like that used for pertussis?

Summary

Outbreaks continue to occur due to:

- Waning immunity to certain recent vaccines
- Low vaccination rates for diseases with high R₀
- Unequal/Intimate exposure opportunities

 Disease complications appear to be lessened by vaccination status

 Vaccination rates tell only part of the disease control story......