

# Measles: It's a Small World After All

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# Measles Outbreaks Around the World

- **China** is reporting > 50,000 suspect and confirmed measles cases in 2015
- **Germany** has reported > 950 cases of measles in 2015. One child has died
- **Kyrgyzstan** is experiencing an ongoing measles outbreak with > 7,400 measles cases . Two children have died.
- **Ethiopia** is experiencing an ongoing measles outbreak with > 14,000 confirmed cases in 2014; cases continue to occur in 2015.
- **Angola** is experiencing an ongoing measles outbreak. With > 12,036 in 2014; cases continue to occur in 2015.
- **The Federation of Bosnia and Herzegovina** has reported > 3,800 measles cases since January 2014
- **Vietnam** > 18,597 suspected measles cases, including 6,498 confirmed cases, and no deaths during 2014
- **Philippines** > 58,010 suspected cases of measles, including 21,420 confirmed cases and 110 deaths during 2014

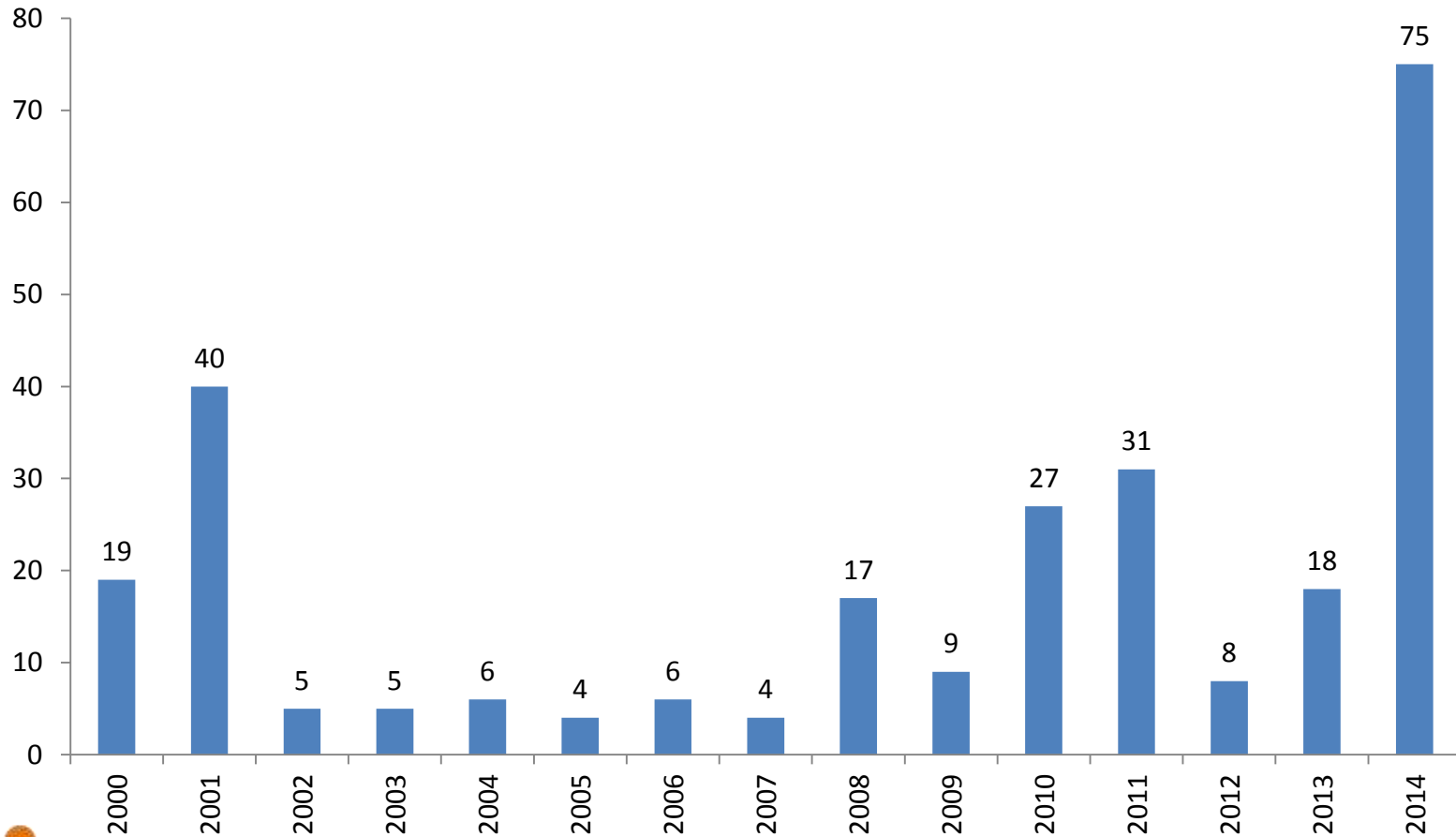
# Risk of Measles Importations Ongoing

- Since measles is still endemic in all countries outside of North and South America, the US is at continued risk of imported measles cases from foreign tourists and US travelers returning from abroad
- In 2014, there were 30 million travelers to the US from other countries other than Canada or Mexico; 7 million of these travelers visited California
- In 2014, 30 million US citizens traveled outside of the US, Canada or Mexico

Data Sources:

<http://industry.visitcalifornia.com/find-research/california-statistics-trends/>  
<http://travel.trade.gov/view/m-2014-O-001/index.html>

# Confirmed Measles Cases, California 2000 - 2014



# Identifying the Outbreak

- January 5<sup>th</sup>, CDPH was notified of a suspect measles case in an unvaccinated 11 yo whose only notable travel was to Disneyland
- On the same day CDPH was notified of two measles suspects from Utah, and four additional suspect cases with travel to Disneyland or California Adventure Park during their exposure period
- By January 7<sup>th</sup>, 7 cases had been confirmed and CDPH initiated notifications to other states

# Measles Associated with a Theme Park

- Disneyland and the adjacent California Adventure Park have over 24 million visitors annually, many from international destinations where measles is endemic
- This is not the first time Disneyland has been implicated as an exposure venue for measles. Report from 1982:

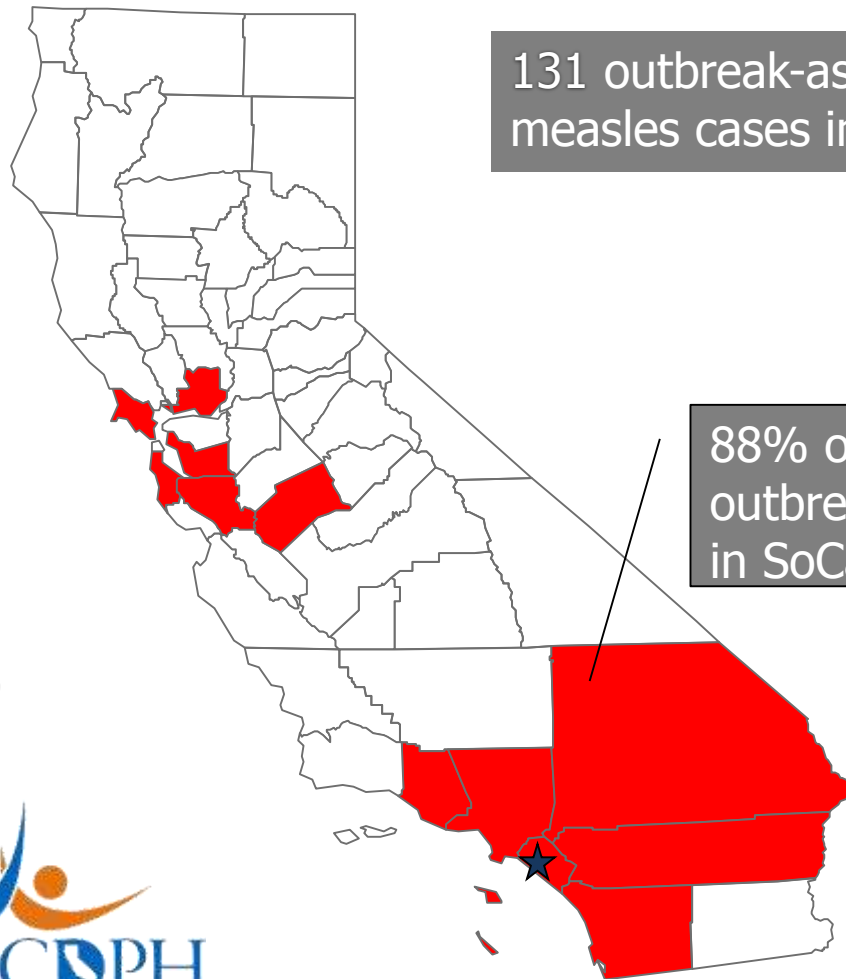
## Measles outbreak linked to Disneyland

ANAHEIM, Calif. (AP)—Public health officials say at least 34 cases of measles in California, Arizona, Oregon and Texas have been traced to 20 children who visited Disneyland on Aug. 17 or 18.

The 20 children transmitted the

disease to 14 other people, and there may be additional unreported cases, according to Russ Charter of the California Department of Health Services. He said the disease may spread now that school has opened.

# California Measles Cases, December 2014 – April 17th, 2015



Outside of CA:

AZ 7

UT 3

NE 2

WA 2

CO 1

OR 1

Mexico 1

Canada 159



# Implementation of Control Measures

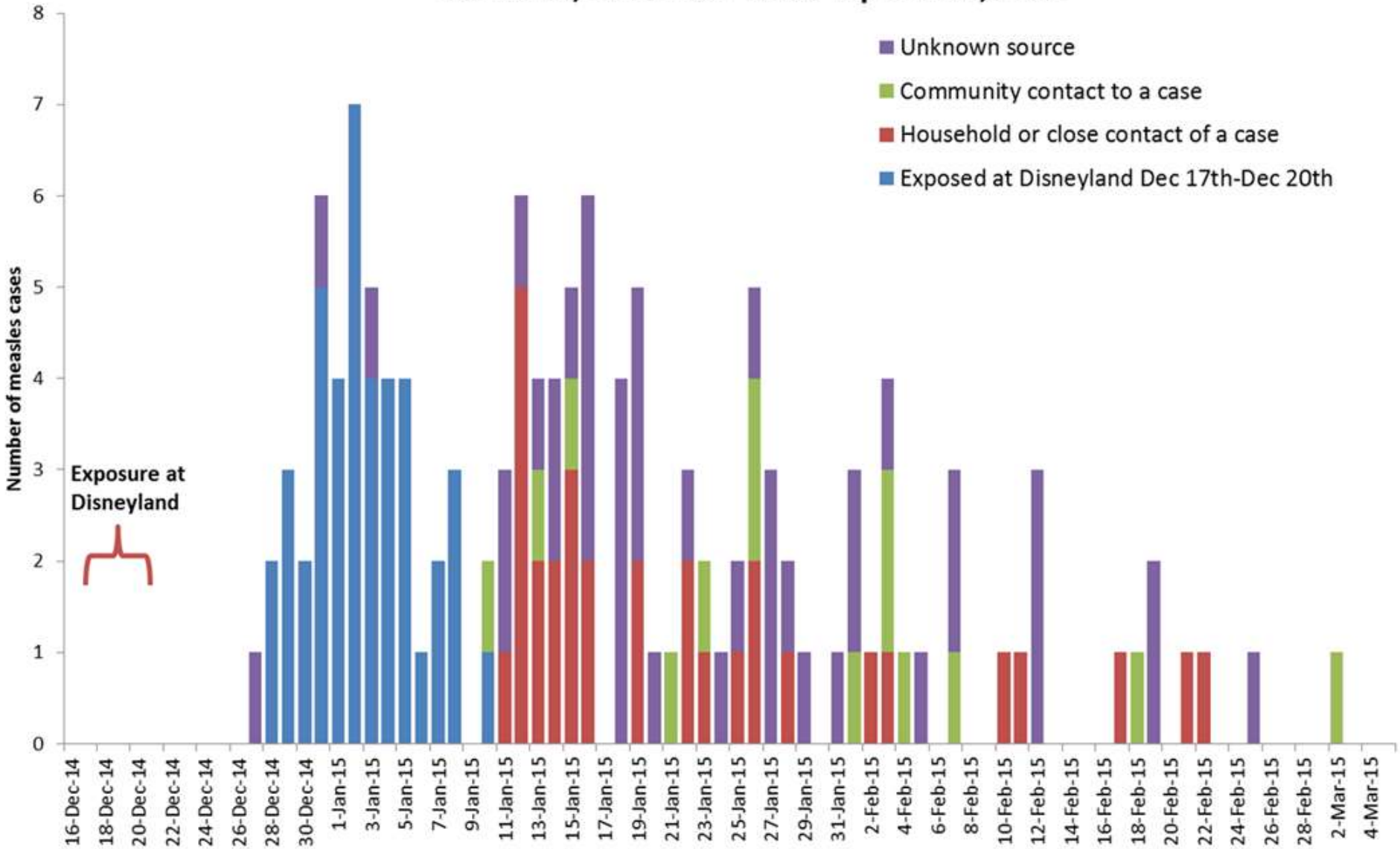
- Prompt identification and isolation of cases
- Prompt identification of contacts and assessment of immune status
  - In addition to CDC presumptions of immunity (birth <1957, documentation of two doses of measles-containing vaccine or serologic evidence of immunity) CDPH has additional criteria:
    - Served in the U.S. armed forces; or
    - Born in the U.S. in  $\geq 1970$  and attended a U.S. elementary school; or
    - Entered the U.S.  $\geq 1996$  with an immigrant visa or have a green card
- Postexposure prophylaxis for high-risk susceptibles
  - MMR vaccine if <72 hours of exposure
  - IGIM for those <66 pounds  $\leq 6$  days of exposure
  - IGIV for pregnant women/severely immunocompromised  $\leq 6$  days
- Quarantine of susceptibles who don't receive PEP



# Measles Testing


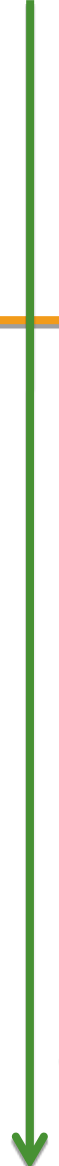

- PCR testing for measles was the primary diagnostic tool in this outbreak
  - Viral and Rickettsial Disease Laboratory (VRDL) and 17 local public health laboratories offer PCR testing
- VRDL performed > 1500 PCR tests; local public health laboratories performed > 900 PCR tests
- VRDL performed genotyping
  - **73 genotype B3**
  - Other genotypes that occurred during the outbreak (but not associated): D4 (1), D8 (2), H1 (2), A (31)

# Confirmed Measles Cases\* by Rash Onset Date and Transmission Setting, California, December 2014 - April 17th, 2015



\*Outbreak declared over on 4/17/2015

# Transmission Setting/Source



<b>Transmission setting</b>	<b>Cases</b>	<b>Percent</b>
Disney primary case - Visited Disney from December 17th - December 20th	42	32%
Household or close contact of a confirmed case	31	24%
Community setting where confirmed case was known to be present*	14	11%
Unknown	44	34%

# Among the 14 'Community' Transmission Events

- 11 (8%) cases were exposed in a healthcare setting; three were healthcare workers exposed at work
  - ED: 7
  - Urgent care: 3
  - Hospital inpatient unit: 1
- 3 (2%) were exposed in a mall

# Vaccination Status

	Total*	Percent
<b>Unvaccinated</b>	57	70%
<b>Vaccinated</b>		
1 dose	10	12%
2 doses	13	16%
3 doses	2	2%
*49 cases have unknown or unverified vaccination status		

- 82 patients had immunization status verified
- The majority of these are unvaccinated
- Majority of unvaccinated were unvaccinated due to personal beliefs

One dose of MMR vaccine is 92% effective at preventing measles  
Two doses of MMR vaccine are 97% effective at preventing measles



# Measles in Vaccinated People?

**930** have received two doses of MMR vaccine

*2 doses MMR vaccine  
97% effective*

**1000** people exposed to measles

**70** are unvaccinated

90% attack rate among susceptibles

**25** vaccinated cases

**63** unvaccinated cases

25/88 or **28%** of cases are vaccinated

# Age Distribution and Hospitalization Status

Age (years)	Total	Incidence per 100,000	
		population*	Percent
<1	14	2.67	11%
1-4	21	1.05	16%
5-19	24	0.31	18%
20-29	30	0.54	23%
30-39	21	0.40	16%
40-49	10	0.19	8%
50-59	9	0.18	7%
60-69	1	0.03	1%
70+	1	0.03	1%

\*Population denominator data from the Department of Finance have been standardized with 2010 Census data

- Majority of cases are in adults
- Higher incidence among < 1 yo
- % hospitalized is lower than in typical years

	Total*	Percent
<b>Hospitalized</b>	21	20%
<b>Not hospitalized</b>	84	80%
*26 have missing hospitalization data		



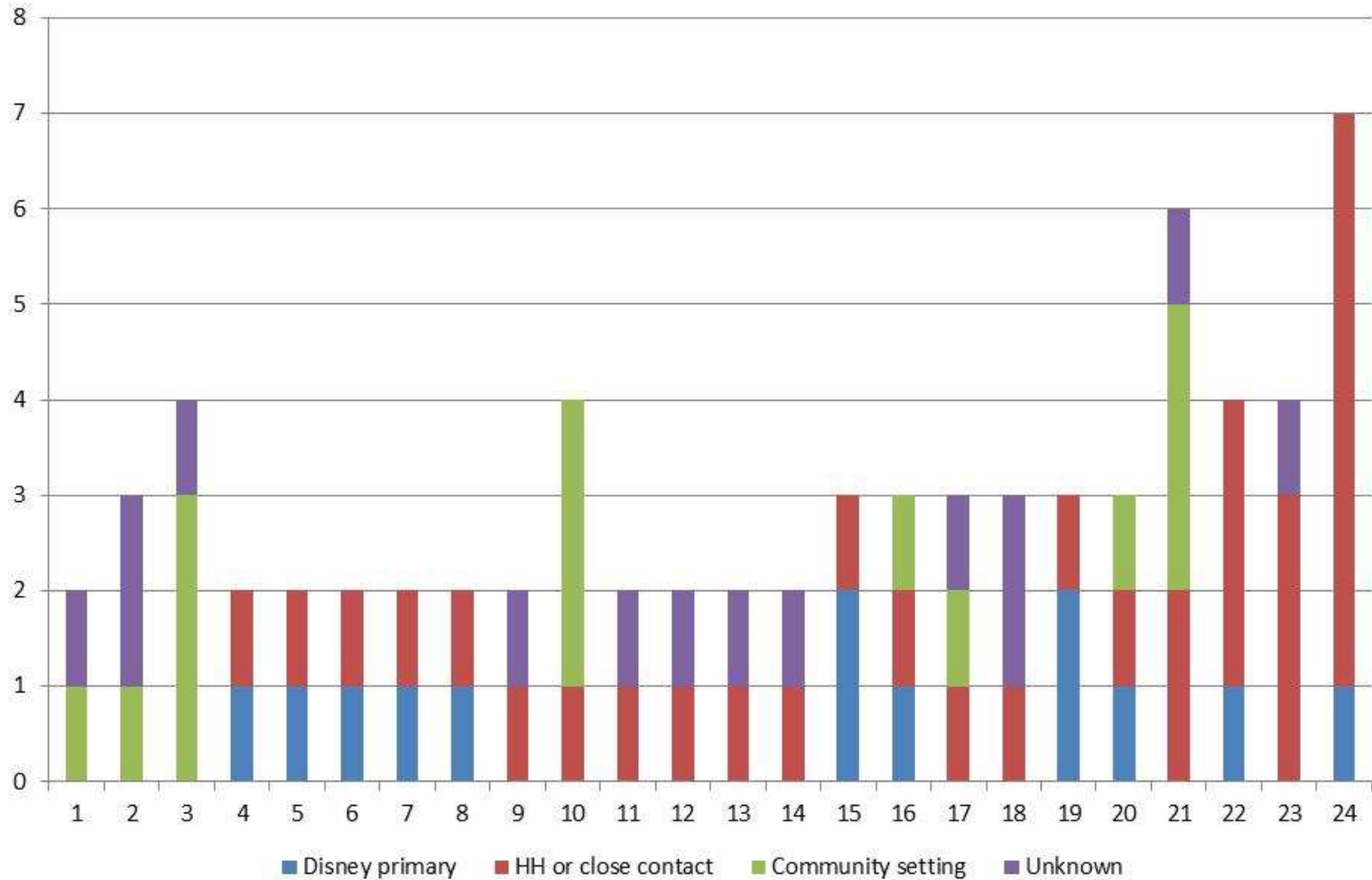
# Vignettes of Severe Measles Cases

- Case #1: An adult collapsed at home and was admitted due to severe pneumonia
  - Intubated and ventilated
  - Multiple organ injury; renal dialysis
  - Extubated during third week of hospitalization
  - Required physical and occupational therapy
  - Discharged home after four weeks on oxygen and using a wheel chair for mobility
  - Required long period of convalescence

# Vignettes of Severe Measles Cases

- Case #2: An adult on high dose steroids was admitted with bilateral pneumonia and subsequently diagnosed with measles
  - Developed acute respiratory distress syndrome and was intubated
  - Remained in respiratory failure for several days and was treated with IV ribavirin on an IND protocol
  - Discharged at day 15 into a rehabilitation program; required a long period of convalescence at home

# Measles Transmission in Clusters with $\geq 2$ Cases



# Measles Clusters, cont.

- 24 clusters (possibly more as we receive more complete data)
- 21/24 clusters have transmission between household or close contacts
- 7/24 clusters involved healthcare settings
  - 11 cases associated with healthcare settings so some healthcare exposures resulted in > 1 transmission event

# Lessons Learned from Investigating Healthcare Exposures

- Nine measles cases in healthcare personnel in 2014 and 2015 (including but not limited to the Disney outbreak cases)
- Exposures include:
  - Six HCP provided direct patient care or had face to face contact with a patient infectious with measles
  - The remaining had no contact (1), unknown if there was contact (1), entered a room that a measles case had been in (1)
- Vaccination status:
  - Appropriate vaccination (4), IgG positivity (2), Unknown status (3)

# Costs of Measles Investigations in a Healthcare Setting

- 2008 – Tucson AZ outbreak with 14 cases
  - Source case had travel to Switzerland and presented to ED twice and was admitted to the hospital and isolated on day 2 of hospitalization
  - 13 additional cases; 7 of which were healthcare associated
  - 2 hospitals spent \$799,136 responding to 7 healthcare-associated cases; 56% of the cost was due to HCP furloughs due to lack of evidence of immunity
- 2013 – 1 measles case in ambulatory care clinic
  - Exposure to 53 patients, 60 parents, and 10 employees
  - Overall clinic costs were \$5655

\*Chen et al. J Infect Dis. 2011 Jun 1;203(11), Wendorf et al. Pediatr Infect Dis J. 2015;34(6).

# Lessons Learned from Investigating Healthcare Exposures

- Rapid identification and isolation of measles cases very important!
- Healthcare personnel should have acceptable evidence of measles immunity
  - It is not recommended to test for measles IgG in personnel with two documented MMR
- Healthcare personnel who have been exposed to measles should self-monitor for symptoms even if they have acceptable evidence of immunity
  - Symptoms may be modified in patients with a history of vaccination
- Healthcare personnel providing direct patient care should wear an N95 respirator regardless of whether they have acceptable evidence of measles immunity



# ATTENTION: YOU COULD HAVE MEASLES.

If you have:



a fever

+



a rash

+



traveled overseas  
in the last 3 weeks

## Tell Staff and Get a Mask.

### Protect Yourself and Others Now!

Measles is very contagious and is widespread in many parts of the world.

# Measles NICU Exposure

An adult who was epidemiologically linked to the measles outbreak visited multiple hospital wards, including a neonatal intensive care unit (NICU), while infectious with measles. A large contact investigation was initiated involving:

- 98 neonates (44 of whom were exposed in the NICU); 70 neonates received IGIM post-exposure prophylaxis (PEP)
- 14 pregnant women, 4 of whom received IGIV PEP
- 237 hospital employees, 8 of whom were not immune to measles and were furloughed from work through the incubation period

# Measles NICU Exposure: Recommendations

- Active monitoring of all neonates
- Biweekly screening of infants with high risk exposures to the case by measles PCR
- Cohorting and isolation of exposed neonates
- Log and symptom check for all visitors to NICU and labor and delivery wards
- Monitoring and symptom checks for all staff who were potentially exposed and continuing to work; work exclusion for any staff not able to document immunity to measles (either 2 MMR or IgG)

**No transmission occurred**

# Outbreak Successes

- Prompt identification of outbreak and notification of local health jurisdictions and providers
- Excellent work by local health departments in case and contact investigations
  - Follow-up on thousands of contacts
- Laboratory capacity
  - Quick turnaround times led to timely intervention
- Communications
  - Health advisories directed toward providers
  - Statewide calls with local health departments
  - Publicly available data and regular press releases
- Outbreak was declared over on April 17<sup>th</sup>

# Outbreak Challenges

- Surge capacity in local health jurisdictions
  - Dedicated staff worked evenings and weekends
- Prioritization of large contact investigations in the setting of an outbreak; one case may have hundreds of contacts
- Inability to rapidly determine immune status of exposed people; IgG immunity testing takes time and resources
- Recently vaccinated persons with febrile rash illness – in the setting of an outbreak, can't assume due to MMR
- Logistics of testing can be complicated

# Satellite Testing Site in Orange County

- 35 (27%) of cases occurred in Orange County where Disneyland is located
- Outdoor clinic under canopy
  - One medical assistant
  - One office technician
- Specimen collection
  - Suspect cases who had already been assessed by a healthcare provider
  - Exposed persons



# Outbreak Challenges, cont.

- Providers initially missed cases; first identified cases originally diagnosed with Kawasaki Disease
- Determining which exposed “immunocompromised” people needed IVIG; ACIP guidance insufficient, treatment expensive and timeliness critical
- Many exposed healthcare personnel had no record of measles immunity; assessing immunity after exposure took time and resources



# Final Thoughts

- How to best balance resources used for contact investigations with the possibility of additional measles cases in a setting of high population immunity?
- Can we better understand what factors enhance measles transmission?
  - Are infants less likely to transmit measles than older persons (as in TB)?
  - Are there “super spreaders”?
  - Are some types of exposures more likely to lead to transmission than others, e.g., host and venue factors?
  - Are some genotypes more transmissible than others?
- How effective is postexposure prophylaxis? (no recent studies)

# Measles Resources

(Check with your state for local resources)

- Keep up with U.S. measles cases and outbreaks:

<http://www.cdc.gov/measles/cases-outbreaks.html>

- California Measles Investigation Quicksheet:

<http://www.cdph.ca.gov/programs/immunize/Documents/CDPHMeaslesInvestigationQuicksheet.pdf>

- California Measles Laboratory Testing Quicksheet:

<http://www.cdph.ca.gov/HealthInfo/discond/Documents/CDPHMeaslesLabTesting2011-01.pdf>

- Browse all of California's measles resources at:

<http://www.cdph.ca.gov/HealthInfo/discond/Pages/Measles.aspx>



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