CALIFORNIA MEASLES AND PERTUSSIS EPIDEMICS

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DISCLOSURE STATEMENT

- **I have no relevant financial relationships with any commercial supporters.**

- **Unlabeled/Investigational products and/or services will *not* be mentioned in this talk.**

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MEASLES

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MEASLES - BASICS

- Rash illness, historically childhood infection with 2-4 year epidemic cycle; most cases in winter and spring
- Complications may include otitis media, pneumonia, encephalitis, miscarriage, and death
- Airborne spread - probably the most infectious communicable disease; R_0 =15-18
- Two doses of MMR vaccine offer >99% protection from disease; however, requires very high population immunity to interrupt transmission (92-95%)
- No endemic transmission in the U.S. at this time – declared eliminated in 2000

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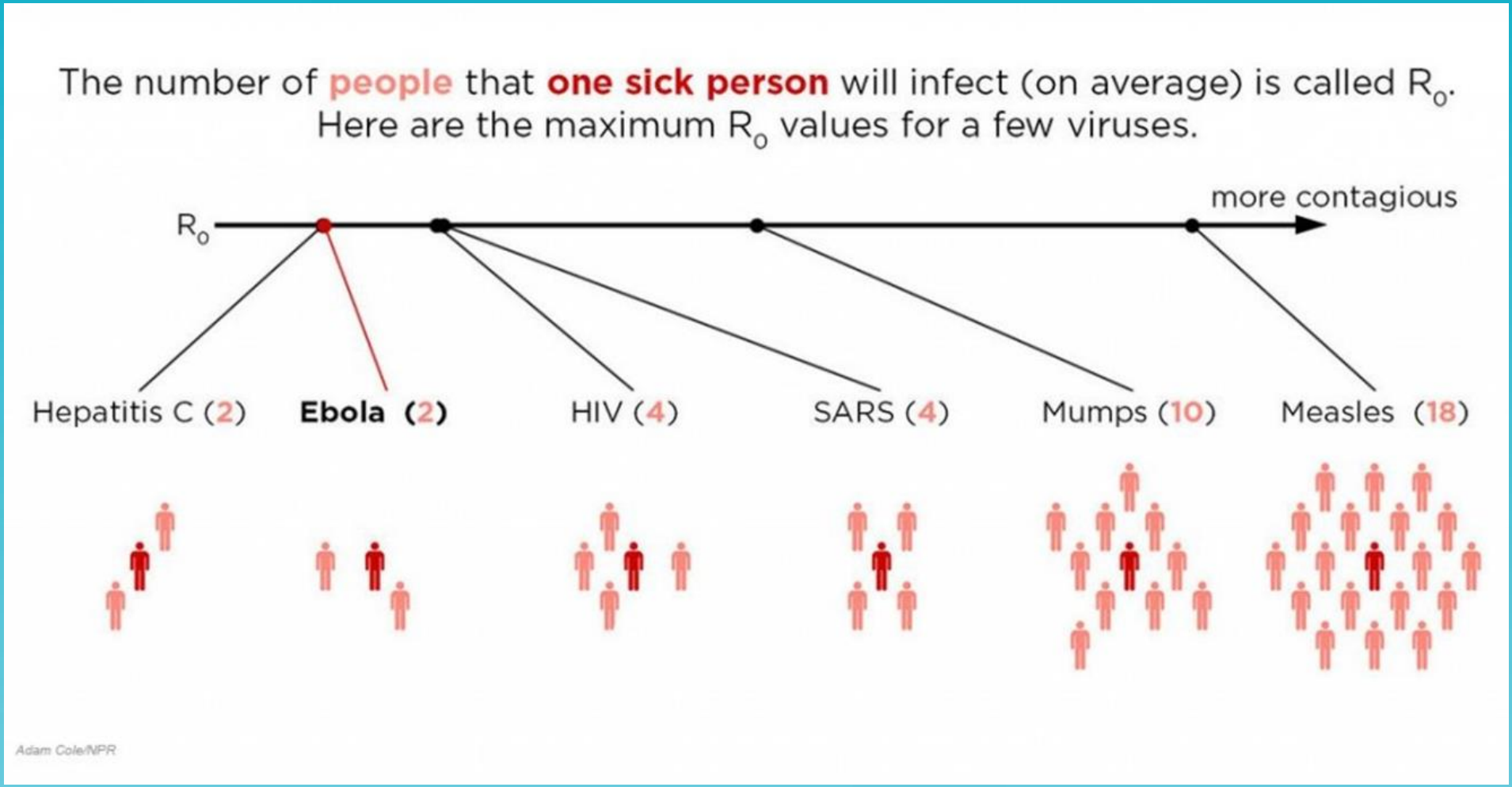
COMMUNICABILITY



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MEASLES IN THE PREVACCINE ERA – UNITED STATES, 1950S

Annually:

- **3-4 million cases**
  - **~ 500,000 reported cases**
- **Severe complications**
  - **4,000 encephalitis cases**
  - **150,000 respiratory complications (pneumonia)**
- **48,000 hospitalizations**
- **450 deaths**

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MEASLES IN CALIFORNIA

- Before widespread immunization for measles, there were ~14-30 measles deaths per year in California, most in infants and young children
- First measles vaccine in U.S. was licensed in 1963
- By 1966, ~24% of California children <10 years of age had been vaccinated
- Intensive vaccination campaigns occurred in 1966-1967
- School law in 1968
  - Measles vaccine needed for kindergarten entry

TABLE 1.—*Measles Cases and Case Rates**
California, 1966-1969

Year	*Cases*	*Case Rate*
1966	15,257	79.5
1967	5,271	27.1
1968	1,464	7.4
1969	916	4.6

*Rates are per 100,000 population

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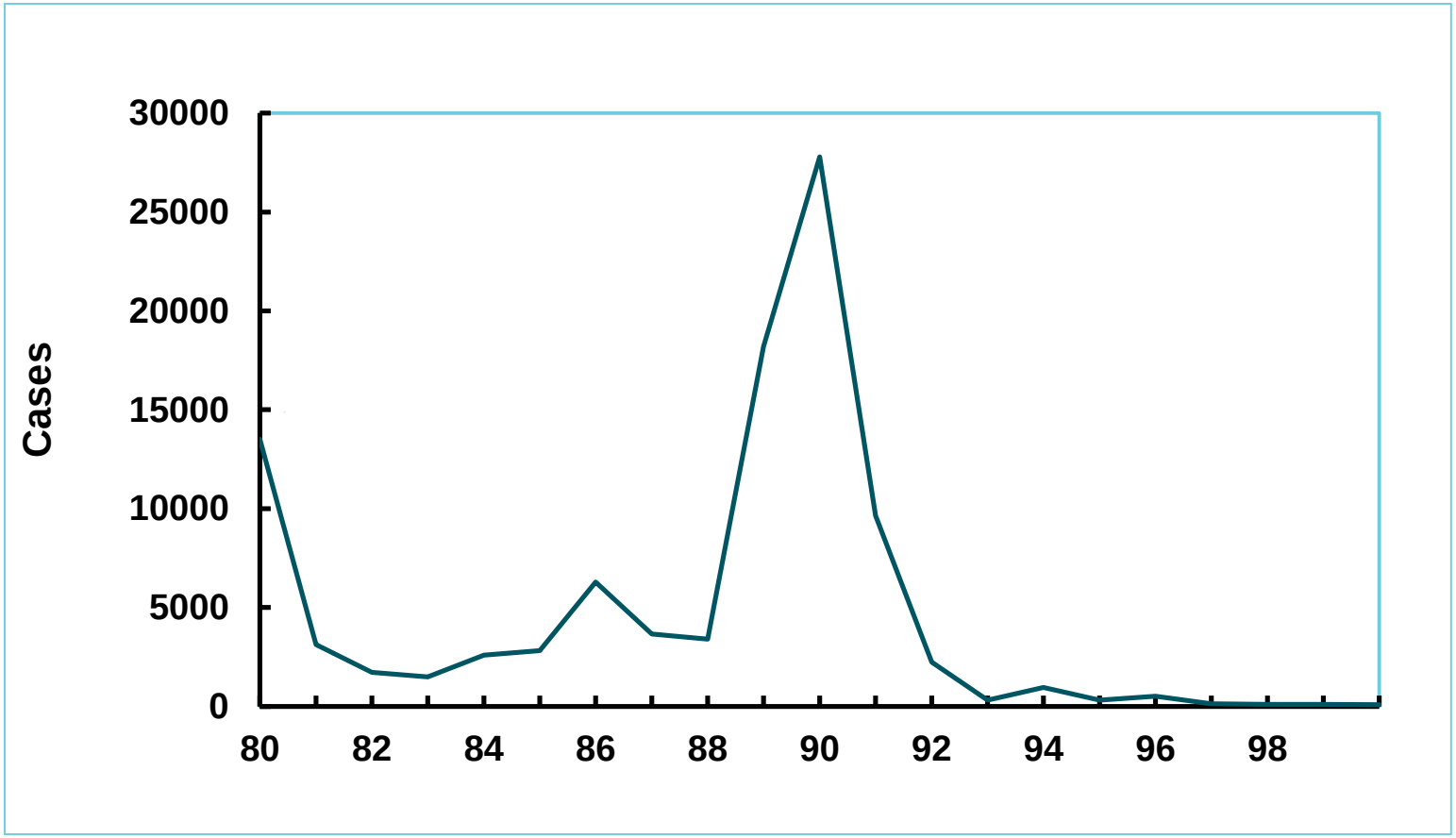
MEASLES IN THE POSTVACCINE ERA – UNITED STATES, 1980 - 2000



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MEASLES RESURGENCE UNITED STATES, 1989-1991

Cases	US 55,622 CA 18,000
Age group affected	Children <5 years
Hospitalizations	>11,000 CA 3,500
Deaths	123 CA 70
Direct medical costs	>$150 million

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MEASLES – UNITED STATES 1993-2007

- Record low annual total in 2004 (37 total cases)
- Introduction of 2nd dose of vaccine in 1989 and Federal "Vaccines for Children" program in 1993
  - 2000: "Measles is no longer endemic in the United States"
- Many cases among adults
- Most cases imported or linked to importation
- Elimination of endemic measles in North and South America was achieved in 2002

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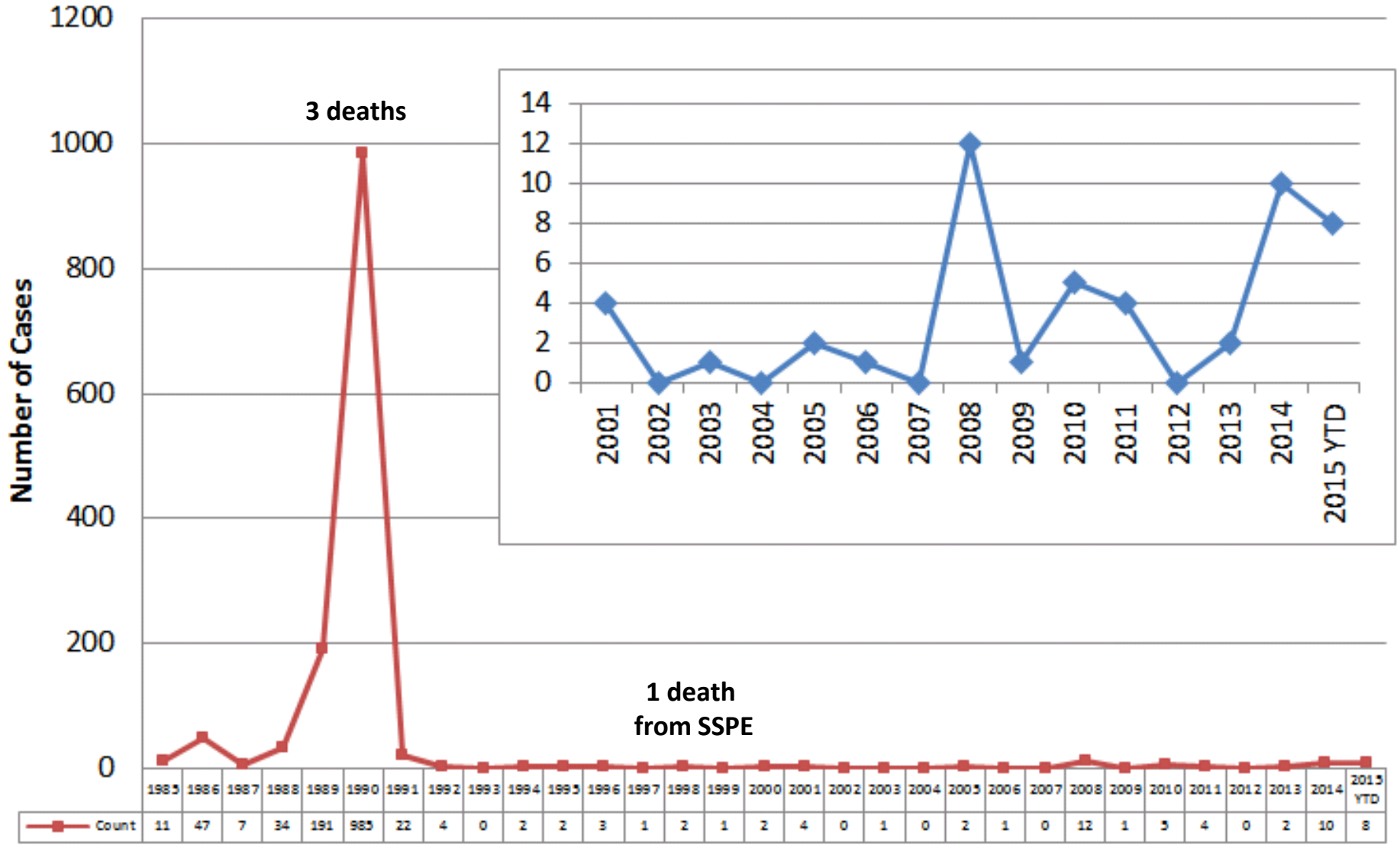
REPORTED CASES OF MEASLES
SAN DIEGO COUNTY, 1985 – AUGUST, 2015



	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015 YTD
Count	11	47	7	34	191	985	22	4	0	2	2	3	1	2	1	2	4	0	1	0	2	1	0	12	1	5	4	0	2	10	8

1990

Data Source: HHSA Immunizations Program
Data through March 31, 2015

MEASLES - EPIDEMIOLOGY

- **"Where have you been?" Most U.S. measles cases are related to international travel or contact with ill travelers**
- **Measles is endemic in Europe with large outbreaks since 2010: >15,000 cases in France in 2011, >11,000 in Ukraine in 2012, >12,000 in EU in 2013, >5,000 in Ukraine in 2014**
- **Ongoing transmission in India, the Philippines (47,000 cases, 77 deaths in 2014) and Ethiopia, among other countries – See CDC Travel Alerts**
- **145,700 deaths from measles were reported in 2013 globally; >95% of measles-related deaths were reported from countries with weak health infrastructure**

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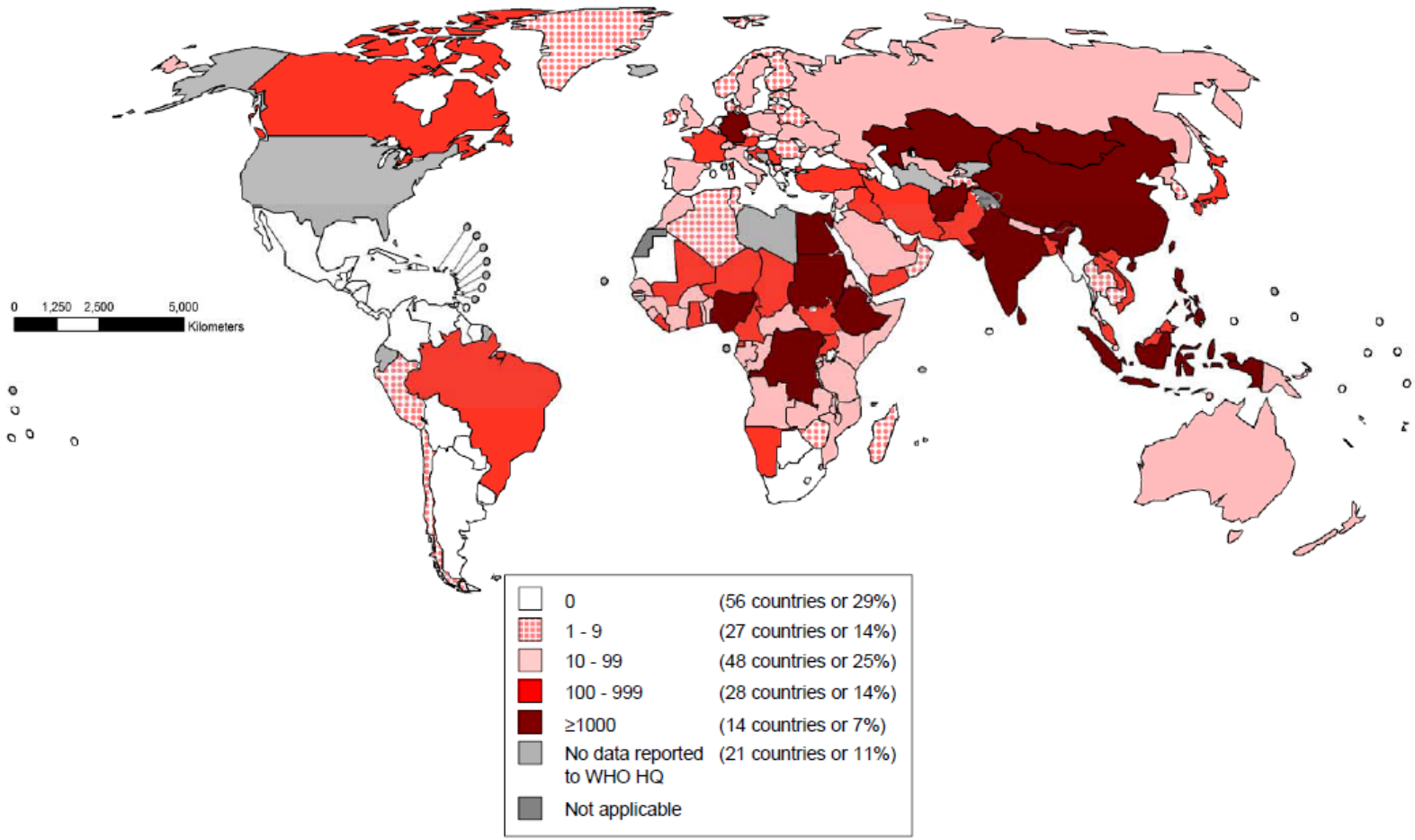
Number of Reported Measles Cases with onset date from Feb 2015 to Jul 2015 (6M period)



Data source: surveillance DEF file
Data in HQ as of 7 September 2015

WHO

Downloaded September 15, 2015
Data Source: WHO HQ as of September 7, 2015
http://www.who.int/immunization/monitoring_surveillance/burden/vpd/surveillance_type/active/big_measlesreportedcases6months_PDF.pdf

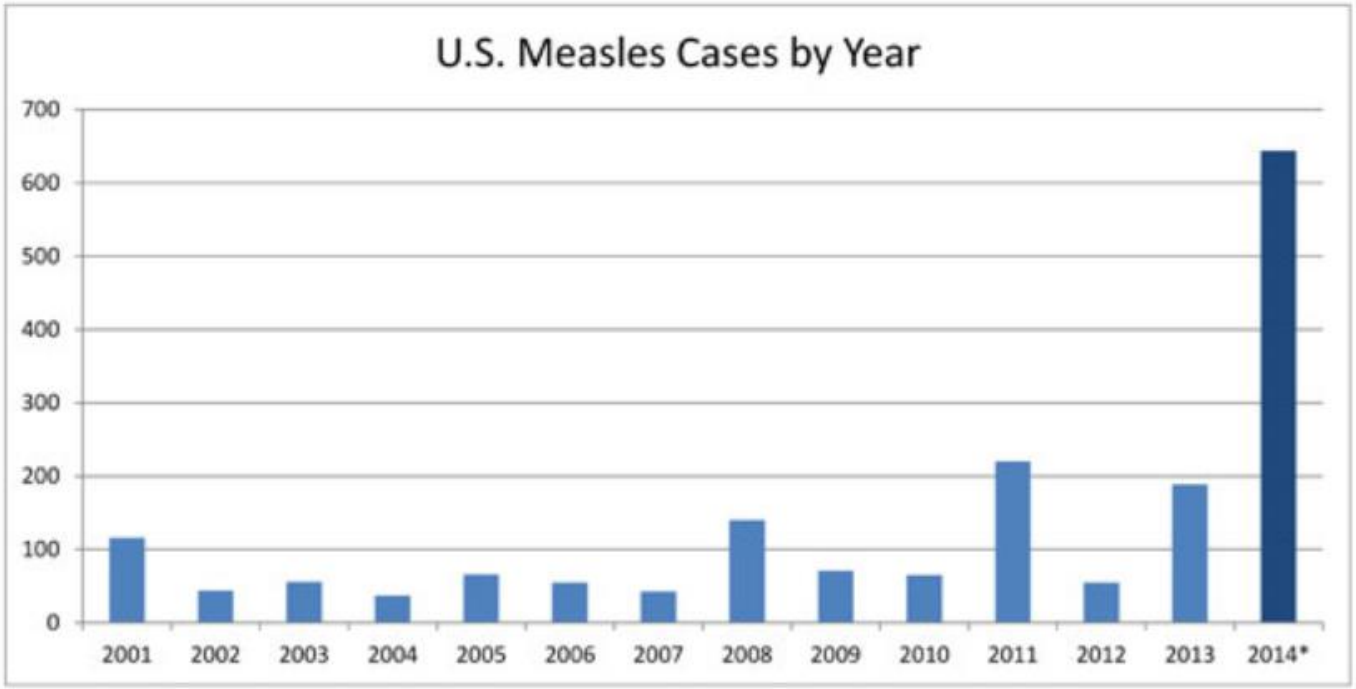
2014 U.S. Measles Cases and Outbreaks

644
Cases

reported in 27 states: Alabama, California, Colorado, Connecticut, Hawaii, Illinois, Indiana, Kansas, Massachusetts, Michigan, Minnesota, Missouri, Nebraska, New Jersey, New Mexico, New York, North Carolina, Ohio, Oregon, Pennsylvania, South Dakota, Tennessee, Texas, Utah, Virginia, Washington, Wisconsin

23
Outbreaks

representing 89% of reported cases this year



*Provisional data reported to CDC's National Center for Immunization and Respiratory Diseases

Downloaded January 14, 2015
Data Source: CDC as of January 1, 2015
http://www.cdc.gov/measles/cases-outbreaks.html

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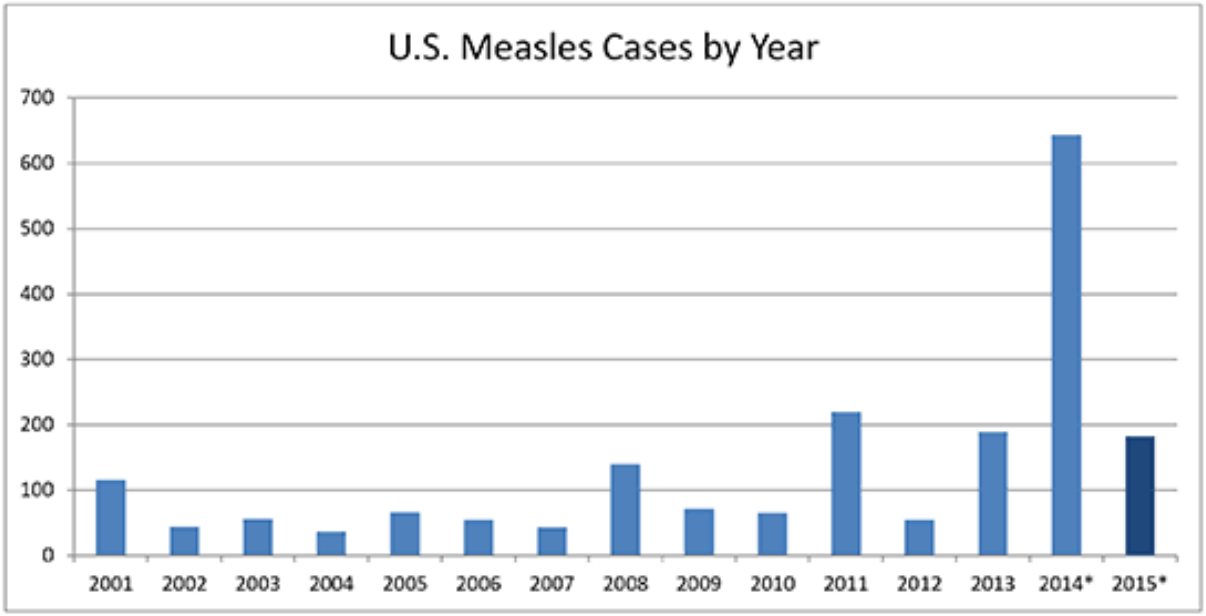
2015 U.S. Measles Cases and Outbreaks

188
Cases

reported in 24 states and the District of Columbia: Alaska, Arizona, California, Colorado, Delaware, Florida, Georgia, Illinois, Massachusetts, Michigan, Minnesota, Missouri, Nebraska, New Jersey, New York, Nevada, Ohio, Oklahoma, Pennsylvania, South Dakota, Texas, Utah, Virginia, Washington

5
Outbreaks

representing 81% of reported cases this year



*Provisional data reported to CDC's National Center for Immunization and Respiratory Diseases

Downloaded September 15, 2015
Data Source: CDC as of August 21, 2015
http://www.cdc.gov/measles/cases-outbreaks.html

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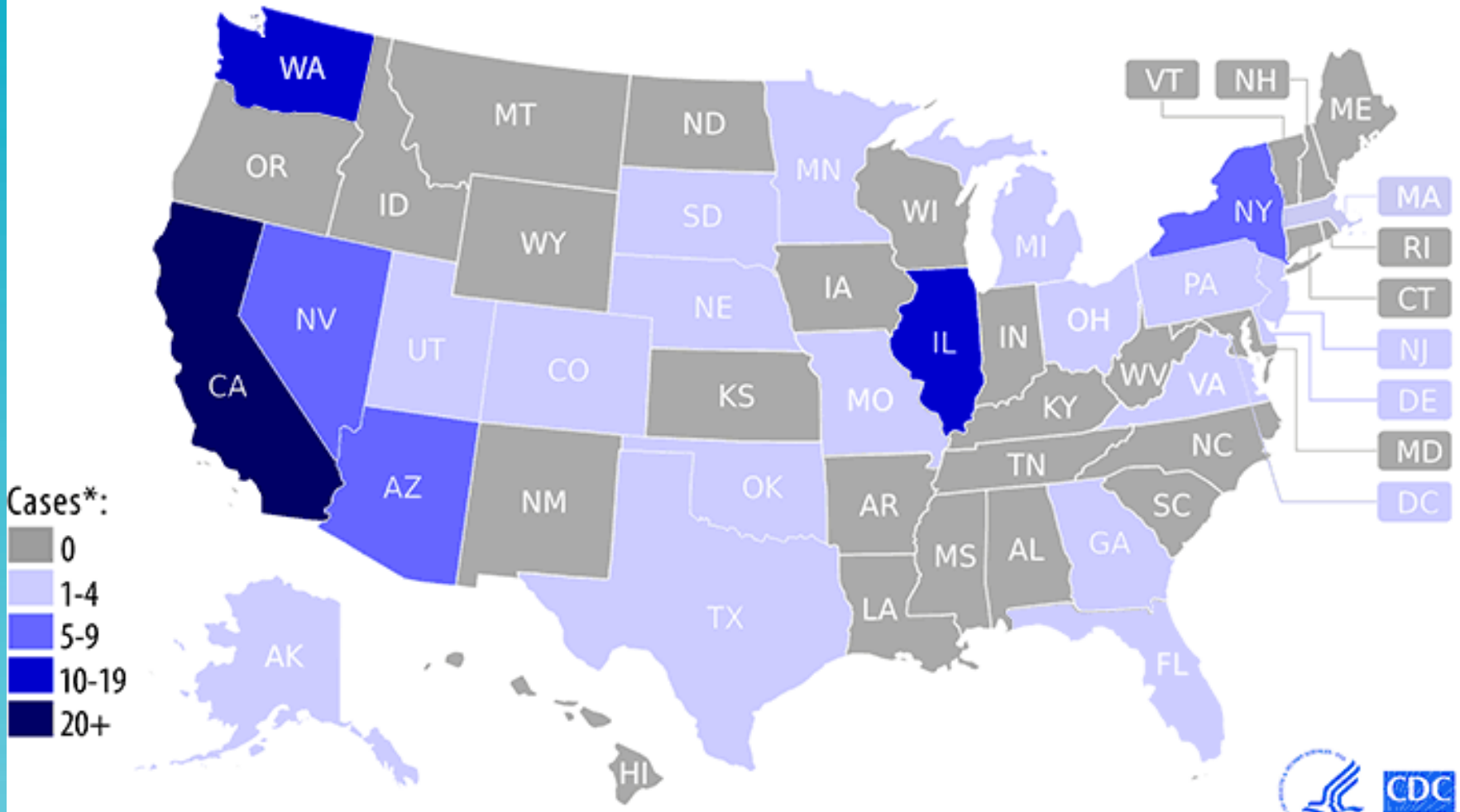
2015 Measles Cases in the U.S.

January 1 to August 21, 2015



*Provisional data reported to CDC's National Center for Immunization and Respiratory Diseases

Downloaded September 15, 2015
Data Source: CDC as of August 21, 2015
http://www.cdc.gov/measles/cases-outbreaks.html

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MEASLES CLINICAL FEATURES

- Prodrome – onset 8 to 12 days after exposure (range=7-21 days)
  - Stepwise increase in fever to 101º F or higher
  - Dry cough, coryza, conjunctivitis
  - Koplik spots (rash on mucous membranes)

KOPLIK SPOTS

Koplik spots in mouth due to pre-eruptive measles on day 3 of illness.
Classically described as appearing like "grains of salt on a wet background."

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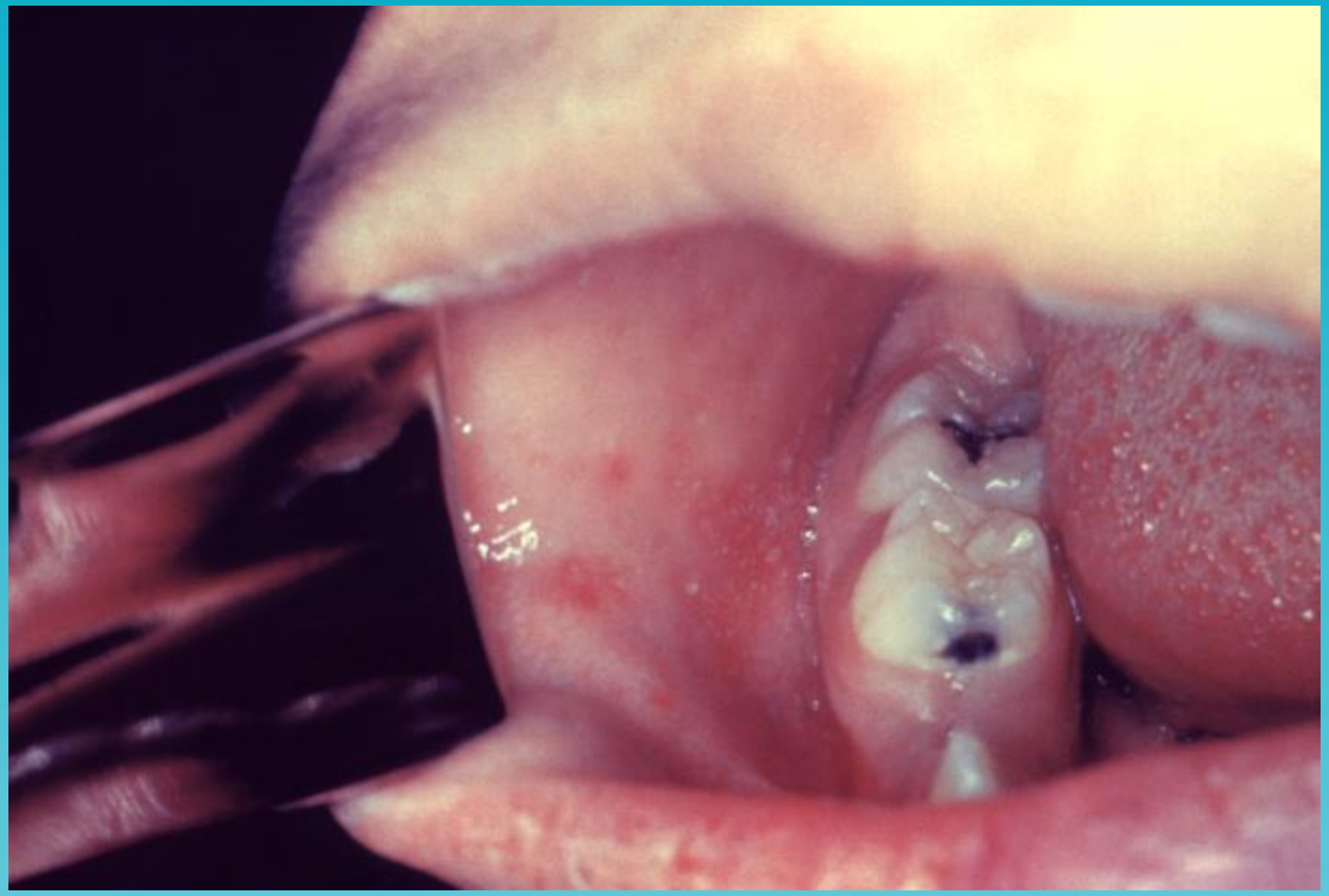

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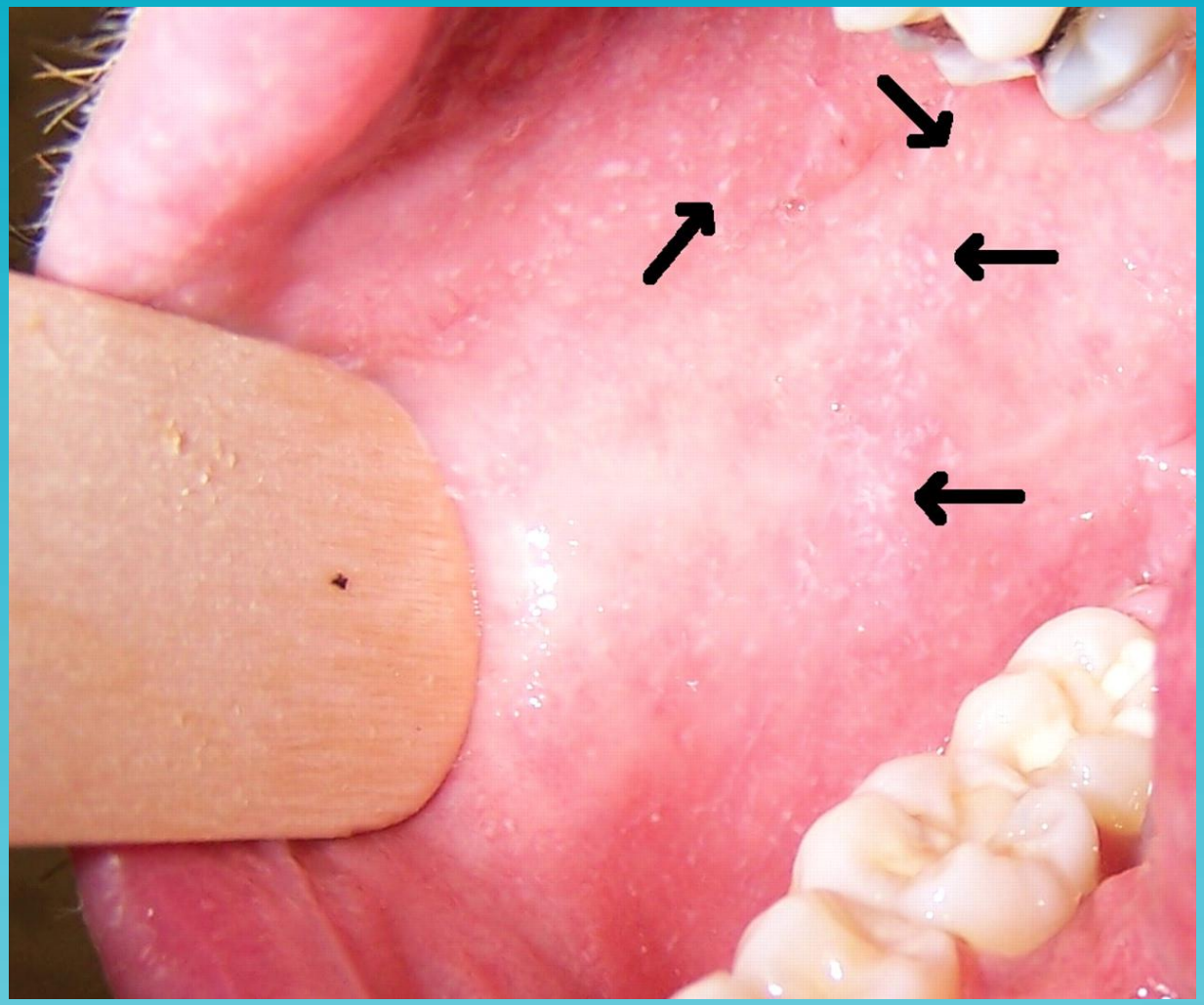

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MEASLES CLINICAL FEATURES

- Rash
  - 2-4 days after prodrome, 14 days after exposure
  - Maculopapular, becomes confluent (not itchy, except late in rash)
  - Begins on face and head (not on face, not measles!)
  - Occurs with fever
  - Persists 5-6 days
  - Fades in order of appearance

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Maculopapular Rashes of Childhood		
	Disease	Cause
First	measles	rubeola
Second	scarlet fever	group A streptococcus
Third	German measles	rubella
Fourth	scarletina, Duke's	Same as #2
Fifth	erythema infectiosa	human parvovirus B19
Sixth	roseola infanticum	human herpesvirus 7

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MEASLES COMPLICATIONS

Condition	Percent reported*
Diarrhea	8
Otitis media	7
Pneumonia	6
Encephalitis	0.1
Hospitalization	18
Death	0.2

*Based on 1985-1992 surveillance data

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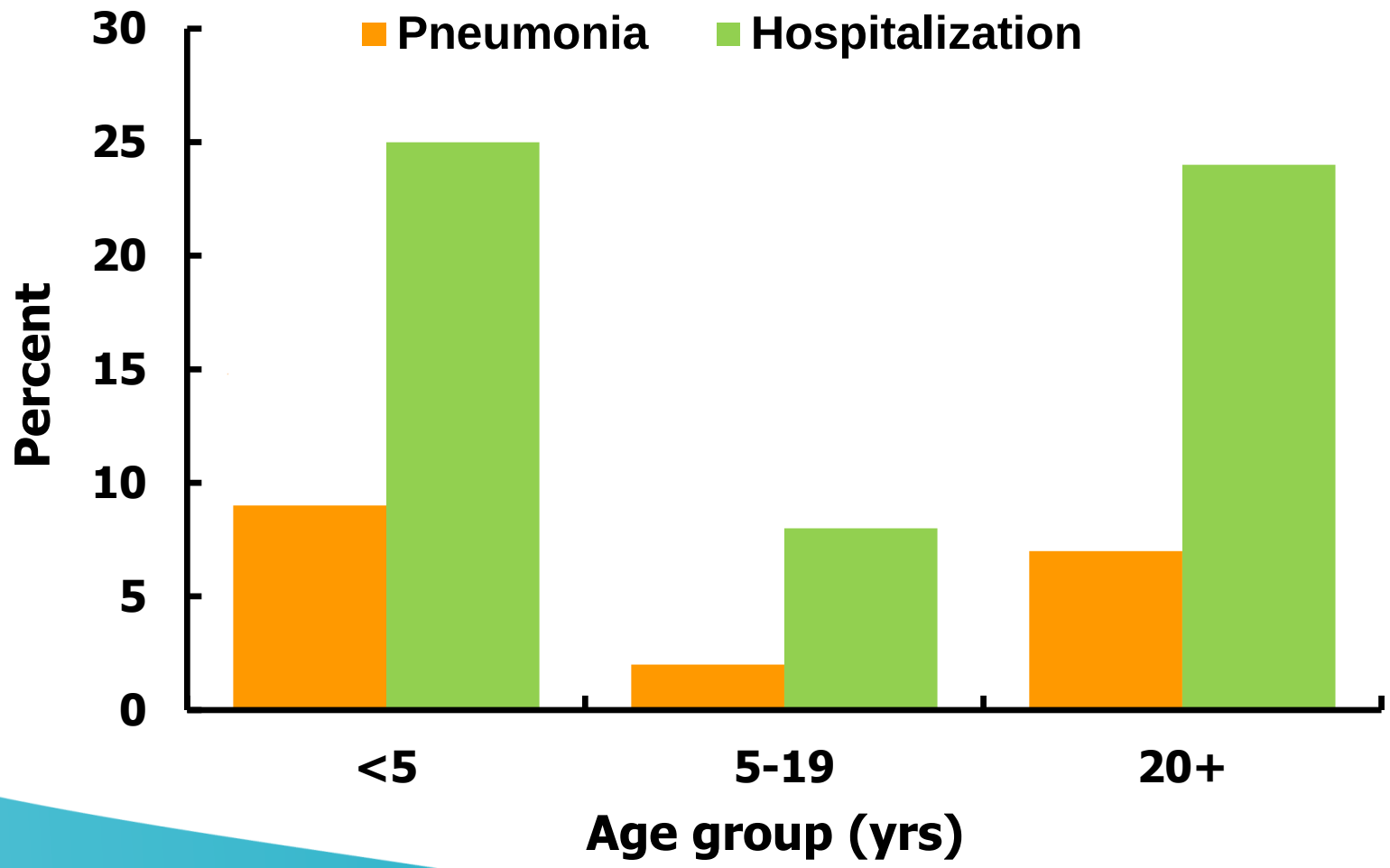
Measles Complications by Age Group



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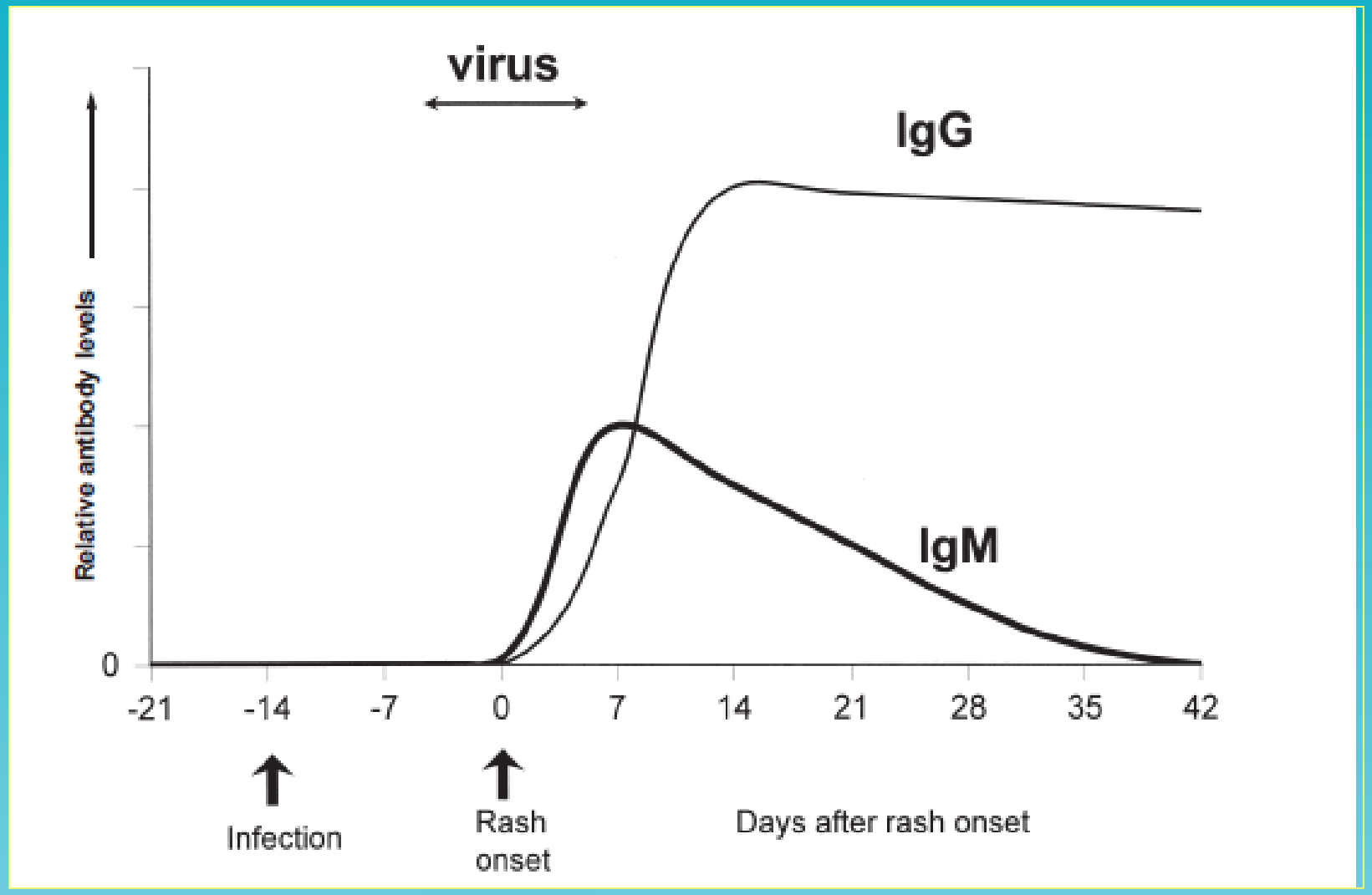
MEASLES LABORATORY DIAGNOSIS

- Serum measles IgM antibody positive test result (may be negative in the first 72 hours)
- Significant rise in serum measles IgG antibody between acute and convalescent titers
- Isolation of measles virus from clinical samples (blood, urine or NP secretions)
- Detection of viral RNA by reverse transcription polymerase chain reaction (RT-PCR).

ALL CASES OF SUSPECTED MEASLES SHOULD BE REPORTED IMMEDIATELY TO THE HEALTH DEPARTMENT WITHOUT WAITING FOR RESULTS OF DIAGNOSTIC TESTS.

IGM AND IGG ANTIBODY RESPONSES TO ACUTE MEASLES INFECTION



Source: WHO

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MEASLES

Treatment

- No specific antiviral treatment available
- Vitamin A once daily for 2 days – World Health Organization (WHO) recommends for all children with acute measles, regardless of their country of residence.
- Supportive

Post-exposure prophylaxis

- MMR vaccine may be given <72 hours of exposure to persons ≥6 months of age with 1 or no documented doses of MMR, if not contraindicated.
- Immune globulin (IG) may be given to exposed susceptible people* of any age ≤6 days of exposure to prevent infection (* = infants <12 months, pregnant women without evidence of measles immunity, severely immunocompromised persons.) CALL COUNTY!

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MEASLES – INFECTION CONTROL

- Infectious Period: 4 days before rash onset through 4 days after rash onset (day of rash onset is day 0)
- Incubation Period: 8-12 days after exposure (day 0) and rash onset is typically 14 days (range 7-21 days) after exposure
- Exposure: sharing the same airspace with an infectious person (during the 4 days prior through the 4 days after rash onset) = same classroom, home, clinic waiting room, airplane, store, etc. up to 2 hours after the person was present.
- KNOW THE IMMUNE STATUS OF ALL STAFF NOW!!!

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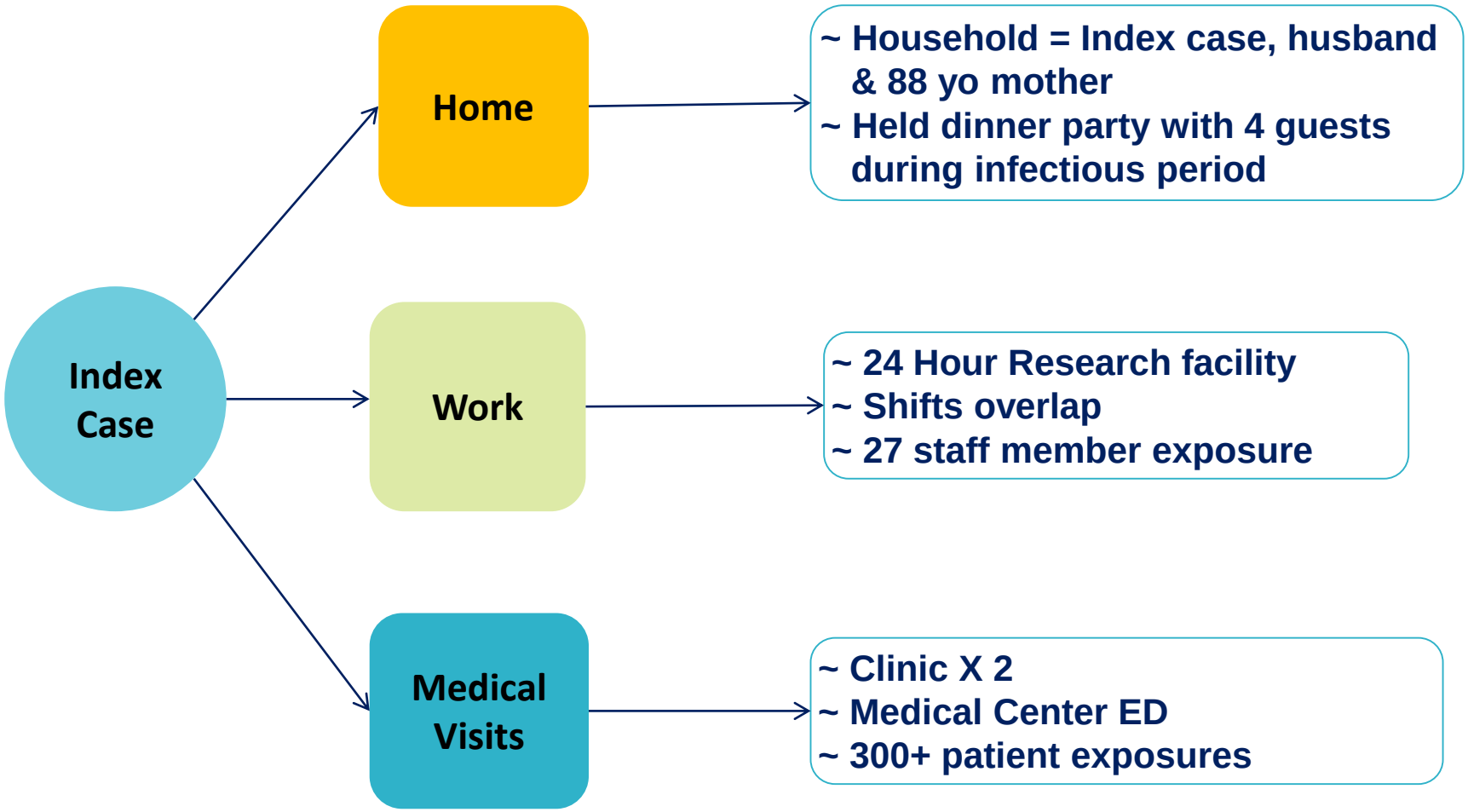
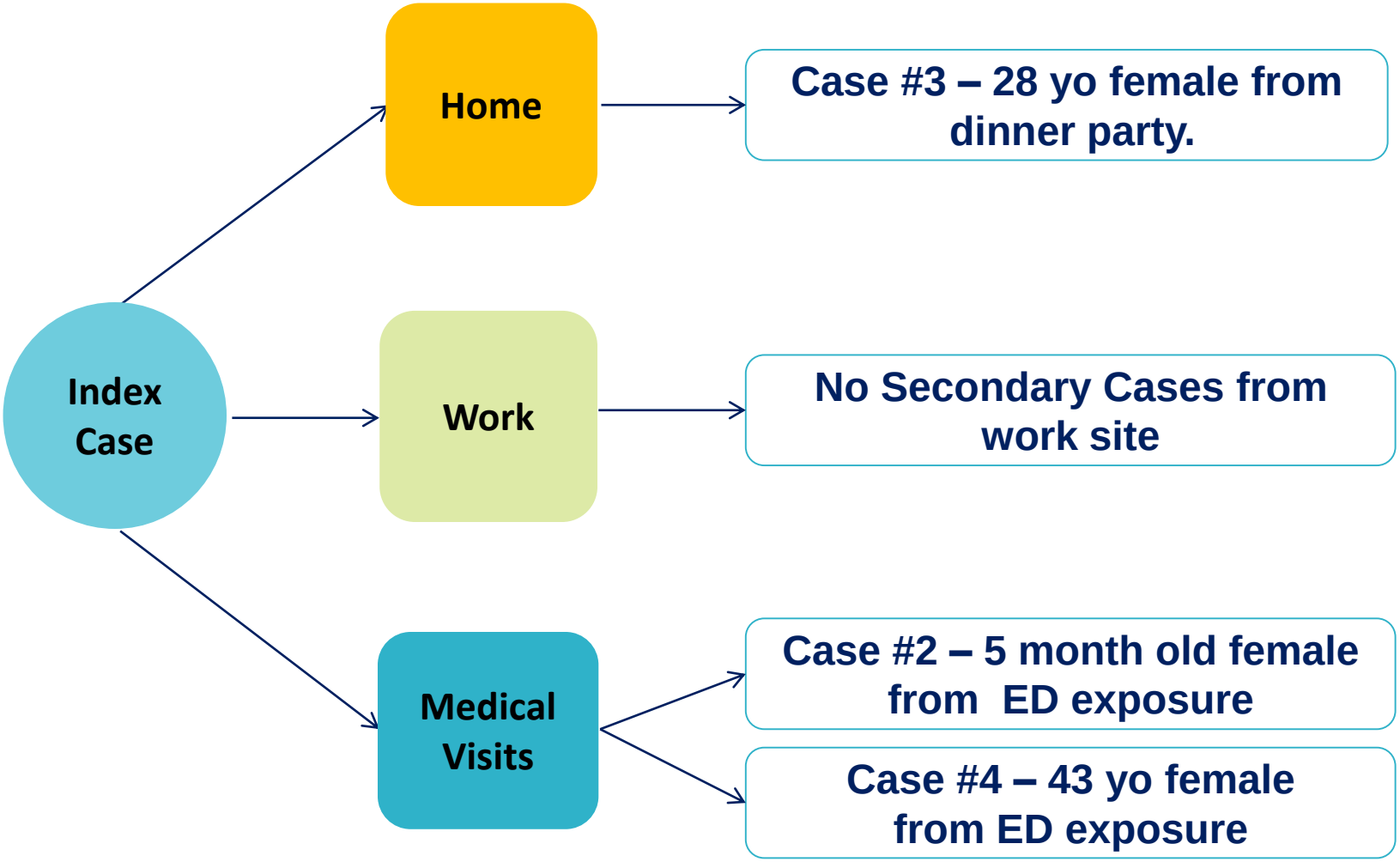
MEASLES – SAN DIEGO 2014



MEASLES – SAN DIEGO 2014



MEASLES – SAN DIEGO 2014

Case #2

- ~ 5 month old female exposed 2/17 at Medical Center ED
- ~ Symptoms: fever, diarrhea, rash, ulcers on soft palate
- ~ Exposed 118 patients & 43 staff at Medical Center ED

MEASLES – SAN DIEGO 2014

Case #3

- ~ 28 yo female exposed during dinner party at Index Case's home
- ~ Symptoms: HA, body aches, N/V, fever, rash, blisters around mouth
- ~ Exposed 225+ at Primary Care & Urgent Care, as well as work, "Babies First Ultrasound"

MEASLES – SAN DIEGO 2014

Case #4

- ~ 43 yo female, healthcare worker, exposed 2/17 at Medical Center ED
- ~ Symptoms: Fever, sore throat, rash
- ~ Exposed 504+ at work clinic, clinic for care, church 24 hour fitness

- **Lessons learned**
  - **Have a policy of evaluating patients (especially children) with fever and rash quickly and separately**
  - **Patients should call ahead when they have fever with rash**
  - **Document the immunization status of providers before potential exposure**
  - **Encourage vaccination on schedule**

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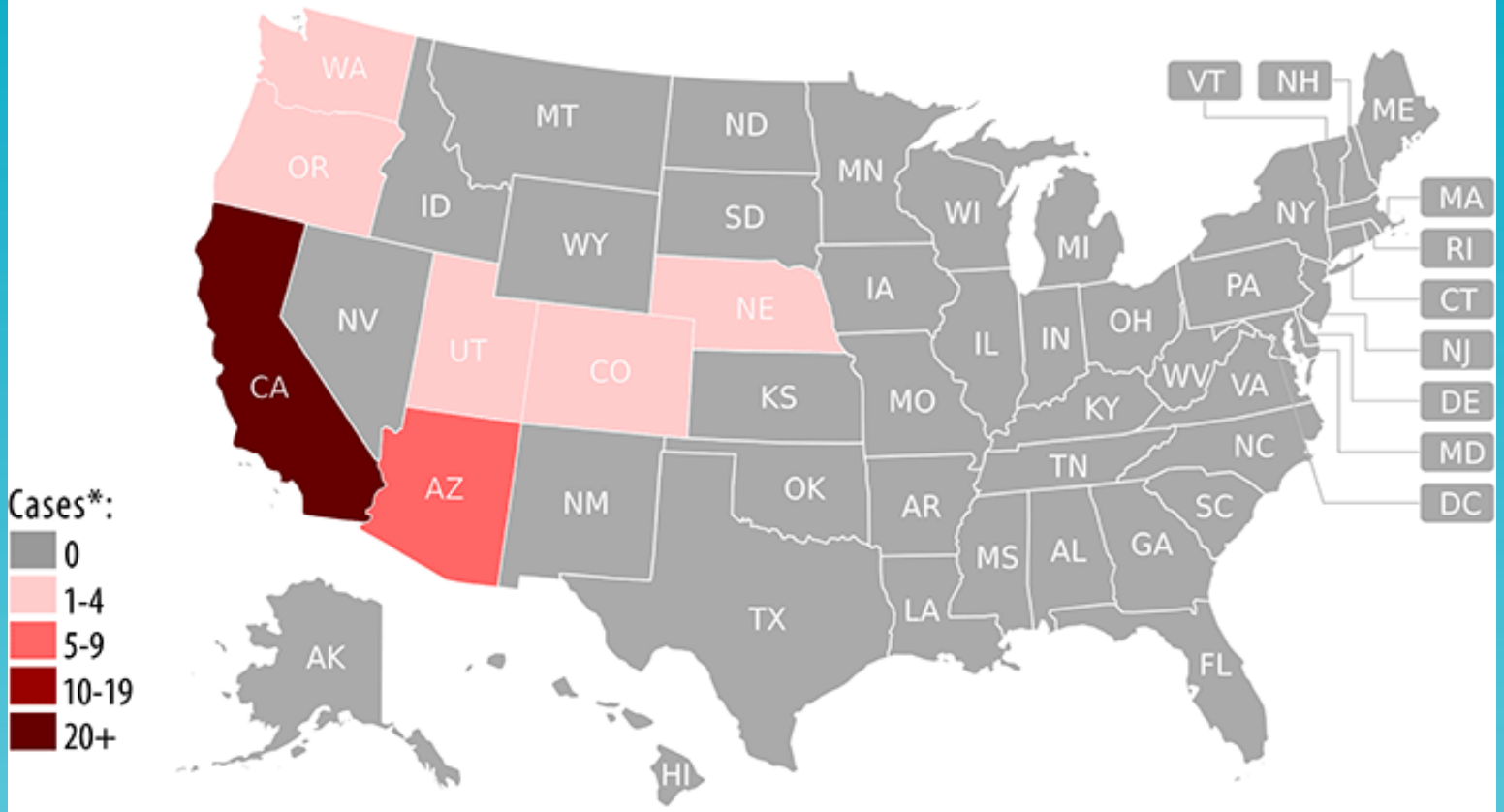
U.S. Multi-state Measles Outbreak December 28, 2014 - March 27, 2015



From December 28 to March 27, 2015, 146 people from 7 states [AZ (7), CA (130), CO (1), NE (2), OR (1), UT (3), WA (2)] were reported to have measles and are considered to be part of a large, ongoing outbreak linked to an amusement park in California*.

*Provisional data reported to CDC's National Center for Immunization and Respiratory Diseases

Downloaded March 31, 2015
Data Source: CDC as of March 27, 2015
http://www.cdc.gov/measles/cases-outbreaks.html

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California Measles Cases

40 cases
Visited Disneyland
12/17 –20/2014

30 household members

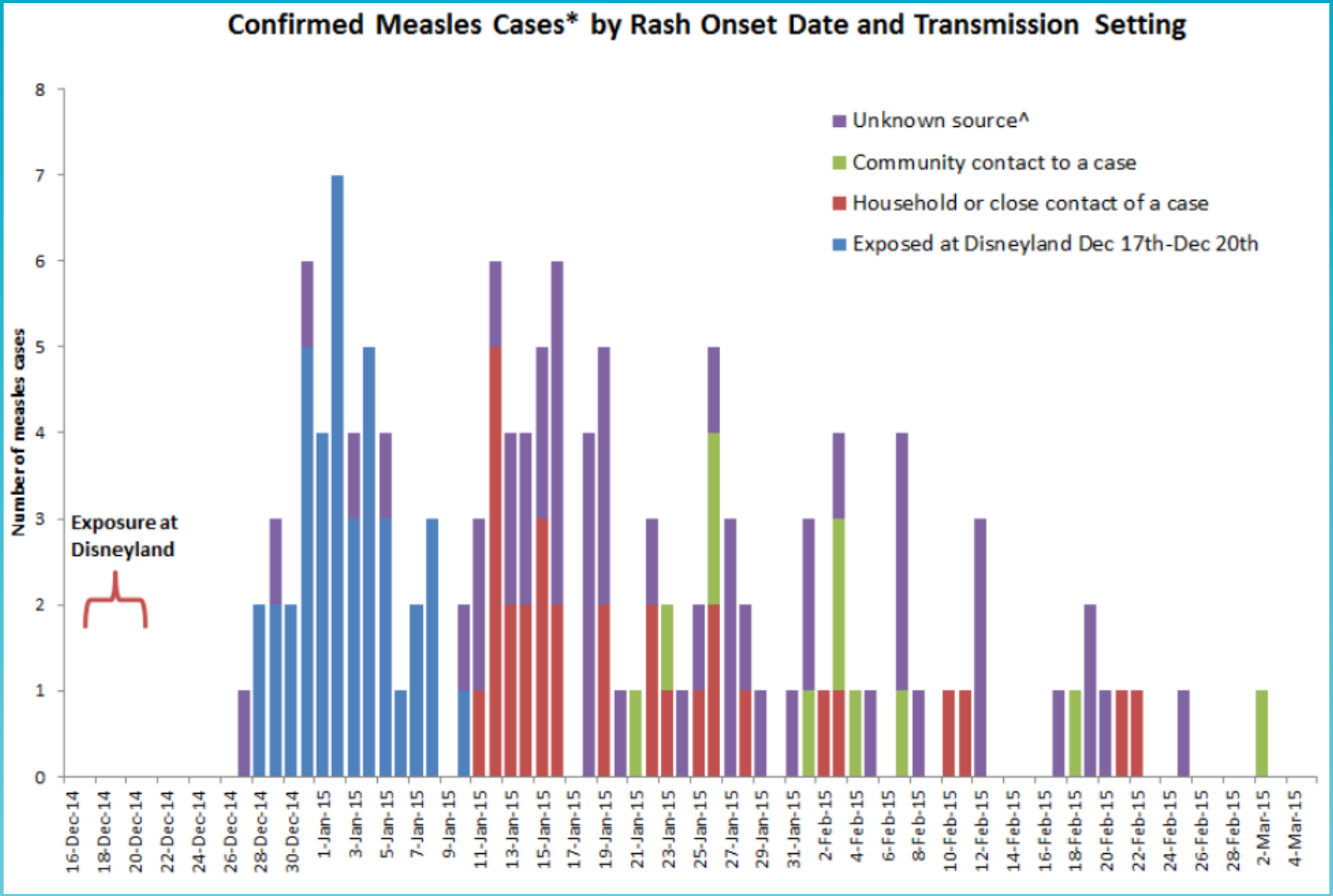
11 community exposures

(e.g. ER)

50 unknown source, but linked via strain type

3 with No linkage
(different genotype)

Data Source: CDPH as of March 27, 2015



Data Source: CDPH as of March 27, 2015

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Age distribution of Confirmed Measles Cases

Age (years)	Total	Incidence per 100,000 population*	Percent
<1	15	2.86	11%
1-4	21	1.05	16%
5-19	24	0.31	18%
20-29	30	0.54	22%
30-39	21	0.40	16%
40-49	12	0.23	9%
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

Data Source: CDPH as of March 27, 2015

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Vaccination status of Confirmed Measles Cases

	Total*	Percent
Unvaccinated	56	69%
Vaccinated		
1 dose	10	12%
2 doses	13	16%
3 doses	2	2%

*20 cases self-report vaccination; 1 case had prior measles IgG positivity; 2 cases were tested as part of a contact investigation and found to be IgG negative; 30 cases have unknown vaccination status

Hospitalization Status of Confirmed Measles Cases

	Total*	Percent
Hospitalized	20	19%
Not hospitalized	86	81%

*28 have missing hospitalization data

Data Source: CDPH as of March 27, 2015

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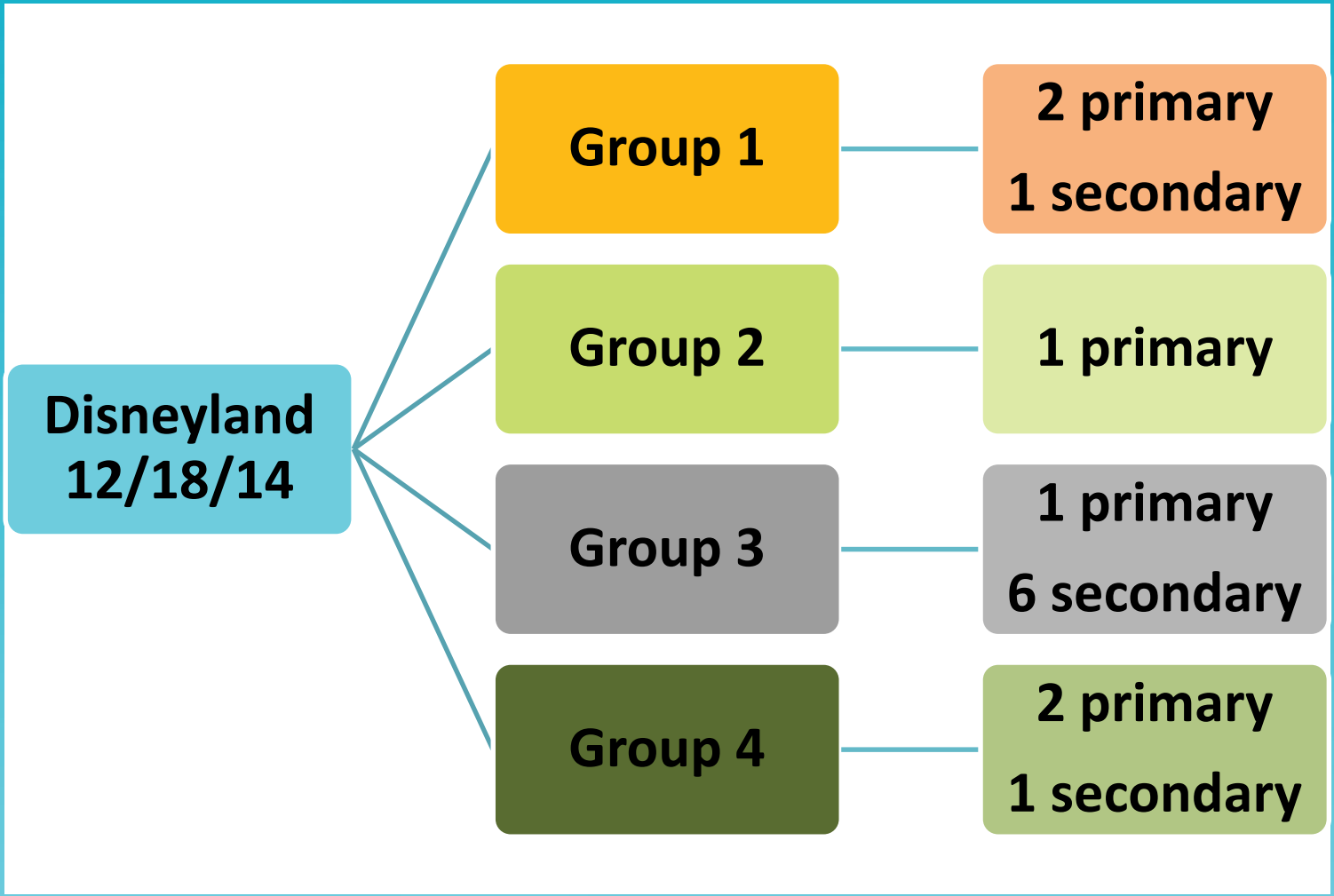
SAN DIEGO CASES



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SAN DIEGO OUTBREAK – GROUP 1

5 year old = Primary case	10 month old = Primary case	3 year old = Secondary Case

• Disneyland 12/18/14
• Unvaccinated
• Onset 1/2/15
• Exposures:
  • Parkway Plaza Mall – GameStop, Sunglasses Hut & Carousel (?)
	• Disneyland 12/18/14
	• Unvaccinated
	• Onset 1/3/15
	• Exposures:
	  • None
		• Household Contact
		• Unvaccinated
		• Onset 1/12/15
		• Exposures:
		  • None

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SAN DIEGO OUTBREAK – GROUP 2

18 month old

- Disneyland 12/18/14
- Unvaccinated (delayed vaccine schedule)
- Onset 12/30/14
- Exposures: Learned of case after PEP & Incubation periods over, so no in-depth contact investigations:
  - Household
  - CPCMG Urgent Care, Grossmont
  - Rady Children's Hospital

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SAN DIEGO OUTBREAK – GROUP 3

18 year old = Primary case

- Disneyland 12/18/14
- Unvaccinated
- Onset 1/1/15
- Exposures:
  - Household (7)
  - SRS UC (78)

14 year old = Secondary case

- Disneyland 12/18/14
- Unvaccinated
- Onset 1/12/15
- Exposures:
  - Julian Fitness Center (?)
  - Absolute Personal Fitness (?)
  - SRS UC (47)

8, 5, & 1 year old = Secondary cases

- Household contacts
- Unvaccinated
- Onset 1/12/15
- Exposures:
  - SRS UC

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SAN DIEGO OUTBREAK – GROUP 3

11 year old = Secondary Case

- Household Contact
- Unvaccinated
- Onset 1/13/15
- Exposures:
  - SRS UC (47)

49 year old = Secondary case

- Disneyland 12/18/14
- Hx of 1 MMR
- Onset 1/14/15
- Exposures:
  - City of San Diego Operations Building (205)
  - Trader Joe's (?)
  - Rite Aid Pharmacy (?)
  - CVS Pharmacy (?)
  - Von's (?)

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SAN DIEGO OUTBREAK – GROUP 4

19 year old = Primary case

- Disneyland 12/18/14
- Unvaccinated
- Onset 12/29/14
- Exposures:
  - Household (5)
  - The Landings, Carlsbad (?)

18 year old = Primary case

- Disneyland 12/18/14
- Unvaccinated
- Onset 12/30/14
- Exposures:
  - Household (5)
  - Ice Plex, Escondido (?)
  - Regal Carlsbad 12 Theater (18)

21 year old = Secondary case

- Close contact to 19 year old
- Unvaccinated
- Onset 01/14/15
- Exposures:
  - Devil's Punchbowl (?)
  - Phil's BBQ, San Marcos (29)
  - Disneyland & CA Adventure(?)
  - Albertson's (58)
  - Sprouts Market (?)
  - Vista Community Clinic (30)

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CONTACT INVESTIGATIONS

- Contact Investigations:
  - Group 1 = 140 + press release
  - Group 2 = None – outside incubation period
  - Group 3 = 330 + press release
  - Group 4 = None – Public setting too large = press release

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QUARANTINE

Total Contacts placed on Quarantine due to lack of immunity & unknown immunity status

- **Group 1 = 12**
- **Group 2 = None**
- **Group 3 = 13**
- **Group 4 = None**

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IMMUNIZATION PROGRAM ACTIONS

- In-depth contact investigations to identify any at risk for developing infection
- Outreach to community providers regarding identification, testing, isolation precautions, and reporting of suspect measles cases
  - Multiple Health Alerts
- Public Notification of possible exposures
  - Multiple Press Releases
- Public Health Lab testing – added capability
  - IgG & IgM testing
  - PCR testing
  - 140 consults for R/O measles in 2015

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PROVIDER RECOMMENDATIONS

- **1. Test:** Suspect cases with classic measles symptoms, regardless
- of vaccination history (or prior IgG seropositivity)
  - Cough, coryza, conjunctivitis
  - Descending rash that starts on the face/head (if no rash on the face/head/neck or if rash starts on the trunk = measles not likely).

2. Test: Contacts of measles cases who have fever and rash of varying severity regardless of vaccine history (or prior IgG seropositivity).

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PROVIDER RECOMMENDATIONS

- **3. Test: At Your Discretion –** Suspect cases who do not meet the clinical case definition (fever <101, or not all Cs) and have no known exposure (but have 2 MMRs or prior seropositivity). May depend on:
  - Epidemiology of measles in the community – are there many cases with an unknown source?
  - Whether the suspect case potentially exposed others in sensitive settings (healthcare facility, childcare facility with infants), e.g., did the suspect visit an NICU while potentially infectious?
  - International travel, international travelers

PROVIDER RECOMMENDATIONS

- **4. Other Considerations:**
  - Itchy rash? May be itchy from day 4-7, but not itchy immediately
  - Rash on palms and soles? Measles rashes may be on palms and soles, but not as prominent as on face/chest.
  - What is the rash distribution and spread look like? Even if disease is modified, the order of appearance (face/head) and direction of spread is the same.
  - Time of fever and rash (fever first followed by rash a few days later).

PROVIDER RECOMMENDATIONS

- **5. Healthcare Immunity Status**
  - Know the immune status of all your staff – NOW!!!
  - Healthcare worker must have documentation of:
    - Positive Measles IgG test; OR
    - 2 doses of measles vaccine given in 1968 or later, separated by at least 28 days, and 1st dose given on or after the 1st birthday
  - If no proof of immunity – home quarantine/symptom watch for healthcare worker begins on day 5 after 1st exposure through day 21 after last exposure.

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VACCINE REACTIONS

- Rash that occurs days 5-12 post vaccination with MMR
- Patients can have symptoms comparable to those associated with wild type measles
- PCR on the patient's urine and throat swab will likely be positive for measles
- Additional testing (genotyping) is needed to discriminate between vaccine strain and wild type strain
  - Vaccine strain is genotype A
  - Additional testing takes several days
- In some cases the level of virus is too low to successfully genotype

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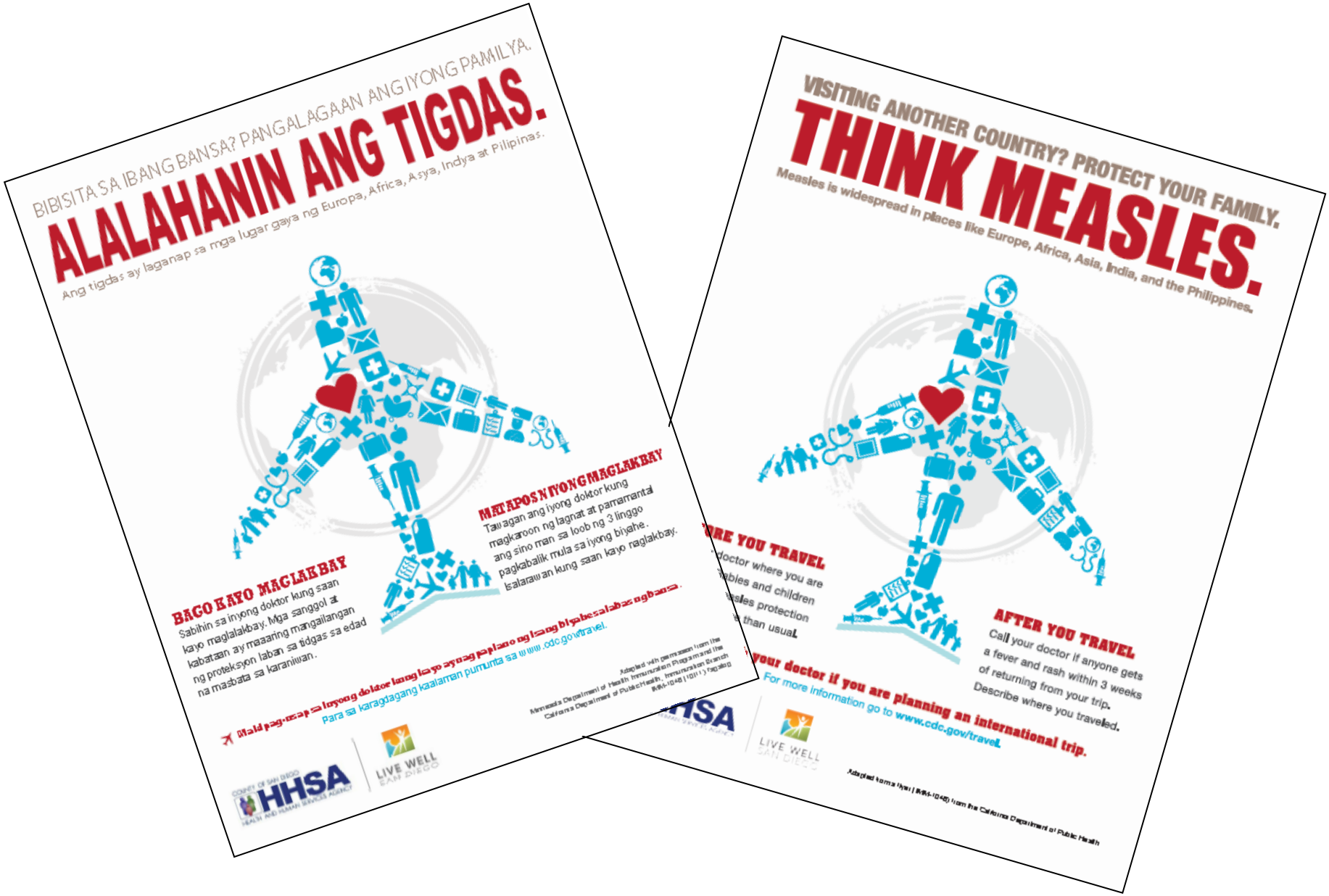
MEASLES – OUTREACH



MEASLES – TOOLS AND GUIDES

CALIFORNIA DEPARTMENT OF PUBLIC HEALTH

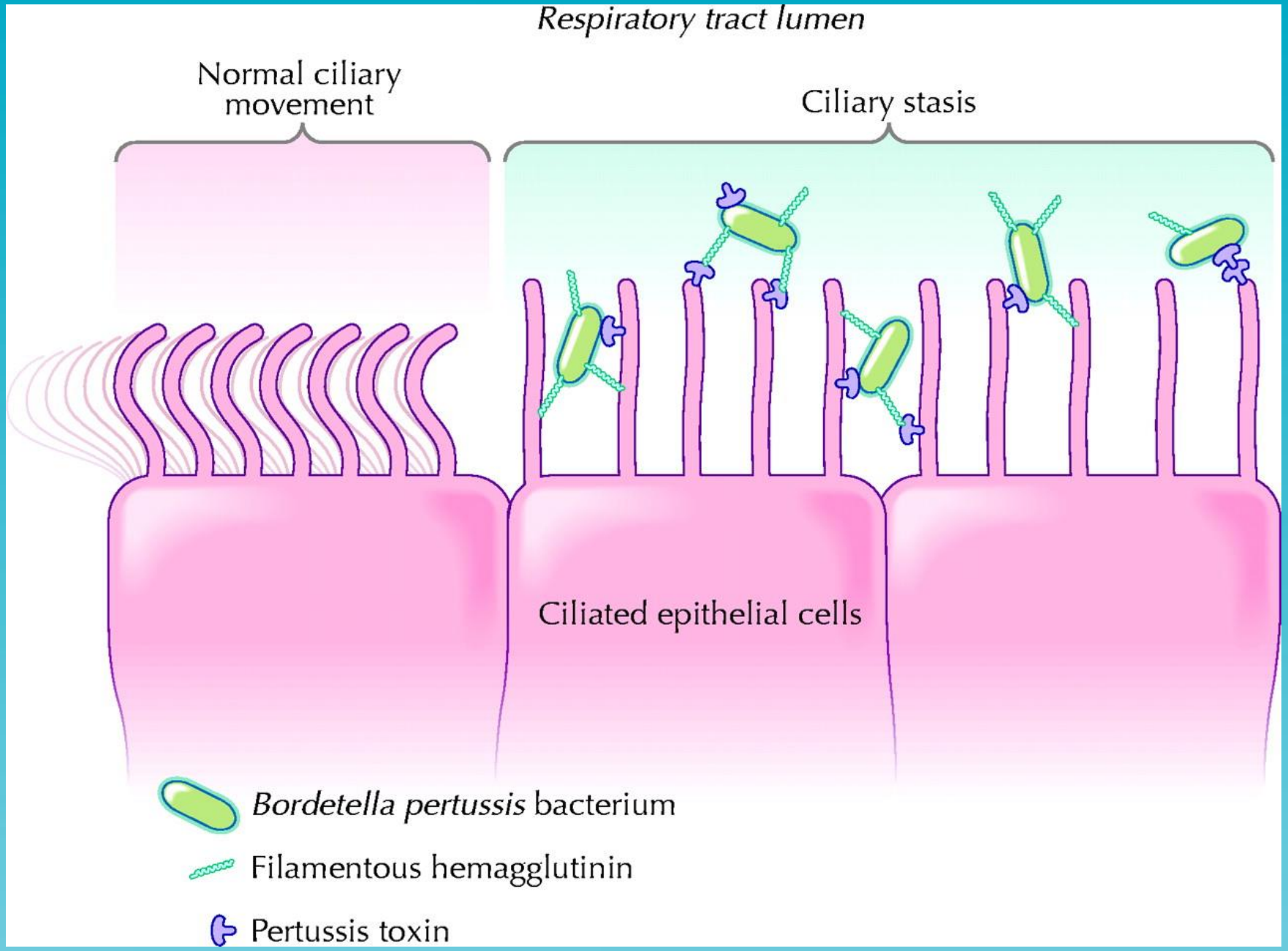
- **CDPH Measles Advisory 1/21/15**
  http://www.cdph.ca.gov/HealthInfo/discond/Documents/CDPH_Measles_Health_Advisory1-21-2015.pdf
- **CDPH Facility Infection Control Guidelines**
  http://www.cdph.ca.gov/HealthInfo/discond/Documents/CDPHHCFacilityICRecsforSuspectMeaslesPatients.pdf
- **CDPH Measles Investigation Quick Sheet**
  http://www.cdph.ca.gov/programs/immunize/Documents/CDPHMeaslesInvestigationQuicksheet.pdf
- **CDPH Measles Laboratory Testing Guidelines**
  http://www.cdph.ca.gov/HealthInfo/discond/Documents/CDPHMeaslesLabTesting2011-01.pdf
- **CDPH-VRDL Guidelines for Laboratory Services**
  http://www.cdph.ca.gov/programs/vrdl/Documents/VRDL%20Guidelines%20for%20Laboratory%20Services%20manual%205-4-8%20130319.pdf

PERTUSSIS

LIVE WELL
SAN DIEGO

PERTUSSIS - BASICS

- Highly contagious respiratory infection caused by *Bordetella pertussis*
- Primarily a toxin-mediated disease
- Bacteria attach to cilia or respiratory epithelial cells

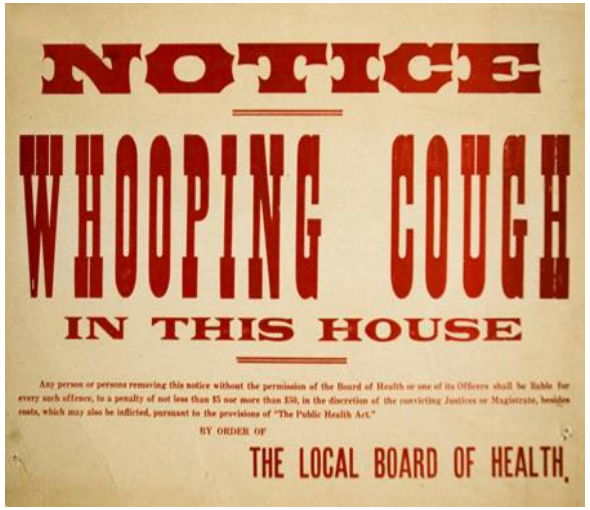


PERTUSSIS - BASICS

- Transmission occurs by close contact via droplets
- Very contagious: approximately 90% of susceptible household contacts become infected
- Cyclic (peaks every 2-5 years)
- Most poorly controlled VPD
- Immunity wanes after vaccination or disease
- 92-95% of population must be immune to eliminate transmission
- Infants ≤ 1 year of age are most vulnerable
- Adolescents & adults transmit disease to infants

PERTUSSIS - BASICS

- Incubation Period 7 – 10 days (range 5 – 21 days)
- Infectious Period
  - Persons ≥ 1 year of age = from onset of cold-like symptoms until after 5 days of treatment or until 21 days after cough onset if no (or partial) treatment is given
  - Infants < 1 year are considered infectious for 6 weeks without treatment



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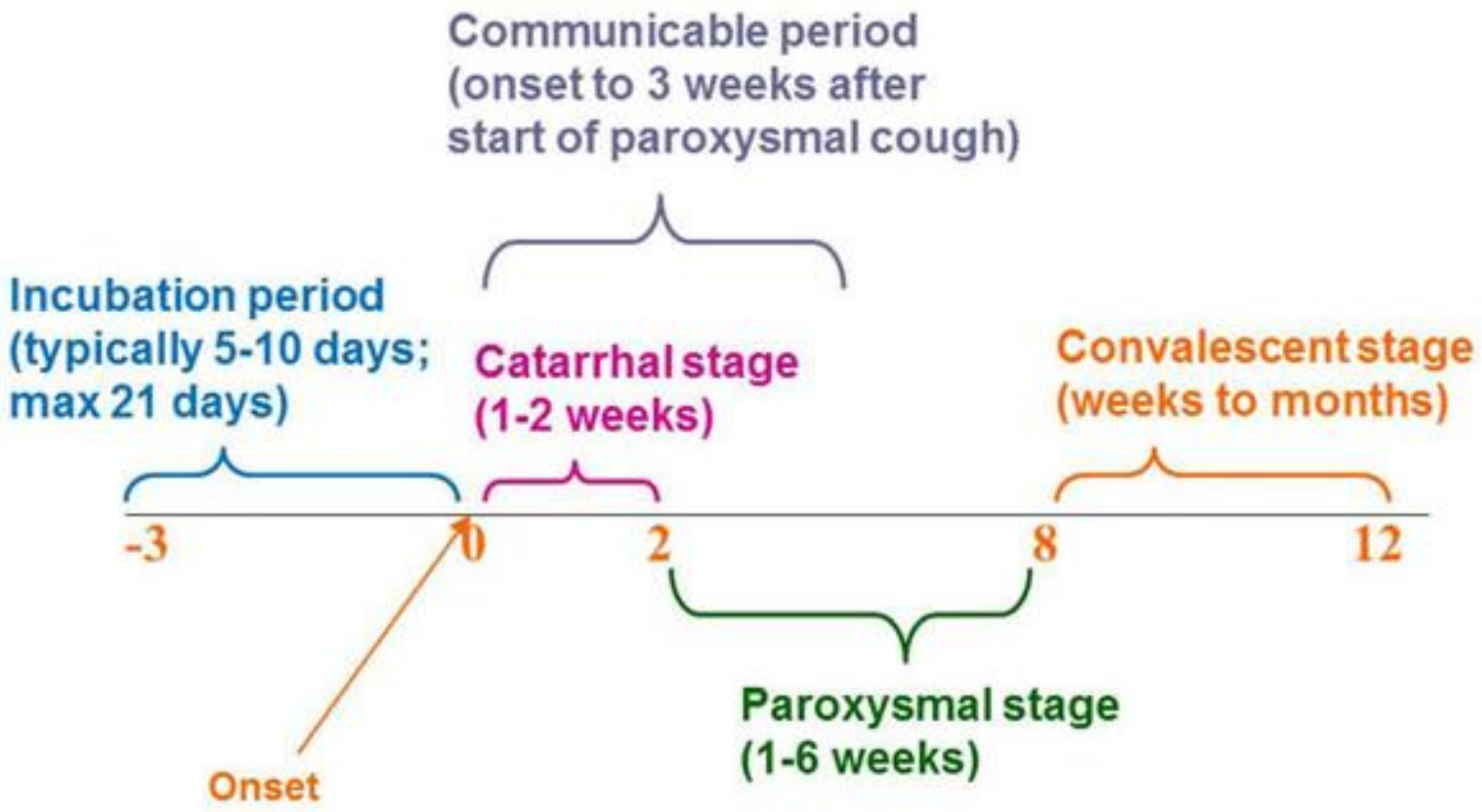
PERTUSSIS - STAGES



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PERTUSSIS - SYMPTOMS

- Cold-like symptoms
  - Coryza
  - Sneezing
  - Occasional cough
- Fever usually absent or minimal
- Stage lasts for about 1-2 weeks with cough gradually becoming more severe

Catarrhal Stage

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PERTUSSIS - SYMPTOMS

- Spasms of severe coughing followed by a sudden deep inspiration
- Characteristic “whooping” sound https://www.soundsofpertussis.com/
- Post-tussive vomiting common in all ages
- Illness may be milder in previously vaccinated people

Paroxysmal Stage

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PERTUSSIS - SYMPTOMS

- Coughing, whooping and vomiting decreasing in frequency and severity
- Paroxysms may recur with subsequent respiratory infections
- Classic pertussis is 6-10 weeks, but may last longer in some people

Convalescent Stage

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PERTUSSIS – YOUNG INFANTS

- Initially mild cough, runny nose, no fever
- Develops into serious symptoms:
  - May gag, gasp or stop breathing (apnea)
  - Face may turn blue, purple or red (cyanosis)
  - Post-tussive vomiting
  - May not have noticeable cough or “whoop”
  - Seizures
  - Respiratory distress
  - Pneumonia

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PERTUSSIS - BASICS

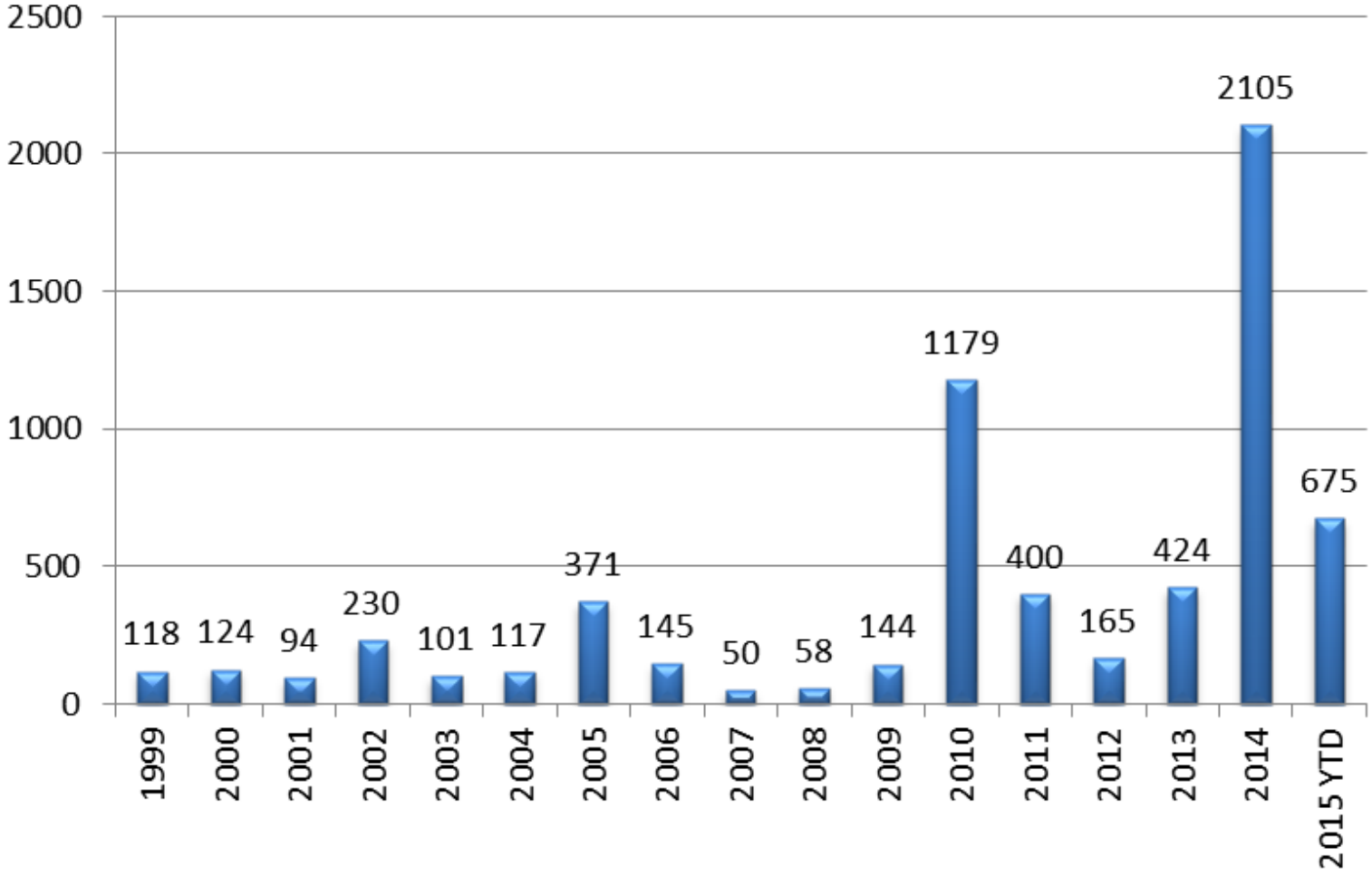
- Adolescents and adults
  - Disease is often milder than infants and children
  - Infection may be asymptomatic or present as classic pertussis
  - Adults may describe intermittent
  - Older persons often source of infection for children

PERTUSSIS – TREATMENT

- **Azithromycin – 5 days (most effective/common)**
- **Erythromycin – 14 days (7-14 days infants ≥6 months & children)**
- **Clarithromycin – 7 days (not recommended for < 1 month of age**
- **Bactrim/Septra – 10-14 days**

Post-exposure prophylaxis (PEP) is SAME AS TREATMENT.

San Diego County Pertussis Annual Total Cases by Year of Report, 1999 – 2015

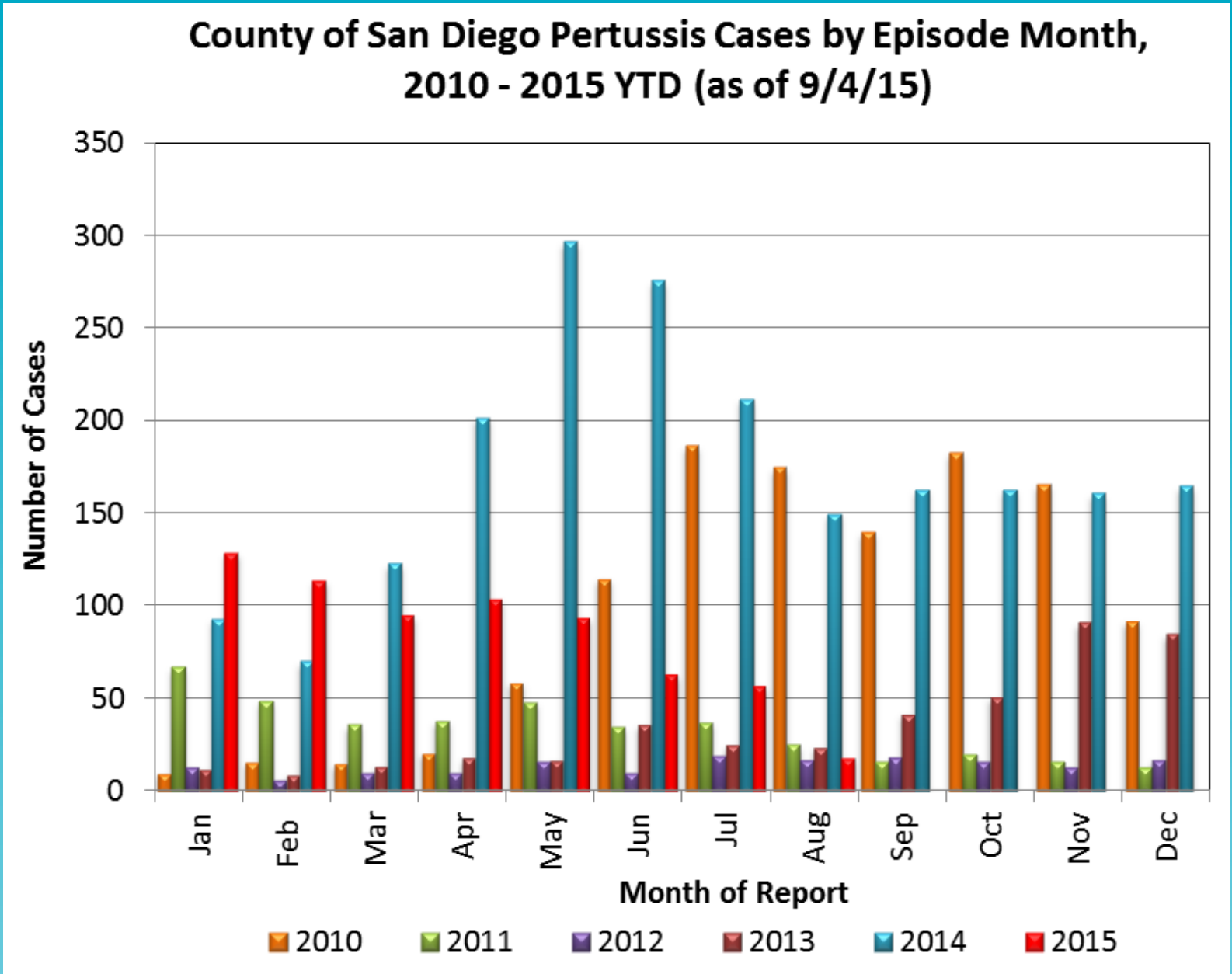


Note: prior to 2007, counts based on diagnosis date. 2007-13 data is based on episode date.

Includes all Closed (Confirmed, Suspect, & Probable) cases reported to Public Health

Prepared by County of San Diego, Health & Human Services Agency,

Public Health Services, Epidemiology & Immunization Services, 9/4/15



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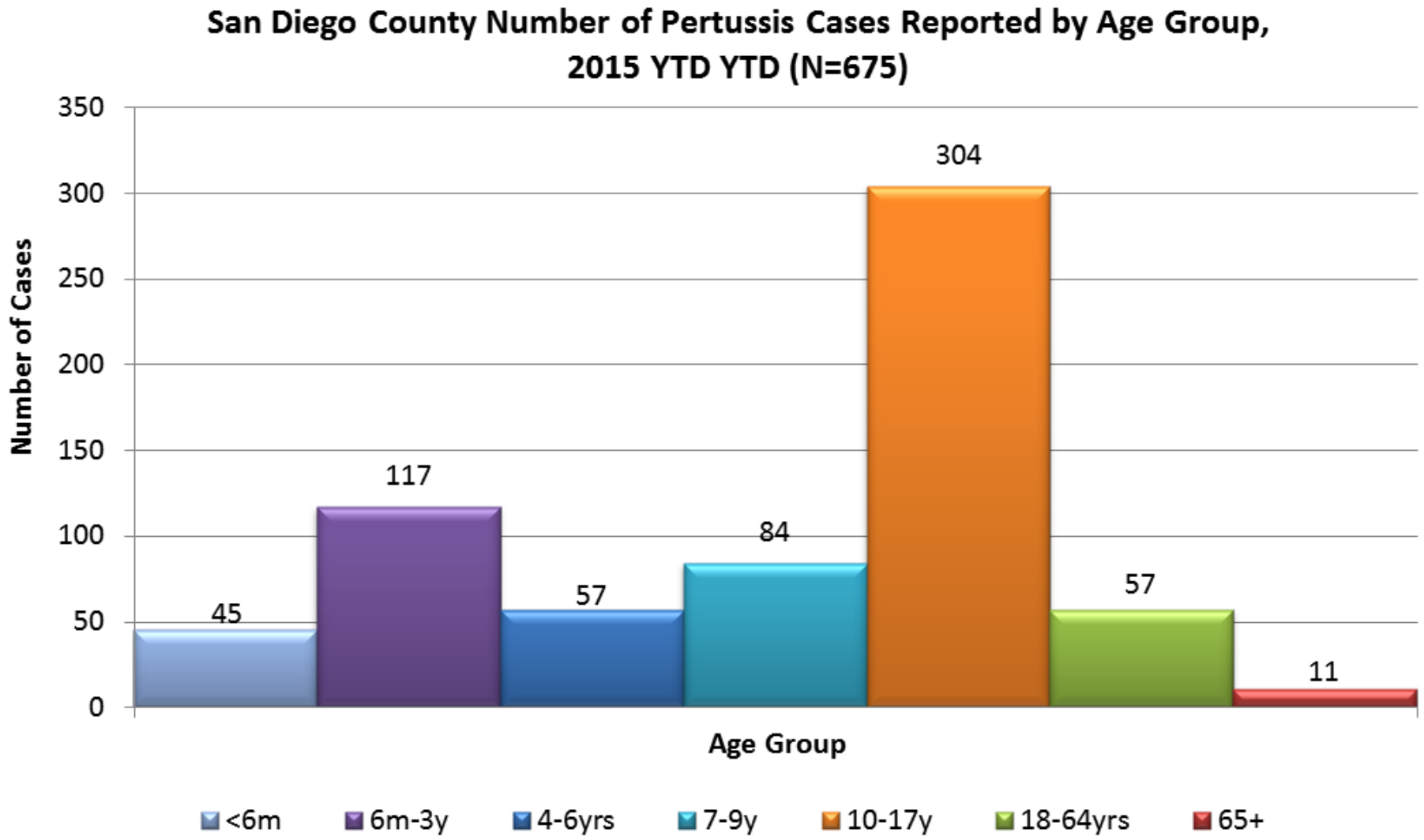

Includes all Closed (Confirmed, Suspect, & Probable) cases reported to Public Health

Prepared by County of San Diego, Health & Human Services Agency,

Public Health Services, Epidemiology & Immunization Services, 2/26/15

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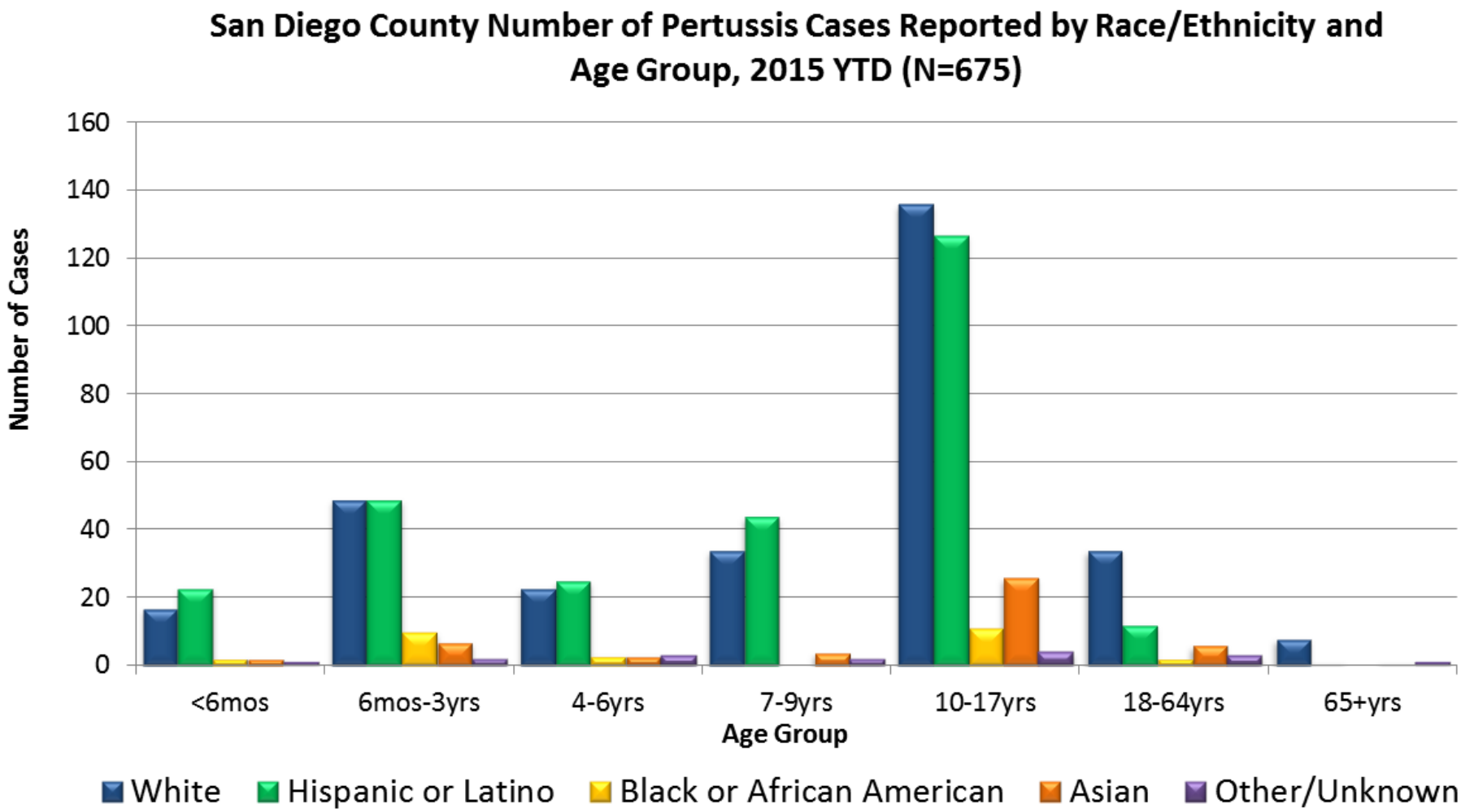

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Public Health Services, Epidemiology & Immunization Services, 9/4/15

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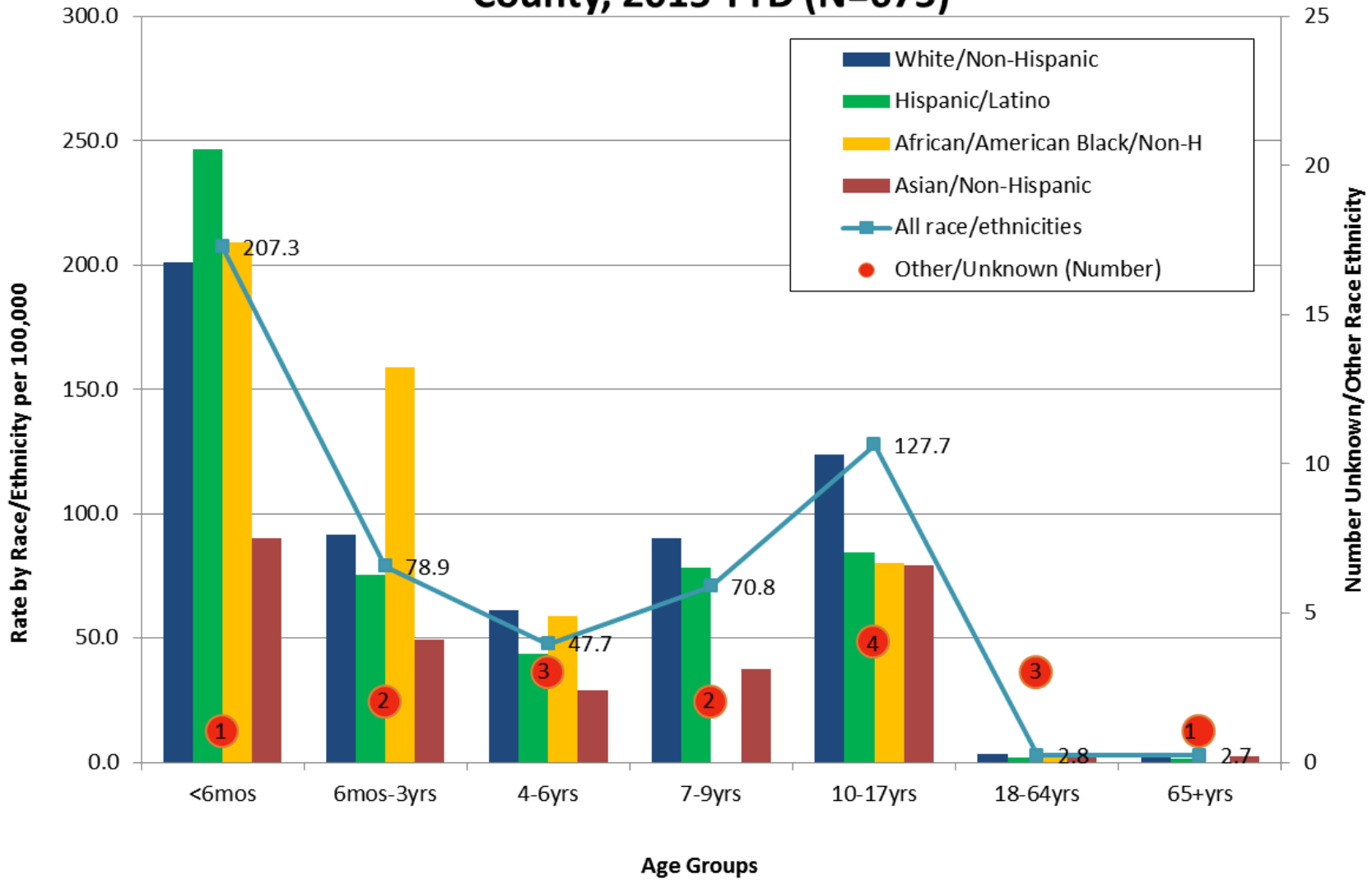
Pertussis Rates by Age Group and Race/Ethnicity, San Diego County, 2015 YTD (N=675)



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Public Health Services, Epidemiology & Immunization Services, 9/4/15

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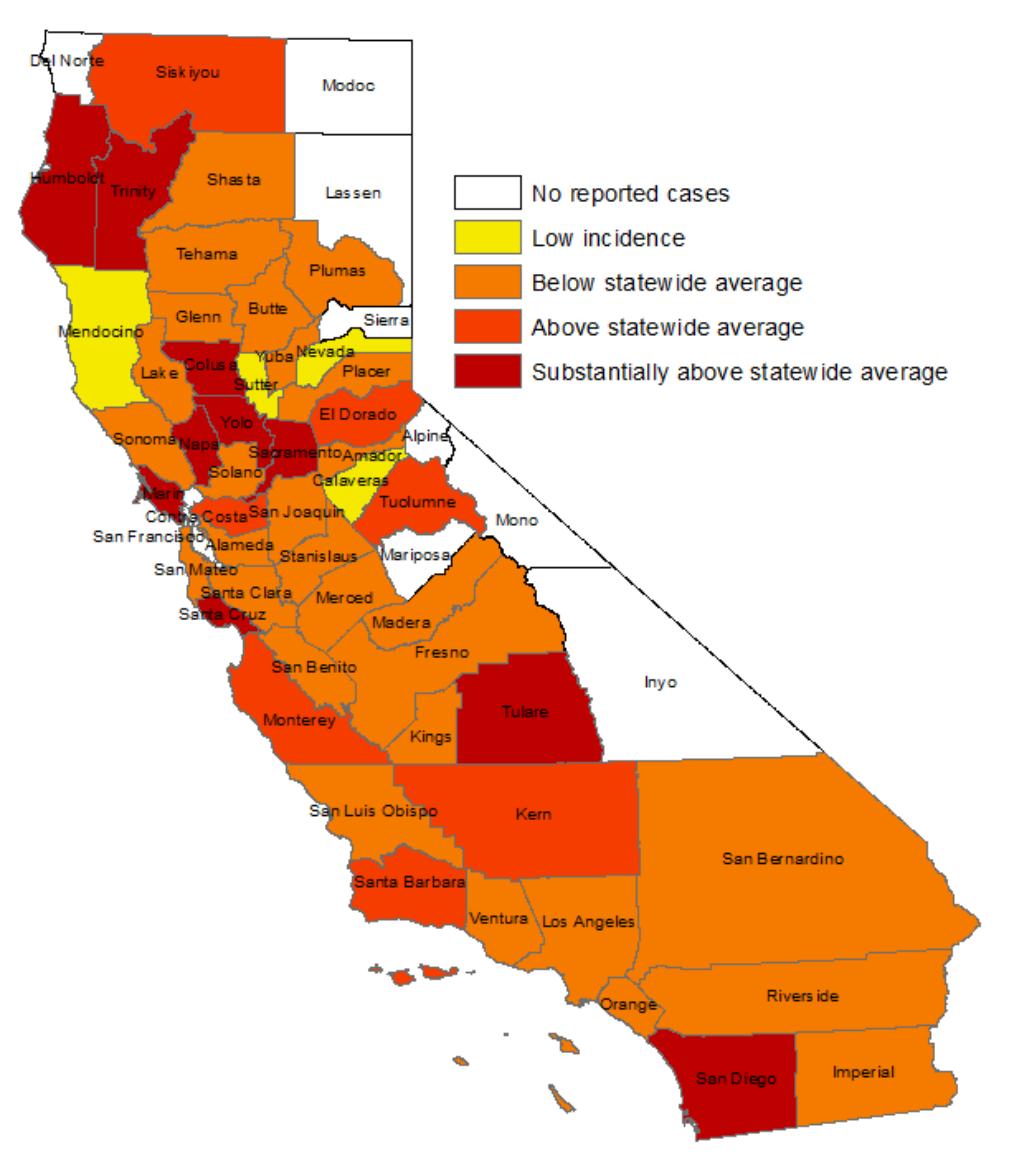
Pertussis incidence per 100,000 population, by county – California, 2015*



Reported to CDPH as of 9/15/2015

Corresponding category ranges: 0; 0.1-2.7; 2.8-8.8; 8.9-18.0; 18.1-41.5

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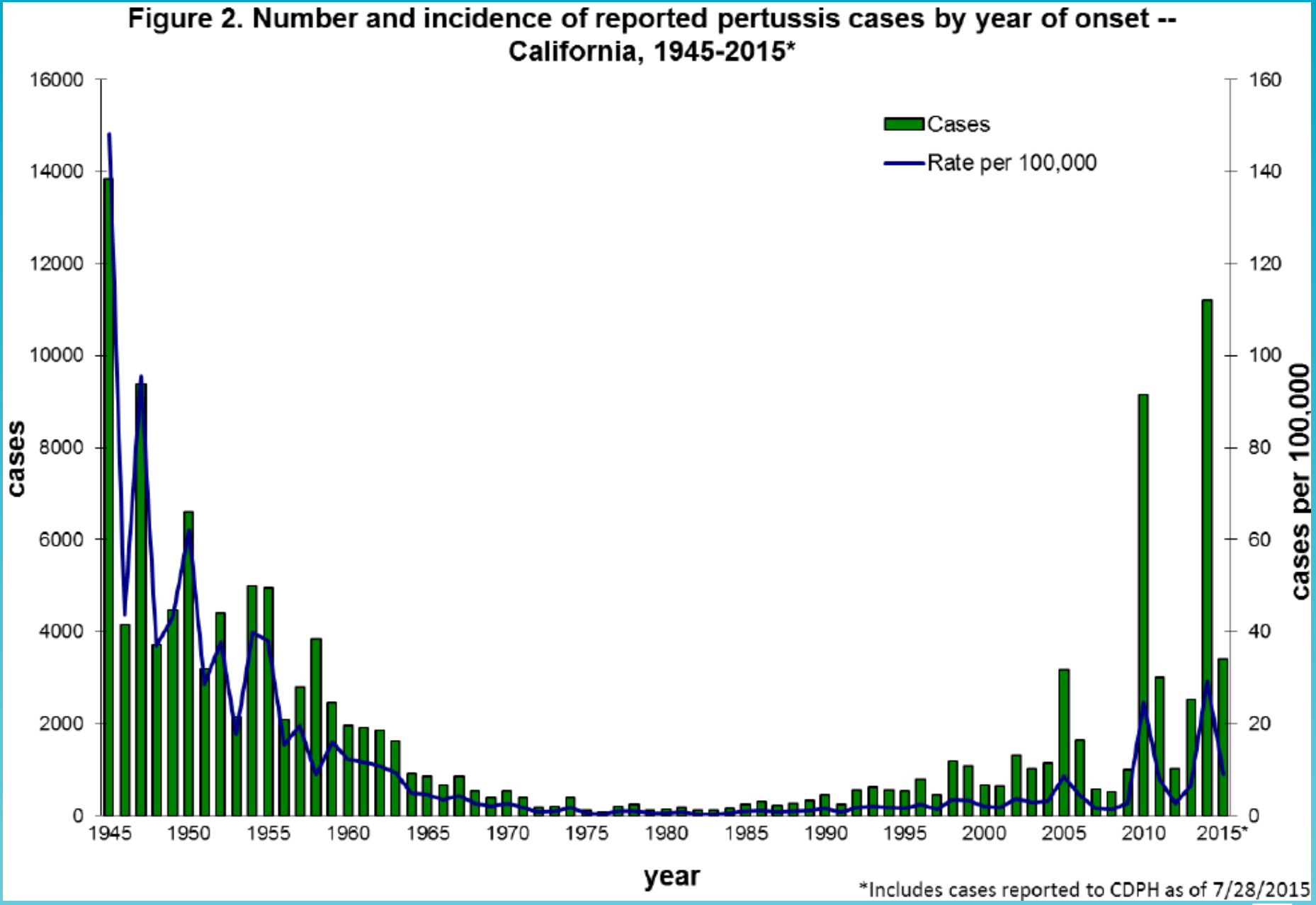

Source: CDPH, downloaded 9/15/15 from:
http://www.cdph.ca.gov/programs/immunize/Documents/PertussisReport8-3-2015.pdf

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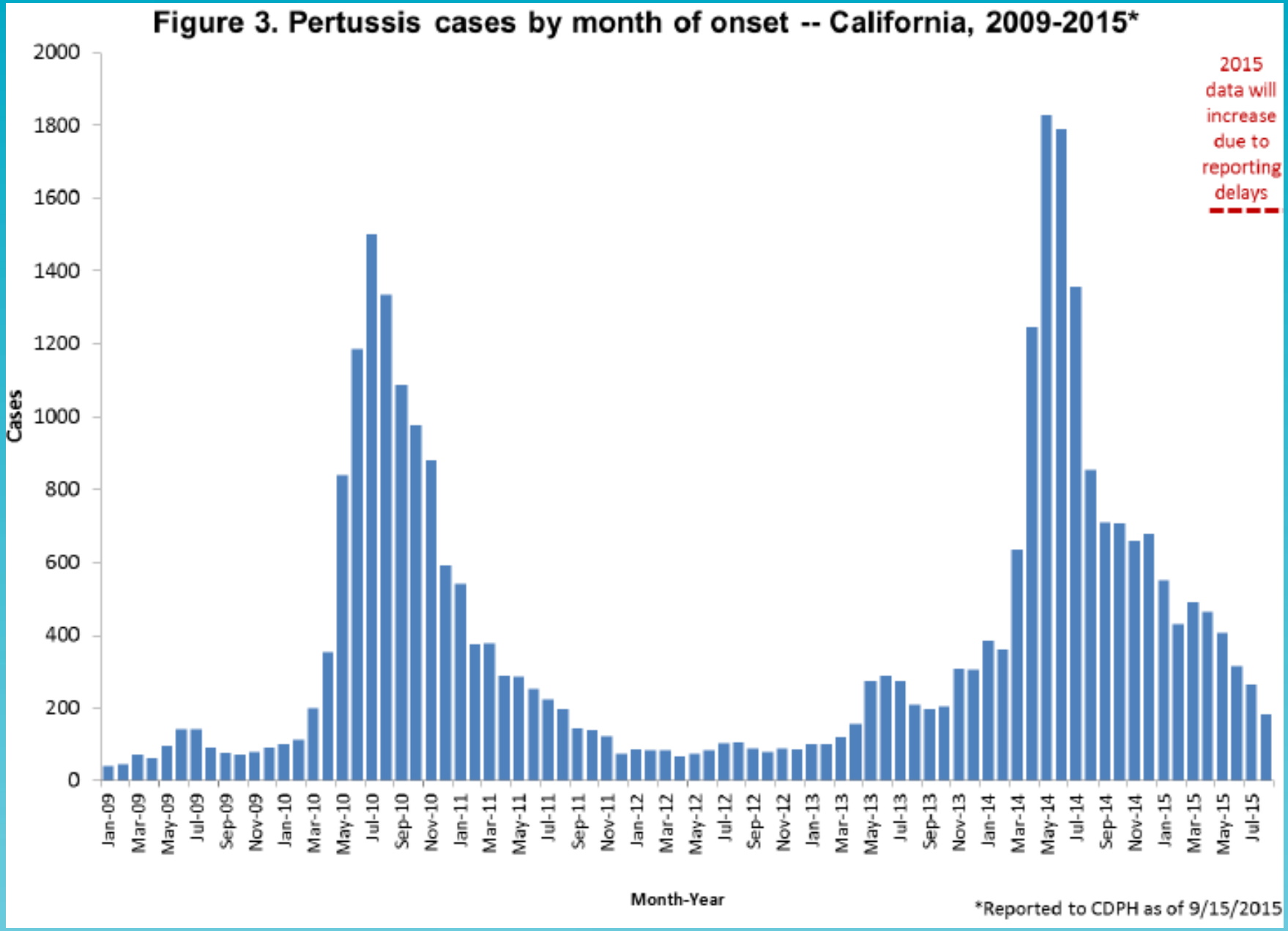

Source: CDPH, downloaded 9/18/15 from:
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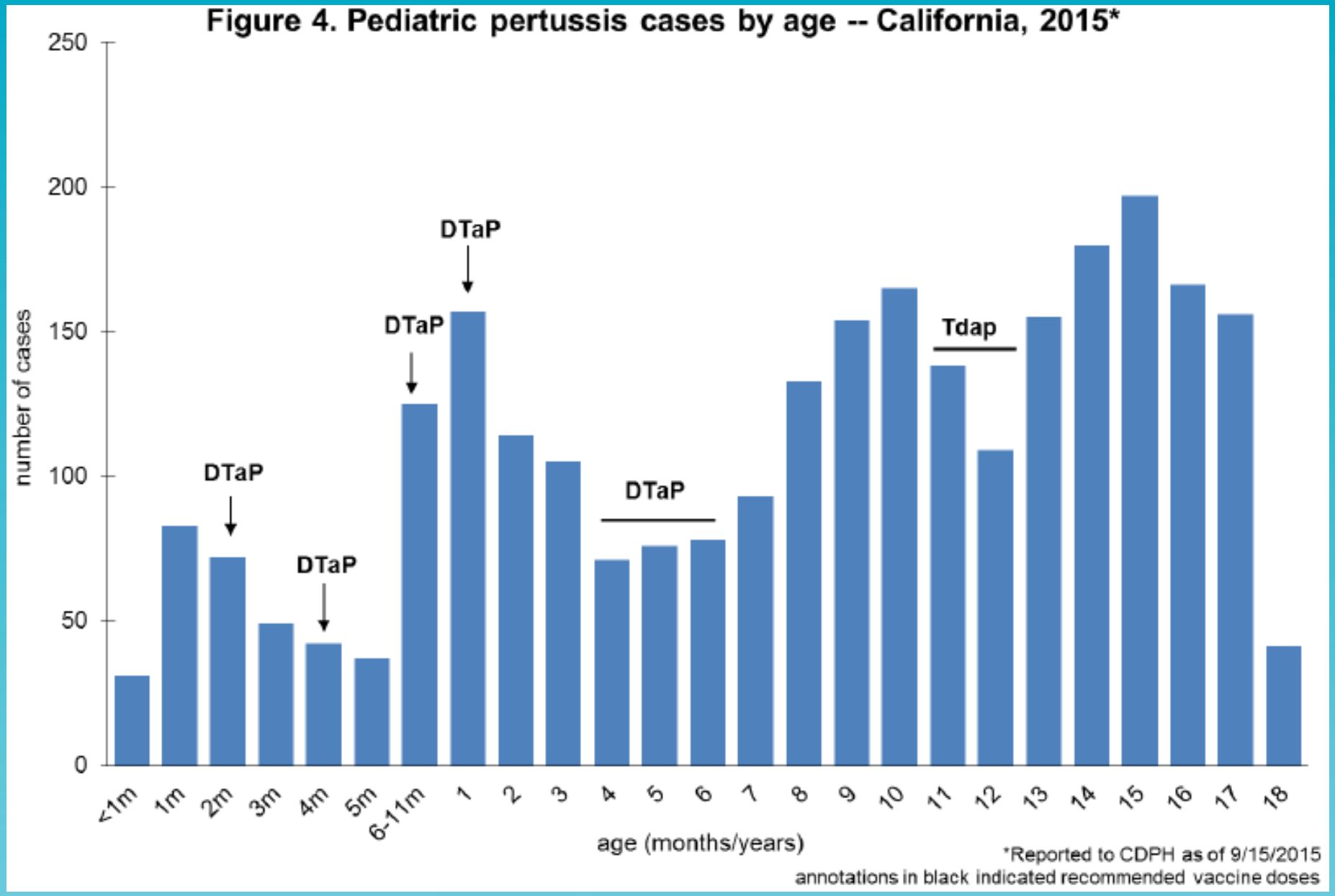

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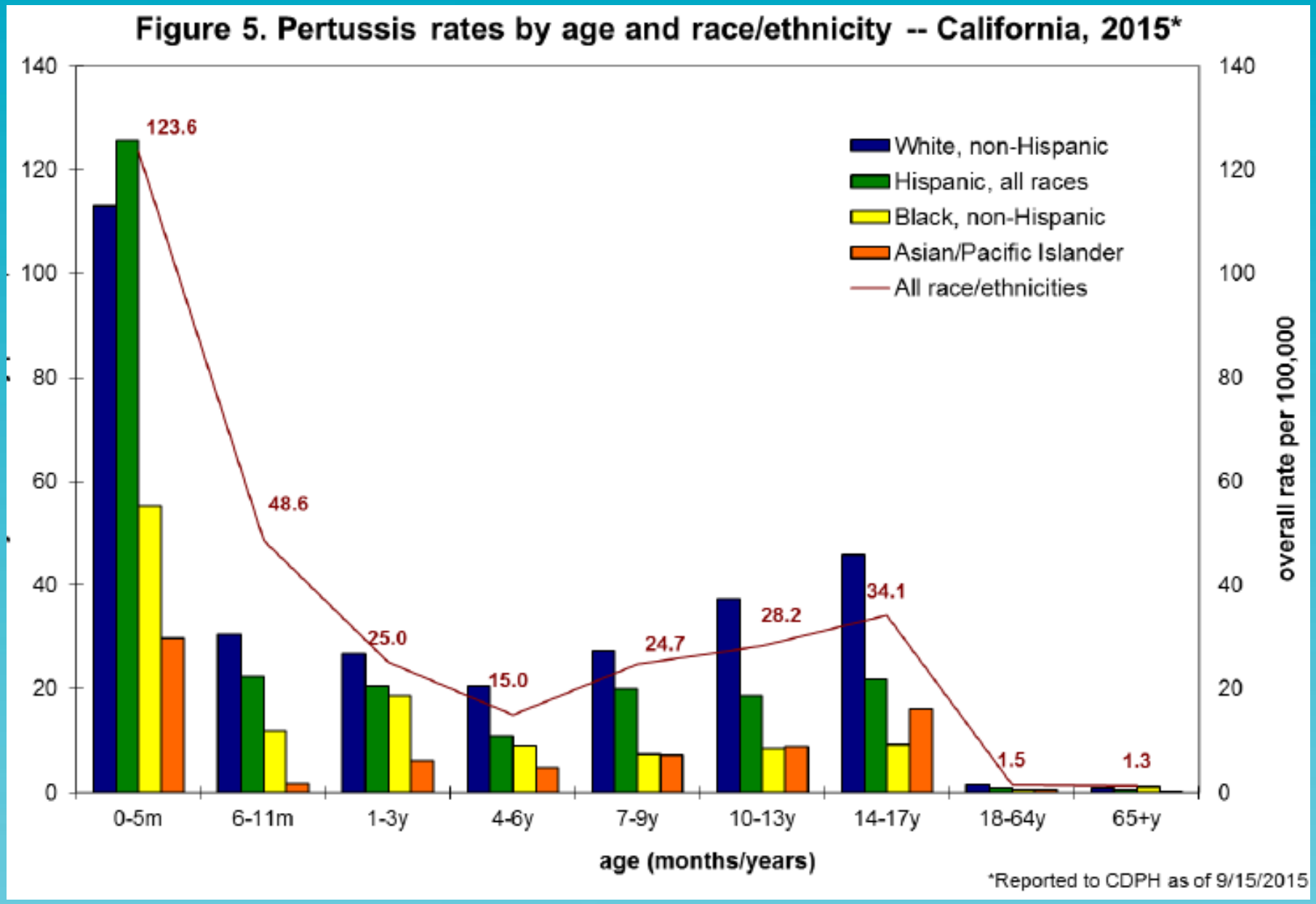

Source: CDPH, downloaded 9/18/15 from:
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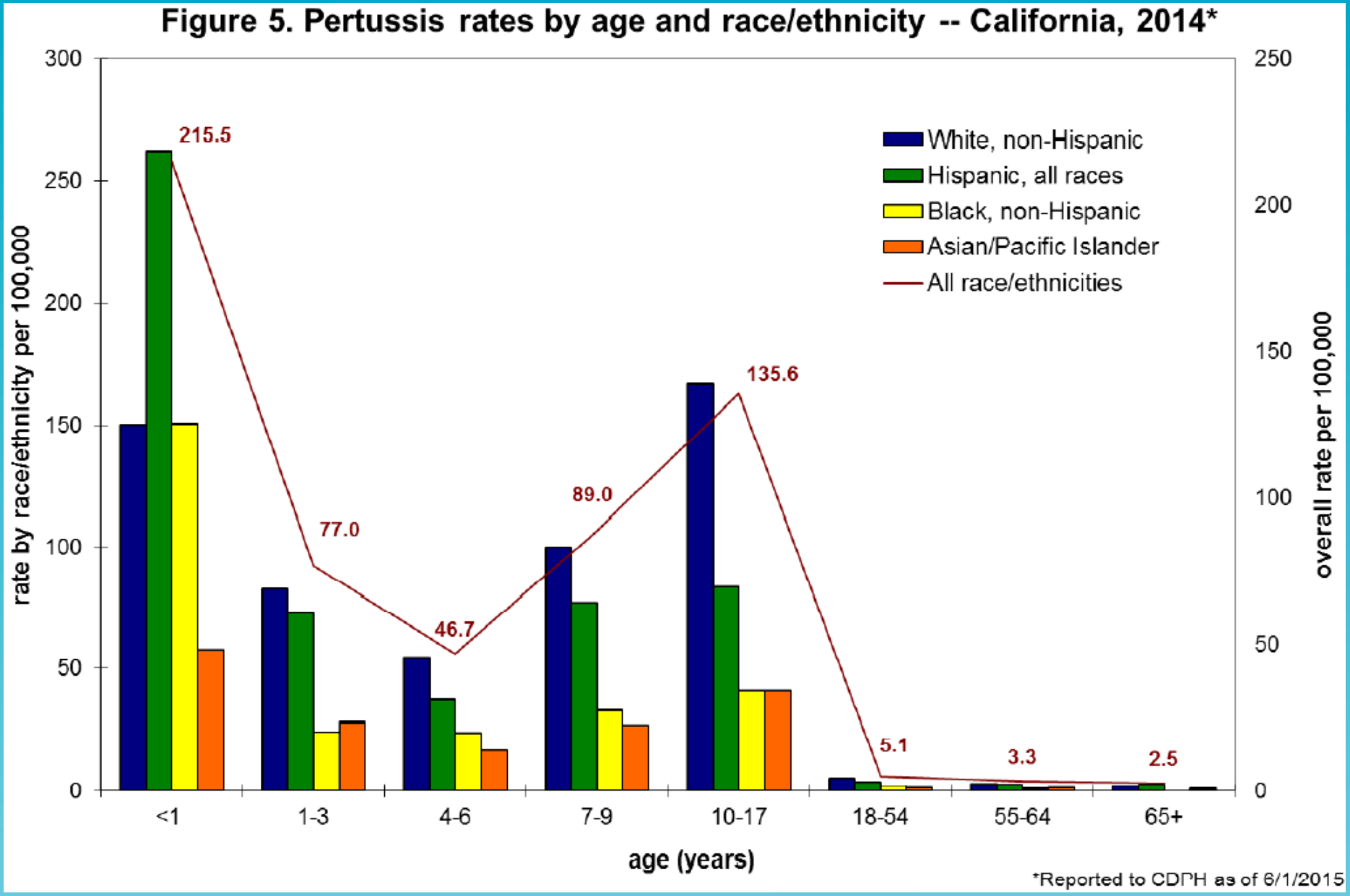

Source: CDPH, downloaded 9/16/15 from:
http://www.cdph.ca.gov/programs/immunize/Documents/PertussisReport6-1-2015.pdf

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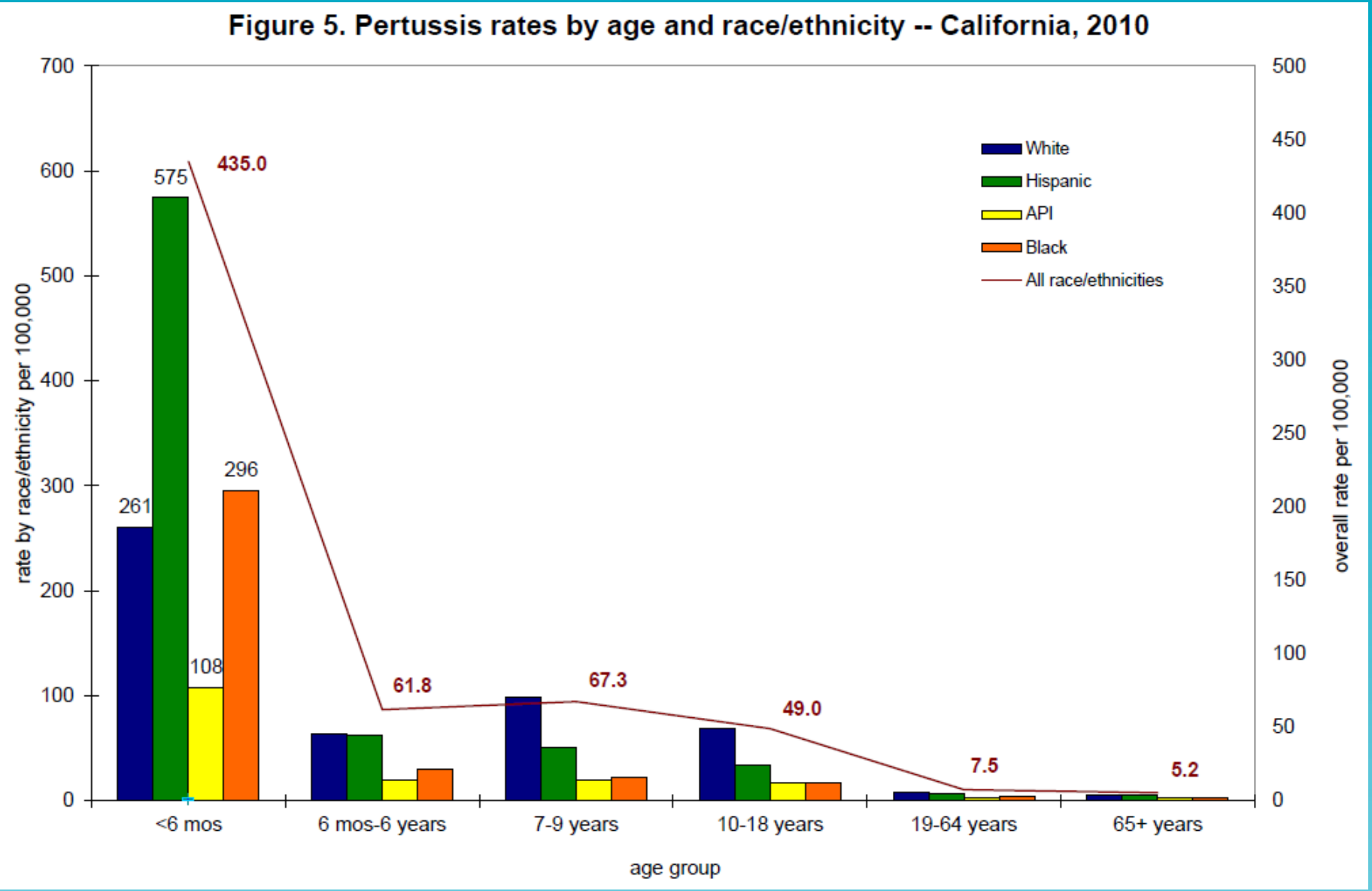

Source: CDPH, downloaded 9/16/15 from:
http://www.cdph.ca.gov/programs/immunize/Documents/PertussisReport2011-11-10.pdf

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PRIORITY CONTROL STRATEGY

EVERY PREGNANT WOMEN RECEIVES TDAP BOOSTER FOR EVERY PREGNANCY AT 27-36 WEEKS EGA!

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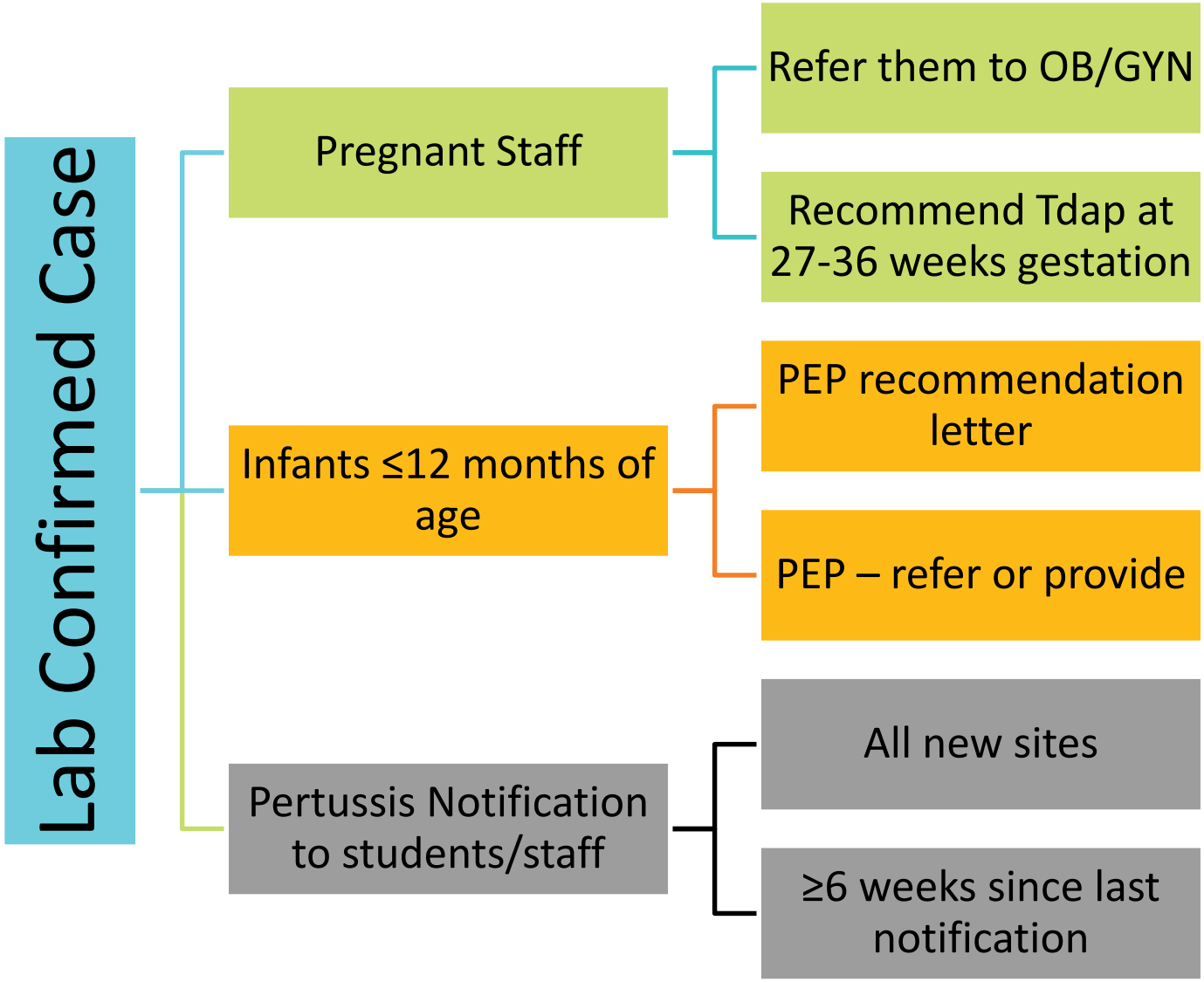
PREVENTION

IMMUNIZATION

- DTaP (Diphtheria, Tetanus, and acellular Pertussis)
  - Total of 5 vaccinations recommended at:
    - 2, 4, and 6 months of age
    - 15-18 months of age
    - booster at 4-6 years of age
- Tdap Booster (Tetanus, diphtheria and acellular pertussis)
  - Everyone 11 years and older should get 1 Tdap
  - No minimum interval between Td and Tdap

EXPOSURE MANAGEMENT IN DAYCARE, CHILDCARE & K-12TH GRADE SETTINGS



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