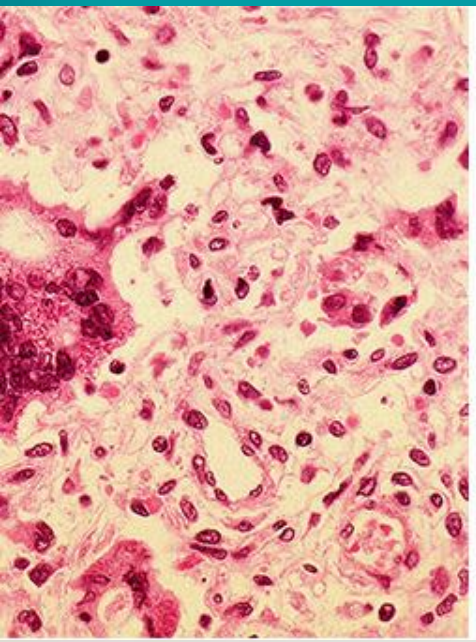
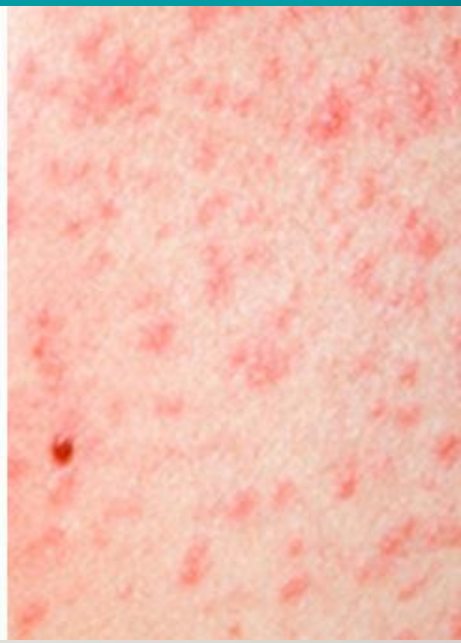
It IS a Small World After All:

The Public Health Impact and Immunologic Assessment of a Disneyland Measles Case in El Paso County, Colorado





Panel: Robyn Espy, M.P.H, Marigny Klaber, M.Sc., Shannon Rowe, M.P.H., Bernadette Albanese, M.D., M.P.H. (Tri-County Health Department), Emily Spence-Davizon, M.P.H. (Colorado Department of Public Health and the Environment)

Date: April 21, 2016

El Paso County, CO Public Health

Prevent • Promote • Protect

Presentation Agenda

- Measles Background and Timeline of Events
- Use of Incident Command System
- Patient Vaccine History and Immunology
- Discussion

Learning Objectives

- Participants will be able to….
  - Conduct a measles contact investigation
  - Describe the use of ICS
  - Define and differentiate quarantine and isolation
  - Discuss measles serologic studies
  - Distinguish between primary and secondary vaccine failure, typical vs. atypical measles

What is Measles?

(Clinical Information)

1. Respiratory viral infection
2. Vaccine preventable disease
3. Causes fever, 3 C's, Koplik Spots, Red Rash*
4. Incubation Period: 7-21 days, usually about 14 days
5. Infectious Period: 4 days before rash onset to 4 days after rash onset
6. Complications are common

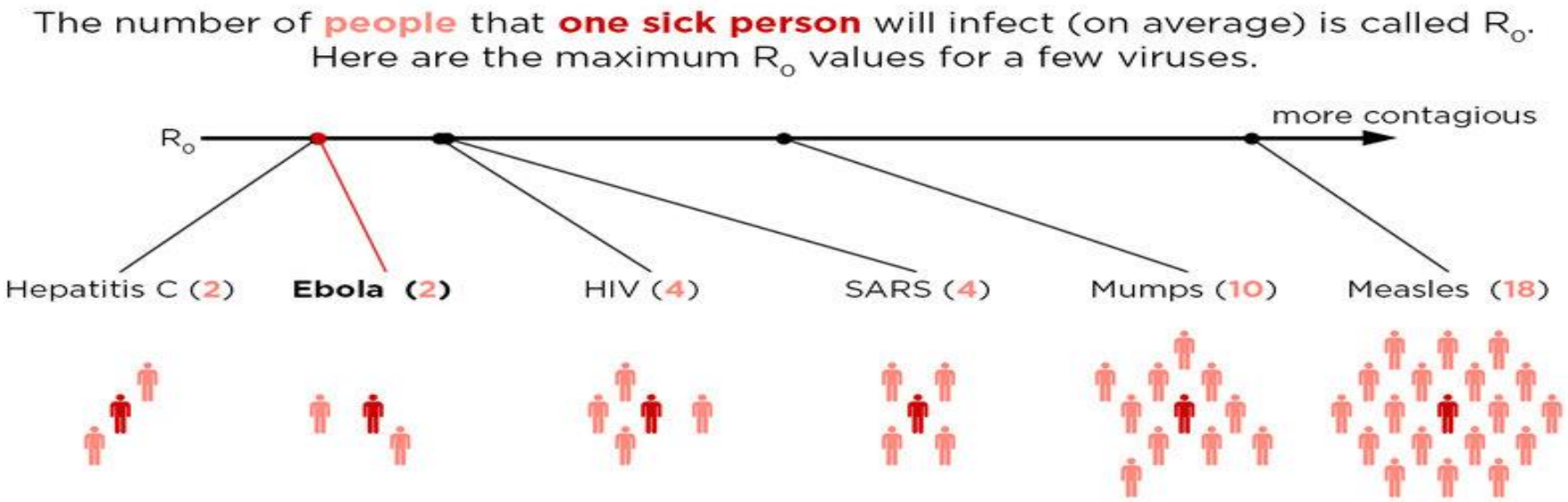
**Photo courtesy of American Academy of Pediatrics*

How Does it Spread?

(Transmission)

- Airborne transmission
  - Lives in nose, throat and mucus of infected person
  - Spread through coughing and sneezing
  - Up to 2 hour survivability in the air and on surfaces
- Highly infective and highly contagious

Reproductive Rate (R_0): Measles and Other Select Diseases*

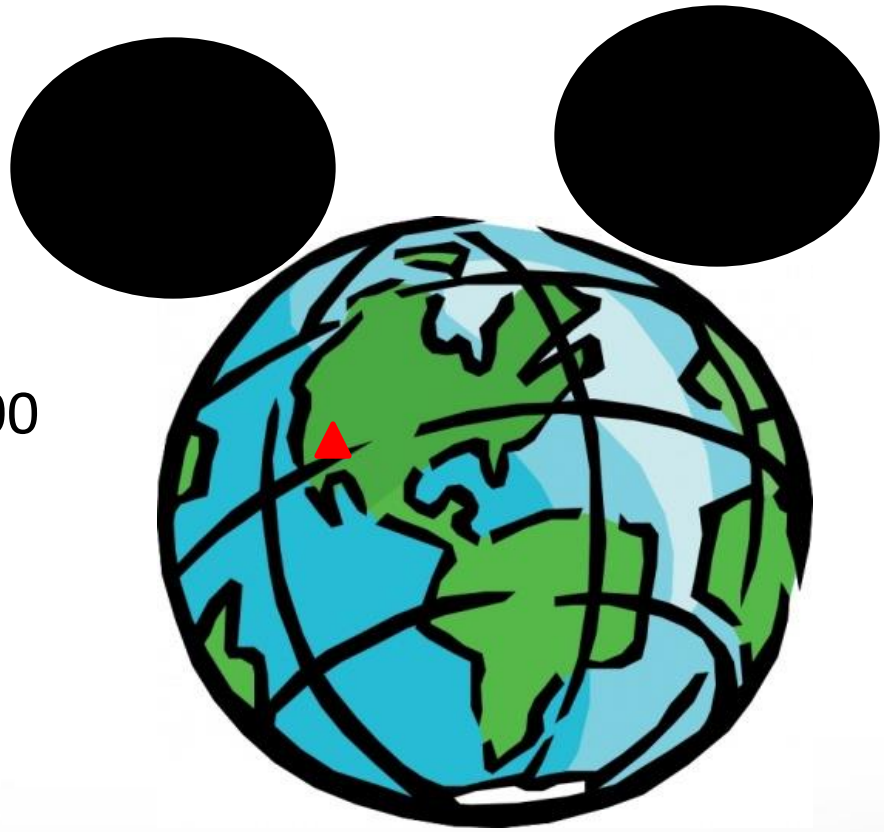


*Source NPR http://www.npr.org/sections/health-shots/2014/10/02/352983774/no-seriously-how-contagious-is-ebola

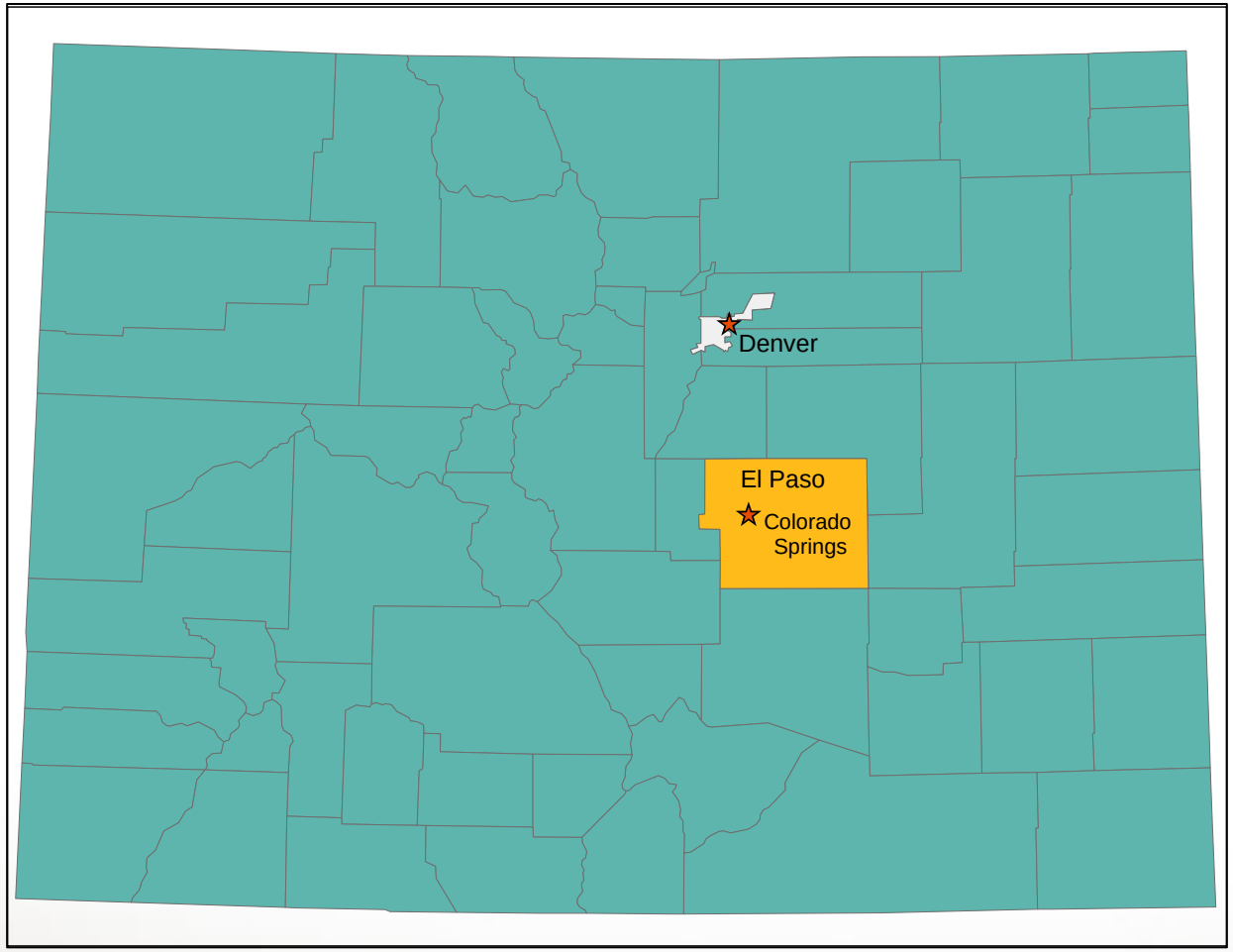
What's the Distribution Look Like?

(Epidemiology)

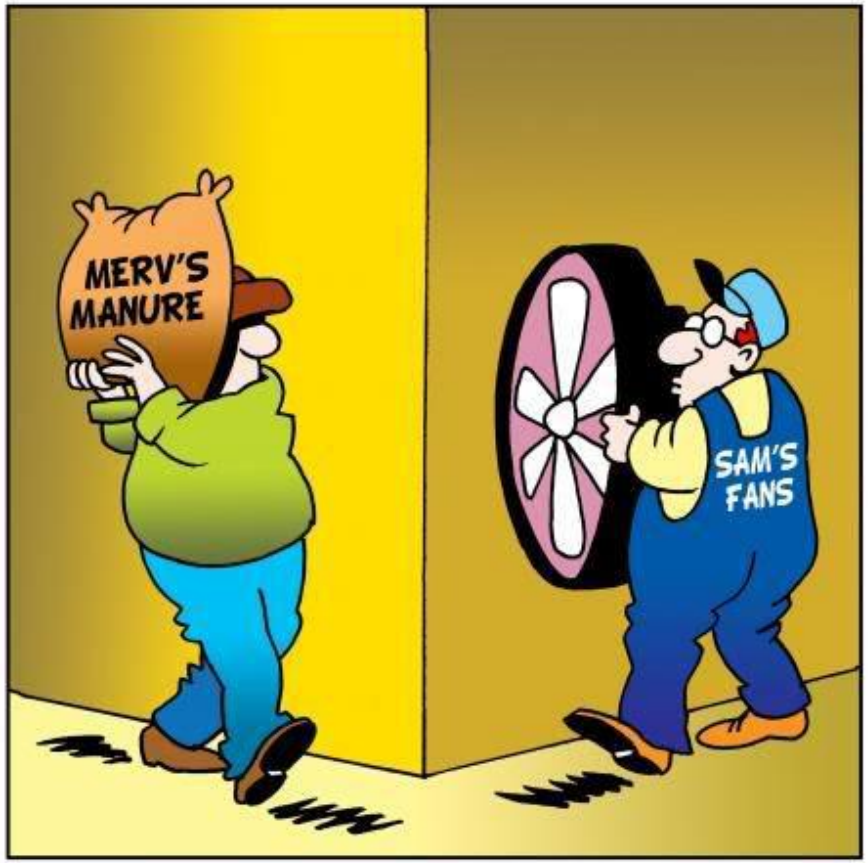
- Global
  - 20 million new infections annually
  - 146,000 deaths
- USA
  - "Eliminated" by the year 2000
  - Most cases imported
- Disneyland 2014-2015
  - 147 sickened in 7 states
  - 1 case in Colorado
  - Cases in Mexico and Canada



Location of Measles Exposures



The Day It All Started……



January 5, 2015

Timeline


Exposure Period & Case Onset of Illness
Case Investigation
Contact Investigation
After Action Activities
12/11-1/3
1/5-1/7
1/8-1/24
1/28-2/6

Case Investigation

- Tri-County Health Department requested case investigation assistance
- Patient and parents interviewed
- Centers for Disease Control and Prevention notification of measles outbreak associated with travel to Disneyland

Progression of Symptoms

Prodrome Dec 29

- Runny nose
- Sore throat
- Cough
- Then fever, malaise

Rash onset Jan 1

- Red, blotchy
- Spread from trunk to extremities

Hospital admission Jan 3

- Diffuse rash, conjunctivitis, Koplik spots
- Cough, shortness of breath
- Pneumonia, pleural effusions
- Extreme weakness

Measles Management Timeline

El Paso County, CO Public Health

Colorado Department of Public Health and Environment

KEY: Signs & Symptoms | Exposure & Incubation | Infectious Period | Lab Specimens | Prophylaxis | Disease Control

Onset of Rash

18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21

PRODROME 2-4 days (range 1-7 d); fever, conjunctivitis, cough, coryza, Koplik spots

EXPOSURE PERIOD – Average incubation is 14 days (range 7-21 days) to rash onset; OR 8 to 12 days to prodrome onset

21 d

RASH - lasts 5-6 days; red or red-brown, blotchy, begins on face at hairline & spreads down; fever may ↑ to >104°F

INFECTIOUS PERIOD – 4 days before to 4 days after rash onset; may be longer for persons with T-cell deficiency (e.g. AIDS, leukemia, lymphoma.)

ACUTE SERUM for IgM[1] – may be positive for 30 or more days after rash onset. May be negative if drawn within first 72 hrs (repeat if negative).

30 d

ACUTE SERUM for IgG – ASAP after rash onset

CONVALESCENT SERUM for IgG 10-30 days after rash onset

30 d

PCR OR CULTURE (Nasal wash, NP swab, or urine) within 10 days after rash onset[2]

ISOLATE CASES through 4 days after rash onset

CASES

CONTACTS

POSTEXPOSURE VACCINATION with MMR within 72 hrs after exposure for persons ≥ 6 mo without contraindications

POSTEXPOSURE IMMUNE GLOBULIN (IG) – May protect certain persons[3] if given within 6 days after exposure

QUARANTINE NONIMMUNE CONTACTS (voluntary or with public health order) from 7 to 21 days following exposure.

[1] Serologic tests may be falsely positive, so positive commercial IgM tests should be confirmed at CDPHE lab.

[2] For best results with viral culture, collect specimens ≤3 days after rash onset. Diagnostic yield is low for specimens collected >10 days after rash onset.

[3] Especially indicated for susceptible household or other close contacts, particularly those contacts <1 year of age, pregnant women, and immune-compromised persons. (Usual dose is 0.25mL/kg, or 0.5mL/kg for immunocompromised {max 15 mL}.)

Note: For detailed information on measles, see: www.cdphe.state.co.us/dc/Epidemiology/Measles/

EPCPH 8/31/2011

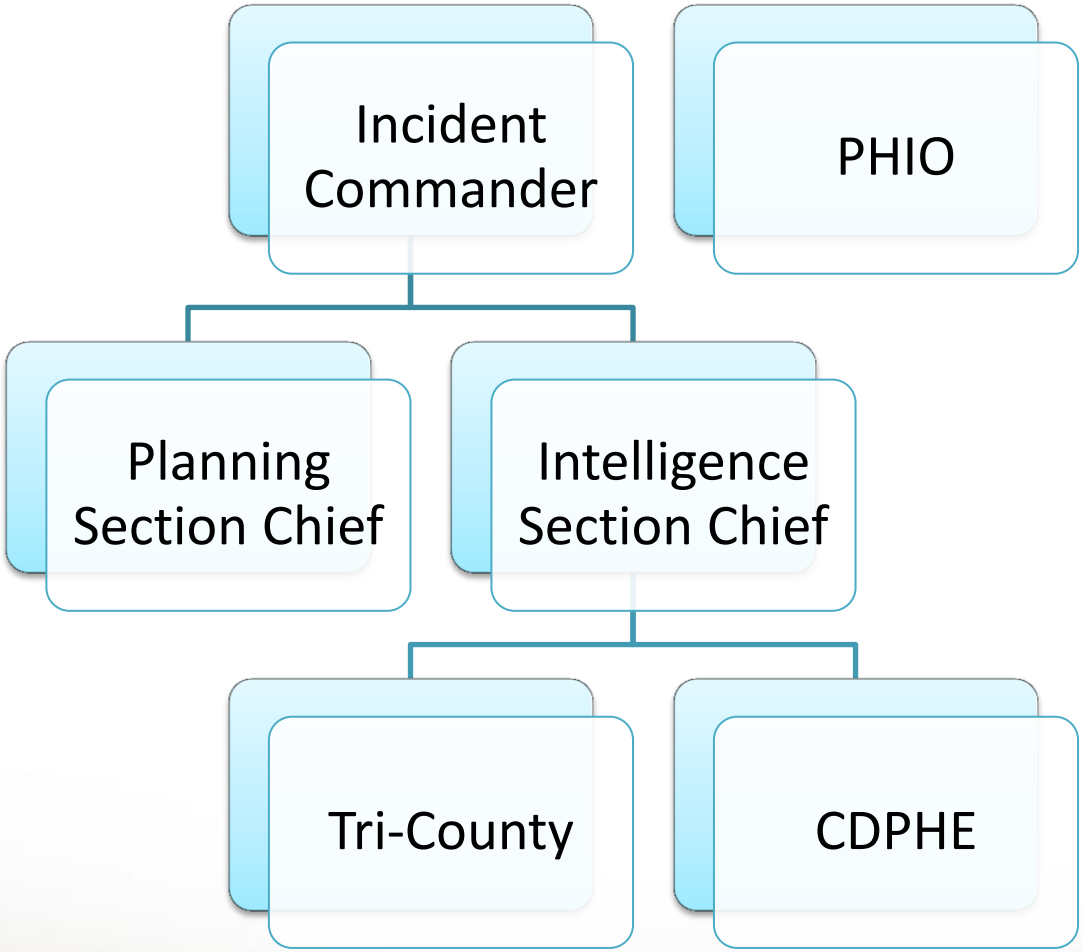
Role of Communication

- Transparent
- Single Overriding Communication Objective (SOCO) Messaging
- Identify Contacts Promote Vaccination
- Processes versus Terminology

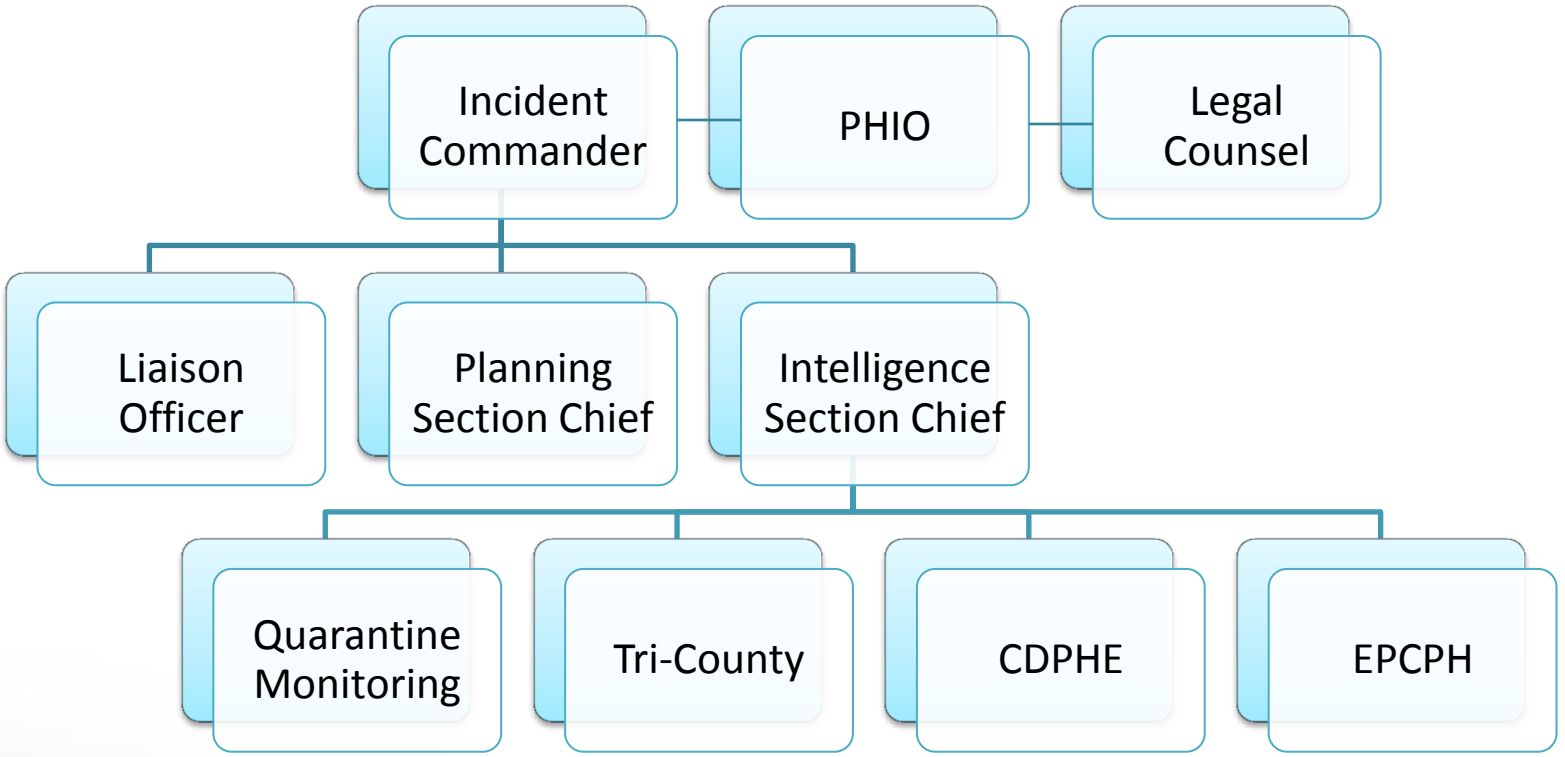
Contact Investigation

- Family and Friends
- Hospital Staff
- Patients and Guests
- Emergency Responders

Use of Incident Command System (ICS)



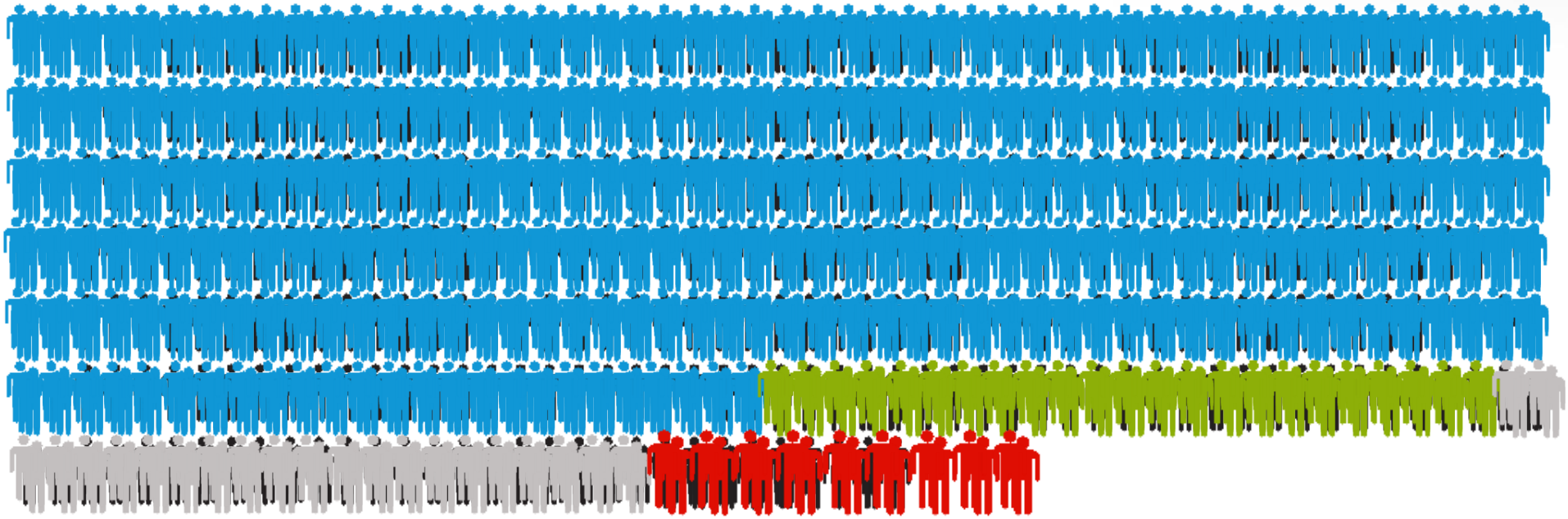
Final ICS Organization Chart



How were People Exposed at the Hospital?

- Based on where and when case was at Penrose Hospital and how air flow in hospital worked
- Exposure happened on January 3 in the following areas:
    - Emergency Department and CAT scan suite from 9:00 a.m. – 7:00 p.m.
    - Fourth floor of hospital from 4:00 p.m. – 11:00 p.m.

Contact Risk Assessment



329 Known Exposures

275 Immune

23 Monitored for 21 Day Incubation Period

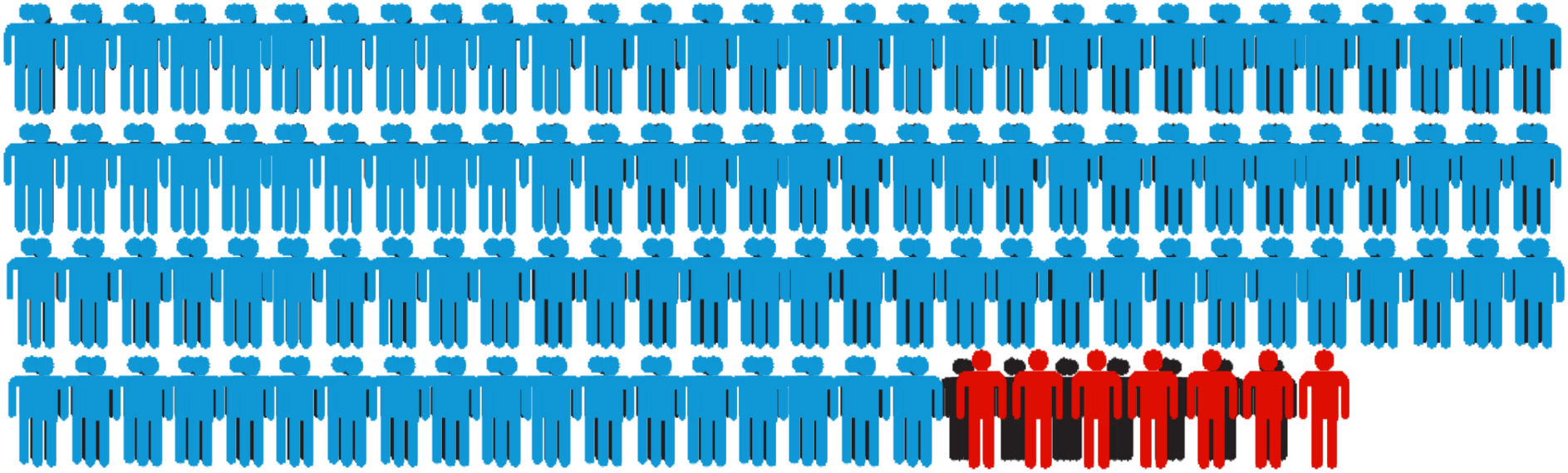
22 Unknown- Lost to Follow-up

9 Quarantined

Health Care Worker Exposure Criteria

Immune	Susceptible
History of measles disease	NO history of measles disease
Positive IgG titer for measles	Negative or NO IgG titer for measles
TWO documented doses of MMR vaccine	NO documented MMR vaccine

Health Care Worker Contacts



115 Known Exposures

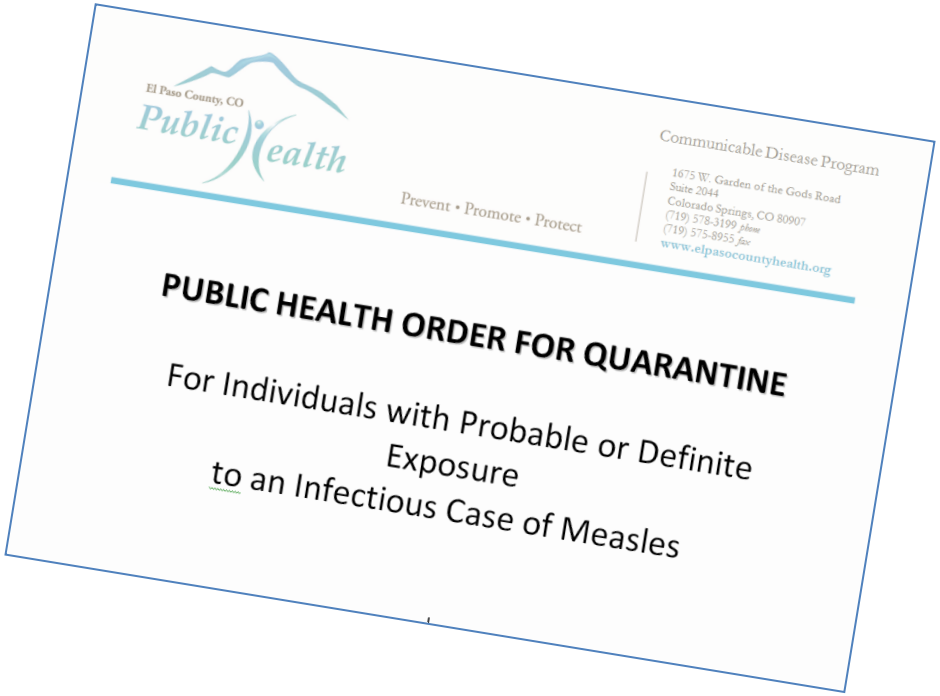
108 Immune

7 Quarantined

Purpose of Isolation and Quarantine

- **Isolation** separates sick people with a contagious disease from people who are not sick.

- **Quarantine** separates and restricts the movement of people who were exposed to a contagious disease to see if they become sick.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Prevent • Promote • Protect

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www.elpasocountyhealth.org

PUBLIC HEALTH ORDER FOR QUARANTINE

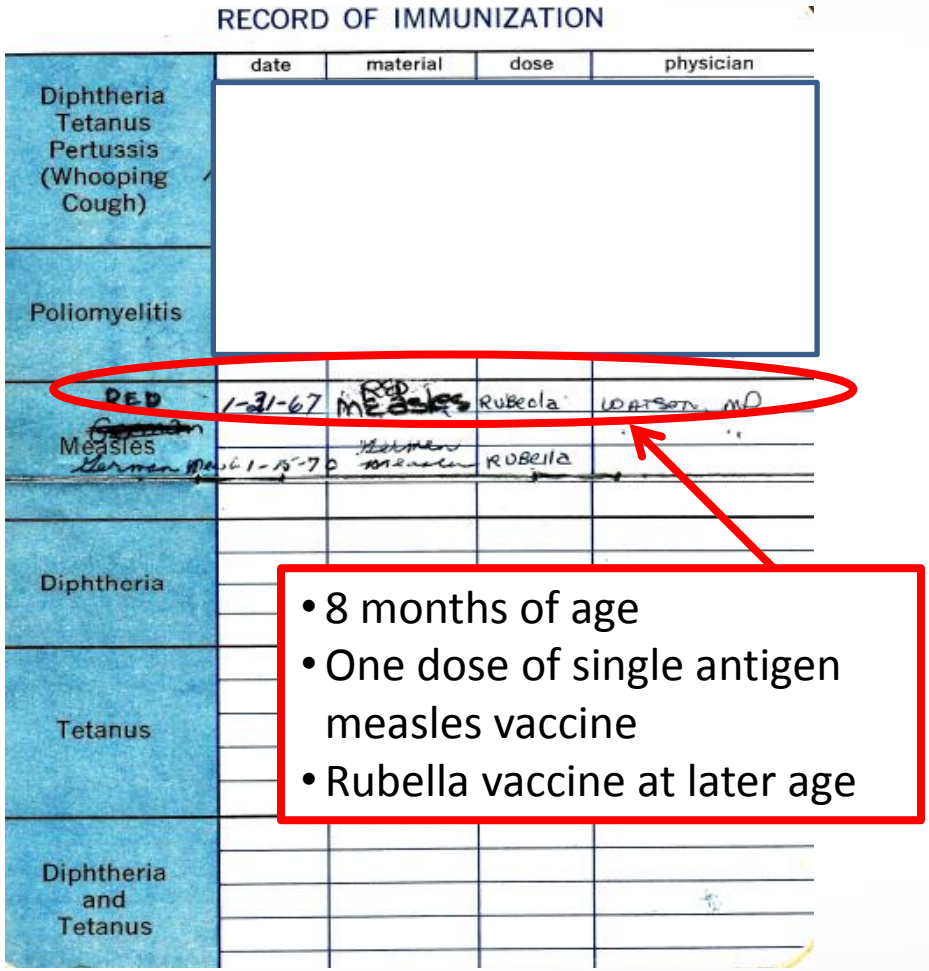
For Individuals with Probable or Definite Exposure
to an Infectious Case of Measles

How Quarantine Orders Were Served

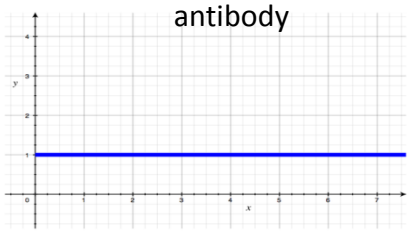
- Used CDPHE measles Quarantine Order template
- Legal review of Quarantine Order prior to issuing by El Paso County Attorney
- 9 people were determined to be high risk contacts needing quarantine
  - Law enforcement escorted public health workers from a distance

Why Did Person Develop Measles?

- Gave verbal history of measles vaccination
- TCHD asked patient to find records

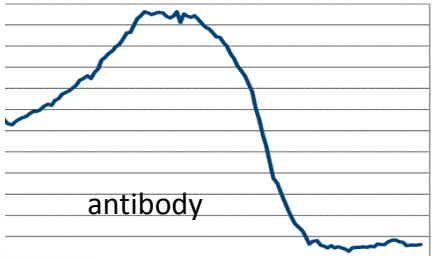


When Vaccination Fails



Primary vaccine failure

- Vaccine related – potency, storage, handling, or administration
- Host related – poor health status, immune compromised, immature immune system



Secondary vaccine failure

- Initial response then loss of immunity (waning)
- Host related – poor health status, immune compromised
- Vaccine related – vaccine potency

Measles Vaccine in the 1960s

- Measles vaccine licensed in 1963
- Live versus killed vaccine
  - Live vaccine
    - Attenuated, live Edmonston strain
    - One dose, given prior to one year of age for many years
  - Killed vaccine
    - Formalin inactivated
    - Infant regimen usually multiple killed “K” doses at 1 month interval THEN dose of live “L” vaccine
      - K-K
      - K-K-K
      - K-K-L
      - K-K-K-L

Measles Vaccine in the 1960s

- Common practice to vaccinate infants
  - Primary vaccine failure not recognized until epidemics during 1970s
    - Live vaccine: due to too early age of administration (blocking maternal antibody)
    - Killed vaccine: due to poor antigen stimulation; Ab short lived
- Vaccine recipients remain susceptible to measles

What About Atypical Measles

- Clinical syndrome
  - Occurs years (adults) after receipt of killed vaccine, then exposure to wild type virus
  - Fever, *myalgias*, abdominal pain, *cough, pleuritic chest pain, dyspnea, pleural effusion*, weakness
  - Rash atypical – distal to central; prominent on wrists/ankles
- Due to exaggerated cellular immune response to virus
- Contributed to removal of killed vaccine from market in 1968

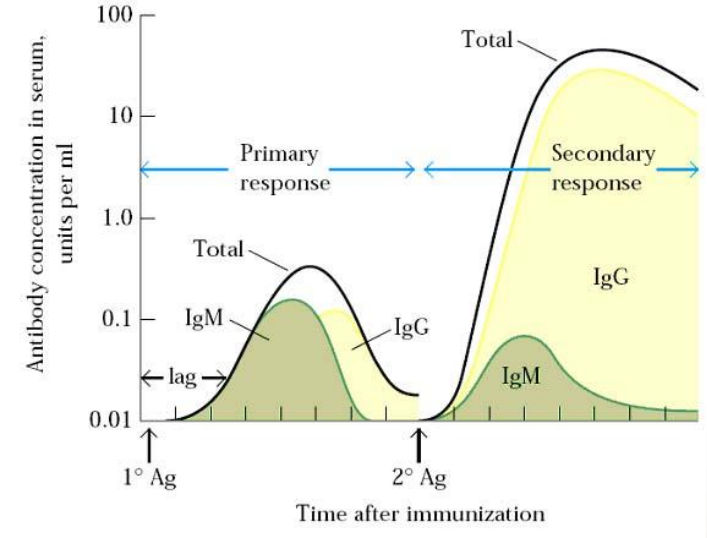
Diagnosis of Atypical Measles

- Serologic marker for atypical measles
  - Very high IgG – part of the aberrant immune response and symptoms
  - Serially dilute serum to 1:1028 (detect measles antibody in very dilute serum)

Testing for Measles Immunity

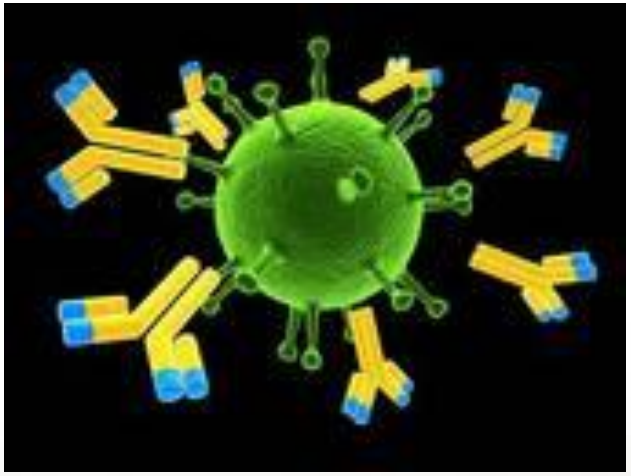
Public health usually tests for:

- Measles IgM – acute disease or recent vaccination
- Measles IgG – measure of immunity from prior infection or vaccination



Supplemental Testing for Measles Immunity

- Avidity testing
  - Measures how “tightly” antibody reacts with measles antigen
  - Special test request from CDC



Avidity Testing

Low avidity

- Weaker binding of antibody to antigen
- Antibody from primary measles infection
  - Naïve (unvaccinated) host

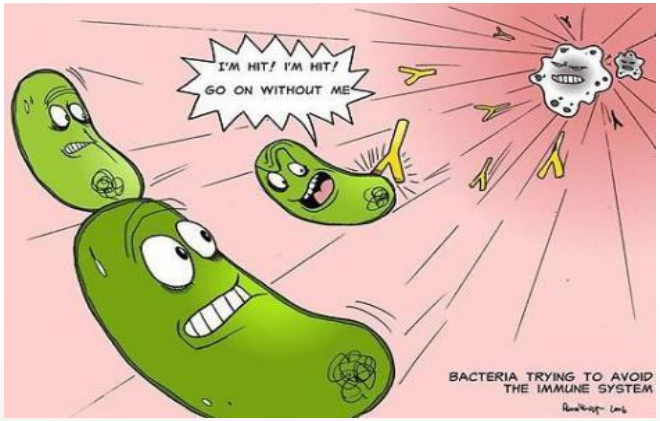
  OR
  - Primary vaccine failure

High avidity

- Stronger binding of antibody to antigen
- Antibody from secondary measles infection
  - Secondary vaccine failure (waning immunity) then production of 'mature' higher affinity antibody when exposed to wild virus

Supplemental Testing for Measles Immunity

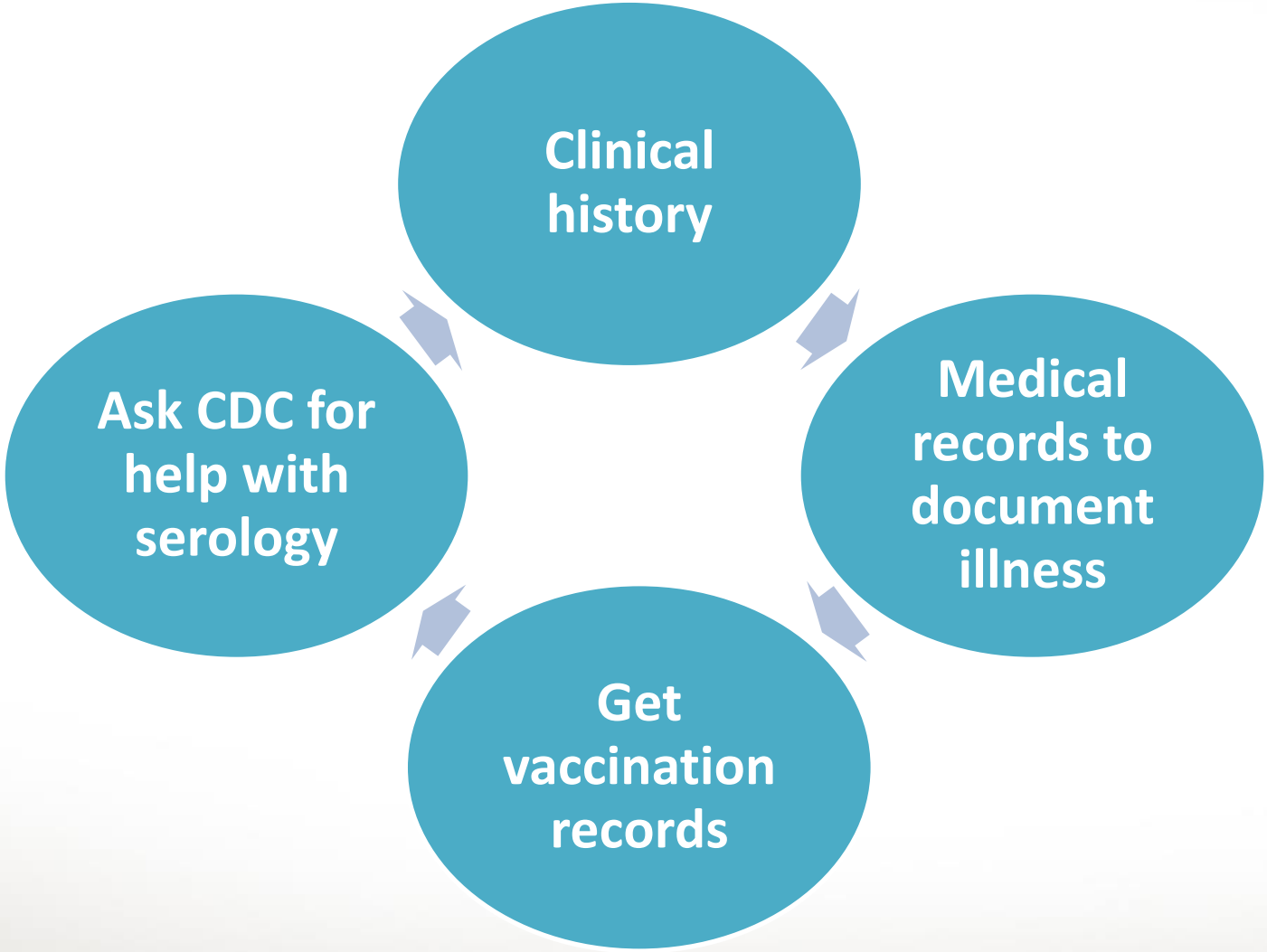
- Plaque reduction neutralization titer
  - Measures functional antibody and ability to bind measles antigen
    - *How well antibody kills the virus in vitro*
  - Not antibody type specific! IgM or IgG



Why Did Person Develop Measles?

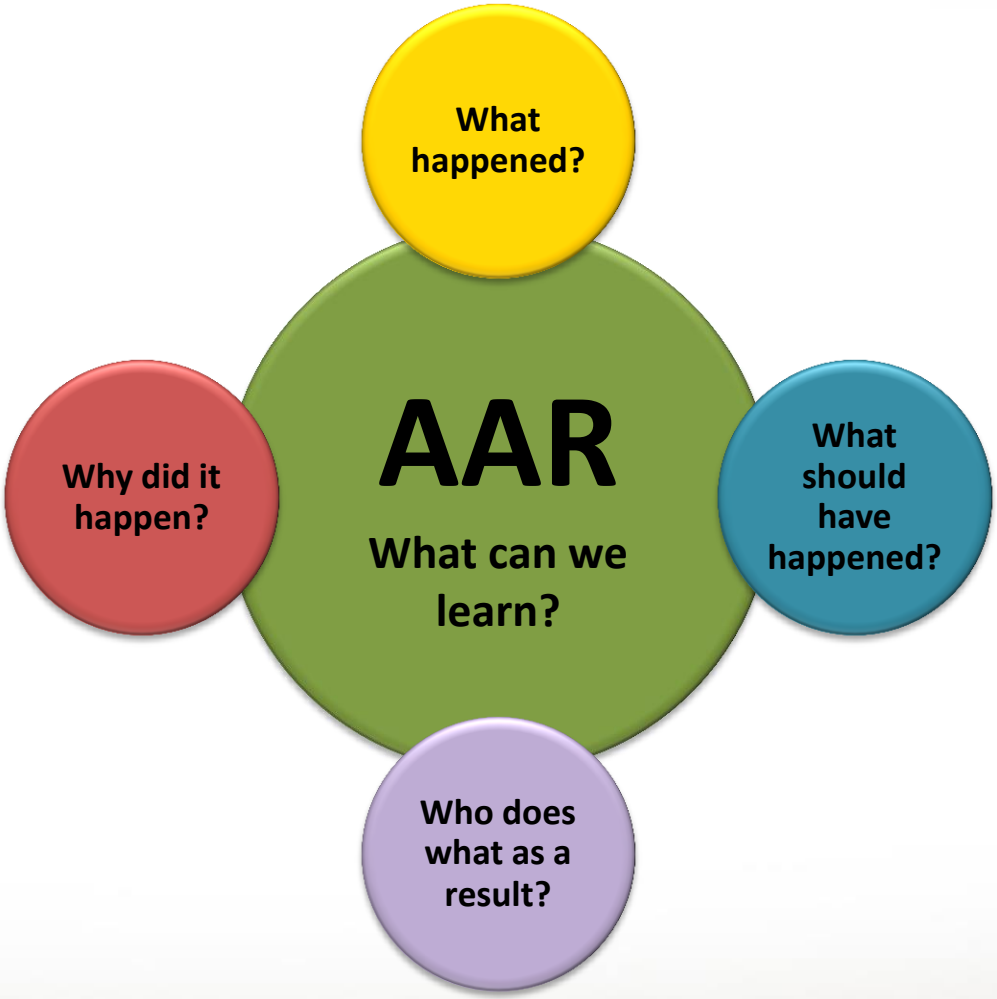
One dose of vaccine	• Received during infancy
2 days post rash	• High IgM • IgG negative
16 days post rash	• IgM still high • Low level IgG
Avidity testing	• Low avidity = primary infection
Plague reduction neutralization titer	• Two fold increase between early & later serum; Likely represents IgM

Sorting Out Immune Response

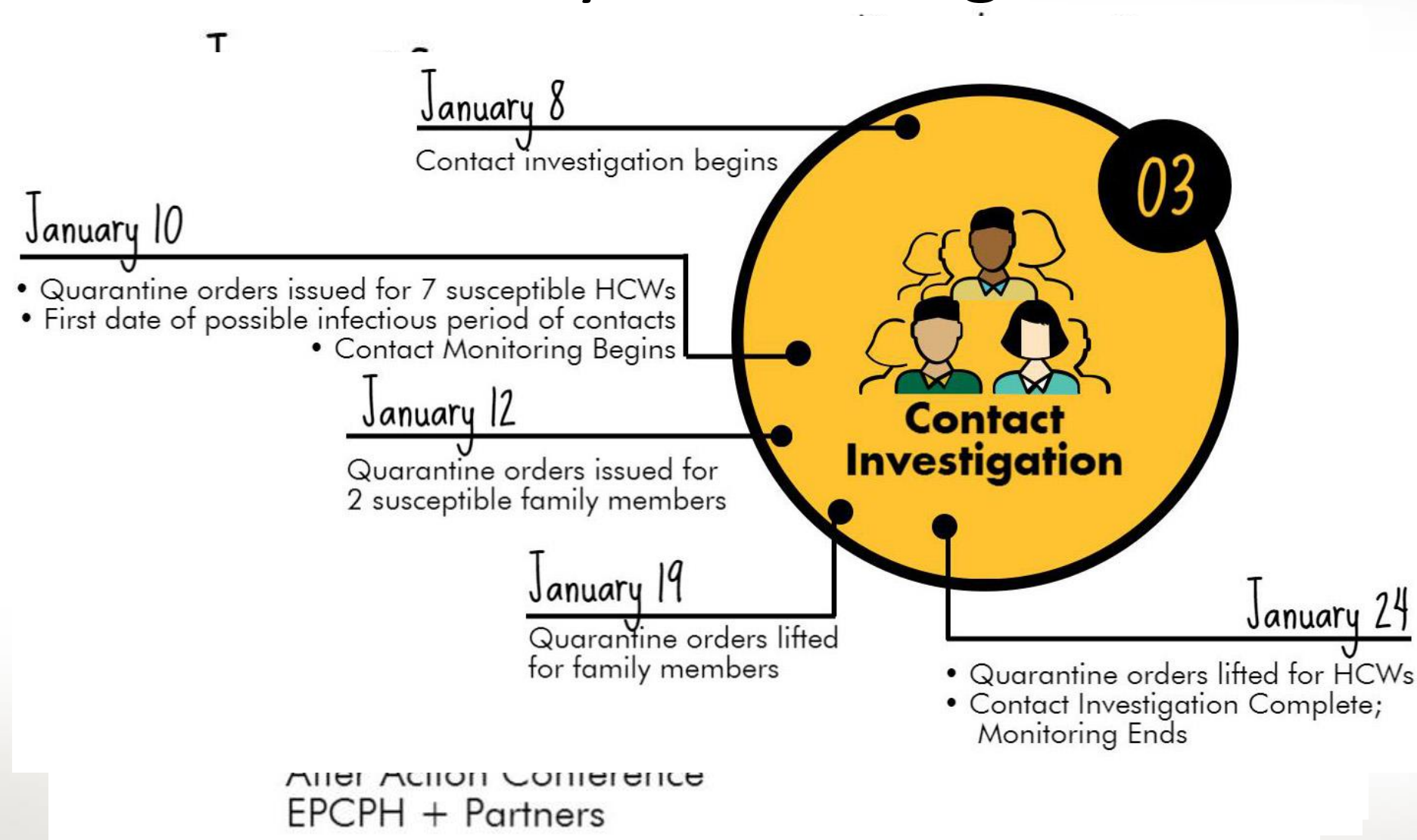


Actions Taken After the Event & Lessons Learned

- Meetings
- After Action Report (AAR)
- Immunology Lessons



Summary of Investigation



After Action Conference
EPCPH + Partners

Questions?


AT DISNEYLAND, SMILES ARE CONTAGIOUS!
...SO IS MEASLES.
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