ONE HEALTH
ARTHROPOD-MEDIATED DISEASES
IN ANIMALS AND HUMANS

Eric McDonald, MD, MPH, FACEP
Medical Director, Epidemiology Program
Public Health Services
San Diego County Health & Human Services Agency

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5 May 2019
One Health recognizes that the health of people is connected to the health of animals and the environment.

It is a collaborative, multisectoral, and transdisciplinary approach—working at the local, regional, national, and global levels—with the goal of achieving optimal health outcomes recognizing the interconnection between people, animals, plants, and their shared environment.

A One Health approach is important because 6 out of every 10 infectious diseases in humans are spread from animals.
ONE HEALTH

Human Health

Animal Health

Environmental Health
 ROUTES OF DISEASE TRANSMISSION

Environment

Wildlife

Humans

Vectors

Fomites

Domestic Animals

Environment

Environment
• Ranger from nearby lake reports increased waterfowl mortalities.

• Are they related to new vector borne disease?

• Domestic goose and ducks submitted for necropsy.

• DDX: WNV, avian influenza, avian malaria, trauma, toxin…
Female, adult goose
Good body condition

Abdominal malformed egg
Abundant seed in stomach
• 26 Hours
• Seed suspicious of strychnine-laced bait for gopher control.
• Raman spectroscopy
• Wet chemistry
• 72 Hours
• Toxicology Lab
• Mass spectrometry confirms strychnine in seed.
LAW ENFORCEMENT

- 72 Hours
- USFWS investigation
- Pesticide Regulation program
LOCAL ONE HEALTH

U.S. Fish and Wildlife Service

Pesticide Regulation Program

Medical Examiner

Hazardous Materials

Parks and Recreation

Vector Control Program

Public Health
63 y.o. female

Prior residence - Sri Lanka and India

Current residence - Lakeside, CA

Nausea, vomiting, abdominal pain

Hospitalized

Plasmodium sp. detected in blood

Diagnosis: malaria
County VCP increased mosquito surveillance initiated
Transmission of Plasmodium vivax Malaria -- San Diego County, California, 1988 and 1989

Malaria transmission in the United States occurs infrequently; since 1950, 21 outbreaks of introduced malaria, all caused by Plasmodium vivax, have been identified. However, 14 of these occurred in California (seven during 1986 (1), 1988, and 1989). Four outbreaks—one each in 1986 (1) and 1988 and two in 1989—occurred in San Diego County. This report describes the outbreaks in San Diego County in 1988 and 1989.

On August 2, 1988, a migrant worker who lived in a canyon near the Lake Hodges reservoir (25 miles north of San Diego) (Figure)

1. was diagnosed with P. vivax infection. Twelve other workers who lived in the same area and had symptoms suggestive of malaria were referred by a public health nurse for diagnosis; on August 3, P. vivax parasitemia was confirmed in all 12 workers.

An epidemiologic investigation identified a total of 30 persons who had symptomatic P. vivax infections with onset between July 24 and September 18. Two cases were in local permanent residents who had no apparent risk factors for malaria, and 28 were in migrant workers employed primarily in agricultural businesses near the Lake Hodges reservoir. All patients denied previous malaria infection, intravenous (IV)-drug use, and blood transfusions in the previous 3 years.

Nineteen of the migrant workers lived in the canyon area; seven lived on a farm directly south of the canyon; one pregnant woman worked at a tree nursery adjacent to the farm and was required to be outside at dawn and dusk; and one migrant worker had onset of symptoms after moving from the canyon. The two cases in local permanent residents occurred in a couple who lived in a development adjacent to the farm.

The migrant workers in the canyon had diverted water flow from a small channel to their camp; some of their shelters (consisting primarily of plastic tarps and cardboard materials) were located within 5 feet of the water. Of the 39 migrant workers (20 of whom had malaria) in this canyon, questionnaires were administered to 31 (79%); the remaining workers could not be located. Cases and noncases were similar in terms of type of shelter used for sleeping (open vs. enclosed), average number of daily hours spent by open water (lagoon, river, or canal), bathing site, and time of day returning to the camp.

It’s happened!

30 cases between July 24 and September 18, 1988.
Migrant workers living in a canyon + Anopheles hermsi
“Between animal and human medicine there is no dividing line—nor should there be.”

Rudolph Virchow, M.D., father of cellular and veterinary pathology
VECTORBORNE ILLNESS

- West Nile Virus
- Tularemia
- Plague
- Murine typhus
- RMSF (will discuss later)
West Nile Virus: Keep it on your radar!
West Nile virus (WNV) is a single-stranded RNA virus of the family Flaviviridae, genus Flavivirus. WNV is widely distributed in Africa, West Asia, & Middle East.

WNV belongs to the Japanese encephalitis antigenic complex.

WNV is closely related to:
- Yellow fever
- Dengue
- Japanese encephalitis
- St. Louis encephalitis

WNV was first detected in Western Hemisphere in 1999 during an outbreak of encephalitis in NYC and has since spread across U.S.
People may develop symptoms 2 to 14 days after they are bitten by infected mosquitoes.

Longer incubation periods have been documented in immunocompromised persons.

WNV is not communicable from person to person, with rare exceptions:

- Blood transfusions
- Organ transplants
- Breastfeeding
- Perinatal transmission
Approximately 80% of those infected with WNV are asymptomatic.

Up to 20% of those infected with virus may develop West Nile fever (WNF).

Clinical features of WNF may include:
- Fever, headache, fatigue
- Skin rash on trunk of the body
- Swollen lymph glands
- Eye pain
Of those infected with WNV, 1 in 150 or <1% may develop severe illness called WN neuroinvasive disease (WNND) because it affects a person's nervous system.

Specific types of WNND may include:
- Encephalitis
- Aseptic meningitis
- Acute flaccid paralysis (AFP)
- Atypical Guillain-Barré Syndrome (GBS)
- Transverse myelitis
Clinical features of WNND may include:

- Fever, gastrointestinal symptoms, ataxia  
  (*failure of muscular coordination; irregularity of muscular action*)
- Extrapyramidal signs (*e.g., extreme restlessness, involuntary movements, and uncontrollable speech*)
- Optic neuritis (*inflammation of the optic nerve*)
- Seizure, altered mental status
- Weakness, flaccid paralysis  
  (*weakness or loss of muscle tone*)
- Myelitis (*inflammation of the spinal cord*)
- Polyradiculitis (*inflammation of the nerve roots*)
- Maculopapular or morbilliform rash involving neck, trunk, arms, or legs
WNV Disease Cases, United States 2003-2018

WEST NILE VIRUS – US 2017

Human disease cases
Reported to CDC ArboNET by county of residence
- 1-10
- 11-20
- 21-50
- >50

Reports state level data only

Dates of symptom onset ranged from February to December, with the majority of the cases occurring during July to September.
554 human cases from 27 counties have tested positive for WNV in 2017.

44 WNV-related fatalities were reported

2 confirmed WNV cases in San Diego, 0 deaths

Source: CDPH  http://www.westnile.ca.gov/
218 human cases from 31 counties tested positive for WNV in 2018.

11 WNV-related fatalities reported

2 confirmed WNV cases in San Diego, 0 deaths

4 counties accounted for 40% of cases (LA, Riverside, Sacramento, Stanislaus)

Source: CDPH  http://www.westnile.ca.gov/ Downloaded 4/15/19
0 human cases have tested positive for WNV in 2019.

0 WNV-related fatalities reported

0 confirmed WNV cases in San Diego, 0 deaths

Source: CDPH  http://www.westnile.ca.gov/
Downloaded 5/4/19
Most efficient diagnostic method is detection of antibodies to WNV in serum and/or CSF collected within 7 days of illness onset.

Routine testing for WNV includes tests by enzyme immunoassay (EIA) and/or immunofluorescent assay (IFA).

Serological testing for WNV is no longer available at SDCPHL.

CDPH Viral and Rickettsial Disease Laboratory (VRDL) continues to accept serum and CSF samples for WNV testing.
WNV Testing capacities at VRDL include:

- IgM and IgG EIA testing
- IgM and IgG IFA testing
- Plaque Reduction Neutralization Test (PRNT)
- Reverse Transcriptase – Polymerase Chain Reaction (RT-PCR)

* Immunocompromised patients may not mount a demonstrable antibody response in sera. CSF from these patients may be sent to VRDL for virus detection by PCR.

Required specimens are:

- **CSF**: 1-2 cc *(if lumbar puncture was performed)*
- **Acute Serum**: ≥ 2 cc serum collected ≤ 7 days after onset †

† If WNV infection is highly suspected and acute serum is negative or inconclusive, testing of a 2nd or convalescent serum collected 3-5 days after acute serum may be considered.
There is currently no specific treatment for WNV infection. More information at: [http://www.cdc.gov/ncidod/dvbid/westnile/clinicians/](http://www.cdc.gov/ncidod/dvbid/westnile/clinicians/)

Key prevention messages:

- Stay indoors at dawn and dusk
- Avoid mosquito bites; wear long sleeves, long pants, and socks when outdoors
- Use mosquito repellent*
- Keep screens on windows and doors in good repair
- Identify and eliminate standing water sources that can be mosquito-breeding areas around the home

Information on repellents can be found at: [http://www.cdc.gov/ncidod/dvbid/westnile/RepellentUpdates.htm](http://www.cdc.gov/ncidod/dvbid/westnile/RepellentUpdates.htm)
West Nile Virus in San Diego County

West Nile virus (WNV) is a disease transmitted to humans, birds, horses, and other animals, by infected mosquitoes. Mosquitoes get the disease from feeding on infected birds and can later pass it on when they bite animals or humans.

WNV is established in San Diego County and can be found in all 50 counties in California. The virus was first isolated in the West Nile district of a Northern Province in Uganda in 1937. It was first detected in the United States in New York City in 1999. From there, the virus spread westward, arriving in California in 2003. West Nile virus is now the most prevalent mosquito-borne disease in the United States.

The Vector Control Program protects communities and the environment by controlling mosquitoes that can transmit diseases to humans.

Vector Control Program staff monitor WNV by trapping, pooling, and testing mosquitoes and by testing sentinel chickens and dead birds.

Current 2018 WNV activity is given below. Information for prior years is available here, and additional information on WNV can be found here.

**Adult Mosquito Treatment Information**

2019 WNV Activity Map

For more information on a specific source click on the source name (hyperlink) below

<table>
<thead>
<tr>
<th>Source</th>
<th>Number of Positives to Date (2019)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Birds</td>
<td>1</td>
</tr>
<tr>
<td>Mosquito Batches</td>
<td>0</td>
</tr>
<tr>
<td>Horses</td>
<td>0</td>
</tr>
<tr>
<td>Humans</td>
<td>0</td>
</tr>
<tr>
<td>Total Source Positives</td>
<td>1</td>
</tr>
</tbody>
</table>

For More Information On
WNV Or Other Vectors Contact:
(858) 694-2888
vector@sdc成功率a.gov
Total Number of Positive West Nile Virus (WNV) Test Results in San Diego County in 2017

Legend:
- Positive Human (Total = 2)
- Positive Horse (Total = 1)
- Positive Bird (Total = 43)
- Positive Mosquito (Total = 9)

County of San Diego
Department of Environmental Health
Vector Control Program
January 1, 2017 - December 31, 2017
Prevent – no standing water, dump once a week

Protect – use repellants with DEET, IR3535, oil of lemon eucalyptus, picaridin (permethrin in clothes)

Report - dead birds, mosquito breeding sites, green pools, and day biting mosquitoes

www.sdvector.com
TULAREMIA

Photo credit: CDC
Tularemia is a disease of animals and humans caused by the bacterium *Francisella tularensis*.

Rabbits, hares, and rodents are especially susceptible and often die in large numbers during outbreaks.

Also called “Rabbit plague”

Named after Tulare County in CA!

Photo credit: CDC
ROUTES OF DISEASE TRANSMISSION

Environment

Ticks, Deer Fly

Rabbits

Humans

Dogs, cats

Environment
Tularemia – Yearly Reported Cases, United States, 1950-2016

TULAREMIA CASES
US – 2004 - 2013

1 dot placed randomly within county of residence for each reported case


1 dot placed randomly within county of residence for each reported case

**TULAREMIA**

**Ulceroglandular** - most common form

- Usually occurs following a tick or deer fly bite or after handling of an infected animal
- Skin ulcer appears at the site where the organism entered the body.
- The ulcer is accompanied by swelling of regional lymph glands, usually in the armpit or groin.

**Glandular**

- Similar to ulceroglandular tularemia but without an ulcer.
- Also generally acquired through the bite of an infected tick or deer fly or from handling sick or dead animals.
TULAREMIA

Oculoglandular

- Occurs when the bacteria enter through the eye.
- Can occur when butchering an infected animal, then touching eyes.
- Symptoms include eye irritation and inflammation, swelling of lymph glands in front of ear.

Oropharyngeal

- Results from eating or drinking contaminated food or water.
- Patients may have sore throat, mouth ulcers, tonsillitis, & swelling of lymph glands in neck.

Pneumonic – most serious form

- This form results from breathing dusts or aerosols containing the organism.
- Can also occur when other forms of tularemia (e.g. ulceroglandular) are left untreated and the bacteria spread through the bloodstream to the lungs.
- Symptoms include cough, chest pain, and difficulty breathing
Physicians who suspect tularemia should promptly collect appropriate specimens and alert laboratory for special diagnostic and safety procedures.

**Rapid diagnostic testing for tularemia is available through the San Diego PHL!**

Growth of *F. tularensis* in culture is the definitive means of confirming the diagnosis of tularemia. Appropriate specimens include swabs or scrapping of skin lesions, lymph node aspirates or biopsies, pharyngeal washings, sputum specimens, or gastric aspirates, depending on the form of illness. Paradoxically, blood cultures are often negative.

A presumptive diagnosis of tularemia may be made through testing of specimens using direct fluorescent antibody, immunohistochemical staining, or PCR.

Diagnosis can also be established serologically by demonstrating a 4-fold change in specific antibody titers between acute and convalescent sera. Convalescent sera are best drawn at least 4 weeks after illness onset; hence this method is not useful for clinical management.
Streptomycin is drug of choice based on experience, efficacy, & FDA approval.

Gentamicin is considered an acceptable alternative, but some series have reported a lower primary success rate. Treatment with aminoglycosides should be continued for 10 days.

Tetracyclines may be a suitable alternative to aminoglycosides for patients who are less severely ill. Tetracyclines are static agents and should be given for at least 14 days to avoid relapse.

Ciprofloxacin and other fluoroquinolones are not FDA-approved for treatment of tularemia but have shown good efficacy in vitro, in animals, and in humans.

Bottomline: consult an ID physician.

Post-exposure prophylaxis may be indicated for certain exposures (doxycycline, ciprofloxacin)
April 5, 2019

Ticks Test Positive for Tularemia, First Detection in County This Year

By Gig Conaghan, County of San Diego Communications Office
Apr. 5, 2019 | 9:57 AM

Several ticks trapped in routine monitoring along Lopez Canyon Trail in Sorrento Valley have tested positive for tularemia, prompting County Vector Control officials to urge people to remember to protect
Total Number of Positive Tularemia Test Results
In San Diego County To Date 2019

Legend
- Tularemia Positives (Total = 3)

<table>
<thead>
<tr>
<th>Location</th>
<th>Positive Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lopez Canyon</td>
<td>3</td>
</tr>
</tbody>
</table>

County of San Diego
Department of Environmental Health
Vector Control Program
January 1, 2019 - April 29, 2019

2019 Tularemia Positive Tick Batches

<table>
<thead>
<tr>
<th>Number of Positive Tick Batches to Date</th>
<th>Date Found</th>
<th>Community Area</th>
<th>Species</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>4/23/19</td>
<td>Lopez Canyon</td>
<td>Pacific Coast Tick</td>
</tr>
<tr>
<td>2</td>
<td>4/23/19</td>
<td>Lopez Canyon</td>
<td>American Dog Tick</td>
</tr>
<tr>
<td>1</td>
<td>3/27/19</td>
<td>Lopez Canyon</td>
<td>Pacific Coast Tick</td>
</tr>
</tbody>
</table>
**PREVENTION**

**When hiking, camping or working outdoors:**
- Use insect repellants containing 20% to 30% DEET (N,N-diethyl-meta-toluamide), picaridin or IR3535.
- Wear long pants, long sleeves, and long socks to keep tick and deer flies off your skin.
- Remove attached ticks promptly with fine-tipped tweezers.
- Don’t drink untreated surface water.

**When mowing or landscaping:**
- Don’t mow over sick or dead animals.
- Consider using dust masks to reduce your risk of inhaling the bacteria.

**If you hunt, trap or skin animals:**
- Use gloves when handling animals, especially rabbits muskrats, prairie dogs, and other rodents.
- Cook game meat thoroughly before eating.
PLAGUE
Caused by Yersinia pestis
Reservoir - rodents
Transmitted by fleas
On every continent except Australia

California ground squirrel (Spermophilus beecheyi)
30 species are known vectors

- *Xenopsylla cheopis* (oriental rat flea; worldwide)
- *Nosopsyllus fasciatus* (worldwide)
- *Oropsylla montanus* (most important vector in US)
  - Hosts: California ground squirrels, prairie dogs
  - Will readily feed on humans
- Cat and dog fleas are not efficient vectors

Photo: CDC
ROUTES OF DISEASE TRANSMISSION

Environment

**Humans**

- **Oropsylla montanus**
- Ground Squirrel
- Dogs, cats

Environment
Orange — countries reporting plague  Red — regions with plague vector  Source: WHO 1998

Source CDC. Downloaded 5/4/19 from: https://www.cdc.gov/plague/maps/index.html
Interactive map available at http://www.cdph.ca.gov/HealthInfo/discond/Pages/Plague.aspx
Bubonic plague – most common form

- Incubation is 2-8 days.
- Patients develop sudden onset of fever, headache, chills, and weakness and one or more swollen, tender and painful lymph nodes (called buboes).
- This form usually results from the bite of an infected flea.
- The bacteria multiply in the lymph node closest to where the bacteria entered the human body.
- If the patient is not treated with the appropriate antibiotics, the bacteria can spread to other parts of the body.
Pneumonic plague – only form spread person-to-person

- Incubation for primary pneumonic plague 1-6 days, most often 2-4 days
- Patients develop fever, headache, weakness, and a rapidly developing pneumonia with shortness of breath, chest pain, cough, and sometimes bloody or watery mucous.
- Pneumonic plague may develop from inhaling infectious droplets or may develop from untreated bubonic or septicemic plague after bacteria spread to lungs.
- Pneumonia may cause respiratory failure and shock.
- Pneumonic plague is most serious form of disease.
Septicemic plague:

- This form results from bites of infected fleas or from handling an infected animal, incubation 2-4 days.
- Septicemic plague can occur as first symptom of plague, or may develop from untreated bubonic plague.
- Patients develop fever, chills, extreme weakness, abdominal pain, shock, and possibly bleeding into skin and other organs.
- Skin and other tissues may turn black and die, especially on fingers, toes, and nose.
Bacterial cultures (sputum, blood, lymph node aspirate specimens) – should be handled in a Biosafety level 2 facility

Wright, Giemsa or Wayson stain shows gram negative coccobacilli with bipolar “safety pin” appearance

Organism grows slowly (48 for observable growth) on standard blood and Mac-Conkey agar

Immunoflourescent staining for capsule (F1 antigen) is diagnostic

SDPHL can do PCR testing!
TREATMENT

Strict respiratory isolation with droplet precautions (gown, glove, and eye protection) until patient has received at least 48 hours of antibiotics and shows clinical improvement.

Streptomycin (15 mg/kg bid) is historically preferred but may be hard to obtain.

Gentamycin under an IND protocol (consult with ID and CDC)

Chloramphenicol for plague meningitis

Doxycycline and ciprofloxacin are used in prophylaxis for seven days after exposure to a case.
Squirrel Tests Positive for Plague Near Palomar Mountain

A ground squirrel trapped in routine monitoring at the Cedar Grove Campground on Palomar Mountain has tested positive for plague, San Diego County Vector Control officials said Friday.

By Gig Conaughton, County of San Diego Communications Office

Sep. 15, 2017 | 1:44 PM
PREVENTION

PLAGUE WARNING

Chipmunks, ground squirrels or other wild rodents in this area may be infected with plague. Plague may be transmitted to humans by the bite of an infected flea or by handling an infected animal.

USE THESE PRECAUTIONS:

1. Avoid all contact with chipmunks, squirrels or other wild animals - DO NOT FEED.
2. Do not camp, rest, or sleep near animal burrows. AVOID ANIMAL FLEAS.
3. Keep pets on a leash. Treat your pets with flea powder and flea collar or LEAVE PETS HOME.
4. See a physician if you become sick. THE DISEASE IS CURABLE.
MURINE TYPHUS

Photo: CDC
Acute febrile illness caused by *Rickettsia typhi* (or *Rickettsia felis*), is distributed worldwide.

Mainly transmitted by fleas of rodents, associated with cities and ports where urban rats (*Rattus rattus* and *Rattus norvegicus*) are abundant.

In the US, cases are concentrated in TX and CA.

Contrary to the classic rat-flea-rat cycle, most important reservoirs of infection these areas are opossums and cats.

Cat flea, *Ctenocephalides felis*, identified as principal vector.

Photo: CDC
ROUTES OF DISEASE TRANSMISSION

- **Environment**
  - Rats, Possums
  - Oriental rat flea
  - Cat flea

- **Humans**

- **Cats**
TX: murine typhus cases occur in spring and summer.

CA: cases have been documented in summer and fall.

Most patients present with fever, and many have rash and headache.

2018-2019 murine typhus cases in downtown LA, Pasadena
Studies reporting clinical findings associated with murine typhus.

<table>
<thead>
<tr>
<th>Clinical finding</th>
<th>Range of occurrence, %</th>
<th>References</th>
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<tbody>
<tr>
<td>Fever</td>
<td>98–100</td>
<td>[4, 13, 30–34]</td>
</tr>
<tr>
<td>Headache</td>
<td>41–90</td>
<td>[4, 13, 30–34]</td>
</tr>
<tr>
<td>Rash</td>
<td>20–80</td>
<td>[4, 13, 30–34]</td>
</tr>
<tr>
<td>Arthralgia</td>
<td>40–77</td>
<td>[4, 13, 30–34]</td>
</tr>
<tr>
<td>Hepatomegaly</td>
<td>24–29</td>
<td>[13, 30, 31, 33]</td>
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<tr>
<td>Cough</td>
<td>15–40</td>
<td>[4, 13, 30, 32–34]</td>
</tr>
<tr>
<td>Diarrhea</td>
<td>5–40</td>
<td>[4, 13, 30–34]</td>
</tr>
<tr>
<td>Splenomegaly</td>
<td>5–24</td>
<td>[13, 30, 31, 33]</td>
</tr>
<tr>
<td>Insect bite</td>
<td>0–39</td>
<td>[4, 30–34]</td>
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<tr>
<td>Nausea and/or vomiting</td>
<td>3–48</td>
<td>[4, 13, 30–34]</td>
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<tr>
<td>Abdominal pain</td>
<td>11–60</td>
<td>[4, 13, 30–32, 34]</td>
</tr>
<tr>
<td>Confusion</td>
<td>2–13</td>
<td>[4, 13, 30–34]</td>
</tr>
</tbody>
</table>

Rachel Civen, and Van Ngo Clin Infect Dis. 2008;46:913-918

© 2008 by the Infectious Diseases Society of America
Serologic testing with the indirect immuno-fluorescence assay is the preferred diagnostic method. (Do this through PHL!)

Doxycycline is the antibiotic of choice and has been shown to shorten the course of illness.
Typhus Case Prompts Flea Protection Warning

By Gig Conaughton, County of San Diego Communications Office
Jun. 1, 2016 | 9:16 AM
In addition to using flea-control products on pets, the public can also protect themselves and their pets by keeping rodents and animals away from their homes, workplaces and recreational areas.

- Remove brush, rock piles, junk, cluttered firewood and food supplies — especially pet food.

- Use Environmental Protection Agency (EPA)-registered insect repellent labeled for use against fleas if they think they could be exposed to fleas during activities such as camping, hiking, or working outdoors.

- Permethrin can be used to treat clothing and outdoor gear, but it should not be used on skin.
For more information contact:

Eric C. McDonald, MD, MPH, FACEP
Medical Director, Epidemiology and Immunizations Services
Public Health Services
County of San Diego Health and Human Services Agency

3851 Rosecrans Street (MS-P578)
San Diego, CA 92110
Phone: (619) 692-8436
Fax: (858) 715-6458