

# Risk and Severity of Recreational Water Associated Infections



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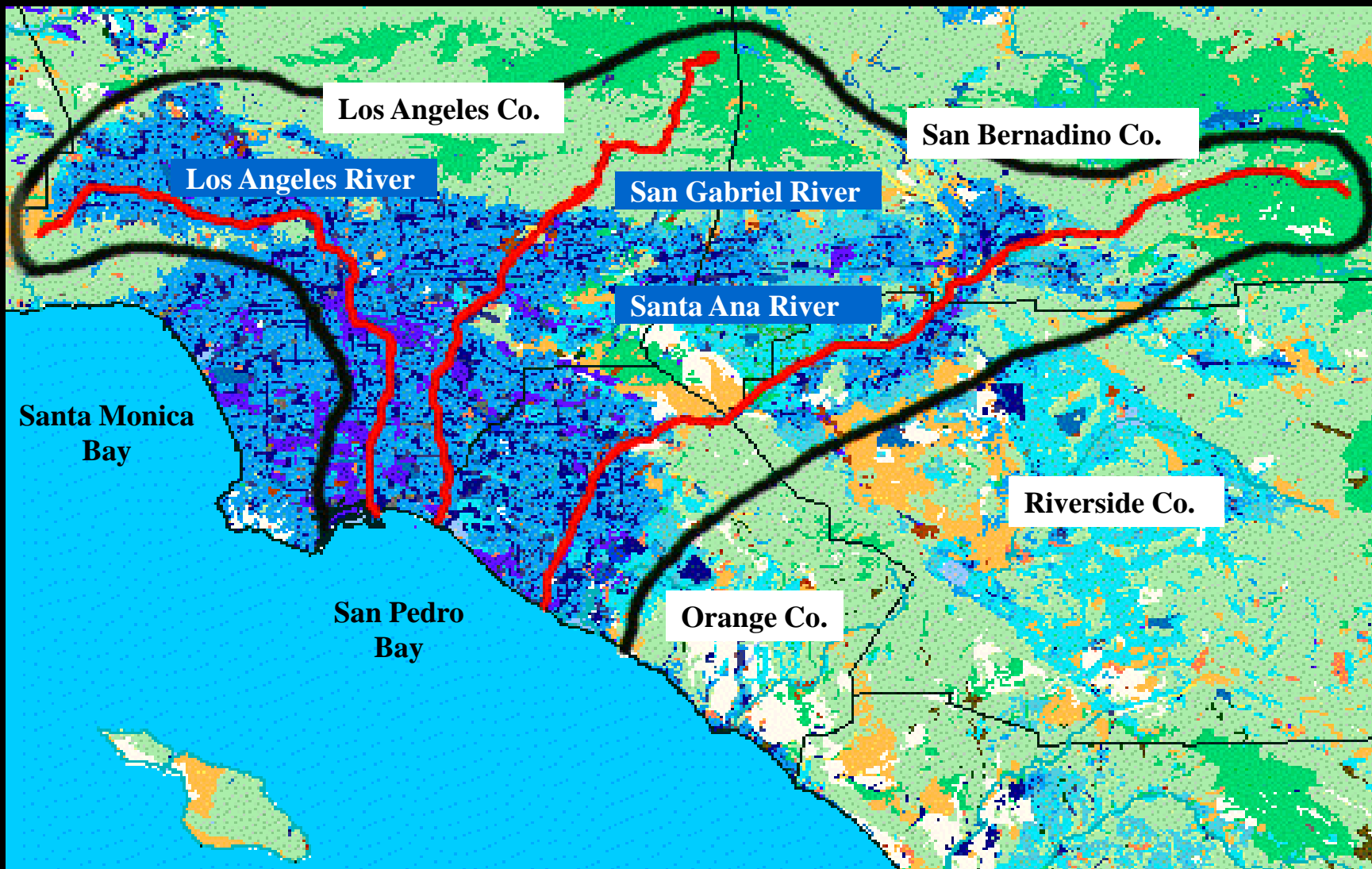
# Overview

- 1 Sources of pathogens in recreational waters
- 2 The diversity of pathogens
- 3 Types and severity of infections
- 4 Epidemiology of recreational waters
- 5 Water quality standards and public risk
- 6 Recreational exposure patterns
- 7 Exposure to toxins
- 8 My research around this area

# Sources of Pathogens

- Human waste, but also animal waste
- Treated domestic sewage discharged off-shore and into rivers.
- Urban runoff is a primary contributor
  - Decaying infrastructure, illegal discharges, accidental spills, pet waste, agricultural waste, etc.
  - North Orange County coastal waters receive runoff from three rivers (3,000 sq/mi urbanized watershed)
  - Millions of gallons per day of untreated runoff discharges directly onto recreational beaches

# Combined Watershed Areas for the Los Angeles, San Gabriel and Santa Ana Rivers



# *Santa Ana River*

**Urban Runoff**



**Urban Flush**



# *Santa Ana River Pollution Plume*



**Santa Ana River**

**Newport Beach**

# *Santa Ana River Pollution Plume*





# ***Santa Ana River***





*Syringes with needles*



*Diaper & Debris field*





*Famine napkin*



*Tampon*

*Prosthetic breast*



*Condom*





*Chocolate brown water and people surfing*



# Pathogen Profile

- **Bacteria**

- Streptococci
- Staphylococci
- E. coli
- Shigella
- Eromonas
- Salmonella
- Leptospira
- Legionella
- Pseudomonas
- Vibrio cholerae
- Campylobacter

- **Viruses**

- Enteroviruses
- Norwalk-like viruses
- Rotaviruses
- Hepatitis A
- Adenoviruses
- Cocksackie
- Poliovirus

- **Parasites**

- Giardia
- Cryptosporidium
- Cyclospora
- Toxoplasma gondii

# Infections and Severity

*Range of infections due to full body exposure.  
Most are self-limiting – few require medical care.*

- **Gastrointestinal infections**
- **Respiratory infections (upper & lower)**
- **Ear infections**
- **Eye infections**
- **Skin infections**

# Rare yet Severe Illnesses

- *Hepatitis*
- *Cholera*
- *Typhoid*
- *Meningitis*
- *Necrotizing fasciitis*  
(Flesh-eating disease)

**FLORIDA**

**Teen Falls Seriously Ill  
From Bacteria in Lake.**

A 15-year-old boy remained in critical condition with a rare bacterial infection he contracted while swimming in a lake.

The boy was swimming July 20 in Lake Talmadge, northeast of Orlando, when a bacteria known as *Chromobacterium violaceum* entered his body through a cut on his leg, officials said.

A 12-year-old boy died Friday of a rare brain infection after he contracted primary amebic meningoencephalitis while swimming in another group of Florida lakes.

*From Times Wire Reports*

# The Epidemiology

- Numerous epi studies in recreational marine waters correlating health risk and water quality
  - Most found a dose-response between pathogen densities & risk
  - Meta-analysis conclude *enterococcus* is the best indicator to predict risk of GI infection

# Water Quality Standards

- “Acceptable” illness rate for GI = 1.9%
  - 0.8% for freshwater
- Based on indicator bacteria not viruses
- Risk level set for adults
- Risk measured for GI only
- Testing efficacy questionable
- Adopted by California in 1998
- No surveillance of illnesses or outbreaks

# Exposure Patterns

- Temporal Variations
  - Hourly: low use in morning, high use mid-day, low in evening
  - Daily: high use on weekend and holidays, low use in mid-week
  - Monthly: Summer months high use by large population (water quality good); Winter months low use by small population (water quality poor)
- Spatial Variations
  - Rivers, creeks and storm drains are hot spots
  - Kiddie beaches and harbors

# Toxins

- Urban runoff concentrates and transports toxins
- Coastal sediments can load toxins
- Public can be exposed to toxins of all types
  - Oils, heavy metals, PCBs, PAHs, DDT, Perchlorate, etc.....
  - Stories of wetsuit threads disintegrating, instant rashes, to skin peeling away.
- Cancer clusters? *Santa Monica & Newport Beach??*
- Pathogens and toxins can concentrate in food chain
  - Bio-accumulation and bio-magnification

# Public Exposure

- *How many people are exposed?*
  - 5.5 million exposures/year in Newport and Huntington Beaches alone
  - No standardized data collected
- *Who's swimming at the beach?*
  - Haile, et al., 1996, An epidemiological study of possible adverse health effects of swimming in Santa Monica Bay. Final Report for Santa Monica Bay Restoration Project
    - 48% of summer beach-swimmers children  
*(more susceptible to pathogens)*
    - 78% are families
    - 88% are Californians





# *Children playing in the Santa Ana River*



# Public Health Burden

- *How many people are getting sick?*
  - **Turbow, et al., 2003:** Evaluation of recreational health risk in coastal waters based on Enterococcus densities and bathing patterns. *Environmental Health Perspectives*, 111(4):598-603
  - Findings calculated >36,000 GI illness events per year in Huntington and Newport Beaches
  - Coastal water quality well below the standard
- *How much are the illnesses costing?*
  - **Dwight, et al., 2005:** Estimating the economic burden from illnesses associated with recreational coastal water pollution: A case study in Orange County, California. *Journal of Environmental Management*, 76(2):95-103
  - Findings estimated health costs to be \$3.3 million per year in Huntington and Newport Beaches

# Recreational Risk

Dwight, et al., 2004. Health Effects Associated with Recreational Coastal Water Use in Urban vs. Rural California, *American Journal of Public Health*, 94(4):565-567

- Cross sectional health study of illness rates in North Orange County and Santa Cruz County
- Surfers as subjects because of high exposure
- Team of interviewers at beaches
  - 1998 (El Nino winter) n= 853
  - 1999 (La Nina winter) n= 1,020

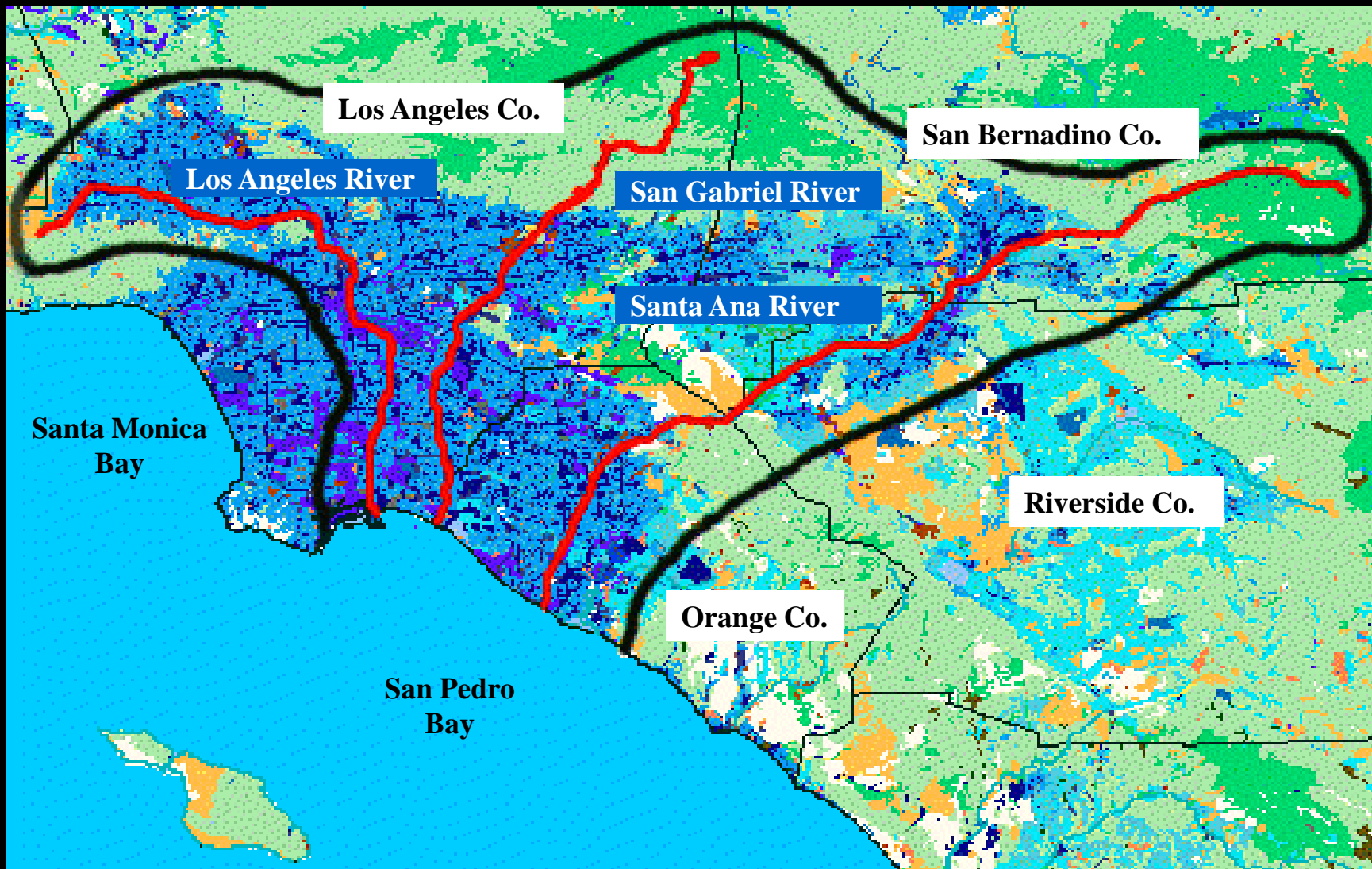


*California*

*Santa Cruz  
County*

*Orange County*

# Combined Watershed Areas for the Los Angeles, San Gabriel and Santa Ana Rivers



# San Lorenzo River Watershed: Santa Cruz, California

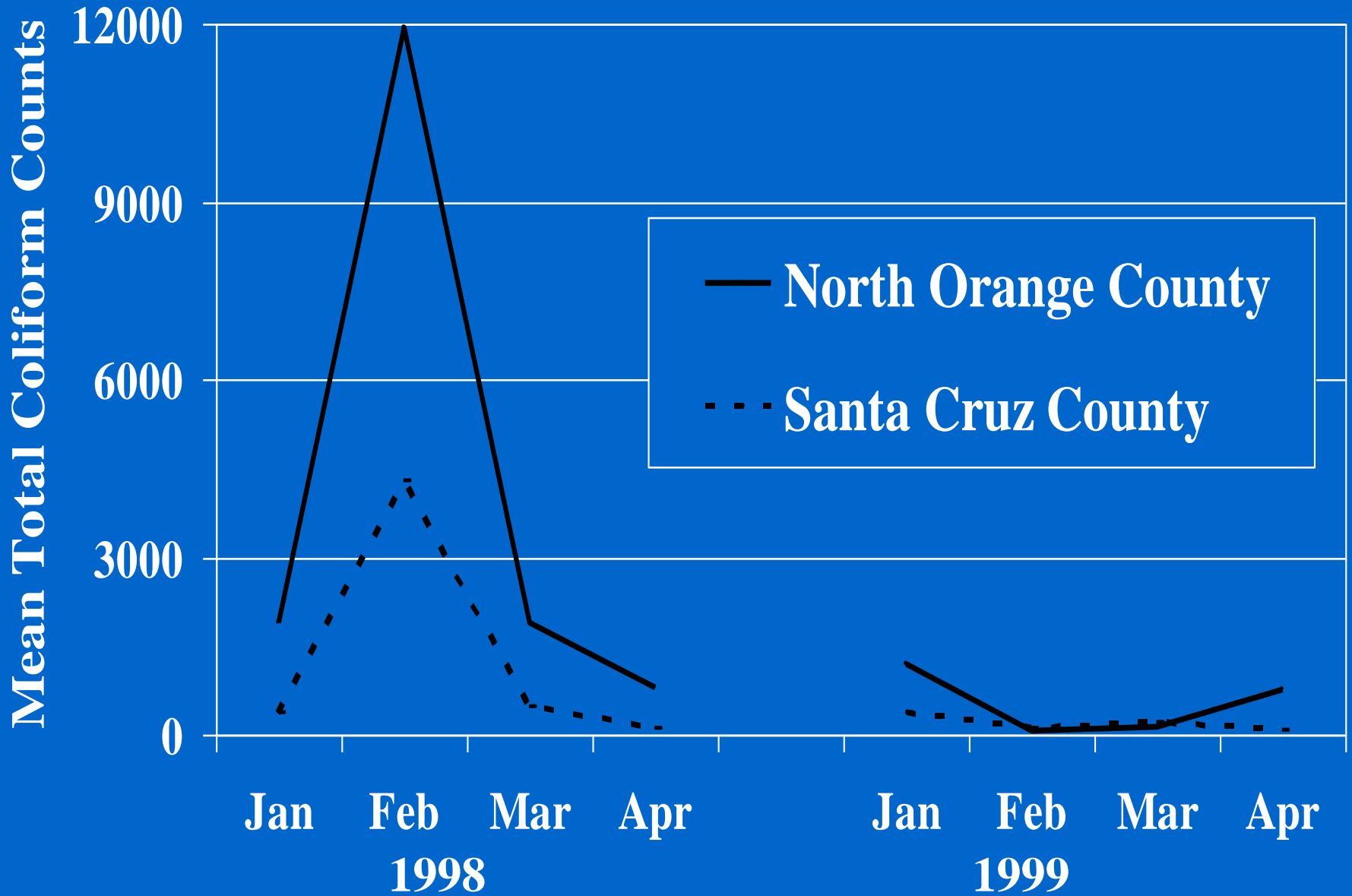


# North Orange County interviews



# Santa Cruz County interviews





## Winter Study Months

# Adjusted Odds Ratios for Reported Symptoms: North Orange County vs Santa Cruz County

	1998	1999
	El Niño Winter	El Niño Winter
	OR	OR
Any Symptom	1.9*	1.2
Fever	1.7*	0.9
Stomach Pain	2.6*	0.9
Vomit	2.2	0.9
Diarrhea	2.1*	1.1
Sinus	1.4*	1.3
Cough	1.4	1.1
Sore Throat	2.0*	1.5*
Eye Infection	2.5*	1.4
Ear Infection	1.3	1.6*
Skin Infection	2.0*	0.7

\* = adjusted odds ratio is significant at P <0.05 level

# Resources

- CDC
  - *cdc.gov/healthyswimming*
- U.S. EPA
  - *epa.gov/surf*

