

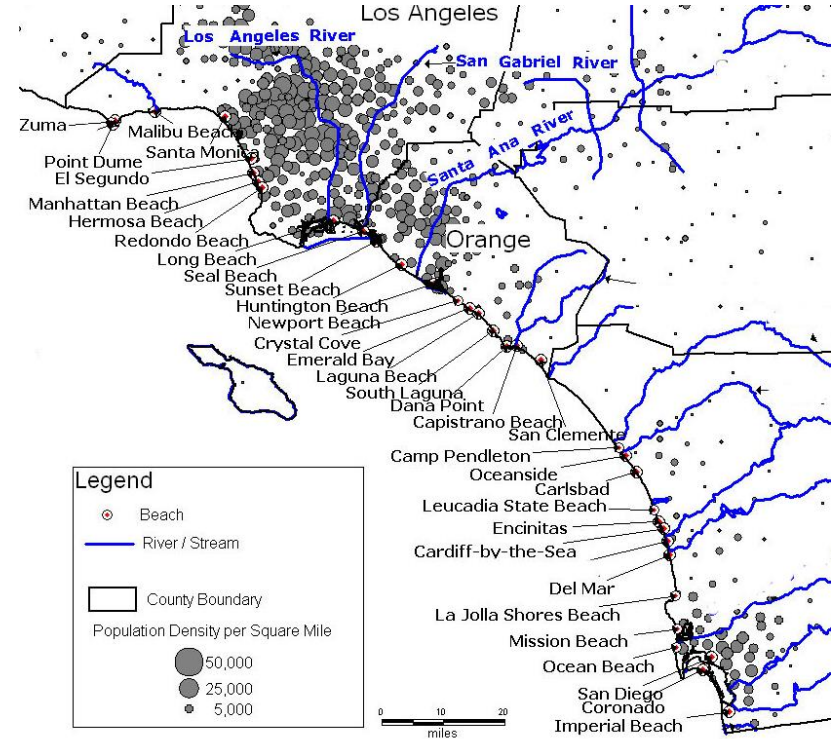
*Beach Water Quality Working Group*  
February 15, 2012

# **U.S. EPA Proposed Recreational Water Quality Criteria and the Potential Public Health Burden for Southern California**

Presented by  
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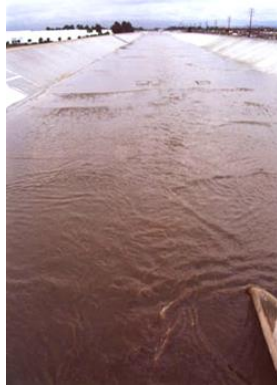
# The Beaches of Southern California



- Over 75 primary beaches
- Over 20 million residents in the region
  - One of country's most densely populated regions
- Over 129 million beach visits annually
  - 45% visitors swim in the ocean
  - Approximately 56 million exposure events per year
  - 88% of beach visitors are Californians living within 35 miles of the beach
- 58% of all U.S. beach visits occur on our beaches
  - Florida + Carolinas = 28%
  - Hawaii = 6%
  - Mid-Atlantic = 6%
  - Gulf Coast, North West, Great Lakes & New England = 3%
- Southern California's beaches are a powerful economic engine for the Nation, State and region.

# Winter Runoff and Urban Runoff

Santa Ana River  
Before and After a rain event



## Winter Runoff

- Outside of AB411 time frame
- High concentrations of contaminants
- Entire coastline can exceed standards
- Three day warning is standard following significant rain
- Flushing is an unfortunate reality of living in an urban environment
  - High population, Intense land-use, impermeable surfaces
- Issue can be addressed up-stream with abatement measures
  - Catch basins, filtration, diversions, changes in codes



## Urban Runoff

- Daily release of leachate from the urban landscape
- Collects in runoff waters and discharged untreated onto beaches
- Tragedy of the Commons: People and business contribute
  - Inadvertently; accidentally; or with purpose
- Can contain high concentrations of a range of pathogens and toxins
  - Dependent on the factors in contributing watershed
  - LA, SG, SA watersheds are large with many land uses
- Most storm drains pipes have been identified
  - Many are now diverted to sewage lines in non-winter months
  - Santa Ana River is diverted in non-winter months
  - After diversions are installed, water quality improves
    - Newport Back Bay

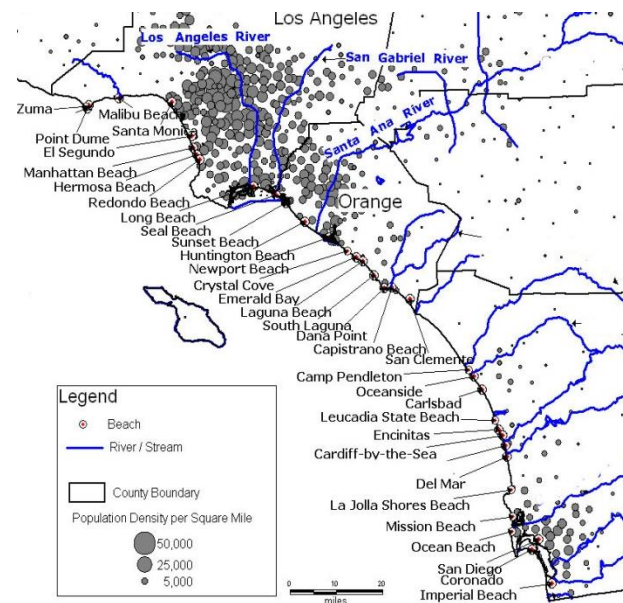
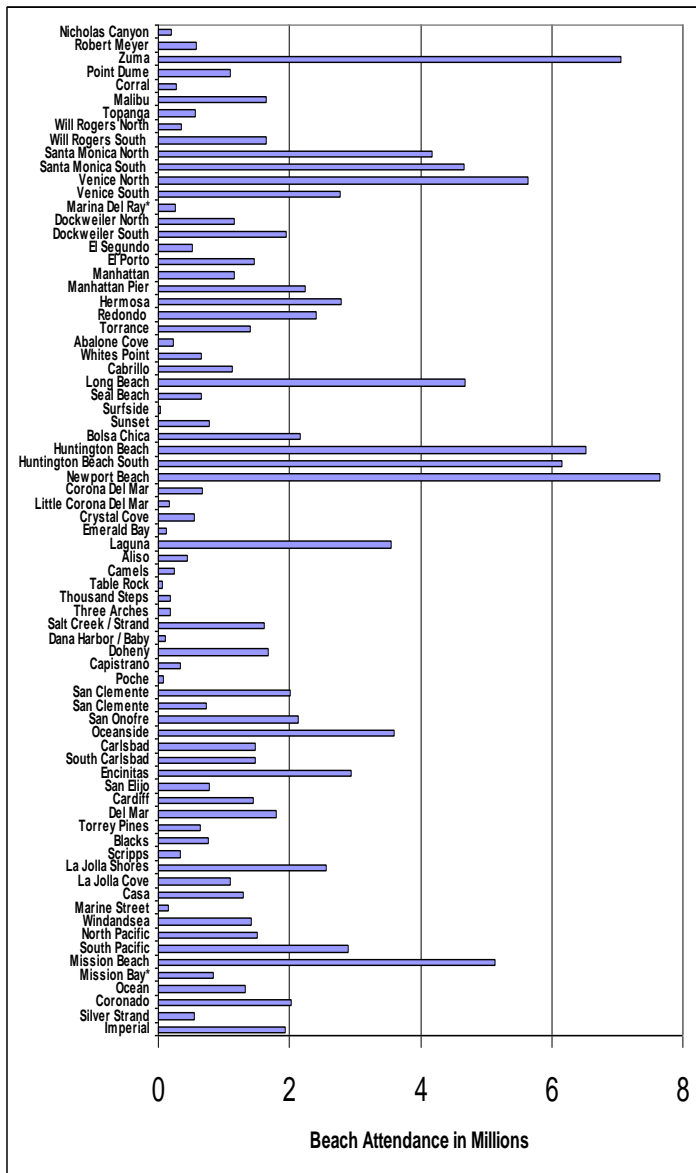
# Sewage Discharges into Southern California's Coastal Waters



- Over 20 million residents contributing daily
- Roughly 1.4 billion gallons a day discharged in near shore waters
- Most discharge treated to secondary levels
  - Some to tertiary level for river discharge
  - Some only to primary level (OCSD partial mixture)
- Los Angeles and San Gabriel Rivers are two largest in region
  - 80% of dry weather flow is tertiary treated discharge
- The ocean can assimilate human waste inputs via dilution and degradation
- Assimilation capacity of Southern California Bight has been exceeded
  - Shallow, sheltered, high volumes of partially treated waste water
  - Doheny outfall (17 m/g/d) volumetrically greater than Exxon Valdez spill – every day
  - Huntington Beach outfall (240 m/g/d) equivalent to a Deep Horizon spill – every day
  - 1.4 b/g/d is greater than 100,000 Exxon Valdez spills – every day.
  - No other coastal region receives this volume of sewage discharge
- No other coastal region has such high beach attendance by the public
- Public Health Concern: When millions of people are exposed to sewage contamination the result is a large health burden
  - We quantitatively investigated the health burden (Brinks, 2008)



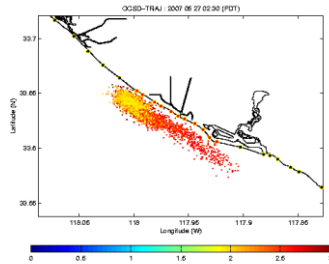
# Water Quality Monitoring Southern California beaches



- Waters are monitored to protect public from exposure to pathogens
- Beaches are not equal but people are
  - You should not be exposed to greater health risk because you choose to swim here rather than there.
  - Reason EPA eliminated differential risk for fresh vs marine
  - Clean/ empty beaches do not deserve the same monitoring resources as contaminated or crowded beaches
- FIBs are used to monitor beaches
  - TC/FC not accepted by US EPA and WHO
  - Epidemiology supports *Enterococcus* for predicting risk
- Monitoring system was developed to identify areas with consistent contamination by analyzing the data long term
  - The reason for the geometric standard
- Now have a decade of standardized coastal water quality data

# Southern California Coastal Water Quality

- Most beaches are clean most of the time
- Clean beaches pose no significant health risk of infection
- Beaches near outfalls have high variability in their bacteria concentrations
  - OCS&D wants to reduce frequency of testing

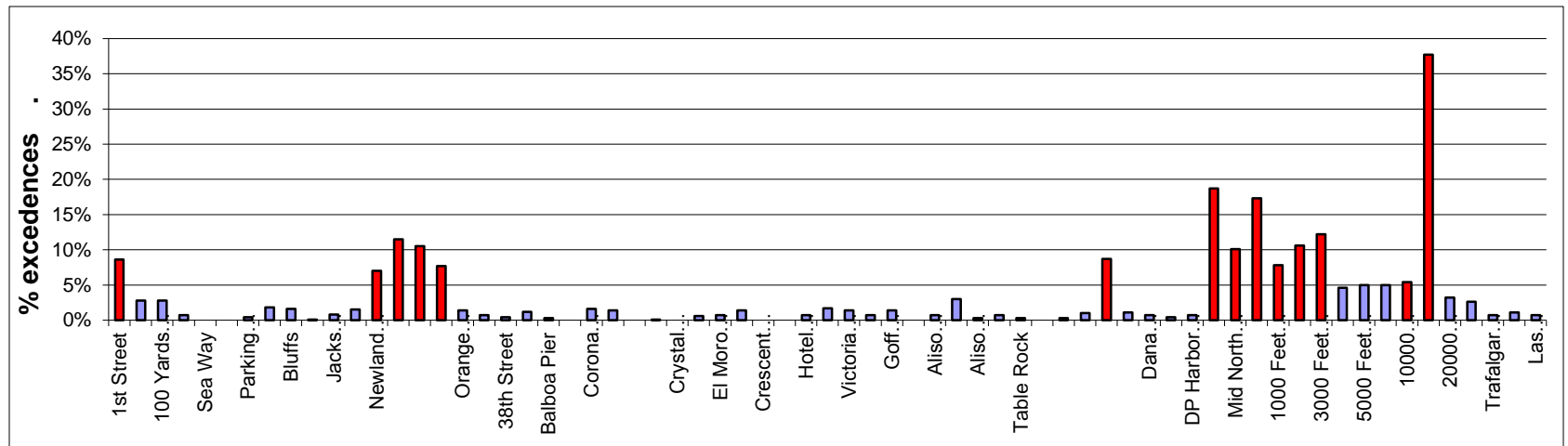


SCCOOS plume tracking images for Orange County Sanitation District's sewage discharge pipe off Huntington Beach



Data from Appendix A: A Collaborative, Integrated, Regional Ocean Water Quality Monitoring Program for Orange County, County of Orange Health Care Agency, May 13, 2010

Orange County California: AB 411 Period - Dry Weather Single Sample Standard Exceedance Rate for Enterococcus (2005 – 2009)



↑  
SG River  
Seal Beach

↑  
Wetland

↑  
Outfall  
Huntington Beach

↑  
Wetland

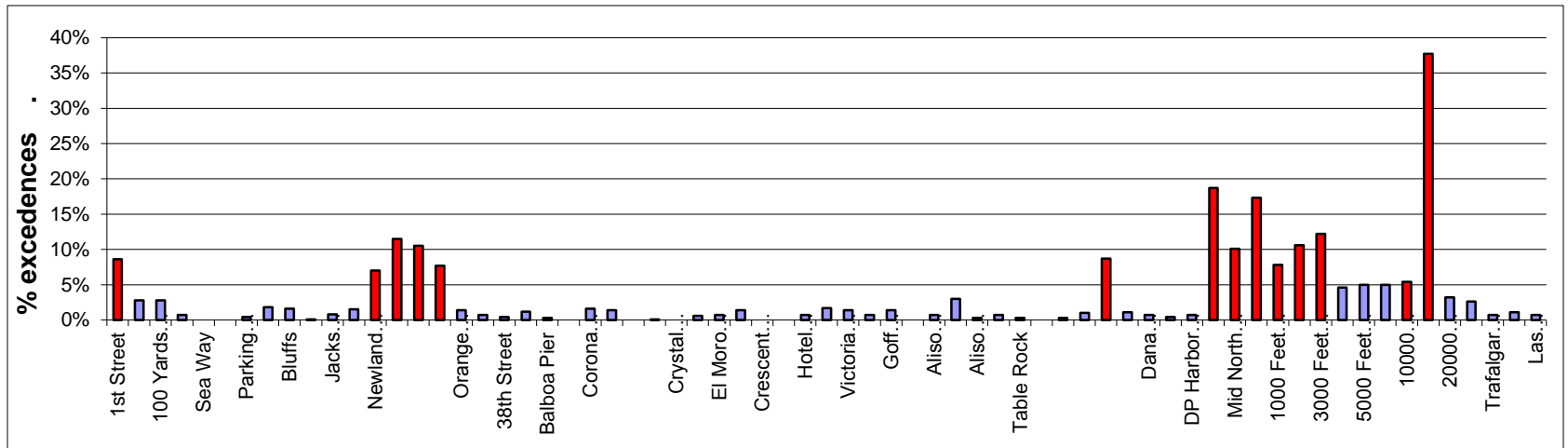
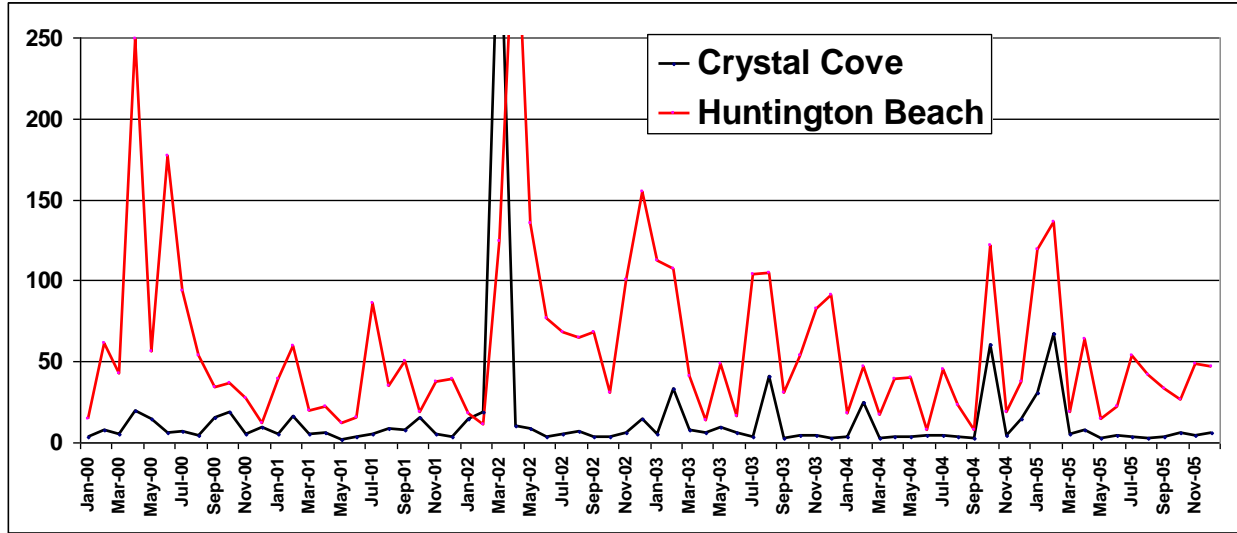
↑  
Outfall  
Doheny

↑  
Poche Beach

# Potential natural sources of *Enterococcus*

- Theory suggests natural components of coastal ecosystems contribute or grow *Enterococcus*
  - The results is beaches appear contaminated when they are not – False Positives
  - 2011 EPA Poster: Blame the Moon: A Critical Analysis of Environmental Sources of *Enterococcus*
    - Examined papers by Drs. Grant, Boehm, Ms. Ferguson, and others
  - Papers conclude that contamination at Huntington Beach and Doheny Beach is due to natural sources
    - Sand; Birds; Groundwater; Plants; Soil; Kelp; Insects; Wetlands; and Tides
  - The studies do not satisfy the scientific criteria for causation
    - Conclusions lack specificity, consistency, coherency, strength of association, and are not biologically plausible
    - Many lack control sites
    - Conclusions are not supported by the results
    - Few papers mention the large outfalls as potential sources of contamination
- 1: Most beaches have these natural components and most beaches have low *Enterococcus* concentrations
- Birds do contribute *Enterococcus* and are a potential cause for False Positives
    - Bird guano lacks the human pathogens of primary concern
    - For open ocean beaches, bird guano is volumetrically insignificant and quickly assimilated
  - It is very difficult to consistently contaminate the coastal ocean
- 2: Decades of epidemiology studies support *Enterococcus* for predicting risk in recreational waters
- All studies were conducted in the environment with the suspected sources present
  - Any background noise was accounted for in the elucidation of the dose/response models
  - There is a lack of epidemiology studies that conclude False Positives with *Enterococcus*
  - Single sample standard of 104 cfu is the 75<sup>th</sup> percentile around 35 cfu.
    - Standard allows for high degree of variability before being exceeded
  - EPA response: “Science does not permit us to recommend different, nationally applicable criteria values for different sources (e.g., gulls)

Mean Monthly *Enterococcus* Concentrations: 2000 – 2005  
 Both beaches have sand, birds, groundwater, tides, kelp, etc.



↑  
 SG River  
 Seal Beach

↑  
 Wetland

↑  
 Outfall  
 Huntington Beach

↑  
 Wetland

↑  
 Outfall  
 Doheny

↑  
 Outfall  
 San Clemente

# U.S. EPA Recreational Water Quality Criteria

- 1976 Criteria: Fecal Coliform standard set at 200 cfu
  - Assumed level was equal to ZERO risk
- 1983/84: EPA epidemiology studies (Dr. Cabelli)
  - Determined *Enterococcus* was a better predictor of risk.
- 1986 Criteria: FIB conversion from FC to *Enterococcus* based on observed ratios
  - 200 FC = 35 *Enterococcus*
  - Epidemiology studies found 35 cfu *Enterococcus* was equal to 1.9% risk for HCGI
- “Acceptable illness rate” was introduced
  - HCGI is a significant illness (requires fever)
  - 1.9% is a high risk level = 1/50 people
  - When criteria were developed, Cabelli (1989) stated: *“The guideline is not very restrictive by design. It is the limit beyond which concern could be expressed at the federal level. The expectation was that local officials would want smaller risks of illnesses and, hence would promulgate more restrictive standards.”*
- 1986 Criteria introduced differential risk levels between fresh and marine waters (0.8% vs. 1.9%)

# U.S. EPA Recreational Water Quality Criteria

- “New” 2012 Proposed Criteria
- New definition for target illness (fever not required)
  - More inclusive – at the same water quality will have 4.5 times more illnesses reported
  - At 35 cfu *Enterococcus* (standard), 100 people exposed = 4 NGI events (1 of 4 with HCGI)
- Differential risk between fresh and marine waters is eliminated
  - EPA says *Enterococcus* works better in fresh water than marine
  - Marine criteria have been overestimating risk by a factor of 2
  - 1.9% is really equal to 0.95% - which equals risk level in fresh water
    - They’ve been equal all along
  - Conclusion is not consistent with historical epidemiology studies
    - Studies report *Enterococcus* works better in marine than fresh waters
    - Studies report dose/response curves higher than Cabelli’s - Not lower
- New Acceptable Illness Rate
  - 35 cfu *Enterococcus* = 0.95% HCGI x 4.5 (NGI health effect) = 4.3% NGI (1/25 people)
  - In conference, EPA stated new acceptable illness rate = 3.6% (1/28 people)
  - Same risk and health burden as before because bacteria standards are unchanged
    - True - but our understanding indicates risk is much higher than previously deemed acceptable
  - This risk level exists nowhere else in public health (1/25)
- From 1976 to 1986 to 2012, the bacteriological standards remain unchanged.
- The “acceptable risk” to the public has gone from zero to 1.9% to 4.3%.

# Health Risk of Bathing in Southern California Coastal Waters

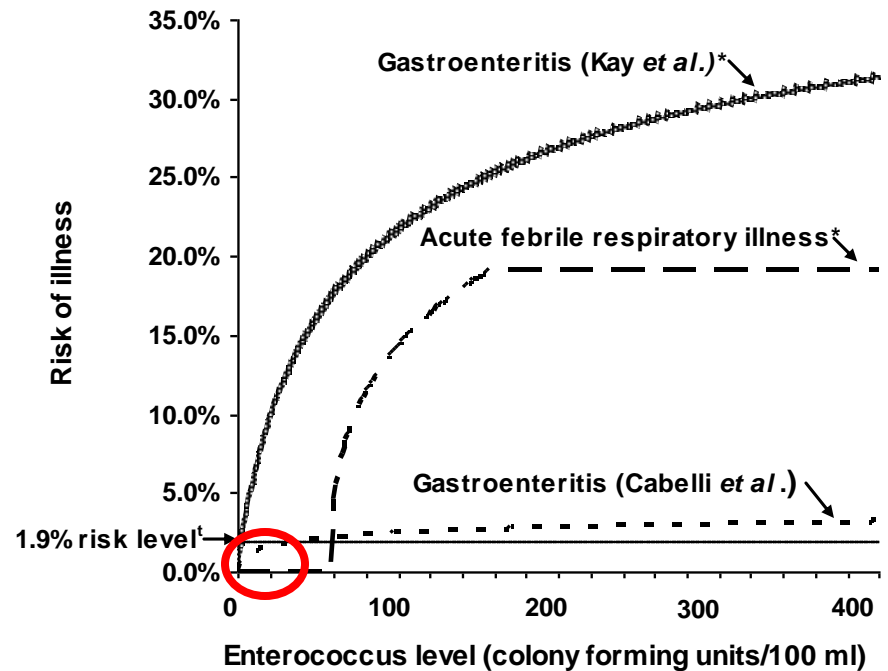
Brinks, MV, RH Dwight, ND Osgood, GS Kumar, DJ Turbow, M El-Gohary, JS Caplan, JC Semenza; 2008, Health risk of bathing in Southern California coastal waters, *Archives of Environmental and Occupational Health*, 63(3):123-135

- Data on Beach Attendance
  - Dwight RH, MB Brinks, GS Kumar, JC Semenza, 2007, Beach attendance and bathing rates for Southern California beaches. *Ocean and Coastal Management*, 50:847-858
  - Five years (2000-2004) daily data collected at 67 Southern California beaches
  - Data collected by lifeguards (73%); Park Departments (16%); Environmental Health Departments (8%)
  - Data acquired by direct observations (73%); Parking, Hotel, Camping receipts (19%); Electronic counters (8%)
- Data on Bathing Ratio (Rate)
  - Three years of daily data collected at two beaches in San Diego
  - Data collected by lifeguards through direct observations
  - Daily (Attendance) x (Monthly Bathing Rate) = Bathing Events /beach/day.
  - Over 56 million bathing events per year in southern California coastal waters.
- Data on Water Quality
  - Five years of data of *Enterococcus* concentrations in coastal waters
  - Data collected by health agencies and others
  - 185 monitoring stations – 67 beaches

# Simulation Modeling

- U.S. EPA model (Cabelli)
  - EPA standard 1986
  - California standard 1999
- WHO model (Kay)
  - WHO standard 2003
  - EU standard 2004

## Concentration – Response Relationships



# Results

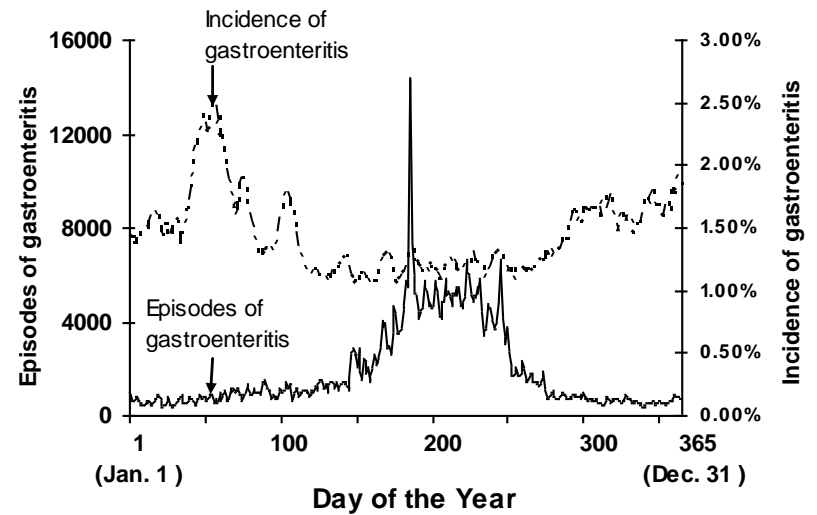
## Estimated Illnesses and Disease Incidence Among Beach Bathers in Southern California, 2000-2004

	<u>Concentration - response relationships</u>		
	Gastroenteritis (Cabelli <i>et al.</i> )	Gastroenteritis (Kay <i>et al.</i> )	Acute Febrile Respiratory Illness
<u>Episodes of illness</u>			
Annual	689,000	4,003,000	693,000
Summer (%)	551,000 (80)	3,060,000 (76)	398,000 (57)
Winter (%)	138,000 (20)	943,000 (24)	295,000 (43)
Annual, when enterococcus level < 35 cfu/100ml (%)*	491,000 (71)	2,434,000 (61)	0 (0)
<u>Disease incidence</u>			
Annual	1.26%	7.30%	1.26%
Summer	1.19%	6.65%	0.86%
Winter	1.55%	10.62%	3.32%

\* California marine water contact standards define coastal water enterococcus levels under 35 colony forming units (cfu)/100 ml as associated with an acceptable risk of gastroenteritis for bathers.

## Mean Daily Number of Episodes and Mean Daily Incidence of Gastroenteritis Among Southern California Beach Bathers, 2000-2004

Calculated using the California / US EPA model (Cabelli)



# Conclusions

- Large disease burden for southern California regardless of model used
  - 1-4 million severe GI illnesses per year
  - 700,000 respiratory illnesses per year
- Attendance has the strongest influence on the disease burden
  - 50% of illnesses occurred at only 12 beaches
  - 80% of illnesses occurred in summer when risk is lowest
- Current “acceptable illness rate” for HCGI is high
  - 1.9% (1 in 50 people) is high for such a significant illness
  - 71% of illnesses occurred when *Enterococcus* levels were below 35 cfu
  - Hypothetically: If waters were at standard: 1.9% x 56 million exposures = >1 million HCGI episodes
- Health Burden Calculation with the New Criteria
  - 700,000 HCGI episodes/ 2 (new d/r) x 4.5 (HCGI/NGI conversion) = **1.5 million** NGI events annually
  - Huntington Beach has exceptionally high attendance (exposures), and consistently elevated bacteria in coastal waters resulting in the largest health burden in the nation.
  - Hypothetically: If waters were at standard: 4.3% x 56 million exposures = >2.4 million NGI episodes
- The Proposed 2012 US EPA Criteria will not decrease the potential public health burden
  - “Aim to carry forward into new criteria level of water quality protection afforded by current criteria recommendations” = no reduction in public health risk.
  - Bacteriological standards remain unchanged – discharges will continue
  - Exposures will continue at the same rate
  - No changes in criteria for children who are more susceptible and ½ the exposed population
  - No inclusion of other illnesses to acknowledge the true larger health burden
  - The result is recreational water quality criteria that is deficient in protecting public health
    - millions of more people will continue to become ill from pathogens in recreational waters

**Thank you for your time and attention**

