

# Chicago Area Waterways Epidemiology Study

February 27, 2007

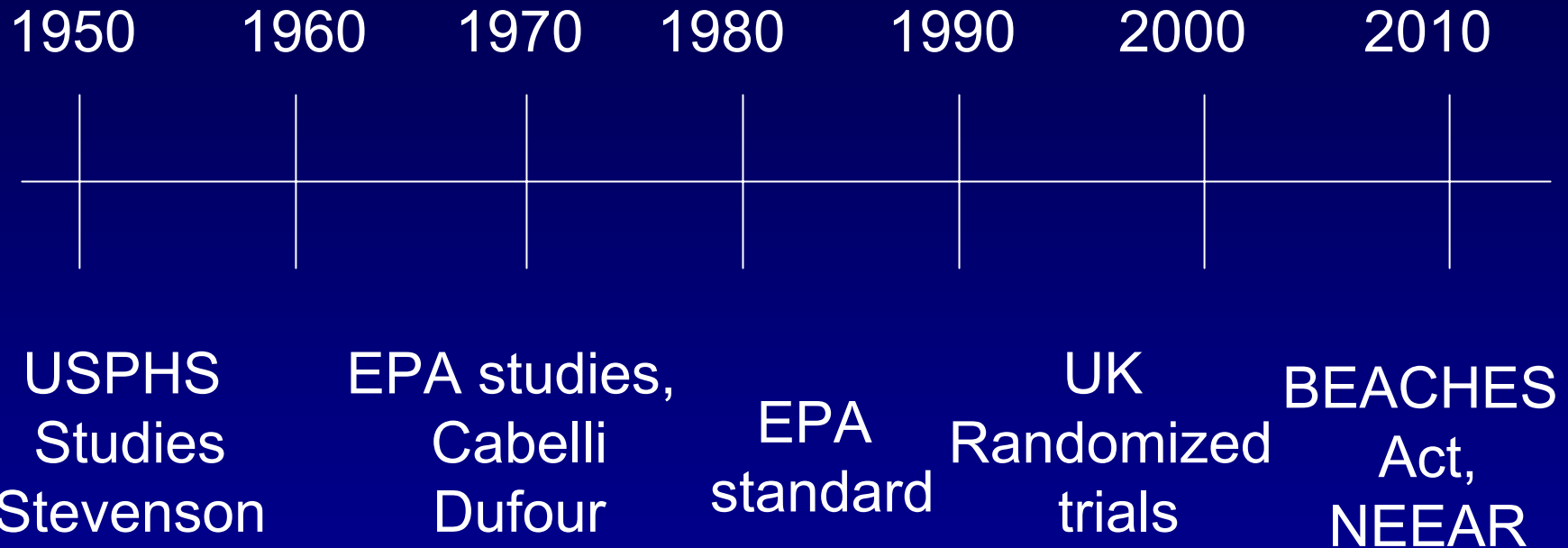
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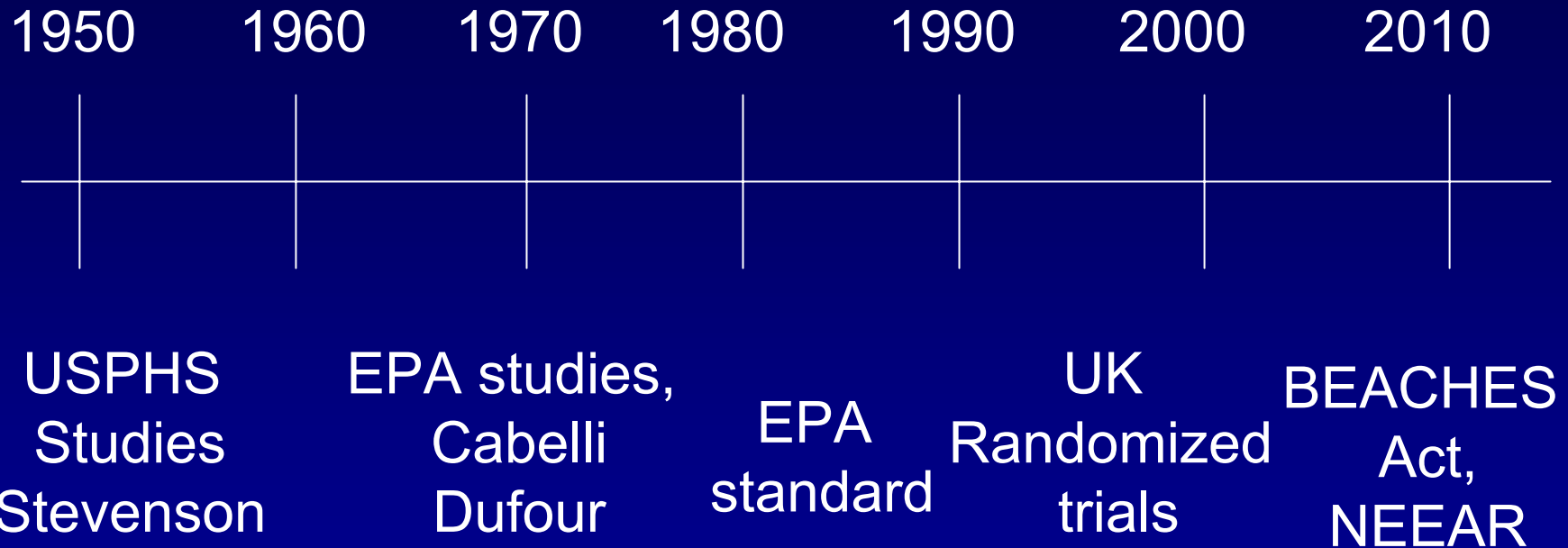
# Overview

- Recreational water exposure and health
  - What we know
  - What we don't know
- Local research questions
- Approaches to local questions
- National research needs
- Potential approaches to national questions

# Development of knowledge regarding primary contact recreation: Highlights



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1972 National Academy of Sciences can't recommend criteria: paucity of epi studies

# Risks of limited contact recreation

## 2007: Paucity of epidemiologic studies

1972 National Academy  
of Sciences can't  
recommend criteria:  
paucity of epi studies

# Limited contact recreation 2007:

- Almost nothing known about rates of illness in limited contact recreation
- Almost nothing known about differences in illness rates for limited contact vs. full contact recreation in same body of water
- Nothing known about ingested or dermal dose of water
- Almost nothing known about indicators vs. pathogens as predictors of illness

# Characterizing rates of illness due to non-swimming recreational contact with the CAW:

Option 1: Look at rates observed in similar prior studies

# Epidemiologic Studies of Recreational Water Exposure

Alexander 1982

Fleisher 1993

McBride 1998

Appleton 1989

Fleisher 1996

Medema 1995

Cabelli 1983a

Fleisher 1998

Philipp 1985

Cabelli 1983b

Foulon 1983

Pike 1994

Calderon 1991

Gray 1997

Prieto 2001

Cheung 1990

Haile 1999

Seyfriend

Colford 2007

Jessop 1985

Stevenson 1953

Corbett 1993

Jones 1991

Taylor 1995

Dufour 1984b

Kay 1994

Van Asperen 1998

Fattal 1986

Kueh 1995

von Schirring 1992

Ferley 1989

Lee 1997

Wade 2006

Fewtrell 1992

Lightfoot 1989

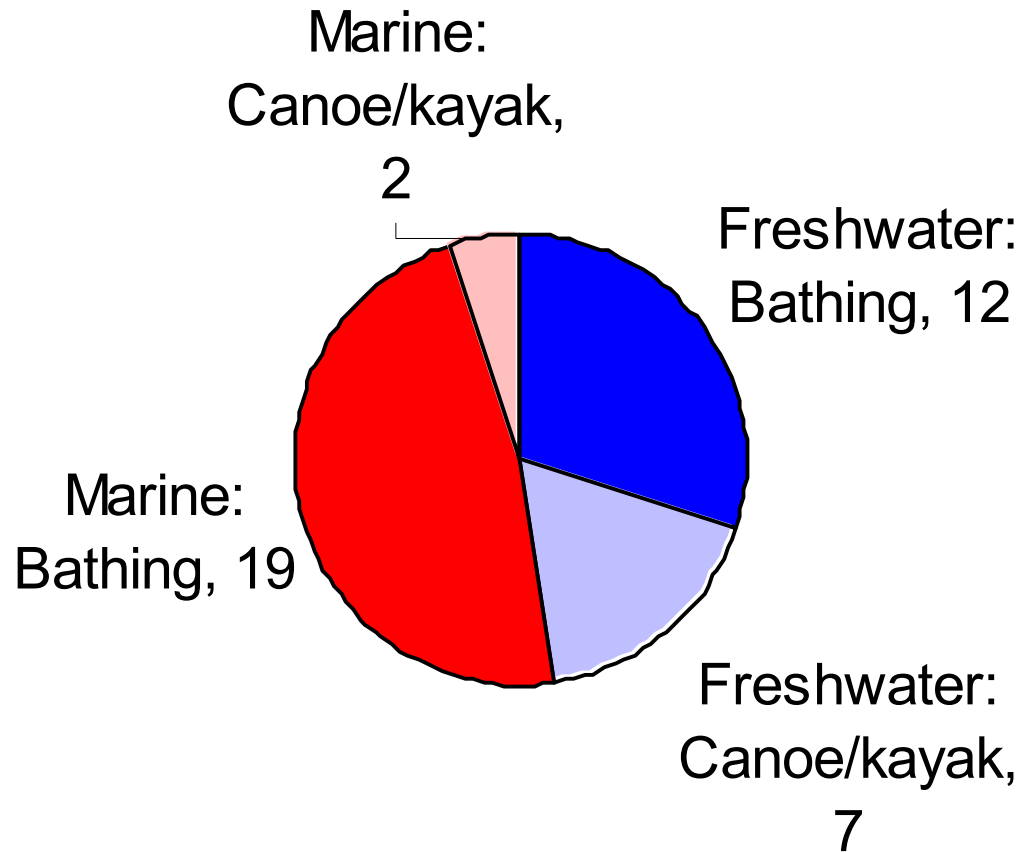
Wiedenmann 2006

Fewtrell 1994

Marino 1995



# Epi studies, by water type & activity



# Epidemiologic Studies of Recreational Water Exposure

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Kueh 1995

von Schirding 1992

Ferley 1989

Lee 1997

Wade 2006

Fewtrell 1992

Lightfoot 1989

Wiedenmann 2006

Fewtrell 1994

Marino 1995

# Studies: Freshwater, “secondary contact” exposure

Appleton 1989

Gray 1997

Jessop 1985

Taylor 1995

Lee 1997

Fewtrell 1992

Fewtrell 1994

# Studies: Drop schistosomiasis, outbreaks, studies without disease rates

Jessop 1985

Lee 1997

Fewtrell 1992

# Jessop 1985

- Lake contact among those who visited their doctor for acute gastrointestinal symptoms (“cases”) compared to those who didn’t
- Self-reporting of water exposure
- No measures of water quality
- Small number of participants (105)
- Conclusion: no association

# Lee 1997: Methods

- Setting: artificial whitewater canoe course fed by the River Trent
- Determined symptoms by questionnaire completed at home by participants 1 week after event
- 8 events, 473 completed questionnaires
- No unexposed controls
- Water: indicators by culture, F-specific RNA bacteriophage

# Lee 1997: Results

- E.coli and S. fecalis concentrations predict GI illness, but not after taking into account F-specific phage concentrations
- Phages concentrations increase risk
- Other predictors of illness (1-2 fold increase in risk): swallowing water, accidental swimming in course, drinking before getting changed

# Fewtrell 1992: Design

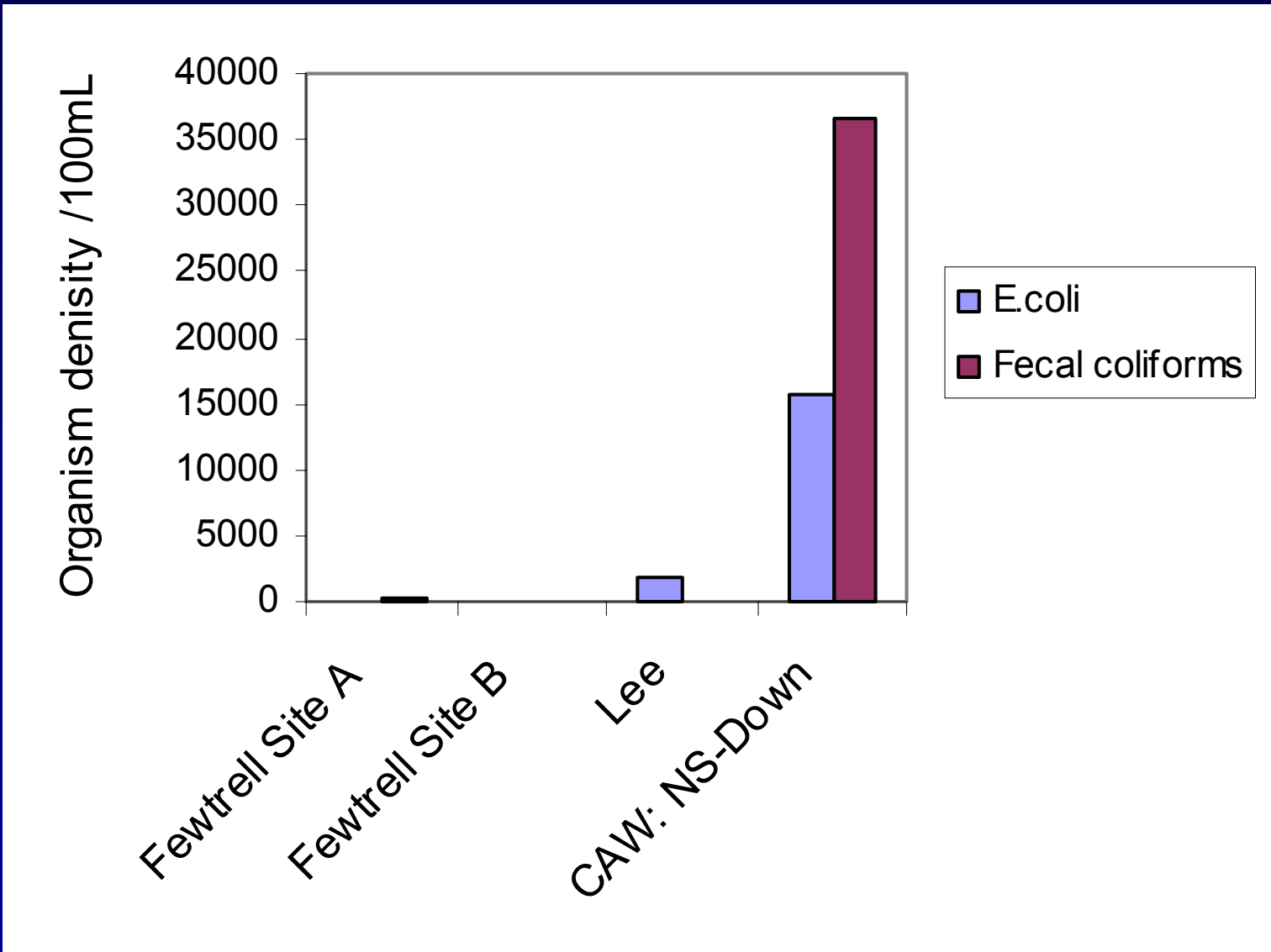
- Setting: Two white water canoeing slalom channels
- Subjects: canoeists and spectators
- Health: by questionnaire at site+telephone follow-up
- Water: Indicators, enterovirus



# Fewtrell 1992: Results

- Canoeists had higher rates of GI symptoms than unexposed study subjects (3-4 fold increase in risk)
- Higher rates of illness among canoeists at the site with higher indicator and enterovirus concentrations

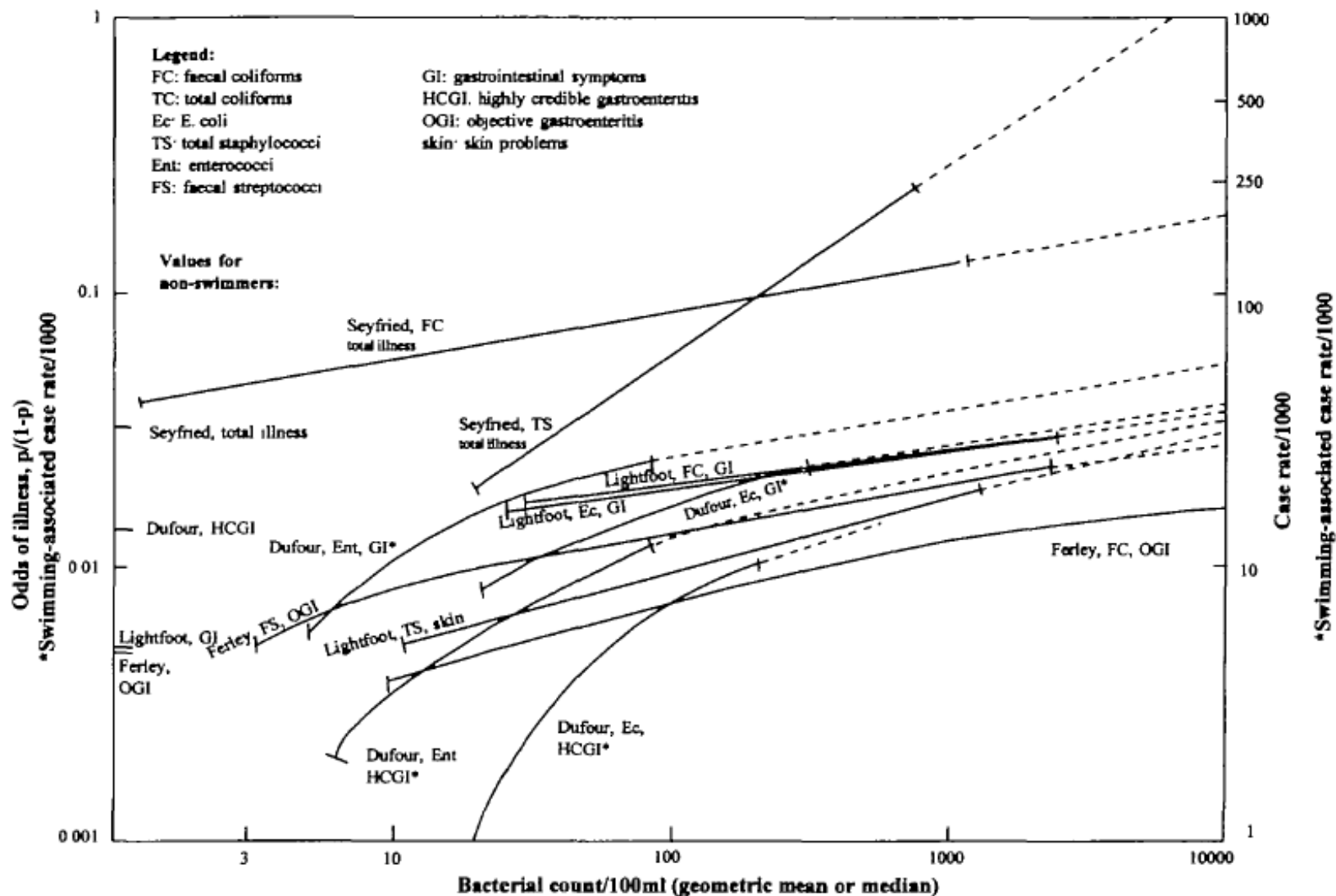
# Water quality: Lee, Fewtrell vs. CAW



# Characterizing rates of illness due to non-swimming recreational contact with the CAW:

Option 2: Extrapolate from studies of swimmers

# Indicator density vs. risk for freshwater swimmers (Pruss 1998)



# Dose-response, freshwater swimmers (Wade 2006)

- 10-fold increase in *E. coli*: 2.1-fold increase in risk of illness
- 10-fold increase in enterococcus: 1.4-fold increase in risk of illness

How much water do swimmers ingest? How much water do people ingest when canoeing? Kayaking? Fishing? Boating? Rowing?

- Swimmers: After 45 minutes, adults swallow 16mL; kids: 37mL (Dufour 2006)
- Other recreators: ??????
- Dermal contact: ??????

# Characterizing rates of illness due to non-swimming recreational contact with an urban river:

Option 3: Empiric observation

# To consider in designing an epidemiologic study: 1

Rates of illness among CAW recreators

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Rates of illness attributable to CAW  
recreation



# Attributing illness to CAW contact

- Background rates of acute gastrointestinal symptoms in general population are approximately 50/1,000 per month
- Exposure to water with low concentrations of microbes is associated with increased rates of skin, eye, respiratory symptoms

# Three groups of subjects



Unexposed  
recreators



Lake recreators



CAW recreators

# Sources of risk, by group



Golfers/Cyclists



Lake recreators

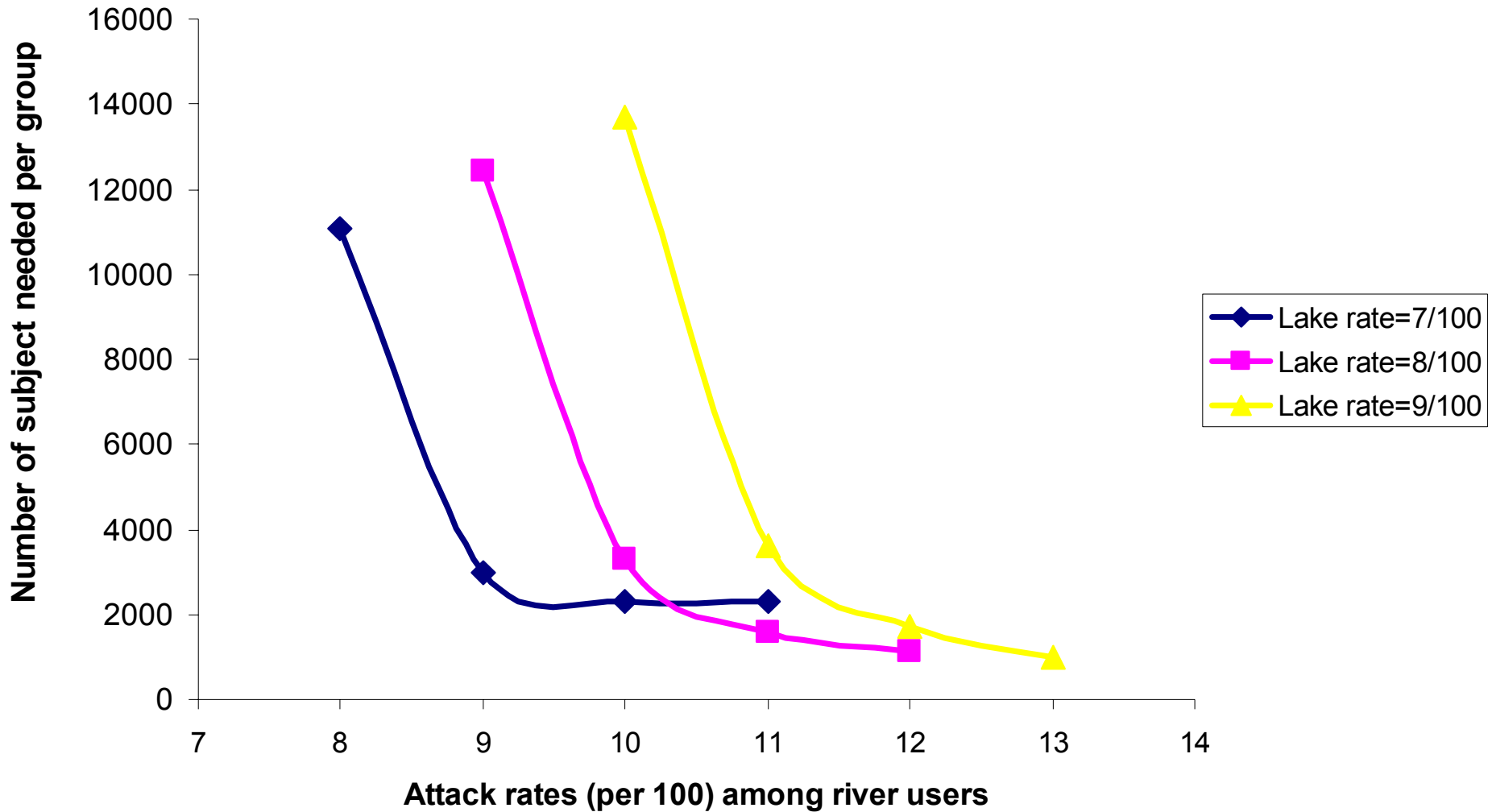


River recreators

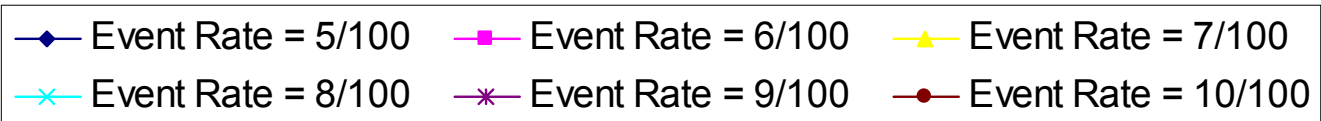
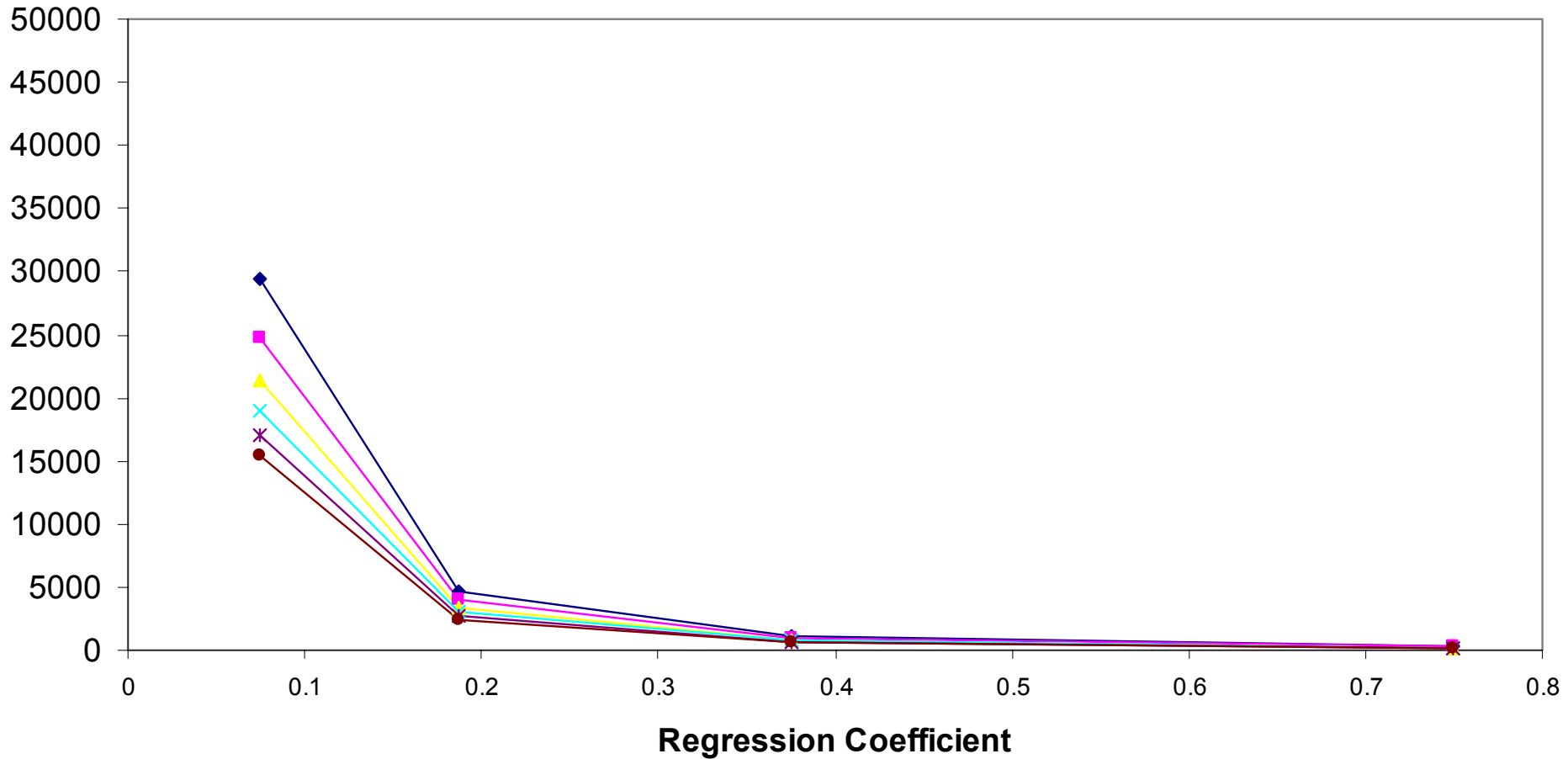
# To consider in designing an epidemiologic study: 2

- Detecting subtle effects requires large sample size
- Identifying with confidence a difference between a 50/1,000 rate and a 60/1,000 rate would require 8,400 subjects per group

## Group sample size for background attack rate of 5/100



# Sample Size Using Logistic Regression: X=Log10 E Coli Concentration



# Objectives: Local

- To determine rates of illness attributable to recreational contact on the Chicago Area Waterways
- To characterize the relationship between measures of microbe densities and rates of illness
- To identify pathogens that cause cases of acute illness in study subjects

# Objectives: Local and Beyond

- To compare pathogens and indicator organisms as predictors of illness among limited contact recreators
- To compare standard and rapid tests of microbe densities as predictors of illness
- To estimate dermal and oral dose of water for various activities
- To compare illness rates for swimmers and secondary contact recreators in the same body of water



# UIC Research Team

- Environmental epidemiology
- Infectious disease epidemiology
- Medical
- Industrial Hygiene
- Water quality sampling and analysis
- Microbiology
- Molecular biology
- Biostatistics and risk assessment

# Human subjects protection

- Protocol to be approved by UIC Institutional Review Board
- Written consent for adults
- Parental consent + assent for kids

# Measurements

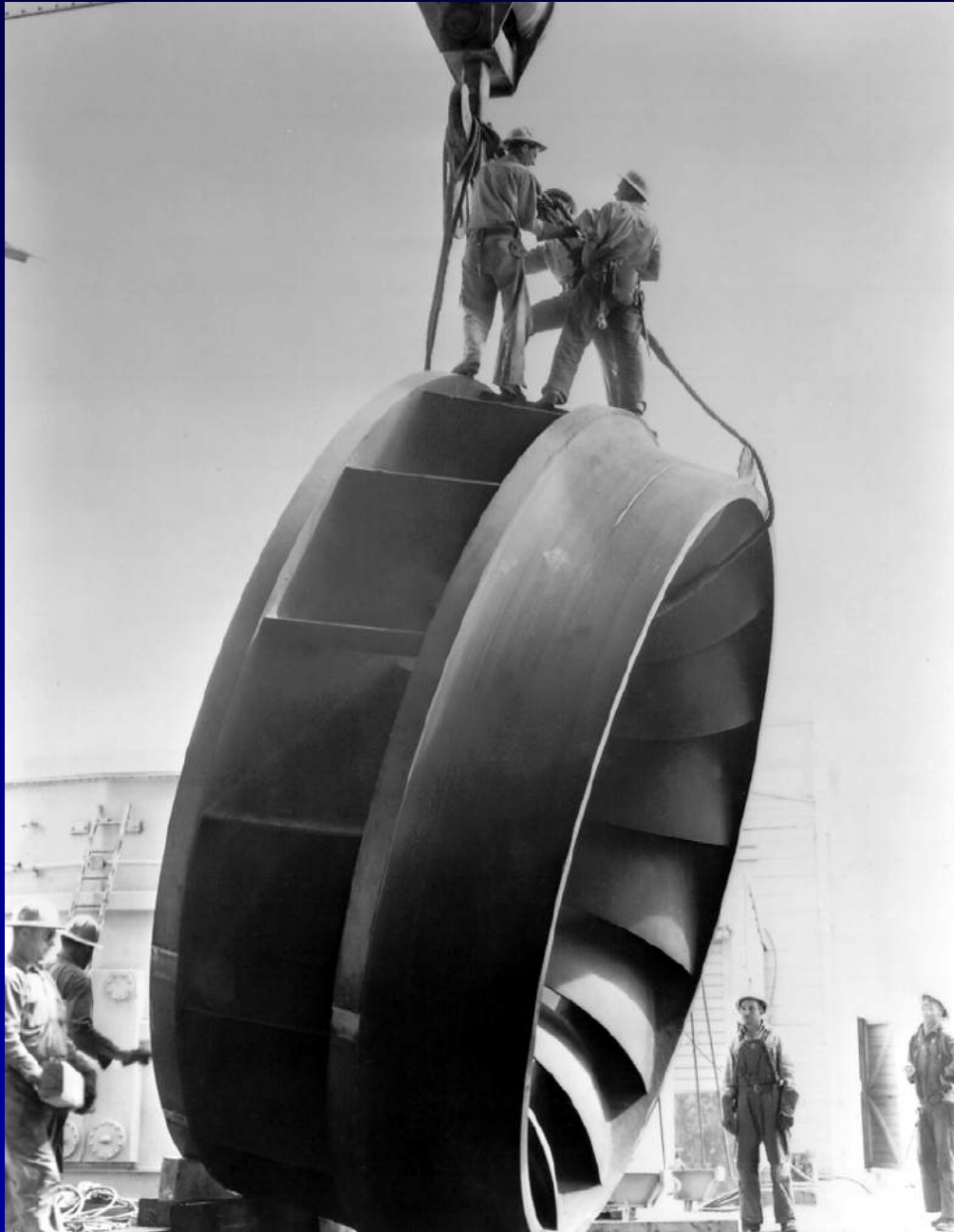
- Pre-activity assessment
- Exposure assessment
- Follow-up monitoring
- Analyses of water samples
- Analyses of biologic samples
  
- Use of standardized methods
- QA and QC protocols

# Data collection

- Multidisciplinary Field teams
  - Recruitment
  - Medical/Nursing evaluations
  - Industrial hygiene
  - Survey questionnaires
  - Logistics
  - Data
- Telephone follow-up
- Home visits for clinical specimens

# Potential Outputs

- Rates of illness among secondary contact recreators as a function of microbe density
- Analysis of the microbe density-illness relationship for threshold effects, guidelines for standard setting
- Comparison of 30-day geometric mean vs. single sample maximum
- Estimation of water exposure (dose) by recreational activity
- Recommendations for monitoring pathogens vs. indicators
- PCR vs. culture-based tests



# Questions and comments