

Neurotoxic Effects of Early Life Exposure to Tetrachloroethylene (PCE)-Contaminated Drinking Water

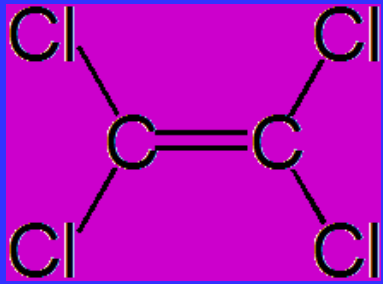
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Superfund Research Program

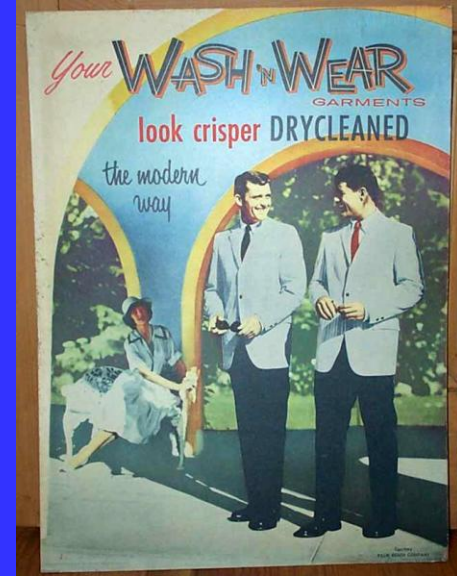
Overview of Presentation

- PCE uses and fate
- How PCE contaminated drinking water in Cape Cod area of Massachusetts
- Cohort study methods and results on occurrence of risky behaviors
- Implications of findings



PCE Uses and Fate

- PCE stands for tetrachloroethylene
- Commercially important solvent used for dry cleaning, textile processing, and metal degreasing
- About 650,000 persons in US are exposed through their work
- Used in small, geographically dispersed, and poorly controlled facilities --dry cleaners, garages, machine shops
- Common drinking water contaminant (8-38%)



PCE in Cape Cod Waters



- In 1980 Massachusetts officials discovered that PCE was leaching into drinking water from vinyl lining in water distribution pipes
- Vinyl liner introduced in 1968 in response to complaints about taste and odor of water
- Liner composed of vinyl toluene resin dissolved in PCE
- Assumed that PCE would disappear in curing process but substantial quantities remained and leached into drinking water

Extent of Problem



Original map showing pipe locations

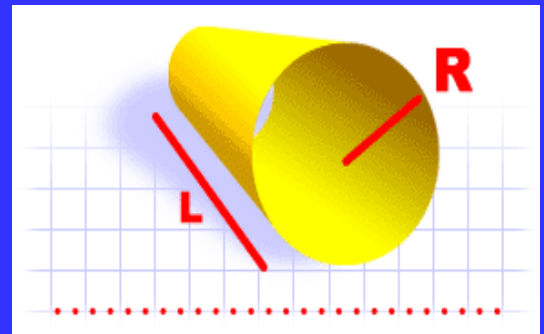
- 660 miles of vinyl-lined asbestos cement pipes installed in 91 Massachusetts communities from 1968 through 1980
- 24% installed on Cape Cod area
- Typical levels varied from 1,600-7,750 ug/l at low flow locations and 1.5-80 ug/l at medium/high flow locations



Cape Cod Health Study

- Retrospective cohort study to examine long-term neurotoxic effects of early life exposure to PCE
- Source population: Children born from 1969-1983 to women who lived in Cape Cod towns with vinyl-lined pipes identified from birth certificates
- Included two groups:
 - (1) children with both prenatal and early childhood exposure
 - (2) unexposed children who neither exposure

Assessing PCE Exposure



- Used geographic information system (GIS) and a leaching and transport model to estimate mass of PCE delivered to each residence from prenatal period through age of 5 years
- Model estimated quantity of PCE entering drinking water using information on initial quantity of PCE in liner (based on pipe length and diameter), age of pipe, leaching rate of PCE from liner into water, and flow of water through the pipes.
- Model used to estimate relative delivered dose (RDD), an ordinal estimate of exposure

Characteristics of Study Population

Characteristic	Prenatal and Early Childhood Exposure N=831	Unexposed N=547
Mean age at enrollment	29.2	29.6
% White	98.4	98.5
% College graduate	61.4	61.2
% Mother received prenatal care	95.5	95.1
% Mother smoked cigarettes during gestation	21.9	20.7
% Mother consumed alcoholic beverages during gestation	36.3	36.8



Risky Behaviors As Teenager and Adult



- Cigarette smoking
- Alcoholic beverage consumption
- Illicit drug use: marijuana, inhalants, cocaine, psychedelics, club drugs
- Self-reported questionnaire information



Findings

- Individuals who were highly exposed to PCE-contaminated drinking water during gestation and childhood experienced 50% to 60% increases in the risk of using two or more major illicit drugs
 - RR for teen use: 1.6 (95% CI: 1.2-2.2)
 - RR for adult use: 1.5 (95% CI: 1.2-2.9)
- Specific drugs for which increases were observed included crack/cocaine, psychedelics/hallucinogens, club/designer drugs, Ritalin without a prescription, and heroin
 - RRs for specific drugs : 1.4-2.1
- 30-60% increases in the risk of certain smoking and drinking behaviors were also seen among highly exposed subjects

Concluding Remarks

- This is the first study to report an association between early life exposure to a solvent and risky behaviors as a teen or adult
- Prior studies of neurotoxic effects among individuals with early life exposure to solvents have examined mainly examined problems with learning, attention, and behavior among young children
- Provocative findings need to be corroborated and we must find other suitable populations for long-term studies
- PCE remains a commercially ubiquitous solvent and common contaminant of drinking water, so it is important to determine its impact on health of vulnerable populations

Thanks to my collaborators.....

