Cancer and the Environment: Reflections from Cancer Alley

Tom Burke
Professor
Johns Hopkins University
Bloomberg School of Public Health
Overview

- Reflections on experiences
- Cancer Alley
- Cluster Investigations
- Environmental Exposures
- Future Directions
- Getting to Prevention
Environmental Cancer

- 2 - 5% (Doll and Peto, 1981)
- 70 – 80%
- A Political Disease?
Male Cancer Mortality
1950-1969

Cancer Mortality Rates by County (Age-adjusted 1970 US Population)
All Cancers: White Males, 1950-69
Female Cancer Mortality 1950-1969

Cancer Mortality Rates by County (Age-adjusted 1970 US Population)
All Cancers: White Females, 1950-69
The Challenges

- Asbestos
- Industrial Emissions
- Ground water and drinking water
- Toxic Waste sites
- Radium
- Radon
- PCBs
- Dioxin
- Chromium
- Clusters
The Pierpont School


Chromium History

- **1897-1971**: Three companies processed chromite ore in Hudson County, NJ.
- **1897-1971**: About 2 million tons of chromite ore processing residue (COPR) used as landfill in Hudson Co.
- **1983**: Concern first raised about potential cancer risk posed by Cr(VI) in COPR in soils.
Roots.....
Intrinsic Genetic

Environmental Exposure

Human Health/Disease

Age/Time

"Genetics loads the gun, but environment pulls the trigger."
Judith Stern, UC Davis

Source: K. Olden (adapted)
Recognized (Suspected) Environmental Cancers

- Leukemia
- Lymphoma
- Myeloma
- Liver
- Lung
- Bladder
- Kidney
<table>
<thead>
<tr>
<th>CANCER TYPE</th>
<th>AGENTS</th>
<th>OCCUPATIONS/ ENVIRONMENTS</th>
<th>DATA</th>
</tr>
</thead>
<tbody>
<tr>
<td>BLADDER</td>
<td>Tobacco, aromatic amines (benzidine, 2-napthylamine, 4-Aminobiphenyl) by-products of chlorination, arsenic, dyes (auramine and magenta), coal tar pitch volatiles</td>
<td>Dye-stuffs and rubber industries, cable making industries, leather workers, painters, truck drivers, aluminum workers, chimney sweeps</td>
<td>Evidence is well-established</td>
</tr>
<tr>
<td>BRAIN/CNS</td>
<td>Radiation, tobacco (second hand exposure to children), alcohol, nonpublic or spring water, cured meats/fish, coal and petroleum products, EMFs, insecticides/fungicides, herbicides, fertilizers, vinyl chloride, N-nitroso compounds (NOCs), PAHs</td>
<td>Petrochemical workers, rubber industry, health professions (pathologists, physicians, nurses, dentists, veterinarians), electrical workers, railway workers, agriculture</td>
<td>Association with high-dose radiation well-established</td>
</tr>
<tr>
<td>KIDNEY</td>
<td>Tobacco, asbestos, alcohol, PAH’s, cadmium, inorganic arsenic, radiation, dyes, coal, natural gas, mineral oil</td>
<td>Dry cleaning workers, coke-oven workers, petroleum refinery workers, truck drivers, electric utility workers</td>
<td>Unclear</td>
</tr>
<tr>
<td>LEUKEMIA</td>
<td>Benzene, radiation, EMFs, styrene, butadiene, pesticides, herbicides, insecticides, fertilizers, ethylene oxide, diesel exhaust, polynuclear aromatic hydrocarbons, hair dyes, tobacco</td>
<td>X-ray technicians, hydrocarbon-related industry, chemical manufacturing, shoe, leather, rubber and rototyping workers, refineries, farmers, embalmers, anatomists, pathologists, welders, foundry workers, hairdressers, dry cleaners, carpet manufacturing, wood products industries</td>
<td>Evidence is well-established</td>
</tr>
<tr>
<td>LIVER AND BILE DUCT</td>
<td>Alcohol, tobacco, vinyl chloride, arsenicals, thorotrast, aflatoxins</td>
<td>PVC workers, automotive and rubber plant workers, textile and metalworkers, aircraft, chemical processing and wood-finishing industries, petroleum refining, paper mills, shoemaking and repairs, shipbuilding and insulation work</td>
<td>Evidence is well-established</td>
</tr>
<tr>
<td>LUNG AND BRONCHUS</td>
<td>Tobacco, alcohol, arsenic, insecticides, asbestos, man-made mineral fibers, chloromethyl ethers, chromium (VI), mustard gas, nickel, PAHs, radon, silica, vinyl chloride, acrylonitrile, beryllium, formaldehyde, chlorinated toluenes, epoxy resins, pesticides, wood dust, radiation, air pollution, Bis(chloromethyl)ether, chloromethyl methyl ether, coal tar pitch volatiles, sulfuric acid mist</td>
<td>Copper smelting, mining, asbestos industries, chromate-producing industries, nickel refining, steel workers (cobe ovens), gas workers, aluminum smelting, roofers, rail workers, rubber workers, welders, paper and pulp industry, butchers and meat packers, cooks and bakers, painters</td>
<td>Evidence is well-established</td>
</tr>
<tr>
<td>LYMPHOMA (Non-Hodgkins)</td>
<td>Radiation, herbicides, pesticides, 2,3,7,8-TCDD, styrene, butadiene</td>
<td>Agriculture, rubber industry, woodworkers, meat workers, metal workers</td>
<td>Occupation associations</td>
</tr>
<tr>
<td>MULTIPLE MYELOMA</td>
<td>Radiation, asbestos, benzene, pesticides, herbicides, paints, solvents, aromatic and aliphatic hydrocarbons, 2,3,7,8-TCDD, metals, textile fibers, inks and dyes</td>
<td>Agriculture, rubber industries, herbicide applicators, textile industries, plastics manufacturing, wood products industries, cosmetologists and hairdressers</td>
<td>Strong env. associations</td>
</tr>
</tbody>
</table>
SEER Age Adjusted Incidence Rates by Race and Sex
All Cancer Sites, All Ages

[Graph showing the age-adjusted incidence rates by race and sex for all cancer sites and all ages, from 1973 to 2002.]
SEER Age Adjusted Incidence Rates by Sex Non-Hodgkin Lymphoma, All Ages
Myeloma Trends

![Myeloma Trends](image-url)
Liver Cancer Trends
Lung Cancer Trends

The graph shows the trends in lung cancer rates per 100,000 population over the years from 1973 to 2002, categorized by race and gender.

- **White/Male** represented by red circles.
- **White/Female** represented by blue squares.
- **Black/Male** represented by green diamonds.
- **Black/Female** represented by brown triangles.

The rates have generally increased over the years, with some fluctuations. The trends for different racial and gender groups vary, indicating disparities in lung cancer incidence.

The y-axis represents the rate per 100,000, and the x-axis represents the year of diagnosis.
Bladder Cancer Trends
Kidney Cancer Trends

The graph shows the trend of kidney cancer rates per 100,000 population from 1973 to 2002, categorized by race and gender. The rates have been increasing over the years, with the most significant increases observed in recent years. The data is represented by different markers and colors for different categories: White/Male, White/Female, Black/Male, and Black/Female.
SEER Age Adjusted Incidence Rates by Sex
Brain and Other Nervous System Cancer, All Ages
SEER 9 Registries for 1973-2002

Graph showing the age-adjusted incidence rates of brain and other nervous system cancer from 1973 to 2002, differentiated by sex (male and female). The rates are expressed per 100,000 population.
Figure 5. Cancer Incidence Rates for 7 Sites (Bladder, Kidney, Leukemia, Liver, Lung, Multiple Melanoma, NonHodgkin’s Lymphoma), Maryland, 1992-1999
Maryland Carcinogen Releases

- 1 - 50,000 pounds
- 50,000 - 100,000 pounds
- 100,000 - 200,000 pounds
- 200,000 - 500,000 pounds
- 500,000+ pounds
Distribution of Maryland counties by cancer risk (tier 1 carcinogens) and incidence (seven environmental cancers) sorted by values above (high) and below (low) the median. Numbers in parentheses are county ranks for adult smoking prevalence for the year 2002 (MD DHMH 2003).
Baltimore Chromium Cleanup
Arsenic in Eastern Maryland
Ground Water

Tracking data + spatial analysis tools

Insights into the role of environmental exposures on human health
Dorchester County (all wells)

Legend
all_wells
arsenicppb
- 0 - 5
- 6 - 10
- 11 - 15
- 16 - 20
- 21 - 25

Note: Map is based on data for 224 wells
Maryland Mean TTHM Concentrations

Mean Total Trihalomethane (ug/L)

Month

January, February, March, April, May, June, July, August, September, October, November, December
Biomonitoring

What is it?
Measurement of chemicals or their metabolites in human specimens including blood, urine, hair, nails, cord blood, milk.
"This is a giant step forward to understanding the relationship between exposure to chemicals and their potential health effects"

Dr. Julie Gerberding, CDC's director
Uses of Biomonitoring

- Measure amount of chemical absorbed into the body
- Provide a measure of individual or population exposure levels
- Evaluate health effects
- Identify those at highest risk
- Track trends
- Guide prevention strategies
Future Directions

- Improved Surveillance (Tracking)
  - Hazards and sources
  - Exposures
  - Biomonitoring
  - Health outcomes
Future Directions

- Improved information to inform public and policy makers

- Refined Epidemiological Studies
  - High risk populations
  - Clusters
  - Infection/environment interaction
  - Social/environmental interaction
Conclusions

- Environmental cancer risks are real
- Understanding and reducing these risks is an essential component of cancer prevention
- There has been great progress, but many challenges remain