How the Environment Impacts Humans: Population Perspective

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The “Environment” and Health

• The *Natural* Environment
• The *Built* Environment
• The *Social* Environment
Environmental Impact (A Model)

\[ I = P \times A \times T \]

- \( I \) = environmental impact
- \( P \) = population
- \( A \) = affluence
- \( T \) = technology

\[ \text{Growth in environ.} = \text{in} \times \text{in} \times \text{in} \times \text{in} \]

\[ \text{Growth in impact} \text{ population affluence technology} \]

Consumerism

World Population Growth

U.S. 328,984,524; World 7,575,934,100

http://www.census.gov/popclock
accessed 6-02-19

21st Century Population Statistics

<table>
<thead>
<tr>
<th>2019</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1 China</td>
<td>1,389,620,713</td>
</tr>
<tr>
<td>2 India</td>
<td>1,311,379,910</td>
</tr>
<tr>
<td>3 USA</td>
<td><strong>328,984,265</strong></td>
</tr>
<tr>
<td>4 Indonesia</td>
<td>263,271,879</td>
</tr>
<tr>
<td>5 Brazil</td>
<td>210,939,227</td>
</tr>
<tr>
<td>6 Pakistan</td>
<td>209,242,560</td>
</tr>
<tr>
<td>7 Nigeria</td>
<td>208,269,059</td>
</tr>
<tr>
<td>8 Bangladesh</td>
<td>163,065,352</td>
</tr>
<tr>
<td>9 Russia</td>
<td>141,059,244</td>
</tr>
<tr>
<td>10 Mexico</td>
<td>127,763,244</td>
</tr>
</tbody>
</table>

*Note: Data updated 6-1-2019

Source: U.S. Census Bureau, International Data Base.*
21st Century Population Statistics

- Note: Data updated 6-30-2012
- Source: U.S. Census Bureau, International Data Base.

Percent Survival in UK Males

Clinical Medicine 2014, Vol 16, No 6, 643–53

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>90% of all cancers occur after age 45

90% of all cancers occur after age 45

By 2050, 2/3 of cancers will occur in Asia

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Death Rates per 100,000 in US, 1969-2013

- Death rate per 100,000 has decreased by 42.9%

- HEART DISEASE: 75% reduction

- CANCER: only 17.9% reduction
  - All air traffic accidents last year equal the number of people who die of cancer every day in US


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The Toxicological Paradigm: The Importance of Susceptibility and Effect Modifiers

**Susceptibility**
- genetic factors

**Effect modifiers**
- diet
- habits
- health
- medication
- co-exposure

**Exposure**
- internal dose
- biologic effective dose
- early biologic effects
- altered structure & function
- clinical disease

**The Importance of Susceptible Subgroups in the Population and Regulatory Implications**

Tarcher (adapted)
The “Environment” as a Contributor to Disease

- **The Narrow View:**
  - “Environment” = Exposure to one or more environmental agents

- **A Broader View:**
  - Internal = Genetic/Biologic (not “environment”)
  - Everything external to the individual = “environment”

- **The Broasted View:**
  - Individual
    - Genetic/biologic
    - Individual-level social & behavioral
  - Environmental
    - Physical environment
    - Group-level social & behavioral

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**Trends in chronic diseases:**
**Good Things Are Happening**
World mortality trends, 1970-2010: risks of dying in selected age ranges

Lines give trends from 1970* (left) to 2010 (circles).

* Mean, 1965-69 & 1970-74

Lancet 2015; 385: 239

World mortality trends, 1970-2010, by country income: risks of dying in selected age ranges

Low-income, 1970-2010

High-income countries, 1970-2010

Lancet 2015; 385:239
**Mortality by age, at world 1970 and 2010 death rates**
(mean of male and female risks)

Risk of Dying

* Risks in England, 1910 & 2010

**Lancet 2015; 385: 239**

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**UNIVERSITY OF KINGDOM 1950–2010: Males & Females**
All vascular mortality at ages 35–69

Death rate / 100,000 age standardized

* Male
  * Female

1980, M+F:
16% dead before 70

2010, M+F:
4% dead before 70

*Mean of annual rates in the seven component 5-year age groups
Source: WHO mortality & UN population estimates

**R. Peto, AACR, 2016**

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US male cancer mortality trends at ages 35-69, 1950-2015: selected sites

Main causes of trends in recent decades

35-year risk (%)

Lung: cigarettes
Colorectal: treatment
Stomach: Unknown

R. Peto, AACR, 2016
Age-Standardized Death Rate From All Causes in the United States, 1969-2013


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Age-Standardized Death Rates per 100,000 in US, 1969-2013

- The age-standardized death rate per 100 000 decreased from 1278.8 to 729.8 for all causes (42.9% reduction)
- From 156.8 to 36.0 for stroke (77.0% reduction)
- From 520.4 to 169.1 for heart disease (67.5% reduction)
- From 65.1 to 39.2 for unintentional injuries (39.8% reduction)
- From 198.6 to 163.1 for cancer (17.9% reduction)
- From 25.3 to 21.1 for diabetes (16.5% reduction)
- In contrast, the rate for COPD increased from 21.0 to 42.2 (100.6% increase)
Maryland and Baltimore Metro Region: A “Model” of Cancer Disparity

### All Cancer Mortality Rank Among States and D.C.

<table>
<thead>
<tr>
<th>Cancer Site</th>
<th>1985 Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lung/bronchus</td>
<td>8&lt;sup&gt;th&lt;/sup&gt;</td>
</tr>
<tr>
<td>Colon/rectum</td>
<td>10&lt;sup&gt;th&lt;/sup&gt;</td>
</tr>
<tr>
<td>Prostate (male)</td>
<td>9&lt;sup&gt;th&lt;/sup&gt;</td>
</tr>
<tr>
<td>Breast (female)</td>
<td>10&lt;sup&gt;th&lt;/sup&gt;</td>
</tr>
</tbody>
</table>
Prevalence of Current Smoking in Maryland

Current Smokers* in Maryland Among Adults Age 18 Years and Older (2001-2010) Compared to Healthy People 2020 Target

<table>
<thead>
<tr>
<th>Year</th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>HP 2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rate</td>
<td>21.1%</td>
<td>21.9%</td>
<td>20.1%</td>
<td>19.6%</td>
<td>18.9%</td>
<td>17.7%</td>
<td>17.1%</td>
<td>14.9%</td>
<td>15.2%</td>
<td>12.0%</td>
<td></td>
</tr>
</tbody>
</table>

*Current smokers defined as those who smoked every day or some days.

Maryland Cancer Report 2013
Life Expectancy at Birth by Race, Maryland, 2003-2012.

Maryland Cancer Report 2013

Life Expectancy Baltimore Washington Region

Engagementnetwork.org
Life expectancy at birth, by neighborhood
Baltimore City, 2002-2006

62 years age to 84 years

Maryland All Cancer Sites Mortality Rates by Geographical Area:
Comparison to U.S. Rate, 2010-2014

Legend
- >25% above U.S. rate
- 10-25% above U.S. rate
- Between 10% below and 10% above U.S. rate
- 10-25% below U.S. rate
- >25% below U.S. rate

Rates are age-adjusted to the 2000 U.S. standard population and are per 100,000 population.

Maryland area-specific rates with 95% confidence intervals are presented in Appendix E, Table 9.

U.S. all cancer sites mortality rate, 2010-2014: 165.1 / 100,000
Maryland all cancer sites mortality rate, 2010-2014: 165.4 / 100,000

Source: NCHS Compressed Mortality File in CDC WONDER
U.S. SEER, Cancer Statistics Review

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Maryland Female Breast Cancer Mortality Rates by Geographical Area: Comparison to U.S. Rate, 2010-2014

Legend
- >25% above U.S. rate
- 10-25% above U.S. rate
- Between 10% below and 10% above U.S. rate
- 10-25% below U.S. rate
- >25% below U.S. rate
- Suppressed

Rates are age-adjusted to the 2000 U.S. standard population and are per 100,000 women.

Maryland area-specific rates with 95% confidence intervals are presented in Appendix E, Table 12.

U.S. female breast cancer mortality rate, 2010-2014: 21.1 / 100,000

Maryland female breast cancer mortality rate, 2010-2014: 22.8 / 100,000

Source: NCHS Compressed Mortality File in CDC WONDER U.S. BEER, Cancer Statistics Review

Note: Rates based on death counts of 0-19 are suppressed per MDH / CDC Mortality Data Suppression Policy

Disparities in Breast Cancer Mortality Rates, Maryland
Lack of decline in rate for Black Women

Female Breast Cancer Mortality Rates by Race
Maryland, 2010-2014

Source: NCHS Compressed Mortality File in CDC WONDER, 2012-2014
Maryland Vital Statistics Administration from MATCH, 2010
Maryland Vital Statistics Administration, 2011

Maryland Cancer Report 2017
No Disparity in Mammography by Race, Maryland, Yet HUGE Disparities in Breast Cancer Mortality Rates!

- If black women have more aggressive disease, then missing the same % for screening, will still yield a mortality racial disparity if treatment at a later stage is less effective.

Maryland Cancer Report 2013

Maryland Prostate Cancer Mortality Rates by Geographical Area: Comparison to U.S. Rate, 2010-2014

Legend
- >25% above U.S. rate
- 10-25% above U.S. rate
- Between 10% below and 10% above U.S. rate
- 10-25% below U.S. rate
- <25% below U.S. rate
- Suppressed

Rates are age-adjusted to the 2000 U.S. standard population and are per 100,000 men.

Maryland area-specific rates with 95% confidence intervals are presented in Appendix E, Table 12.

U.S. prostate cancer mortality rate, 2010-2014: 20.1 / 100,000
Maryland prostate cancer mortality rate, 2010-2014: 20.3 / 100,000
Source: NCHS Compressed Mortality File in CDC WONDER U.S. DEE, Cancer Statistics Review

Note: Rates based on death counts of 0-10 are suppressed per MDH / CCPC Mortality Data Suppression Policy.
Disparities in Prostate Cancer Incidence and Mortality Rates, Maryland

Maryland Cancer Report 2017

Maryland Cervical Cancer Mortality Rates by Geographical Area: Comparison to U.S. Rate, 2010-2014

Legend:
- >25% above U.S. rate
- 10-25% above U.S. rate
- Between 10% below and 10% above U.S. rate
- 10-25% below U.S. rate
- <25% below U.S. rate
- Suppressed

Rates are age-adjusted to the 2000 U.S. standard population and are per 100,000 women.

Maryland area-specific rates with 95% confidence intervals are presented in Appendix E, Table 16.

U.S. cervical cancer mortality rate, 2010-2014: 2.3 / 100,000

Maryland cervical cancer mortality rate, 2010-2014: 2.0 / 100,000

Source: NCHS Compressed Mortality File in CDC WONDER
U.S. SEER, Cancer Statistics Review

Note: Rates based on death counts of 0-15 are suppressed per MDH / CCPC Mortality Data Suppression Policy.
Lung/Bronchus Cancer Rate (2011-2015)

- Lung cancer nearly 4x higher in Kentucky than Utah
- Prostate cancer 2.5 x higher in DC than Arizona
• When the right thing can only be measured poorly, it tends to cause the wrong thing to be measured only because it can be measured well. And it is often much worse to have good measurements of the wrong thing - especially when, as so often is the case, the wrong thing will in fact be used as an indicator of the right thing - than to have poor measurements of the right thing.

• Tukey, J.W. (1979)
Key Points - 1

• Population health hazards have increased during human cultural evolution, starting with combat, vector-borne infections, and periodic famine. The advent of towns and cities brought nutritional deficiencies and contagious diseases; the industrial revolution brought industrial toxins and pollution; modern affluence has brought over-nutrition; and global ecological disruption is potentially next.
• Many industrialized countries have exhibited an epidemiologic transition during industrialization, with the major human health hazards transitioning from infectious diseases to cardiovascular disease and cancer.
• Individual variation, due to susceptibility and effect modifiers, hinders our ability to understand dose-response relations and risks in populations.

Key Points - 2

• The emerging view is that health is determined by individual genetic/biologic factors, physical environmental factors, individual behaviors, and group social and behavioral factors.
• A confounding factor is associated with both the exposure and the disease, but is not directly studied, and can lead to a false observed association between exposure and disease.
• Factors making environmental disease hard to identify include latency, multi-factorial etiology, disease non-specificity, individual characteristics (susceptibility), dose-response relations, and mixed exposure scenarios.