The Promise of Prevention in Cancer Control

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Key Questions

1. What is Cancer?

2. What do we mean by “prevention”?

3. How important is preventing cancer?

4. Why do we think cancer is preventable?

5. How much cancer could we prevent now?
WHAT IS CANCER?

• Popular definition:

“A cellular tumor whose natural course is fatal...” Dorland’s Medical Dictionary
WHAT IS CANCER?

• Scientific definition:

Uncontrolled proliferation
Invasion
Metastasis
Cellular atypia
Cellular atypia
Chromosomal abnormalities
Genetic mutation/loss/amplification
WHAT IS CANCER?

Etiological definition:

Cancer is the later stages of carcinogenesis: “…an evolutionary process of aberrant cellular differentiation.”

M. B. Sporn 1991
What does it mean to “prevent” Cancer?

Answer depends on one’s perspective.
Basic scientist’s perception

Retard progression of carcinogenesis.

Modify biomarkers.
Clinician’s perception

Prevent clinical diagnosis of cancer.

Decrease incidence rate.
Public perception

Prevent death from cancer.

Decrease mortality rate.
Global Importance of Cancer Prevention


2. Forecast cancer trends.
World Deaths and DALYs

Major Diseases and Conditions in the World

Rank
1. Cardiovascular diseases
2. Cancer
3. Injuries
4. Respiratory infections
5. HIV infection or AIDS
6. Perinatal conditions
7. Digestive diseases
8. Diarrheal diseases
9. Tuberculosis
10. All other communicable diseases

Disability-Adjusted Life-Years (billions)

Deaths (millions)

- Mental illness
- Injuries
- Cardiovascular diseases
- Perinatal conditions
- Respiratory infections
- HIV infection or AIDS
- Cancer
- Sensory organ diseases
- Diarrheal diseases
- Respiratory diseases
- All other noncommunicable diseases
- All other communicable diseases

- Noncommunicable disease
- Communicable disease
- Injury
DALYs and Deaths
Low and Middle Income Countries
New Cancer Cases and Deaths: Males 2002

Lung
Stomach
Colon/Rectum
Prostate
Liver
Esophagus
Bladder
Oral cavity
Leukemia
Non-Hodgkin lymphoma
Larynx
Pancreas
Kidney etc.
Other Pharynx
Brain, nervous system
Cancer Mortality Trends

- Low-income
- Middle-income
- High-income

Year 2000 to 2030

Total deaths (millions)
Components of Cancer Death Trends
2002-2030

- Lung
- Stomach, colon, and rectum
- Breast, cervix, uterus, and ovary
- Prostate

- Total change
- Population growth
- Population ageing
- Epidemiological change
Summary: Global cancer importance

Accounts for 7.5 million deaths per year.

Two-thirds of deaths outside the high income countries.

Deaths will increase, largely due to aging of populations in low and middle income countries.
Why do we think cancer is preventable?

- International variations
- Migrant studies
- Historical trends
- Known risk factors
- Proven interventions
International Variations
Stomach Cancer Incidence Rates

Age standardized incidence per 100,000
## International Variations

Ratios of highest to lowest incidence rates

<table>
<thead>
<tr>
<th>Cancer type</th>
<th>High incidence area</th>
<th>Low incidence area</th>
<th>Ratio of highest rate to lowest rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oesophagus</td>
<td>Iran</td>
<td>Nigeria</td>
<td>300</td>
</tr>
<tr>
<td>Lung</td>
<td>England</td>
<td>Nigeria</td>
<td>35</td>
</tr>
<tr>
<td>Stomach</td>
<td>Japan</td>
<td>Uganda</td>
<td>25</td>
</tr>
<tr>
<td>Prostate</td>
<td>United States, African-Americans</td>
<td>Japan</td>
<td>40</td>
</tr>
<tr>
<td>Breast (female)</td>
<td>Canada</td>
<td>Israel, non-Jewish population</td>
<td>7</td>
</tr>
<tr>
<td>Corpus uteri</td>
<td>California, United States</td>
<td>Japan</td>
<td>30</td>
</tr>
</tbody>
</table>
Migration
Breast cancer risk in Hispanic women by migration history (RR-95%CI)

<table>
<thead>
<tr>
<th>Generation</th>
<th>Premenopausal</th>
<th>Postmenopausal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Third</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Second</td>
<td>0.83 (0.51-1.36)</td>
<td>0.91 (0.64-1.30)</td>
</tr>
<tr>
<td>First</td>
<td>1.01 (0.64-1.59)</td>
<td>0.59 (0.42-0.83)</td>
</tr>
</tbody>
</table>

$P_{\text{trend}} = 0.97$  
$P_{\text{trend}} < 0.01$
Historical Trends US Males

Annual age-adjusted cancer death rates

[Graph showing historical trends of cancer death rates for US males, with specific emphasis on rates for Stomach, Colon and Rectum, Leukemia, Liver, Lung and Bronchus, and Pancreas.]
Historical Trends US Females

Annual age-adjusted cancer death rates
Known risk factors

• Smoking causes most cancers in smokers.

• Among non-smokers, most cancers are of unknown cause.

• Infection causes most cancers in the lowest-income countries.
**Avoidable Known Cancer Risks USA**

<table>
<thead>
<tr>
<th>Cause</th>
<th>Current smokers*</th>
<th>Non-smokers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smoking</td>
<td>60</td>
<td>—</td>
</tr>
<tr>
<td>Known infections†</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>Alcohol‡</td>
<td>0.4</td>
<td>1</td>
</tr>
<tr>
<td>Sunlight</td>
<td>0.4</td>
<td>1</td>
</tr>
<tr>
<td>Air pollution§</td>
<td>0.4</td>
<td>1</td>
</tr>
<tr>
<td>Occupation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lack of exercise¶</td>
<td>0.4</td>
<td>1</td>
</tr>
<tr>
<td><strong>Diet</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overweight (BMI &gt; 25 kg m⁻²)</td>
<td>4</td>
<td>10</td>
</tr>
<tr>
<td>Other dietary factors</td>
<td>4–12?</td>
<td>10–30?</td>
</tr>
<tr>
<td>Presently unavoidable☆</td>
<td>About a quarter</td>
<td>At least half</td>
</tr>
</tbody>
</table>
Proven Cancer Prevention Strategies
RCT Evidence

• Screening
  Mammography with Clinical Breast Exam

Fecal Occult Blood Test (colorectal cancer)
Proven Cancer Prevention Strategies
Compelling non-RCT Evidence

• **Risk Factor Avoidance**
  - Smoking prevention/cessation counseling
  - Worker exposure reduction (asbestos, etc.)

• **Immunization**
  - Hepatitis B
  - HPV

• **Screening**
  - Cervical PAP testing
Widely-Accepted Prevention Strategies
Insufficient or Negative Evidence

• Oral cancer screening examination
• PSA testing for prostate cancer
• Lung cancer screening with CT or Xray
• Dietary change: More vegetables and fruits
• Dietary change: Less fat
• Dietary antioxidant supplements
• Weight loss and exercise
• Sun avoidance: skin cancer
How Many Cancer Deaths/Yr Could we Prevent Now?

• Tobacco Control

• Screening

• Infection Control
How Many Cancer Deaths/Yr Could we Prevent Now?

Tobacco-Caused Cancers – 1.15 million deaths

Lung  75% of 1,300,000 deaths

Oropharynx  40% of 320,000 deaths

Other sites  15% of 350,000 deaths
How Many Cancer Deaths/Yr Could we Prevent Now?

Screen-detectable cancers – 660,000 deaths

Colorectal 50% of 620,000 deaths

Cervix 90% of 230,000 deaths

Breast 30% of 475,000 deaths
How Many Cancer Deaths/Yr Could we Prevent Now?

Infection-related Cancers – 750,000 deaths

Liver (immunization) 40% of 600,000 deaths

Stomach (antibiotics) 60% of 850,000 deaths

[Cervix (immunization)] 50% of 230,000 deaths
How Many Cancer Deaths/Year Could we Prevent Now?

- Tobacco programs 1,115,000 at low cost
- Infection Control 750,000 at low/moderate cost
- Screening 660,000 at low/very high cost

Total deaths preventable: about 2.5 Million of the 7.5 million deaths/year from cancer worldwide
Deaths averted in the next 10 years by a 2% reduction in Cancer
Conclusions

More than 1 Million cancer deaths per year could be prevented by effective, low-cost tobacco programs, and these deserve a high priority in all countries.
Conclusions

Infection control holds promise for preventing 750,000 cancer deaths, at low to moderate cost.
Conclusions

Screening potentially can prevent more than 600,000 cancer deaths per year, but except for cervical screening, the costs may be prohibitive for lower and middle income countries.
Conclusions

All countries, regardless of income, should develop and implement a cancer control policy.