Accelerating cancer prevention

We already know how to prevent most cancer.

Joint BSA&NCAB meeting
Dec 4 2014
National Cancer Institute

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Division of Public Health Sciences

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Goals of talk
Review potential for prevention

Challenge us to address and define – distinctive roles for NCI in cancer prevention research

Issues:
• Improving cancer prevention,
• Implementing what we know,
• Identifying what needs to be done to achieve desired effects, and
• NCI’s role/priorities and collaborations with other agencies.

Shared understanding of what implementation science is

Clarity on boundaries between components of HHS
Medical interventions proven to prevent cancer  
(Sci Trans Med 2012)

<table>
<thead>
<tr>
<th>Intervention</th>
<th>Target</th>
<th>Magnitude of reduction</th>
<th>Time (yrs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aspirin</td>
<td>Colon mortality</td>
<td>40%</td>
<td>20+</td>
</tr>
<tr>
<td>SERMs</td>
<td>Breast incidence</td>
<td>40-50%</td>
<td>5+</td>
</tr>
<tr>
<td>Salpingo oophorectomy</td>
<td>Familial breast cancer</td>
<td>50%</td>
<td>3+</td>
</tr>
<tr>
<td>Screening for colorectal ca</td>
<td>Colon cancer mortality</td>
<td>30-40%</td>
<td>10</td>
</tr>
<tr>
<td>Vaccination</td>
<td>Cervical cancer incidence</td>
<td>50-100%</td>
<td>20+</td>
</tr>
<tr>
<td></td>
<td>Liver cancer incidence</td>
<td>70-100%</td>
<td>20+</td>
</tr>
<tr>
<td>Mammography</td>
<td>Breast cancer mortality</td>
<td>30%</td>
<td>10-20</td>
</tr>
<tr>
<td>Serial CT lung</td>
<td>Lung cancer mortality</td>
<td>20%</td>
<td>6+</td>
</tr>
</tbody>
</table>
Population approach versus high risk strategy

Rose, 1992
## Behavioral, Social and Policy Interventions that Impact Cancer Prevention

<table>
<thead>
<tr>
<th>Intervention</th>
<th>Target</th>
<th>Type of Interventions</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduce tobacco use</td>
<td>Children and Adolescents Smokers to quit</td>
<td>Combined Pharmaco/behavioral Interventions Smoke-free policies Tobacco taxes</td>
<td>SG</td>
</tr>
<tr>
<td>Increase physical activity</td>
<td>Individuals and community norms</td>
<td>Urban design Stairs and workplace</td>
<td>SG</td>
</tr>
<tr>
<td>Reduce Obesity</td>
<td>Population</td>
<td>Messages School &amp; work environment Physical activity Food &amp; beverage</td>
<td>IOM report</td>
</tr>
<tr>
<td>Limit alcohol intake</td>
<td>Population</td>
<td>Taxes</td>
<td>WHO</td>
</tr>
</tbody>
</table>
When we implement what we know, we prevent cancer

Tobacco –
lung cancer mortality decreased by one third
  • Adolescent smoking decrease 35% (1999) to 18% (2011)

Colorectal cancer screening –
steady increase in use and reduction in CRC mortality over time
Adult smoking prevalence
US & Massachusetts, 1990-2005

Figure 2: Percentage of adult smokers

Data Source: BRFSS 1990 - 2005

Massachusetts Dept of Public Health, 2007
Trends in smoking and lung cancer, USA

Cigarette consumption

Lung cancer
Men

Lung cancer
women

Number of cigarettes per capita

Year

Lung cancer death rate per 100,000
<table>
<thead>
<tr>
<th>Cause</th>
<th>% cancer caused</th>
<th>Magnitude possible reduction</th>
<th>Time (yrs)</th>
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<tbody>
<tr>
<td>Smoking</td>
<td>33</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overweight/oobesity</td>
<td>20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diet</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lack of exercise</td>
<td>5</td>
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<td>Occupation</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Viruses</td>
<td>5-7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Family history</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alcohol</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>UV/ionizing radiation</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reproductive</td>
<td>3</td>
<td></td>
<td></td>
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<tr>
<td>Pollution</td>
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Colditz et al. Sci Transl Med 2012: March 28
Lifestyle: high income countries

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<tr>
<td>Smoking</td>
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<td>20</td>
<td>50%</td>
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<td>50%</td>
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<tr>
<td>Lack of exercise</td>
<td>5</td>
<td>85%</td>
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Burden Cigarette Smoking, USA

Rate per 100,000

- US incidence
  - 1992
  - 2010
- State incidence
  - Kentucky
  - Utah

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Time course: lung & total mortality

Current smoker: continuing

Sources: Kenfield et al, 2008; Aberle et al, 2011
Infections

- Helicobacter pylori
- HPV
- Hepatitis B
- Hepatitis C
- Epstein-Barr virus
- HTLV
- Human herpes virus 8
- *Schistosoma haematobium*
- *Opisthorchis viverrini*

- High income countries 7.4%
- Low and middle income countries 23% of cancer
- 2 million cases/yr (16%)

Note: IARC excludes HIV as only a co-factor for other infectious causes through immunosuppression

de Martel et al, Lancet Oncology, 2012
Hepatitis B (HepB3) immunization coverage among 1-year-olds (%)
Abbreviations: Tdap = tetanus, diphtheria, acellular pertussis vaccine; MenACWY = meningococcal conjugate vaccine; HPV-1 = human papillomavirus vaccine, ≥1 dose; HPV-3 = human papillomavirus, ≥3 doses.

* Tdap and MenACWY vaccination recommendations were published in March and October 2006, respectively.
† HPV vaccination recommendations were published in March 2007.
Gaps ➔ Research opportunities

Target vaccine: whole population

• Convenient dosing current vaccines
• Next generation vaccine / broader protection, easier storage, etc, fewer doses
• Oropharyngeal HPV infections and cancer
• More effective ways to communicate about HPV-associated disease and HPV vaccines
• Determine how best to integrate HPV vaccination and cervical cancer screening

President’s Cancer Panel Annual Report 2012-13
Gaps ➔ Research opportunities
Target: high risks women – SERMs to prevent breast cancer

Stratify risk (epidemiology/genomics/imaging)

Identify “high risk” women

Communicate risks and benefits

Clinical implementation of tools and strategies

Uptake and sustained use by women

Identify ➔ Deliver ➔ Reduce incidence
Moving from Discovery to Delivery

Translation scientific evidence base to population health

- Implementation of what works
- Evidence $\rightarrow$ guidelines (USPSFT or CDC community guide)
- Benefit estimates $\rightarrow$ time frame for risk reduction
- Disparities $\rightarrow$ Worsened, improved, or unchanged?

Understanding how to sustain changes
Adapted from: Warnecke, Oh, Gehlert et al., AJPH, 2008

Social Conditions and Policies

Institutions

Neighborhoods

Social Relationships

Individual Risk Factors

Biologic/Genetic Pathways

Cancer Disparities

Fundamental Causes

Patterns of Social Organization

Individual Characteristics

Biology

Distal

Intermediate

Proximal
The Critical Intersection of Basic and Population Science

What are the biological mechanisms that translate disadvantaged social and economic circumstances into poorer health???
Does the social-psychological environment that inner city black women live in increased their chances of dying from breast cancer?

- Socially isolated mice:
  - Experience stress as a result of isolation
  - Developed spontaneous mammary gland cancers faster than control-group rats that were not kept in isolation.
- Studied 230 newly diagnosed black breast cancer patients living on Chicago’s South Side.
  - Endocrine burn-out?
Why are we not preventing more cancer now?

Multiple barriers:
1. Skepticism that cancer can be prevented
2. Short term focus of cancer research
3. Interventions deployed too late in life
4. Research focused on treatment not prevention
5. Debates among scientists
6. Societal factors ignored
7. Lack of transdisciplinary training
8. Complexity of implementation

Colditz et al Sci Transl Med 2012: March 28
Barrier 2: *Short-term* focus

Time required for cancer prevention does not match funding periods

Long-term benefits, e.g., smoking cessation takes decades to show at population level

Funded studies focus too late in disease development process

In contrast, the natural history or time-course of cancer shows development over decades

Colditz et al. Sci Transl Med 2012: March 28
What Potentially Influences Cancer?

**Genetic factors**
- telomere length
- Inherited mutations
- Sporadic mutations

**Macro-level factors**
- Crime
- Poverty
- Availability of services
- Toxins

**Individual-level factors**
- Diet
- Health behaviors

**Demographic factors**
- Age
- Gender
- Ancestry
Definition – implementation science

Scientific study of how to move evidence-based interventions into practice and policy

Includes study of how to sustain changes to improve population health

**PAR13-055**
Cancer Prevention Gaps to Fill

• How do we identify gaps in discovery?
• Where do we strengthen science?
• How do we sharpen focus: on individual/community/broader public health programs
  High risk vs. population-wide programs
• Increase translation and delivery to all members of society
• How much should NCI be doing and where do responsibilities of funding partners (NIH, CDC, AHRQ,) tie in?
• Even when program implemented, research gaps remain to achieve full population coverage and health benefits