Improving population health through cancer prevention

We already know how to prevent most cancer.

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April 12, 2013

Department of Surgery
Division of Public Health Sciences
No Relevant Financial Relationships with Commercial Interests
Learning objectives

Goal
- Improve population health through greater awareness and use of prevention strategies against cancer

Objective
- At the end of this activity, the participant will identify evidence-based prevention strategies for cancer prevention
- Recognize barriers to implementing prevention and
- Change practice to advance cancer prevention
Return to Hopkins is always exciting

At the end of last month I had the opportunity to retitle my talk:

• “Plan A” should be prevention and early detection
• “Plan B” (therapy for advanced cancers) should be necessary only when plan A fails

• But we need to implement Plan A!

Implementing Plan A:
“To make it viable we need government and philanthropic organizations to dedicate much greater fraction of resources to this cause, with long term consideration in mind.”
• Vogelstein Science 2013
A growing population, or preventing cancer will not put anyone in the room out of a job

Today: 315,6310,054 (April 7, 2013)

- 1 birth every 8 sec
- 1 immigrant (net) every 39 sec
- 1 death every 13 sec

Net increase 1 person every 14 sec

- [www.census.gov/population](http://www.census.gov/population)
Aging US population

Over 65 rising from 13% in 2012 to more than 20% of pop. in 2050

Cancer burden

• Assume incidence per 100,000 holds steady at each age
• Number of new cancer cases will double by 2050 simply due to aging population
Figure 2.
Population by Age and Sex: 2000 and 2010
(For information on confidentiality protection, nonsampling error, and definitions, see www.census.gov/prod/cen2010/doc/sf1.pdf)

Sources: U.S. Census Bureau, Census 2000 Summary File 1 and 2010 Census Summary File 1.
Figure 1.
Age and Sex Structure of the Population for the United States: 2010, 2030, and 2050

Source: U.S. Census Bureau, 2008.
Projected number of cases, USA

## New cases, women: 2012

<table>
<thead>
<tr>
<th>Cancer</th>
<th>New Cases</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Breast</td>
<td>226,870</td>
<td></td>
</tr>
<tr>
<td>Lung</td>
<td>109,690</td>
<td>51.5%</td>
</tr>
<tr>
<td>Colorectal</td>
<td>70,140</td>
<td></td>
</tr>
<tr>
<td>Uterus</td>
<td>47,130</td>
<td></td>
</tr>
<tr>
<td>Lymphoma</td>
<td>36,070</td>
<td></td>
</tr>
<tr>
<td>Thyroid</td>
<td>43,210</td>
<td></td>
</tr>
<tr>
<td>Melanoma</td>
<td>32,000</td>
<td></td>
</tr>
<tr>
<td>Kidney</td>
<td>24,520</td>
<td></td>
</tr>
<tr>
<td>Ovary</td>
<td>22,280</td>
<td></td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>790,740</strong></td>
<td></td>
</tr>
</tbody>
</table>

Cancer Facts and Figures, 2012
Why are we not preventing cancer now?

Multiple barriers:
• Skepticism that cancer can be prevented
• Short term focus of cancer research
• Interventions deployed too late in life
• Research focused on treatment not prevention
• Debates among scientists
• Societal factors ignored
• Lack of transdisciplinary training
• Complexity of implementation

Colditz et al Sci Transl Med 2012: March 28
Overcoming obstacles of skepticism and time frame

• Must counter skepticism that cancer can be prevented
  - Goals of prevention: risk marker, premalignant lesion, invasive disease, death
  - Avoid exposure vs. remove later in life
  - Can we intervene if we don’t have the pathway defined?

• Take into account time frame of cancer development
Long history of prevention

- Pott P, SCC scrotum described in chimney sweeps based on clinic experience 1775
  - Chimney Sweeper’s act of 1788 passed by Parliament preventing employment of children under 8; age then increased until 1875 use of young climbing boys forbidden

- Cook J. Capt. 1768 -1780
  - 3 voyages, 3 men lost to scurvy cf standard 50%
  - British navy adopted citrus in 1795

- Given this type of evidence why do we still take so long to get from discovery to delivery?
Complexity of prevention

- Success requires more than a “finite medical intervention” to achieve prevention in the broader community and improve population health
- Interplay of individual behavior, social circumstances, behavior, genetics, and health care system
What Potentially Influences Cancer?

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

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

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

**Demographic factors**
- Age
- Gender
- Ancestry
Complexity of implementing prevention

“MANY problems are so complex that even if we had the money to fix them, we wouldn’t know how to do it.”

“But some problems are frustrating in another way: we know how to fix them and we can afford to fix them, but we drop the ball.”

Public health benefits

1. Lie in the future

2. Beneficiaries generally unknown

3. Public has no idea what public health programs do. Thus, when people benefit from prevention they don’t recognize they have been helped

4. Opposition to public health approaches that require societal change

Hemenway D. Why we don’t spend enough on public health. NEJM 2010
Trends in smoking and lung cancer, USA

Cigarette consumption

Lung cancer Men

Lung cancer women

Number of cigarettes per capita

Lung cancer death rate per 100,000
Time course: lung & total mortality

Current smoker: continuing

Sources: Kenfield et al, 2008; Aberle et al, 2011
Time frame for cancer development

• We look in the wrong places.. Under the lamp post

• End result intervention too late in life...
Figure 3 | Schema of the genetic evolution of pancreatic cancer.
Tumorigenesis begins with an initiating mutation in a normal cell that confers a selective growth advantage. Successive waves of clonal expansion occur in association with the acquisition of additional mutations, corresponding to the progression model of pancreatic intraepithelial neoplasia (PanIN) and time $T_1$. One founder cell within a PanIN lesion will seed the parental clone and hence initiate an infiltrating carcinoma (end of $T_1$ and beginning of $T_2$). Eventually, the cell that will give rise to the index lesion will appear (end of $T_2$ and beginning of $T_3$). Unfortunately, most patients are not diagnosed until well into time interval $T_3$ when cells of these metastatic subclones have already escaped the pancreas and started to grow within distant organs. The average time for intervals $T_1$, $T_2$, and $T_3$ for all seven patients is indicated in the parentheses at left (see also Supplementary Table 6).

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Lifestyle: high income countries

<table>
<thead>
<tr>
<th>Cause</th>
<th>% cancer caused</th>
<th>Magnitude possible reduction</th>
<th>Time (yrs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smoking</td>
<td>33</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overweight/obesity</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>
<td></td>
<td></td>
</tr>
<tr>
<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>
</tr>
<tr>
<td>Pollution</td>
<td>2</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Lifestyle: high income countries

<table>
<thead>
<tr>
<th>Cause</th>
<th>% cancer caused</th>
<th>Magnitude possible reduction</th>
<th>Time (yrs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smoking</td>
<td>33</td>
<td>75%</td>
<td></td>
</tr>
<tr>
<td>Overweight/obesity</td>
<td>20</td>
<td>50%</td>
<td></td>
</tr>
<tr>
<td>Diet</td>
<td>5</td>
<td>50%</td>
<td></td>
</tr>
<tr>
<td>Lack of exercise</td>
<td>5</td>
<td>85%</td>
<td></td>
</tr>
<tr>
<td>Occupation</td>
<td>5</td>
<td>50%</td>
<td></td>
</tr>
<tr>
<td>Viruses</td>
<td>5-7</td>
<td>100%</td>
<td></td>
</tr>
<tr>
<td>Family history</td>
<td>5</td>
<td>50%</td>
<td></td>
</tr>
<tr>
<td>Alcohol</td>
<td>3</td>
<td>50%</td>
<td></td>
</tr>
<tr>
<td>UV/ionizing radiation</td>
<td>2</td>
<td>50%</td>
<td></td>
</tr>
<tr>
<td>Reproductive</td>
<td>3</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Pollution</td>
<td>2</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>
Tobacco control: population wide strategies

MPOWER

- Monitor tobacco use and prevention policies
- Protect people from tobacco smoke
- Offer help to quit tobacco use
- Warn about the dangers of tobacco
- Enforce bans on tobacco advertising, promotion, and sponsorship
- Raise taxes on tobacco

Implement Framework Convention on Tobacco Control
## Lifestyle: high income countries

<table>
<thead>
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<th>Time (yrs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smoking</td>
<td>33</td>
<td>75%</td>
<td>10-20</td>
</tr>
<tr>
<td>Overweight/obesity</td>
<td>20</td>
<td>50%</td>
<td>2-20</td>
</tr>
<tr>
<td>Diet</td>
<td>5</td>
<td>50%</td>
<td>5-20</td>
</tr>
<tr>
<td>Lack of exercise</td>
<td>5</td>
<td>85%</td>
<td>5-20</td>
</tr>
<tr>
<td>Occupation</td>
<td>5</td>
<td>50%</td>
<td>20-40</td>
</tr>
<tr>
<td>Viruses</td>
<td>5-7</td>
<td>100%</td>
<td>20-40</td>
</tr>
<tr>
<td>Family history</td>
<td>5</td>
<td>50%</td>
<td>2-10</td>
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<tr>
<td>Alcohol</td>
<td>3</td>
<td>50%</td>
<td>5-20</td>
</tr>
<tr>
<td>UV/ionizing radiation</td>
<td>2</td>
<td>50%</td>
<td>2-10</td>
</tr>
<tr>
<td>Reproductive</td>
<td>3</td>
<td>0</td>
<td>N/A</td>
</tr>
<tr>
<td>Pollution</td>
<td>2</td>
<td>0</td>
<td>N/A</td>
</tr>
</tbody>
</table>
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%)
  - de Martel et al, Lancet Oncology, 2012
Medical interventions proven to prevent cancer

<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 ca</td>
<td>50%</td>
<td>3+</td>
</tr>
<tr>
<td>Screening for colorectal ca</td>
<td>Colon ca mortality</td>
<td>30-40%</td>
<td>10</td>
</tr>
<tr>
<td>Viruses</td>
<td>Cervical ca incidence</td>
<td>50-100%</td>
<td>20+</td>
</tr>
<tr>
<td></td>
<td>Liver ca incidence</td>
<td>70-100%</td>
<td>20+</td>
</tr>
<tr>
<td>Mammography</td>
<td>Breast ca mortality</td>
<td>30%</td>
<td>10-20</td>
</tr>
<tr>
<td>Serial CT lung</td>
<td>Lung ca mortality</td>
<td>20%</td>
<td>6+</td>
</tr>
</tbody>
</table>
Reducing colorectal cancer mortality

Massachusetts colorectal cancer work group formed in 1997

- Academic medical/public health centers
- State department of public health
- ACS (New England Region)
- Support from Mass Medical Society

Undertook broad range of education and outreach to providers and the public to facilitate CRC screening in primary care
Colorectal Cancer Screening and Prevention in Massachusetts (1994 – 2010) Harvard Center for Cancer Prevention Activities

**Mortality**
Naishadham et al (2011): Colorectal cancer mortality in Massachusetts (link):

27.5 (per 100,000)

**Research**
Winawer et al: Colorectal cancer screening: clinical guidelines and rationale (link).


Kavanagh et al: Screening endoscopy and risk of colorectal cancer in United States men (link).

**Outreach**
Colorectal Cancer report mailed to all health care providers in state (link).

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**Screening**
Prevalence of ever having a sigmoidoscopy or colonoscopy (age 50+) in Massachusetts:

41%

**Partnerships**
Creation of Mass. Colorectal Cancer Working Group – Partnership of HCCP, state government, NGOs, health insurers, med centers, and universities.

**Outreach**
Screening & prevention pocket card developed and mailed to all primary care providers in state.

**Recommendations**
Colorectal Cancer Screening and Prevention in Massachusetts (1994 – 2010)
Harvard Center for Cancer Prevention Activities

**Outreach & Education**
Screening & prevention brochures (6th grade reading level; in 8 languages) mailed to all primary care providers and available for bulk order:
- You Can Prevent Colorectal Cancer (links: English, Spanish, Khmer, Russian)
- Take Control: Get Screened for Colorectal Cancer (links: English, Spanish, Chinese, French)

**Research**
Wei et al (w/ HCCP, Dartmouth, ACS): Study of targeted office systems in primary care to improve screening rates (link).

**Recommendations**
HCCP/Mass Colorectal Cancer Working Group: Colorectal Cancer – a risk management guide for health care professionals (link).

- **2000**
- **2001**
- **2002**
- **2003**

**Outreach & Education**
- ACS/HCCP hosted conferences for providers and legislators across state.
- Information and guidelines resource for health plans across state.
- City of Boston population wide mailing of cancer prevention brochure, with emphasis on low income neighborhoods.
- Western Massachusetts communication campaign.

**Research**
Colorectal Cancer Screening and Prevention in Massachusetts (1994 – 2010)
Harvard Center for Cancer Prevention Activities

**Recommendations**
ACoS, HCCP: *Tools and Strategies to Increase Colorectal Cancer Screening Rates - A practical guide for health insurance plans* (link).

**Research**
HCCP/Mass Cancer Registry/Mass DPH: *Data Report on Colorectal Cancer in Massachusetts* (link).

**Mortality**
Naishadham, et al (2011): Colorectal cancer mortality in Massachusetts:

- **17.4**
  - per 100,000

**Screening**
Prevalence of ever having a sigmoidoscopy or colonoscopy (age 50+ ) in Massachusetts:

- **75%**

**Research**

**Research**

**Research**
Emmons et al: *Colorectal cancer screening: Prevalence among low-income groups with health insurance* (link).
Trends: CRC mortality

Naishadham et al
CEBP 2011
Trends: CRC mortality

Naishadham et al
CEBP 2011
Using epidemiologic data to guide and sustaining social change

- Common agenda
- Shared measurement system
- Mutually reinforcing activities
- Continuous communication and
- A backbone support organization

Kania et al 2011 Stanford Social Innovation Review
Debates among scientists

- Magnitude of benefit
- Underlying pathway necessary for inference of causation
- Precision of measure.
- Etc etc
- But recommendation for action is to the very people who report things in surveys, from census to NHANES etc
**Rosenberg et al**
Case-control: NSAIDS and large-bowel cancer.
RR = 0.50

**Giovannucci et al**
Observational: Aspirin and colorectal adenoma and cancer (men).
RR = 0.51 (total cancer)

**IARC**
Working Group review: “limited evidence for the cancer-preventive activity of aspirin...”

**Baron et al**
Randomized trial: Aspirin and colorectal adenomas.
RR = 0.59 (adenoma)  
HR = 0.75

**Rothwell et al**
Randomized trials: Aspirin and colorectal adenoma and cancer (20-year follow-up).

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**Thun et al**
Observational: Aspirin and fatal colon cancer.
RR = 0.60 (men)  
RR = 0.58 (women)

**Giovannucci et al**
Observational: Aspirin and colorectal cancer (women).
RR = 0.56 (total cancer)

**Baron and Greenberg**
Editorial: “...controlled clinical trial...would be most useful...”

**IARC**
Handbooks on Cancer Prevention: Non-Steroidal Anti-Inflammatory Drugs

**Sandler et al**
Randomized trial: Aspirin and colorectal adenomas (previous cancer)
RR = 0.65

**Flossman et al**
Randomized trial: Aspirin and colorectal cancer
HR = 0.63  
Review: “...consistent with findings from observational studies”

**Burn et al**
Randomized trial: Aspirin and colorectal cancer (hereditary Lynch syndrome)
HR = 0.41

**Chan and Lippman**
Editorial: “...continuing uncertainty about dose and duration.”  
“...results... arguably support more general recommendations...”
Current obstacles to cancer prevention

SOCIETY
- Familiar and communities largely shape one's lifestyle from adolescence to early adulthood, when cancer risks accumulate. Despite this fact, our society views cancer as but a distant threat, an older person's disease.

RESEARCH
- Studies of the causes, biology, and treatment of cancer are generally too brief, fragmentary, and isolation. But full exploration of the disease's decades-long origins require years of data. Human impatience impedes more comprehensive research.

MEDICINE
- Cancer medicine is mostly a crisis response: Screenings and histories are typically done near age 50, emphasizing high-risk individuals. Late intervention costs technologies and reactive therapies often fail to stem cancer's fatal progression.

DIAGNOSIS & TREATMENT
- Medical care may be powerless to stop the disease.
Commitment to change

• Through our relationships, advocacy and support of social programs, we can make a profound difference.

• Simply practicing the 8 basic ways to live healthier promises more than preventing just cancer. It offers a much broader hope for revitalizing society
8 WAYS TO PREVENT CANCER
8 WAYS to Stay Healthy & Prevent Cancer

1. Maintain a healthy weight
2. Exercise regularly
3. Don’t smoke
4. Eat a healthy diet
5. Drink alcohol only in moderation
6. Protect yourself from the sun
7. Avoid sexually transmitted infections
8. Get screening tests
Why are we not preventing cancer now?

Multiple barriers:
• Skepticism that cancer can be prevented
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Colditz et al Sci Transl Med 2012: March 28
Scientific Knowledge

Health

Political Will

Social strategy

Provider

Regulations

Community

Atwood, Colditz, Kawachi, AJPH 1997; 87: 1603-1606.
Protect yourself from the sun

Message

• Avoid too much sun.

• Skin damage starts early in childhood, so it’s especially important to protect children.
6 Protect yourself from the sun

Tips

• If UV index is above 3 protection is needed. Avoid direct sunlight between 10:00 a.m. and 4:00 p.m.
  • Use hats, long-sleeve shirts, and sunscreens with SPF15 or higher, broad spectrum.
• Don’t use sun lamps or tanning booths.
7 Avoid sexually transmitted infections

- Among other problems, sexually transmitted infections—like human papillomavirus (HPV)—are linked to a number of different cancers.

- Infection with HPV (human papilloma virus) causes cervical cancer, head and neck, anus
Avoid sexually transmitted infections

Take home message

• Protecting yourself from sexually transmitted infections can lower your cancer risk.
• From 2007, 12-13 year olds covered through Immunise Australia
When and How Do We Bridge the Gap Between Data and Application?
Data will never be perfect. You can act on known evidence.

Create cross-discipline teams

Think about end user, even during manuscript development

Use varied modalities
Why are we not preventing cancer now?

Multiple barriers:
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Colditz et al Sci Transl Med 2012: March 28
How much physical activity do you need?

Regular physical activity helps improve your overall health and fitness, and reduces your risk for many chronic diseases.

Fitting regular exercise into your daily schedule may seem difficult at first, but the 2008 Physical Activity Guidelines for Americans are more flexible than ever, giving you the freedom to reach your physical activity goals through different types and amounts of activities each week. It’s easier than you think!

Physical Activity Guidelines

<table>
<thead>
<tr>
<th>Children</th>
<th>Adults</th>
<th>Older Adults</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 to 17 years of age</td>
<td>18 to 64 years of age</td>
<td>65 years of age or older</td>
</tr>
</tbody>
</table>

If you are a healthy pregnant or postpartum woman, physical activity is good for your overall health. See our section on Healthy Pregnant or Postpartum Women.
Our societal obligation

• As cancer prevention scientists, we must accept responsibility for cancer prevention.

• Prioritize studies that will identify key points for intervention to maximize prevention.

• Move beyond obstacles to implement prevention of cancer here and throughout the world.
“In the beginning of every enterprise we should know, as distinctly as possible, what we propose to do, and the means of doing it... We desire to lay the foundation and to mature some parts of the plan. Those who come after us must finish the work.”

William Greenleaf Eliot, co-founder
Washington University in St Louis
1854