A Public Health Approach to Winning the War Against Cancer

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ABSTRACT

The “war on cancer” in the United States has been viewed primarily as an effort to develop and disseminate cancer cures, but cancer is far more easily prevented than cured. There are three major approaches to cancer prevention: Primary prevention, through reduction in risk factors and changes to the environment that reduce human exposure to widely-consumed cancer-promoting agents. The most important actions for primary prevention of cancer are those that reduce tobacco use through taxation, smoke-free environment policies, advertising restrictions, counter-advertising, and cessation programs. The World Health Organization’s MPOWER package outlines these actions, each of which covered less than 5% of people in the world in 2007. Similarly, cancer can be prevented by reducing alcohol consumption through policies such as alcohol taxes and limits on alcohol sales, and restoring caloric balance through policies such as creating healthier food environments and engineering the built environment to increase opportunities for physical activity. Vaccination is an effective approach to preventing specific virus-associated cancers, such as using human papillomavirus vaccine to prevent cervical cancer and hepatitis B virus vaccine to prevent hepatocellular cancer. Secondary prevention reduces cancer mortality through screening and early treatment; this approach has been used successfully for breast and cervical cancer but is still underused against colon cancer. Progress can be made in all three approaches to cancer prevention, but will require a greater emphasis on public health programs and public policy. Winning the war on cancer will require a much larger investment in prevention to complement efforts to improve treatment.

INTRODUCTION

In 1971, the President of the U.S. declared a “War on Cancer” [1]. A cure was perceived to be imminent, and Congress passed the Cancer Act of 1971, which provided massive funding for cancer treatment research, but limited funding for cancer prevention and cancer prevention research [2]. Although progress in cancer treatment is evident, this funding has failed to reduce the mortality from cancer substantially; for example, despite a national goal of reducing cancer mortality by 50% between 1985 and 2000, the all-site cancer mortality rate in 2005 was only 10% below that in 1978 and only 6% below that in 1950 [3, 4]. While treatment is effective for certain cancers, it ranks far behind both early detection and risk-factor modification in its potential to reduce cancer mortality [5]. To win the war on cancer we must reframe cancer not only as a curable illness, but primarily as a preventable one [6].

The approaches to cancer prevention that are most rec-
Recognized by cancer specialists and the general public involve secondary prevention—detection of early malignancies or premalignancies through screening and treatment of these lesions before spread occurs. But primary prevention is not only possible, it can be easy to achieve. Primary prevention includes reduced exposure to cancer-promoting environmental influences and vaccination against oncogenic viruses. While physicians are responsible for some of these actions, many require changes in organizations and in public policy.

**Primary Prevention Through Risk-Factor Reduction and Environmental Change**

Humans are routinely exposed to chemical agents that cause cancers. Contrary to popular belief, these agents are not primarily trace chemicals found in food, water, or air, but instead are the major constituents of what humans consume voluntarily. These agents are best viewed as toxins, and public policies can substantially reduce our exposure to them.

**Tobacco**

Tobacco smoking causes cancer of the lung and larynx, head and neck, bladder, esophagus, mouth, pharynx, cervix, pancreas, stomach, and kidney, as well as acute myeloid leukemia [7]. Each year >150,000 smokers die in the U.S. from smoking-attributable cancer, with about 80% of these deaths from lung cancer. Additionally, >3,000 nonsmokers die from lung cancer attributed to secondhand smoke exposure [8].

Because one in five adults in the U.S. continues to smoke, tobacco control is central to a public health approach to cancer prevention. A comprehensive tobacco control program to implement six key features of the Framework Convention on Tobacco Control has been established by the World Health Organization and is known as MPOWER (Table 1). These features are: 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; and raise taxes on tobacco [9].

In 2002, New York City launched a tobacco control program that included some of these strategies. As a result, adult smoking prevalence declined by 300,000 smokers, saving approximately 100,000 early deaths in future years [10]. Teen smoking was also reduced by more than half, from 17.6% in 2001 to 8.5% in 2007, compared with a national teen smoking rate in 2007 of 20% [11].

Taxation reduces smoking in all populations, but teenagers and young and low-income adults are the most sensitive to price [12]. More than half of New York City’s smoking reduction was attributed to a tax increase to $1.50 per pack in 2002, along with a state tax increase to $1.50 that same year [10]. (Between 2002 and 2003, smoking prevalence decreased from 21.6% to 19.2%, a relative decrease of 11.1% [13].) In June 2008, the state tax was raised by another $1.25, making New York City, with a combined cigarette tax of greater than $5.00, the most expensive place in the U.S. to buy cigarettes. New prevalence data are not yet available to show the effect of this latest intervention.

Comprehensive smoke-free workplace laws not only eliminate exposure to secondhand smoke at work, they also reduce employee cigarette consumption by an average of 29% by increasing quit rates [14]. The 2002 New York City Smoke Free Air Act made virtually all workplaces, including restaurants and bars, smoke-free. When New York City passed its smoke-free workplace law, only one U.S. state and no countries had indoor smoking restrictions that were this comprehensive. As of this writing, more than half the people in the U.S. live in smoke-free jurisdictions and more than a dozen countries have comprehensive smoke-free policies.

Tobacco companies aggressively promote smoking as something enjoyable, sociable, and glamorous. Counteradvertising can reverse positive social norms about smoking by portraying the habit realistically—as deadly and socially unappealing. Evaluations strongly suggest that such counteradvertising campaigns are effective in inducing adults to quit smoking [15]. In 2006, New York City launched a media campaign that featured testimonials from sick and dying smokers. One television commercial that was broadcast in English and Spanish featured a former smoker who spoke through a mechanical larynx held to his neck, having lost his larynx, and consequently, his natural voice, to throat cancer at age 39. The campaign resonated especially with Hispanic New Yorkers, whose smoking prevalence dropped by 15% from 2005 to 2006, from 20.2% to 17.1% [13].

Counteradvertising can appear in a wide variety of stan-

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**Table 1. Public policies to achieve tobacco control: The MPOWER package**

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monitor tobacco use and prevention policies</td>
<td>Protect people from tobacco smoke</td>
</tr>
<tr>
<td>Offer help to quit tobacco use</td>
<td>Warn about the dangers of tobacco</td>
</tr>
<tr>
<td>Enforce bans on tobacco advertising, promotion, and sponsorship</td>
<td>Raise taxes on tobacco</td>
</tr>
<tr>
<td>Raise taxes on tobacco</td>
<td>Adapted from World Health Organization [9].</td>
</tr>
</tbody>
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standard media channels, but cigarette packs are a particularly
well-targeted location for such messages. To warn people
about the dangers of tobacco, Australia, Canada, Thailand,
and many other countries require that cigarette packs graph-
ically display the ravages of smoking. Comprehensive mar-
keting bans that eliminate direct and indirect advertising
and sponsorship activities, and end promotional tactics
such as discount sales, are another effective intervention
[16]. Furthermore, substantial evidence suggests that there
is a dose-response relationship between exposure to smok-
ing on-screen in movies and the initiation of adolescent
smoking; running counteradvertising before the screening
of films depicting tobacco use or altering the Motion Pic-
ture Association of America’s rating system (to establish
on-screen tobacco use as a criterion for an “R” rating) might
reduce or eliminate this effect [17].

Governments have also provided smokers with free nic-
otine-replacement therapy [18]. Before, during, and after
New York City’s campaigns, the city offered quit assis-
tance to people who called a telephone hotline and ex-
panded smoking cessation clinics at public hospitals. Those
who received assistance were more than five times as likely
to quit after 6 months as those who did not [18].

The U.S. Centers for Disease Control and Prevention
(CDC) recommends the implementation of statewide, com-
prehensive tobacco control programs and describes an inte-
grated, programmatic structure for implementing evidence-
based interventions [19]. Recognizing that the more states
spend on comprehensive tobacco control programs, the
greater the reductions in smoking, the CDC also establishes
minimum recommended levels of state investment in tobacco
control. Despite the very specific nature of the CDC recom-
mendations, all states still miss these key benchmarks; only
seven states invest ≥50% of the CDC-recommended amount,
and no states meet this recommendation. Nationally, the total
amount spent by all states was only 22% of the total recom-
mended investment by the CDC [20]. This limited investment
reflects the generally low priority placed on tobacco control,
not only at the state level but also at the federal level; such fi-
nancial neglect may undermine future tobacco control
progress. Internationally, tobacco control is similarly under-
emphasized, with <5% of the world’s population covered by
any one of five key interventions (Fig. 1) [9].

### Alcohol

Alcohol causes nearly 4% of the global cancer burden [21].
Daily alcohol consumption, even in low amounts, can en-

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**Figure 1.** Only 5% of the world is covered by effective tobacco control policies. Adapted from World Health Organization. WHO Report on the Global Tobacco Epidemic, 2008: The MPOWER Package. Geneva: WHO, 2008:1–329.

| Table 2. Public policies to achieve alcohol abuse prevention/alcohol control |
| Limit how, when, and where alcohol is sold |
| Increase the price of alcohol |
| Public policies to reduce harmful alcohol use |
| Limit underage access |
| Provide assistance to those with or at risk for problem drinking |

Obesity—chronic excess calorie consumption over calorie expenditure—is epidemic in many developed and some developing nations. The association between obesity and both diabetes and coronary heart disease has long been recognized, but obesity is also associated with a higher incidence of many cancers, including cancers of the endometrium, kidney, gallbladder (in women), breast, colon, and esophagus [34]. It has been estimated that, in the U.S., if the prevalence of overweight and obesity was reduced, some 90,000 cancer deaths could be prevented every year [34]. Obesity has more than doubled in the U.S. in the past 25 years [35]. Human genes have not changed rapidly enough to cause this epidemic; changes in diet and physical activity over the past few decades are to blame. These changes are caused by the transformation of the modern environment. A public health approach to obesity must alter the environmental context for healthy eating and increased physical activity (Table 3).

At a minimum, consumers should be provided information so they can choose to purchase lower-calorie food items if they wish. Coincident with the increase in calorie consumption in the U.S. over the past 30 years is an increase in the proportion of foods eaten at locations other than the home [36]. Quick-service, or “fast-food,” restaurants provide an especially large and rapidly growing proportion of the foods eaten in the U.S. [36]. Currently, many chain restaurants either fail to provide nutritional information or do so inconveniently—on Websites, tray liners, or food wrappers. Information in these locations is generally seen by <5% of customers, usually only after they purchase meals [37]. To give consumers important calorie information at the time of purchase, New York City has passed regulations requiring certain restaurants to post calorie amounts prominently on menus and menu boards; similar regulations have been introduced in many other jurisdictions.

Higher fruit and vegetable consumption has long been associated with lower body mass index (BMI). An international review estimated that increased fruit and vegetable consumption could prevent 5%–12% of the worldwide cancer burden, and 20%–30% of upper gastrointestinal cancers [38]. Providing greater access and point-of-purchase price

Table 3. Public policies to achieve obesity prevention/control

<table>
<thead>
<tr>
<th>Change context for healthy food</th>
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</thead>
<tbody>
<tr>
<td>Create price incentives/disincentives</td>
</tr>
<tr>
<td>Institute food policies to promote healthier living</td>
</tr>
<tr>
<td>Regulate fast-food restaurant density</td>
</tr>
<tr>
<td>Provide point-of-purchase nutritional information</td>
</tr>
<tr>
<td>Eliminate unhealthy food advertising to children</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Change context for physical activity</th>
</tr>
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<tbody>
<tr>
<td>Engineer the built environment to create increased opportunities for physical activity</td>
</tr>
<tr>
<td>Create policies to encourage fitness in workplace/schools</td>
</tr>
<tr>
<td>Reduce children’s use of TV</td>
</tr>
<tr>
<td>Capitalize on unique opportunities in the school environment</td>
</tr>
<tr>
<td>Limit unhealthy foods offered in schools</td>
</tr>
<tr>
<td>Improve physical education</td>
</tr>
<tr>
<td>Enhance classroom-based nutritional and fitness education</td>
</tr>
</tbody>
</table>


Excess Calories

Obesity—the result of chronic excess calorie consumption over calorie expenditure—is epidemic in many developed and some developing nations. The association between obesity and both diabetes and coronary heart disease has long been recognized, but obesity is also associated with a higher incidence of many cancers, including cancers of the endometrium, kidney, gallbladder (in women), breast, colon, and esophagus [34]. It has been estimated that, in the U.S., if the prevalence of overweight and obesity was reduced, some 90,000 cancer deaths could be prevented every year [34].

Many public policy options exist for alcohol control (Table 2) [24]. Alcohol availability can be reduced through various regulations, and as with tobacco control, taxes can increase the price of alcohol, the social environment can be altered to discourage consumption, and assistance can be provided to those with or at risk for problem drinking.

When alcohol is sold for extended hours, overall sales volume and reports of drunken driving increase; reducing retail hours reduces sales and consumption [25]. Studies have found associations between the density of alcohol outlets and various alcohol-related health outcomes, suggesting that limiting opportunities to buy alcohol reduces consumption and its adverse effects [26, 27]. And limiting underage alcohol access reduces alcohol consumption and alcohol-related health outcomes in youth [28].

Raising alcohol prices through excise taxes reduces alcohol consumption and alcohol-related health outcomes including motor vehicle accidents, child abuse, interpersonal violence, and sexually transmitted diseases [29]. It has been estimated that eliminating alcohol advertising could decrease alcohol-related life-years lost by about one sixth [30]. Counteradvertising against alcohol has not been attempted nearly to the degree it has been against tobacco, but the success in tobacco control suggests that it may be effective [31]. Limiting the locations in which people can drink alcohol, such as creating alcohol-free parks, beaches, and college dormitories, may also help support a social norm that is less accepting of alcohol. For people at risk of becoming problem drinkers, brief intervention in primary care and other settings can be successful [32], and can be promoted by public health agencies [33].
VACCINATION

Certain viral infections are proven to cause cancer, and vaccination against these viruses can prevent cancers from developing [52]. Cervical cancer and hepatocellular cancer are strongly linked to infection with human papilloma virus (HPV) and hepatitis B virus (HBV), respectively. Prevention of both these virus-associated cancers rests on strong government policies and programs to ensure high levels of vaccination coverage in entire populations. These include broad-based rather than targeted recommendations about who should be vaccinated, vaccination mandates enforced at the time of school entry, government subsidies that offer vaccination at reduced or no cost, and convenient provision of vaccines.

HPV

HPV can be detected in virtually every case of cervical cancer [52]. More than 20 million people in the U.S. are currently infected with this sexually transmitted infection, with 6.2 million people infected annually [53]. The newly available HPV vaccine protects against 70% of the oncogenic HPV types [54]. In the U.S., the HPV vaccine is currently recommended for girls age 11–12 years [55]; substantial reductions in cervical cancer incidence resulting from HPV vaccination are not likely to occur until vaccination levels of this cohort become high and these females become adults. In the meantime, “catch-up” vaccination of young adult females may be needed.

HBV

Hepatocellular cancer, which kills about 320,000 people globally each year [56], is believed to be attributable in about 80% of cases to viral hepatitis, particularly HBV [57]. Infants infected perinatally have a 90% risk of developing chronic HBV infection, whereas <5% of those infected at ≥5 years of age will develop chronic infection [58]. The risk of developing hepatocellular cancer is 100 times higher among those with chronic HBV infection [59].

Many countries attempt to vaccinate all infants against HBV, a practice that has contributed to dramatic declines in HBV prevalence. When Taiwan began universal vaccination of infants, both chronic HBV [60] and hepatocellular cancer [61] rates fell sharply. It is also important to provide postexposure prophylaxis to infants born to hepatitis B surface antigen–positive women, but this occurs for only about half of the eligible births in the U.S. [58], with a far lower proportion of infants receiving prophylaxis at birth.

SECONDARY PREVENTION

Screening is responsible for important progress in cancer prevention, reducing mortality in the U.S. from cancers of
the breast, cervix, skin, colon, and possibly prostate [3]. Yet screening for colon cancer, the second leading cause of cancer death in the U.S. [3], lags. Although detecting colorectal cancers when still localized results in a 90% survival rate, only 39% are diagnosed at these early stages [4]. Despite the value of early colon cancer detection, in 2006, nearly 40% of U.S. adults aged ≥50 years had not had the recommended screening for colon cancer, and almost 45% of U.S. adults aged ≥50 years had not undergone a lower endoscopy in the previous 10 years [62]. Mammography and Papanicolaou testing have achieved much higher penetration in their respective target populations [63, 64].

There are many reasons for the low screening rates for colorectal cancer. As with many other medical procedures, being uninsured or underinsured is a major barrier to screening [65, 66]. With 47 million people in the U.S. uninsured, nearly one sixth of the U.S. population lacks ready access to even the most basic preventive care [67]. Additionally, primary care physicians may be unaware of guidelines [68, 69], may forget to recommend screening [70], or may not know when patients are due for screening [71]. Patients are also reluctant to undergo colonoscopy or sigmoidoscopy because it is a complex procedure that requires uncomfortable preparation [72, 73]. Many interventions to increase screening rates have been devised, some with significant success; a patient navigator system in three New York City hospitals increased screening volumes by 50% [75].

CONCLUSION
For decades, success in cancer control has been “just around the corner.” Yet, to wage a true war on cancer, we must expand our approach to give preventive interventions at least as much focus as medical treatment. This will require an emphasis on public health programs and public policy.

Two long-standing funding mismatches undermine efforts to achieve a true public health approach to cancer control. The first is between money invested in cancer treatment and money invested in cancer prevention. Of the National Cancer Institute’s $4.8 billion total budget, only about 11% was allocated for cancer prevention and control [76]. This is reflective of a medical care system with the wrong priorities, focusing on end-of-life care at the expense of prevention [77]. In fact, there would have been no gains in overall cancer mortality rates since 1990 had it not been for reductions in smoking [78]. The second is between monies allocated to local public health departments for cancer and for all other diseases. Although 23% of all U.S. deaths in 2002 are attributed to cancer and approximately 5% of all health care dollars are spent on cancer [76], local health departments spend on average <2% of their budgets on chronic disease in general and only slightly >1% on cancer programs and tobacco control efforts combined [79].

National support must also increase substantially, with monies allocated more consistent with disease impact. In 2008, the CDC distributed among all states >200 million dollars for breast and cervical cancer [80]. Since the program began in 1991, it has served >3.1 million women [81]. By comparison, a CDC program for colorectal cancer—a condition that kills more people and is more preventable and curable if caught early—began in 2005, and by 2008 had provided only $14 million to 17 states. Until the overall funding increases—at local, state, and national levels—we will continue to lose the largely winnable battle to prevent cancer in the U.S.

As with infectious disease control in the past century [82], public health strategies that implement a range of novel interventions can have a dramatic effect. It’s time to add prevention, especially primary prevention, to the paradigm of cancer control, and to recognize that prevention requires not just medical care but also strong public health systems and effective public policy.

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