

Fred Hutchinson Cancer Research Center

Cancer Prevention Strategies for Washington State

Analysis and Recommendations

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Abstract

In this paper we seek to evaluate various cancer prevention strategies by considering the costs, benefits, and potential drawbacks associated with these measures. We provide an overview of the current burden of disease on the population, a review of public and educational policies that might mitigate this encumbrance, and an assessment of the treatment costs for some of the most prevalent cancers in Washington State. We analyze the impact of prevention tools on cancer prevalence and further provide a business case showing that relatively small investments in prevention techniques and appropriate policies can have a much larger impact on the cost of cancer treatment. We conclude with specific policy recommendations for tobacco prevention and cessation, mammography, and colonoscopy.

A comprehensive cancer prevention program involves multiple groups of people that work in concert to relieve the burden of disease on the population.

The key players include:

- a) Patients – Cancer patients have the goal of receiving the most effective treatments at the lowest costs. Establishing extended progression free survival (PFS) and a high quality of life is critical for members of this group and their friends and families.
- b) Doctors – Like patients, medical professionals want to improve PFS and survival rates. They are interested in administering the best, most novel treatments to as many patients as possible. This community faces fiscal challenges, too; managing treatment is an expensive task and requires trained professionals, high-tech facilities, and various resources.
- c) Researchers – Innovators in the medical community, scientists develop the best treatments and help identify prevention strategies by creating models and conducting studies to determine the efficacy of different strategies, some of which are approved into practice.
- d) Insurance companies – These entities, public or private, foot the bill for a large fraction of the treatment and prevention costs (such as mammography, colonoscopy, vaccination, etc.). They must find ways to keep health policies economically viable to balance stakeholder value and therefore may not be able to offer expensive protocols to large segments of population.
- e) Policy makers – These bodies implement prevention methods after evaluating the economic value of cancer programs and determining if they are to be used in public settings. They must weigh public and medical benefits against cost to the government and thereby determine resource allocation policies.

The Burden of Cancer – An Overview

Cancer continues to be a major burden on Washington State. In 2013 alone, over 37,000 new cases are estimated to have caused over 12,000 deaths¹. While rapid advancements in medical research and increased access to care have significantly improved both the PFS and long-term survival rates of patients, cancers continue to threaten the lives of millions of citizens each year. Much of the difficulty in treating carcinomas is caused by late detection; the symptoms of most lethal cancers are not apparent until later stages—if they do make themselves visible, these indicators are often attributed to other complications and the threat of malignant disease is ignored. Once metastasis of cancer cells occurs, treatment becomes increasingly challenging, and survival rates rapidly diminish. The most effective way of combating malignancy is, therefore, implementing preventative and early detection methods. By focusing on risk factors and educating the populace, medical practitioners are able to a) reduce the number of incidences and b) diagnose cases at earlier stages, thereby improving survival rates.

	New Cases, WA, 2013	New Cases, USA, 2013	Deaths, WA, 2013	Deaths, USA, 2013	5 Year Survival Rate, USA (All stages combined)
Lung	4,700	228,190	3,260	159,480	16%
Colon	2,730	102,480	980	50,830	64%
Female Breast	5,610	232,340	800	39,620	89%
Cervix	230	12,340	*	4,030	68%
Liver	*	30,640	530	21,670	15%
Melanoma	2,350	76,690	*	9,480	91%
All Sites Combined	37,290	1,660,290	12,390	580,350	68%

Table 1: Statistics retrieved from *Cancer Facts and Figures 2013*, published by the American Cancer Society. Incidence and mortality rates are calculated using Surveillance, Epidemiology, and End Results (SEER) data from 1975-2010 and adjusted based on delays and population changes. *Data currently unavailable

For more information, visit the Washington State Cancer Registry (Updated with data until 2010) at <https://fortress.wa.gov/doh/wscr/WSCR/Report.mvc/Report> or <https://fortress.wa.gov/doh/wscr/WSCR/PDF/10Report/CancerBySite10.pdf>.

¹ American Cancer Society. *Cancer Facts & Figures 2013*. Atlanta: American Cancer Society; 2013.

Prevention Methods

In this section, we provide an overview of various applicable prevention methods for reduction and prevention of the major cancers described above.

Smoking Cessation

Tobacco cessation programs, here in Washington as well as nationwide, suffer due to the lack of necessary funding. In 2012, only \$750,000 was spent on the WA Tobacco Program, leaving the state ranked 42nd nationally in overall spending². This is a massive shift from earlier governmental support; between 2002 and 2009, the state was required to spend at least \$26.24 million a year on tobacco cessation (Tobacco Free Kids). As of 2010, tobacco tax revenue was no longer directed towards tobacco control; rather, this money was allocated to the state general fund. In 2011, Washington became the only state that failed to provide quit line services to its residents; in the following year, over 6500 people called the line for help but failed to qualify for service³. With funding from the State Legislature, the quit line was re-introduced in 2012, and currently costs roughly \$1.7 million per year, contributing to over two-thirds of Washington State's total tobacco prevention budget (\$2.5 million/year). It should be noted that the state generated over 570 million dollars in tobacco-related revenue in 2013, and receives roughly \$2.5 million per year from the federal government to fund the prevention program.

According to the American Lung Association, tobacco caused an estimated 7,619 deaths in Washington in 2012 and cost the state's economy over \$3 billion in healthcare costs and lost productivity; lung cancer is the number one cause of preventable death in the state today. Still, only a miniscule fraction of tobacco settlement money is being used towards combating the tobacco epidemic.

A 2007 study published by the Center for Disease Control and Prevention demonstrates that funding for a Washington State Tobacco Control Program has been effective in the past. Dilley et al show that while smoking rates remained constant between 1990 and 2001, the enactment of a well-funded tobacco cessation program[†] in Washington State in 2000 led to declines in smoking prevalence by an average of 1.22 percentage points per year between 2001 and 2005, a decay substantially greater than that of the national rate at the same time period (1). The investment proved successful when dealing with youth cessation, too; the national smoking rates among eighth graders dropped by an average of 0.72 percentage points per year between 2001 and 2005—the WA prevalence among the same age group dropped by an

² Spending on Tobacco Prevention: Washington:
http://www.tobaccofreekids.org/what_we_do/state_local/tobacco_settlement/washington

average of 1.18 percentage points per year over the same interval, proving efficacy of the funded program.

†The program referred to in this study was allocated \$17.5 million from the state legislature; it included tax raises, smoking bans, and distribution and sales restrictions.

	2002	2004	2006	2008	2010	2012
Grade 8 - WA	9.2	7.8	6.4	7.3	6.6	5.1
Grade 10 - WA	15.0	13.0	14.9	14.4	12.7	9.5
Grade 12 - WA	22.7	19.7	20.0	20.0	19.6	15.6
Adults - WA	21.5	19.2	17.1	15.7	15.2	17.2

Table 2: Smoking rates in Washington State, 2002-2012. *Sources: Healthy Youth Survey, Behavioral Risk Factor Surveillance System.*

As a 1.2% reduction in a cost of \$3 billion dollars is an immediate benefit of \$36 million per year and a statewide smoking cessation program can be effectively launched at the cost of \$17.5 million per year, it is clear that establishing such a program will not only benefit populace from a health perspective, but would also be economically profitable. Furthermore, direct medical costs attributed to lung cancer will decrease by \$2.7 million dollars per year (1.2% of \$222 million); this in itself funds the statewide quit line (with NRT and extended phone time) for the year.

There are three major strategies that can be applied in a tobacco cessation program. The following section includes specific measures.

Option 1: Increase Excise Tax on Cigarettes

As the price of cigarettes increases, smoking prevalence decreases. Tworek et al show that a price increase of \$1.00 per pack is associated with a 30% increase in the odds of wanting to quit smoking among youth¹. An examination of the 2009 federal tax increase by J. Huang and F. Chaloupka reveals that in just one month after the raise (of \$0.62 per pack) the percentage of adolescents that reported smoking dropped approximately ten percent, resulting in roughly 250,000 fewer youth smokers in the next year.

Currently, Washington has the 6th highest cigarette excise tax among all 50 states, at \$3.025 per pack.⁴ This rate has been in place since May 2010, when it was raised from \$2.025. It is therefore difficult to evaluate the efficacy of the tariff; the only follow-up data available (2011) suggests that the increase was ineffective, as the smoking prevalence increased from 15.2% to 17.5%.

Because of the steep rate that exists already, as well as the apparent failure of the 2010 increase, it would seem illogical to raise the excise tax further at this time.

Instead, by using revenue generated already as a product of this tax, as well as a portion of tobacco settlement funds—as recommended by the Center for Disease Control—the WA Cancer Prevention program will be able to impose more targeted measures that will ultimately reduce the economic burden on the state's economy by aiming resources towards high-risk groups and individuals.

Option 2: A More Targeted Approach: Age, Economic, and Racial Factors

In the 2012 Washington State Healthy Youth Survey, 15.6 percent of high-school seniors reported smoking (down from 19.6 percent in 2010 and 35.2 percent in 1999). An estimated 40 youth begin smoking each day in Washington. The rate for 10th-graders is 9.5 percent (down from 12.7 percent in 2010 and 25 percent in 1999). In 2007, over half of all high-school smokers had tried to quit at least once in the preceding year, according to the Centers for Disease Control and Prevention.

While there was also a positive correlation between strong youth access (sale-to-minors) laws and smoking non-continuation among regular high school smokers, imposing

⁴ <http://www.tobaccofreekids.org/research/factsheets/pdf/0097.pdf>

smoke-free air regulations and youth possession laws did not impact cessation rates. Tworek et al show that school-based prevention programs did not lead to an increased desire to quit among high school students.

Novak et al found in a 2006 study that tobacco retailers were disproportionately located in areas of low-income and high youth populations. Youth in the 75th percentile of the tobacco retail density were 13% more likely to have smoked than their peers in the 25th percentile. Gruzca et al have found that restricting access to tobacco among women in childhood leads to reduced smoking prevalence later in life. The same study also concluded that, when used together, numerous youth access laws lead to a 29% reduction in heavy smoking among ever smokers later in adulthood.

According to the American Lung Association, 70% of smokers start before they are 18 years old. By promoting prevention and cessation in the pre-teen and teen years, we might be able to combat the tobacco epidemic from below, with the hope that future generations do not suffer from the burden of lung cancer. Since general school-based programs have been unsuccessful, targeting high-risk school districts (based on income and race factors) might be more appropriate. A 2011 Behavioral Survey Data shows that half of all smokers in Washington make under \$50,000 per year, and that African Americans (25% prevalence) and Native Americans (36% prevalence) have significantly higher smoking rates than other racial groups.

Option 3: Media and Quit line Services

The tobacco industry spends an estimated \$88 million on marketing campaigns each year, while the State spends no money on anti-advertising. Media, when used nationally, has been effective in decreasing smoking rates. Farelly et al showed that the “Truth” advertisement campaign, running between 1998 and 2002, was responsible for 22% of the decline in the smoking rate among adolescents during that period. Terry-McElrath et al showed while anti-tobacco ads did not impact taking up smoking, adults ages 20-30 had improved likelihoods of quitting when exposed to these advertisements, especially when exposed to between 100 and 150 ads over the course of a year⁵.

According to the WA State Department of Health, over 160,000 individuals have received help from the tobacco quit line since the service began in 2000; as of August 1, 2013, WA callers no longer receive free support such as counseling, customized quit plans, or materials such as nicotine patches and gum. ⁶Now, callers are only eligible for one call, and will

⁵ <http://tobaccocontrol.bmj.com/content/22/1/38.short>

⁶ http://seattletimes.com/html/localnews/2021475058_quitlinexml.html

not receive access to quit materials such as nicotine replacement therapy. The quit line costs the state roughly \$2 million to run each year. In 2007, Maher et al found that the quit rate among 1312 callers to the Washington State quit line after 3 months of calling the service was 31%, demonstrating clear efficacy of such a statewide program. Hollis et al further show that “Offering free NRT and multisession telephone support within a state tobacco quitline [OR] led to higher quit rates, and similar costs per incremental quit, than less intensive protocols.”

Appendix 1: Tobacco Master Settlement Agreement Payout

As per the 1998 Tobacco Master Settlement Agreement, Washington State receives annual payments from Philip Morris Inc., R. J. Reynolds, Brown & Williamson and Lorillard, which are listed in the table below. These funds are allocated to the State General Fund, from where they may be placed in any governmental program.

Year	Compensation from Tobacco Settlement Agreements (Millions of USD)
1998-2001	293.5
2002	142.2
2003	117.7
2004	127.6
2005	130.9
2006	119.8
2007	124.6
2008	173.0
2009	187.2
2010	157.5
2011	147.8
2012	150.7
Total: 1998-2012	1872.5
Average Payment Per Year	124.8

Table 3: Funds received by Washington State from TMSA, 1998-2012.

Mammography

Breast cancer is the most common cancer diagnosed among women in Washington State, and is the second-leading cause of cancer-related deaths.

Description: Screening mammography is usually conducted in females with no history or symptoms of breast cancer, and involves four x-rays (two of each breast) of the patient. The test is usually done in a physician's office, and, if required, the patient may be called back for further testing (e.g. diagnostic mammogram).

While it serves as the main detection method for the most prevalent cancer in Washington, mammography remains one of the most controversial cancer prevention methods. Firstly, finding a cancer does not mean that it is treatable or that its progression can be restricted. Furthermore, fibroglandular tissue and tumor tissue have similar densities, and the difference between the two is hard to detect in a screening mammogram. Therefore, around one-fifth of mammograms miss tumors that are present at the time of the screening; these are more common in younger women and can lead to delayed treatments. False-positive results are not uncommon; 5 to 15 percent of women are called back for further tests after initial mammograms, most of which lead to no evidence of disease. A women who has annual mammograms between age 40 and 49 has a 30 percent chance of receiving a false positive result at least once in that decade, according to the Radiological Society of America. While the effects of radiation are indeed a risk, these do not possess any significant harm and should not be of concern to the patient unless she is pregnant or has cancer at another site.⁷

Among all 50 states, Washington had the fifth-highest incidence rate for female breast cancer (measured by average number of cases per 100,000 individuals) between 2005 and 2009. While the mortality rate has decreased consistently by an average of 2.2% per year between 1992 and 2010, the incidence rate remained level between 2006 and 2010 after decreasing in the earlier part of the decade.

Undoubtedly, mammography is the best prevention method for lethal breast cancers. A major point of debate among researchers and physicians is the appropriate age at which to begin testing—currently, the U.S. Preventative Task Force recommends screening every two years for women between the ages of 50 and 64; others, however, believe that screening should start a decade earlier, at age 40.

Meta-analyses of randomized, controlled trials demonstrate a 7% to 23% reduction in breast cancer mortality rates from screening mammography in women 40 to 49 years of age.

⁷ <http://www.radiologyinfo.org/en/info.cfm?pg=mammo>
<http://www.cancer.gov/cancertopics/factsheet/Detection/mammograms#r1>

Rates of false-positive mammograms are high (20% to 56% after 10 mammograms), but false-positive results have little effect on psychological health.⁸

As of the 2010 census, there were a total of 1.56 million women over the age of 40 years in Washington State. Screening women annually instead of biennially would lead to an increase in preventative cost by \$78 million (an extra \$50 per capita per year) but actually yields net savings of \$99 million in treatment costs (25% fewer cases of metastasis will occur, treatment costs an average of \$86,310 per patient). We therefore recommend annual screening for women over the age of 40.

⁸ Screening Mammography in Women 40 to 49 Years of Age: A Systematic Review for the American College of Physicians

Colonoscopy

Description: An examination of the colon (large intestine) by a gastroenterologist using a colonoscope, a four-foot long flexible tube about a centimeter in diameter with a light at the end that captures photographs of the inside of the digestive system. Practitioners are thereby able to detect colon polyps, or precancerous growths, which they are able to remove from the patient. Colorectal cancer screening is vital, because after metastasizing, polyps are able to spread uncontrollably through the lymph nodes and bloodstream, often reaching vital organs such as the liver and abdominal cavity. Left untreated, tumors can also extend into the intestinal lining, making them harder to treat and/or remove.

Approximately 9% of cancer deaths in 2013 are due to colon cancer; the average man or woman in the United States today has a 5% chance of developing colorectal cancer over his or her lifetime. Currently, men over 50 are recommended to have a colonoscopy once every 10 years, a sigmoidoscopy once every 5 years, and a blood stool test once each year. An investigation by Johnson et al shows that an individual with inflammatory bowel disease is 2.93 times more likely to develop colorectal cancer; history of the disease in a first-degree relative also increases risk by a factor of 1.8. Lower physical activity, increased BMI, smoking, and diets high in red meat and low in fruits/vegetables all demonstrated increased risk for the cancer.⁹ Other studies confirm that family history is the most significant risk factor for this disease.

A fecal occult blood test (or FOBT) checks for blood in the feces. Randomized trials have shown that screened patient groups have mortality rates 15% to 33% lower than controls.¹⁰ Furthermore, Mandel et al show that FOBT can be effective when done either annually or biennially.¹¹ Subramanian et al found that, while guaiac-based fecal occult blood tests are not as accurate or reliable as colonoscopies, the significantly lower costs of these tests would result in more individuals getting screened and more life-years saved, in most cases. Because FOBT tests are only a fraction of a cost of colonoscopies, these might be advisable for individuals with low insurance coverage and limited resources, as well as those under the age of 50 who have perceived risk of colorectal cancer. For those over the age of 50, a colonoscopy once every decade is advisable; this allows for the investigation of smaller polyps which can be both detected and removed during the test. If polyps are found during a colonoscopy, the patient might want to schedule more frequent colonoscopies. If FOBT tests do come out positive, it is

⁹ Meta-analyses of colorectal cancer risk factors, 2013.

¹⁰ Levin B, Lieberman DA, McFarland B, et al. Screening and surveillance for the early detection of colorectal cancer and adenomatous polyps, 2008: a joint guideline from the American Cancer Society, the US Multi-Society Task Force on Colorectal Cancer, and the American College of Radiology. *CA Cancer J Clin.* 2008;58:130-160. Hardcastle JD, Chamberlain JO, Robinson MH, et al. Randomised controlled trial of faecal-occult blood screening for colorectal cancer. *Lancet* 1996; 348:1472–1477.

¹¹ Mandel JS, Church TR, Bond JH, et al. The effect of fecal occult-blood screening on the incidence of colorectal cancer. *N Engl J Med* 2000;343: 1603–1607.

imperative that individuals pursue a colonoscopy for further evaluation; if they fail to do so, the test is ineffective. Ultimately, it must be understood that all positive FOBT tests eventually lead to colonoscopy screening; and for no reason should individuals perceiving risk from a colonoscopy procedure believe that the FOBT is a strict alternative. Rather, this test provides a low-cost test for individuals with no family history or other risk factors.

Assuming the cost of a colonoscopy to be as high as \$1000, screening individuals every 7 years instead of every decade leads to an incremental increase in cost of \$43 per year. Screening the 2.2 million people over the age of 50 in Washington State would lead to extra spending of \$93 million per year. With the screening, we are able to prevent 75% of colon cancers, thus saving \$210 million (at the rate of roughly 3000 cases per year at \$90,000 per treatment).

Vaccination

Description: Two major types of preventative cancer vaccines exist today: the Hepatitis B vaccine, designed to combat cancer of the liver, and the Human papillomavirus vaccine, which targets cervical cancer. Lymphocytes, a certain type of white blood cell, carry out the immune system's responses to threats from abnormal cells. B cells, a type of lymphocyte, make antibodies—large proteins—that disable mutant cells by binding to them. HBV and HPV vaccines both stimulate the production of these antibodies.¹² When injected into the body, cancer vaccines release antigens, which activate B cells as well as killer t-cells, which prompt cancerous cells to self-destruct (apoptosis).

Gardasil and Cervarix are the two vaccines currently approved by the Food and Drug Administration for HPV—both these drugs combat virus types 16 and 18 (which cause ~70% of all cervical cancer cases worldwide); Gardasil is also able to target virus types 6 and 11, which are responsible for genital warts in both men and women (but not cause cervical cancer).

In 2011, 66.5% of females aged 13 to 17 living in Washington State reported to have received at least one dose of the human papillomavirus vaccine. However, only 40% of these teens reported having received 3 or more doses—the quantity recommended by the Center for Disease Control. At the same testing period, the national rate for one or more doses was 53.0% and the national rate for three or more doses was 34.8%.¹³ In the testing intervals 2003-2006 and 2007-2010, the prevalence of vaccine-type-HPV (16, 18, 6, and 11) decreased from 11.5% to 5.1% among girls aged 14-19.¹⁴

It is important to note that at this time the efficacy of the vaccine can only be tested by observing the prevalence of HPV. The efficacy of the vaccine in targeting cervical cancer directly cannot be investigated because Gardasil (2006) and Cervarix (2009) have not been on the market long enough to impact cervical cancer rates of the United States or Washington State adult population.

Presently, two vaccines for Hepatitis B are available on the public market: Engerix-B, produced by GlaxoSmithKline and Recombivax HB, made by Merck. Vaccinations for Hepatitis B began as early as 1981, when plasma-based immunization (using virus surface proteins) was used; today, recombinant yeast is used. Between the years 1990 and 2005, incidence of acute hepatitis B in the United States declined 78%, with the most significant reduction in prevalence

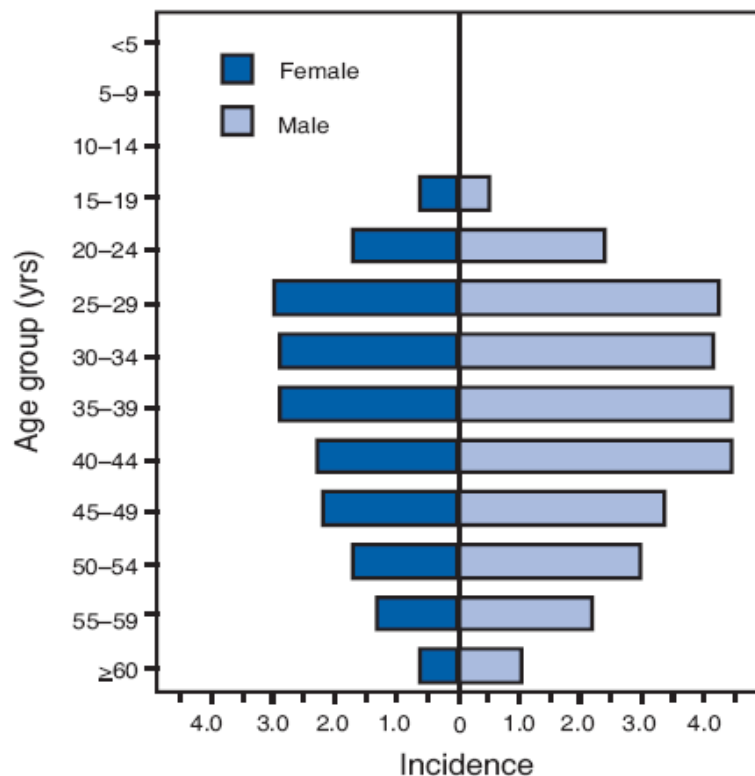
¹² <http://www.cancer.gov/cancertopics/factsheet/Therapy/cancer-vaccines>

¹³ <http://www.cdc.gov/mmwr/preview/mmwrhtml/mm6134a3.htm>

¹⁴ http://www.oxfordjournals.org/our_journals/jid/prpaper.pdf

(96%) occurring among children and adolescents, due to increased vaccination rates.¹⁵ While Washington State began to mandate vaccination for elementary school in 1997, HBV vaccination as a requirement for entry to middle school was only established in July 2008.¹⁶

FIGURE 1. Reported incidence* of acute hepatitis B, by age group and sex — United States, 2005



* Per 100,000 population.

Adults aged 25-44 have significantly higher incidence rates of acute HBV than those in younger age groups, due to the fact that immunization rates were lower at the time of their childhood. The adult prevalence rate of HBV is projected to drop over the next two decades as younger cohorts (vaccinated at the time of infancy) reach adulthood.

¹⁵ <http://origin.glb.cdc.gov/mmwrR/preview/mmwrhtml/rr5516a1.htm>

¹⁶ <http://www.immunize.org/laws/hepb.asp>

Tanning Bed Legislation

Description: The use of tanning beds has been linked to cases of cutaneous melanoma. The frequency of tanning salon use has increased rapidly only in the last decade; thus, fewer studies have been done on the health effects of exposure to these artificial UV rays. Recent research, however, clearly shows the increased risk of cancers following the use of such devices, with adolescents placed at even greater risks. However, as with tobacco cessation, appropriate bans, taxes, and advertisements might be able to mitigate the grave health risks of tanning beds.

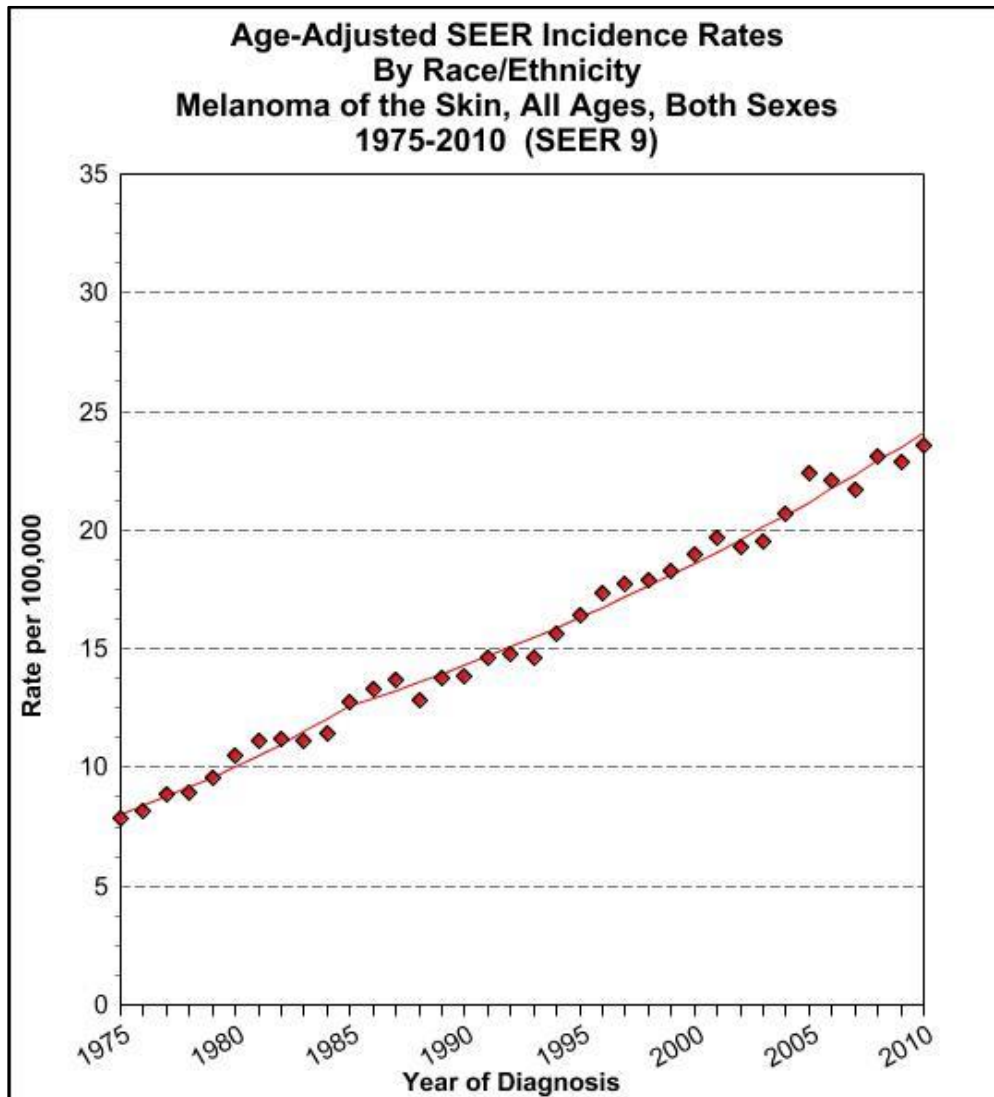
Boniol et al of the International Prevention Institute completed a meta-analysis of 28 studies (ranging from 1981 to 2012) relating tanning bed use to melanomas around the world. They found that the risk for cutaneous melanoma is increased by 20% for those who have ever used artificial tanning devices. They also found a 59% risk increase for individuals who began using artificial tanning devices before the age of 35 and a 42% increase for those who use tanning beds frequently (more “heavy” dosage). The risk for skin cancer increased by 1.8% after each tanning session, according to the meta-analysis.¹⁷

In a 2009 national survey, 15.6% of students reported using a tanning bed at least once in the past year; half of these individuals also stated that they had used such a device 10 or more times. 25.4% of girls reported using tanning beds at least once per year. Currently, skin cancer is the most prevalent form of cancer, with over 5.5 million Americans diagnosed with either basal cell carcinoma or squamous cell carcinoma in 2012—while these are usually treatable, an estimated 10,000 people are expected to die of skin cancer in 2013 alone.

Cokkinides et al found that 30% of teens with caregivers who used tanning devices used the devices themselves, and that older youth and females were especially at risk. As can be seen in the graph below, which tracks incidences in melanomas across the United States between 1975 and 2010, the prevalence of the disease increased significantly between 1995 and 2005 in females under the age of 50; tanning beds were introduced in 1979.

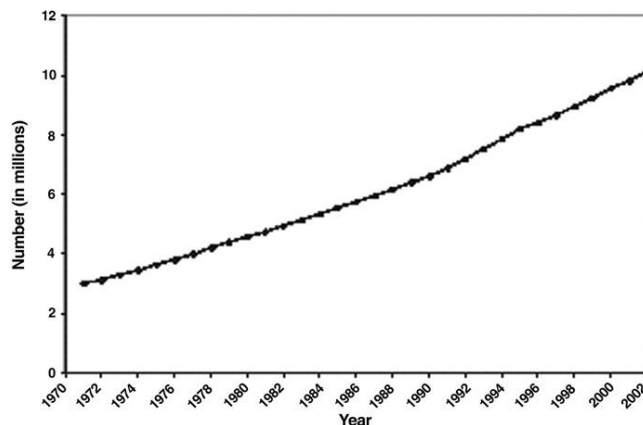
According to the Journal for Consumer Affairs, graphic+ text warnings are much more effective among teen non-smokers than simple text-only warnings, which are comparable in efficacy to no warning at all. As has been done with tobacco, more severe warning labels should be tested with tanning beds to see if such an intervention has an impact on the teen populace (as it had with cigarettes).

¹⁷ <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3404185/pdf/bmj.e4757.pdf>



Unlike many other cancers, the Incidence of melanoma is steadily rising in the United States. The lax regulations placed on tanning bed use place a significant health threat to the population if left unchanged.

Survivorship



Number of cancer survivors,
USA (Millions of People).

The number of cancer survivors in the United States is rapidly increasing, having surpassed 10 million in 2005.¹⁸ Due to rapid innovations in treatment, even patients of highly lethal carcinomas secure prolonged survival time. Furthermore, improved prevention strategies mean that more cancers are being detected; this leads to more treated patients and an increased number of cancer survivors. After treatment, patients often face a variety of physical, psychological, and social complications associated with their return to post-cancer life. School aged children, for instance, might struggle on the sports fields, in the classrooms, and in social groups; adults, on the other hand, might have difficulties keeping up at work or dealing with their household responsibilities. In order to ease the transition from clinical care to independent living at home, a team of researchers, physicians, oncologists, and nurses are needed to coordinate care.

Earle and Neville found that colorectal cancer survivors were less likely than their control cohort peers to receive follow up for heart failure, necessary diabetic care, or recommended preventive services. They also found that while cancer survivorship was linked with an increased chance of forgoing necessary care to target a variety of medical conditions, having both oncologists and primary care physicians take part in treatment follow-up bettered this outcome.¹⁹ While this trial was restrictive in the age of patients (mean age of 79 years), the study suggests that cancer survivors are at higher risk of falling prey to other conditions if not provided with appropriate resources to help re-insert themselves into society.

*From Cancer Patient to Cancer Survivor*²⁰ outlines strategies for improved patient care and a smooth transition between the hospital and the household:

1. **Prevention** of recurrent and new cancers, and of other late effects;

¹⁸ Cancer Survivorship: Challenges and Changing Paradigms - Scott M. Gilbert, David C. Miller, Brent K. Hollenbeck, James E. Montie and John T. Wei

¹⁹ Under Use of Necessary Care among Cancer Survivors - Craig C. Earle, M.D., M.Sc.; Bridget A. Neville, M.P.H.

²⁰ http://www.nap.edu/openbook.php?record_id=11468&page=R1

2. **Surveillance** for cancer spread, recurrence, or second cancers; assessment of medical and psychosocial late effects;
3. **Intervention** for consequences of cancer and its treatment, for example: medical problems such as lymphedema and sexual dysfunction; symptoms, including pain and fatigue; psychological distress experienced by cancer survivors and their caregivers; and concerns related to employment, insurance, and disability; and
4. **Coordination** between specialists and primary care providers to ensure that all of the survivor's health needs are met.

The first priority, therefore, is to establish a cancer survivorship program as part of the outlined medical treatment prescribed for a patient. This must be done with the compliance of insurance companies, physicians, oncologists, and caregiving nurses. Families of cancer patients must come to understand that systematic follow-up care is crucial so that cancer recurrences can be detected, physical ailments and psychological problems can be diagnosed and treated, and potentially harmful side-effects of treatment can be prevented.

At the time of completion of treatment, a patient should work together with his or her physician and/or oncologist to develop a survivorship plan scheduling regular scans, check-ups, and follow-up visits. The length and content of such a schedule is dependent on the patient and the severity of his or her disease or treatment regimen.

A study of adult survivors of childhood cancers at St. Jude Children Research Hospital revealed that at age 45, the cumulative prevalence of a chronic health condition was 95.5% while the prevalence for a serious, life-threatening condition was 80.5%.²¹ Such a study reveals the necessity for an appropriate follow-up program for survivors, especially those who went through treatment at an early age. Among the cancer survivors who had received pulmonary toxic treatments, 65.2% had abnormal pulmonary function—74.4% of those treated with lung radiation developed pulmonary issues. Among individuals with a mean age of 26 years, pediatric cancer survivors were over 3 times as likely as their siblings to develop a chronic health condition.²² Such outcomes raise the need for awareness both among survivors and medical practitioners for raising awareness of possible complications that may arise as a result of treatment and the appropriate methods for detecting and treating these complications in a timely and effective manner. Cancer patients should not be discharged before completely understanding their increased health risks and the absolute necessity of follow up care.

Gilbert et al outline four major methods of survivorship care that might be applicable in the United States today.

²¹ Clinical Ascertainment of Health Outcomes Among Adults Treated for Childhood Cancer

²² Chronic Health Conditions in Adult Survivors of Childhood Cancer

1. The Shared Care Model
 - a. Involves regular consultation between general physicians and cancer specialists (oncologists and surgeons) to customize care for patient.
 - b. Relatively easy to implement, drawing from existing establishments of oncologists and physicians. Makes use of modern collaborative methods and technologies.
 - c. Might require the need of a third health care practitioner to serve as the intermediary between the two medical authorities and the individual patient
2. Risk Based Follow Up Care
 - a. Very adaptable, malleable based on patient's needs
 - b. Especially important in childhood cancers, where varying treatments place patient at long-term risk for certain conditions
 - c. Nurses must be trained to serve as coordinators
3. Survivorship Clinics
 - a. Oncology nurse practitioners manage the needs of the patient, coordinating radiologists, physicians, and oncologists as well as surgeons, financial advisors, and psychiatrists.
 - b. Institutional – allows patients of all cancers to receive treatment at the same location, using shared clinical and research expertise and a core set of practitioners to maximize efficiency and increase number of patients.
 - c. Cancer-specific– More customized to a single disease, allowing the medical team to research and administer follow-up care for specific treatments in a single location. Is very expensive to implement for most cancers; would only be suitable for diseases with higher prevalence (breast, prostate, lung)

Overall, more funding and clinical research is needed to determine the most effective and reliable methods of survivorship care. The cancer patient must take on significant responsibility once finished with his or her course of treatment to ensure that further health problems are avoided.

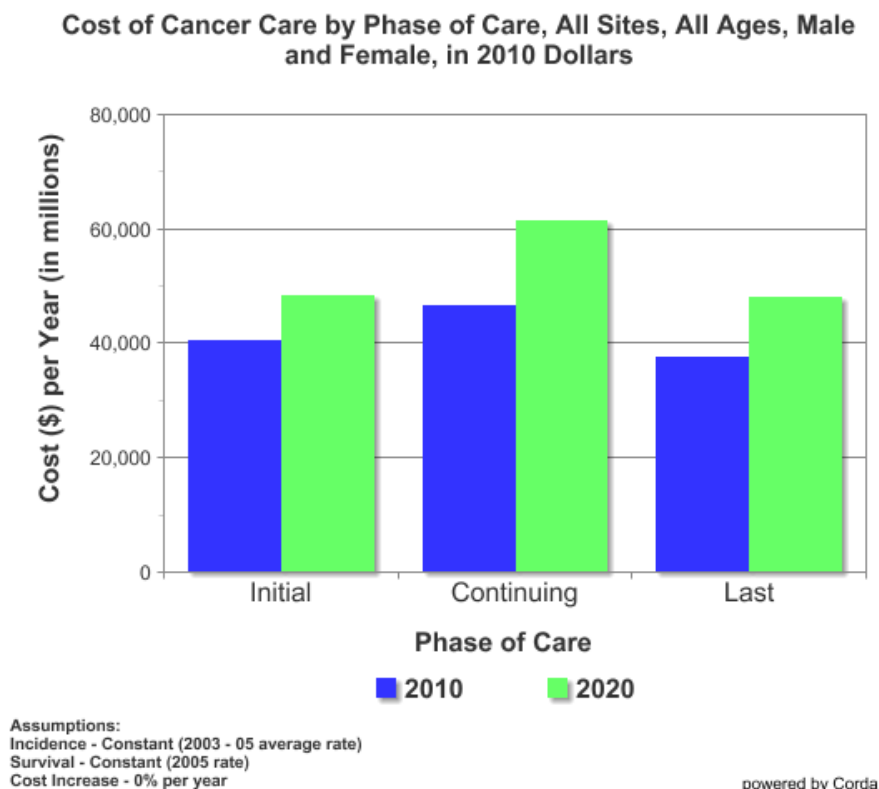
The Economics of Prevention

In 2010, the medical cost for cancer care alone (disregarding productivity time lost and lost income) summed to over 124 billion dollars. Assuming no rise in medical costs, the cost of continuing care is estimated to exceed 60 billion dollars per year by 2020. Novel treatments, while more effective than traditional therapies, are often more expensive. By investing in a prevention program, however, much of the cost—not to mention grief, anxiety, and suffering of disease—can be avoided.

Further resources:

<http://www.cancer.gov/newscenter/newsfromnci/2011/CostCancer2020>

<http://costprojections.cancer.gov/graph.php#>



All Cancers

Tanga et al estimate that in Washington State between 2004 and 2008, private insurance, Medicaid, and Medicare paid an average of 3,014,000,000 dollars per year (in total) for cancer treatment costs. Roughly 32% of this sum was funded by Medicare (965 million/year), 4% by Medicaid (109 million/year), and 46% by private insurance (1.37 billion/year). Overall, then, the government spent an average of 1.074 billion dollars per year in treatment costs.

We will conduct a cost analysis for Lung, Female Breast, and Colon cancers—the three most cost-consuming cancers in the United States—and then compare this to the cost of prevention programs and the relevant ROI to create a business plan for WA.

Lung

Lightwood and Glantz found that between 1989 and 2008 the California Tobacco Program cost \$2.4 billion and led to healthcare expenditure savings of \$134 billion.

In 2010, national health care costs (treatment) for lung cancer summed to \$12.12 billion.²³

As of the April 1, 2010 census, there were 3,349,707 males living in Washington State and 3,374,833 females, who, according to the American Cancer Society, had incidence rates of 78.7/100,000 and 59.5/100,000 for lung cancer, respectively. This produces an estimated 1993 male individuals with lung cancer at the time and 2008 female individuals with lung cancer in our state alone.

The United States population was composed of 151,781,326 males and 156,964,212 females in 2010, for who the incidence rates for lung cancer were 86.4 (per 100,000) and 55.5 (per 100,000), respectively. This produced an estimated 131,139 males with lung cancer and 87,115 females with lung cancer nationally.

In conclusion,

Lung Cancer Incidence, 2010, USA: 218,254

Lung Cancer Incidence, 2010, WA: 4001

The total cost for all health programs (Private, Medicare, Medicaid):

$$\frac{4,001}{218,254} \times \$12,120,000,000 = \$222,182,044$$

²³ <http://www.cancer.gov/aboutnci/servingpeople/cancer-statistics/costofcancer>

These estimates assumed a) costs for male and female lung cancer treatment was equal and b) cost of lung cancer treatment was equal in all states.

Breast

Total cases, USA: 191182

Total cases, WA: 4549

2010 National Treatment Cost: \$16,500,000,000

$$\frac{4,549}{191,182} \times \$16,500,000,000 \equiv \$392,625,218.5$$

Colon

Total cases, USA: 157987

Total cases, WA: 3115

2010 National Treatment Cost: \$14,140,000,000

$$\frac{3,115}{157,987} \times \$14,140,000,000 \equiv \$278,795,724$$

Detailed Tobacco Cessation Program Costs

- I. School-Based Prevention Program – as per Wang, Crosett, et al
 - a. Cost: \$20,000 for 8 schools (1200 students)
 - i. Includes \$4,000 training professionals
 - ii. \$8,000 dollars for teaching costs
 - iii. \$5,000 for materials (manuals, etc.)
 - b. Results: Prevented estimated 35 students from becoming smokers
 - i. Including medical costs, saved \$13,000 per life year saved
 - ii. Excluding medical costs, cost \$700 per life year saved
 - iii. Led to an estimated \$300,000 saving in overall medical care cost
 - iv. 1500% ROI
 - c. Application

- i. As of 2010, 4 counties had smoking prevalence rates for 10th graders above 17% (state average is 14.4%). These were: Grays Harbor (18.3), Mason (22.3), Skamania (24.6), and Spokane (17.6).
- II. Quit Line Service
 - a. Efficacy: Maher et al show that 3 months after calling the Washington State quit line, the 7 day quit rate among callers was 31% in Washington State, with satisfaction rates for the service at over 90% for all racial groups.
 - b. Cost: Based on Hollis et al Oregon State Quit Line study
 - i. The offer of “moderate” nicotine replacement therapy proved to be more cost effective (per quit) than no NRT, brief NRT, and “intensive” NRT. Among 715 quitline callers who received this service, 21.3% had abstained from any form of tobacco use for 6 months.
 - ii. Cost per caller: \$242
 - iii. Incremental cost/quit: \$2109
- III. Media - as per Friend et al, Hu et al
 - a. California, between 1990 and 1992, spent \$19.6 million on anti-tobacco ads. Hu et al estimate that the media campaign resulted in the sale of 232 million fewer packs, or 7.7 fewer packs per capita.
 - b. Michigan spent \$0.45 million per year on its media campaign, or \$0.05 per capita per year, starting in 1991; this led to a 4.4% drop in statewide smoking prevalence before the tax hike (at the same time, the national prevalence rates stalled)
 - c. Oregon implemented a \$4 million media campaign in 1997 (using 10% of funds from a \$0.30 tax increase); over the next two years, prevalence rates dropped by 11%--a 5% decline was attributed to the campaign after the tax was taken into account.
 - d. Florida – 1998 \$25 million, “Truth” campaign—consisted of 33 commercials, 7 billboards, 8 print ads, 4 posters. Focused heavily on youth participation in development, by May 1999 over 95% of teens aged 12 to 17 knew of campaign, suggesting excellent outreach. Between Feb 1998 and Feb 1999, teens defined as “current smokers” dropped by 19.4 percent among middle-school students and 8 percent among high-school students—effectively leading to 29,000 fewer smokers.

Conclusions

We investigated the costs and benefits of various cancer prevention methods. We provided an overview of the current burden of disease on the population, a review of public and educational policies that might mitigate this encumbrance, and an assessment of the treatment costs for some of the most prevalent cancers in Washington State. We analyzed the impact of prevention tools on cancer prevalence and showed the following:

- a) A statewide tobacco prevention program of up to \$36 million per year would yield a positive return on investment in terms of treatment and productivity costs.
- b) A statewide program providing annual screening for mammography for every woman over the age of 40 (instead of biennial screening) would lead to potential savings of \$21 million per year.
- c) A statewide program providing colonoscopies to individuals over the age of 50 every seven years (instead of every ten years) would lead to potential savings of \$117 million.

Bibliography

- (1) Dilley JA, Rohde K, Dent C, Boysun MJ, Stark MJ, Reid T. Effective tobacco control in Washington State: a smart investment for healthy futures. Prev Chronic Dis [serial online] 2007 Jul [date cited]. Available from: http://www.cdc.pcd/issues/2007/jul/06_0109.htm.

ⁱ http://monitoringthefuture.org/pubs/text/tworek_tobacco_control_2010.pdf