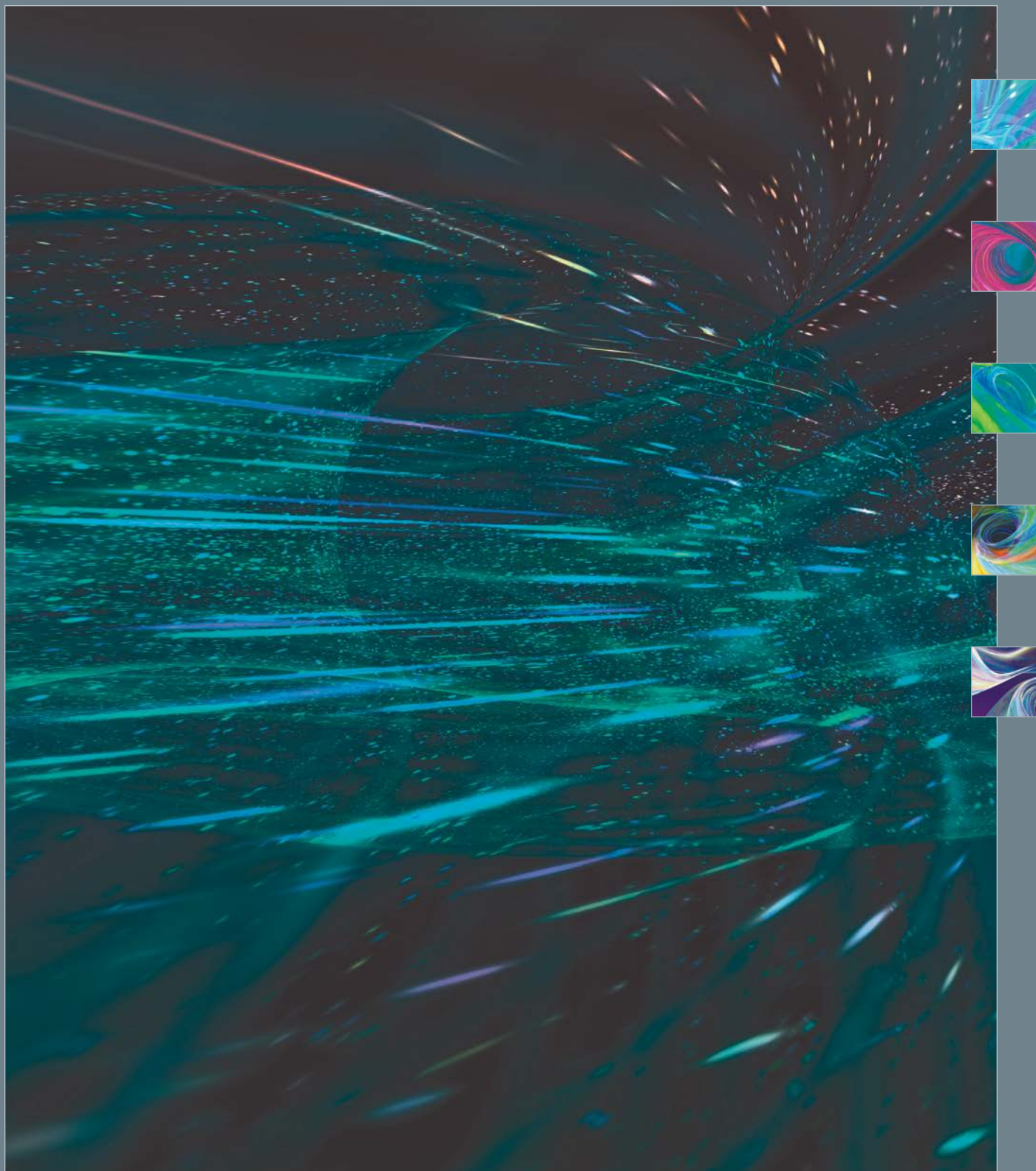


Chronic Disease and Medical Innovation in an Aging Nation

The Silver Book[®]: Cancer





Introduction

The United States is undeniably a graying nation. There are currently more than 43 million people ages 65 and older, and that number is projected to come close to doubling by 2050 to 83.7 million. At that point, 20 percent of our population will be age 65 and older. With these shifting demographics come far-reaching and wide-ranging implications for our society, not the least of which is the potentially crippling effect of chronic and costly diseases that become more prevalent with age.

While cancer can strike at any age, it is largely a disease of aging with around 78 percent of all cancer cases diagnosed in people age 55 and older. So it is not surprising that the incidence of cancer will grow as our nation ages. In 2015, more than 1.6 million new cases of cancer are expected to be diagnosed. By 2035, that number is projected to grow to as high as 2.4 million new cases a year. With the cost of cancer projected to increase accordingly—from \$290 billion in 2010 to \$458 billion in 2030—we can’t afford to let cancer continue on its current path.

Fortunately most experts agree that this is an exciting time in cancer research. A rapidly expanding understanding of the molecular basis of the more than 100 different types of cancer is allowing for major breakthroughs in how we prevent, treat, and cure cancer. Treatments are becoming increasingly personalized for the patient and use groundbreaking technologies that, even as recently as ten years ago, seemed like science fiction. The field of immuno-oncology uses the body’s own immune system to fight the cancer. This is causing a significant paradigm shift in cancer treatment and may soon be considered with surgery, radiation, and chemotherapy as a standard part of cancer care.

Because of the progress we have already made in fighting cancer, the 5-year survival rate has increased 40 percent in the last 40 years. There are now nearly 14.5 million people in the U.S. living with a history of cancer. And the gains from this progress are not limited to the patient. One study found that investments in cancer research since the 1970s have generated \$1.9 trillion in value to society overall. And scholars at the University of Chicago have estimated that just a one percent reduction in cancer-related deaths in the U.S. would be worth an estimated \$500 billion to society from the increased quality and productivity of longer lives.

This is why we need to focus the conversation on the tremendous personal and societal value that innovation brings. This newest volume of *The Silver Book®: Chronic Disease and Medical Innovation in an Aging Nation*, outlines the mounting burden of cancer on older Americans,

continued >

Cost of Cancer



Innovative Medical Research



Conclusion



References



their families, and society—and showcases the power of research and innovation in significantly reducing those burdens. It aims to promote national policies that turn to investments in innovation, rather than short-term cost-cutting—a goal that is particularly important in a time of increasingly expensive cancer care.

In the more than eight years since its launch, *The Silver Book* has become a trusted resource for policymakers, thought leaders, academics, and health advocates across the nation who are looking for the latest data on chronic diseases of aging and innovation in the field. *The Silver Book* is an almanac of compelling statistics and key findings extracted from dense reports and technical studies. It provides essential information in a single, easy-to-use, and well-referenced resource. Previous volumes have included data on cardiovascular disease (including stroke, thrombosis, and atrial fibrillation), diabetes, healthcare-associated infections, infectious disease, neurological disease (including Alzheimer's disease and Parkinson's disease), persistent pain, osteoporosis, and vision loss.

This latest volume on cancer focuses broadly on the burden of cancer, as well as on breast, lung, colon & rectum, and prostate cancers—the most common sites for cancer in Americans age 65 and older. It also shares data on some of the recent breakthroughs in cancer treatment, particularly in personalized medicine and immuno-oncology.

All facts are cited and provide easy access to the original source. Note that information pertaining specifically to the older population is in silver type. All data is also available at www.silverbook.org/cancer, where it joins more than 2,000 facts and figures, from more than 600 sources and experts.

Research and innovation are clearly our best weapons in the fight against cancer. This volume of *The Silver Book* helps show us why.



Lindsay Clarke, JD
Vice President of Health Programs
Alliance for Aging Research



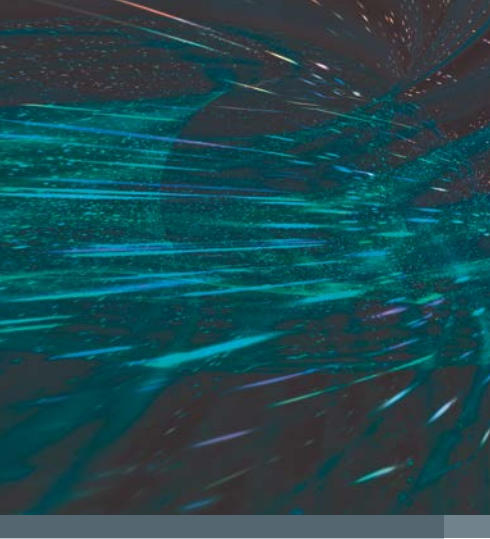
Advancing Science. Enhancing Lives.

www.agingresearch.org/cancer
SilverBook@agingresearch.org

Chronic Disease and Medical Innovation in an Aging Nation

The Silver Book®: Cancer

Introduction	1
Preface	4
Cost of Cancer	5
Prevalence and Incidence	6
Breast Cancer	6
Lung Cancer	6
Prostate Cancer	6
Colorectal Cancer	7
Age—A Major Risk Factor	7
The Burden of Cancer	8
Human Burden	8
Economic Burden	9
The Future Cost	10
Innovative Medical Research	11
The Human Value	12
Breast Cancer	13
Lung Cancer	14
Prostate Cancer	14
Colorectal Cancer	14
The Economic Value	15
The Future Value	15
Conclusion	17
References	18



Preface

The Personalized Medicine Coalition is very pleased to have partnered with the Alliance for Aging Research to help produce *The Silver Book®: Cancer*. It is being released at a time of great transformation of cancer treatment in the United States and the world—from one-size-fits-all, trial-and-error medicine to a targeted approach utilizing an individual patient's molecular information. This volume of *The Silver Book* brings together important information on the burden of cancer, and the promise of research and technological advancements in personalized cancer care. For many types of cancer, we now have the capacity to detect the onset of disease at its earliest stages, pre-empt the progression of disease, and at the same time increase the efficiency of the health care system by improving quality and accessibility and putting patients at the center of their own care.

In his State of the Union address on January 20, 2015, President Barack Obama said, "I want the country that eliminated polio and mapped the human genome to lead a new era of medicine, one that delivers the right treatment at the right time." By calling attention to the promise of personalized medicine, the president recognizes that we are in the midst of a paradigm shift in modern medicine. This transformation has begun with cancer care.

However, challenges remain in order to fully realize the promise of personalized cancer care. There is a continuing debate regarding regulatory and reimbursement policies, and we have only scratched the surface of educating health care providers and patients about the power of personalized medicine. Also in this series, *The Silver Book: Cancer Fact Sheet* addresses key policy priorities necessary to realize continued advances that will improve cancer care in the future.

Sincerely yours,

Edward Abrahams, PhD
President
Personalized Medicine Coalition





Cost of Cancer

Almost everyone has been affected by cancer in some way, either through their own diagnosis or that of a loved one or friend. The lifetime risk of developing cancer is around one in two for men, and one in three for women. There are more than 100 known types of cancer and every year, over 1.5 million new cases of cancer are diagnosed in the United States alone.

- Our knowledge of cancer biology has expanded greatly in the past two decades and we have seen tremendous medical breakthroughs and innovation in prevention, early detection, and treatment. Despite these advances, cancer continues to be the second most common cause of death among Americans, accounting for one out of every four lives lost.
- Older people shoulder most of the human burden of cancer, as close to 80 percent of all diagnoses are made in people over the age of 55. The most common sites for cancer in Americans over age 65 are lung and bronchus, prostate, breast, and colon and rectum, which are highlighted in this volume.

- More than one in four cancer survivors have a high symptom burden at one-year after their diagnosis, even those who are no longer getting treatment. Many cancer patients, both in active treatment and in remission, suffer from pain, depression, and a decreased ability to perform activities of daily living. People diagnosed with cancer that remain active in the workforce, report feeling less productive and incur 33 million days of disability each year.

Cancer is also one of the costliest diseases to both individuals and society. The total cost of cancer in 2009 was \$216.6 billion: \$86.6 in direct medical costs and \$140 billion for indirect costs. The value of life lost from all cancer deaths is estimated to be an astounding \$960 billion. Individuals diagnosed with cancer experience higher out-of-pocket treatment costs and are at a higher risk of bankruptcy than those without a cancer history. This can often cause those with cancer to cut back on spending, dip into savings to pay for treatment, and partially fill or avoid filling prescriptions altogether.

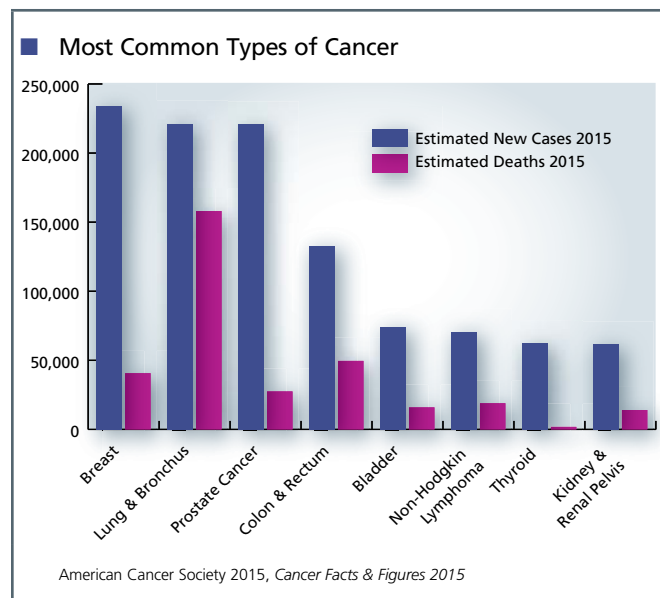
Without significant changes in treatment and care, the total cost of cancer in the U.S. is projected to reach \$458 billion in 2030. By 2035, the incidence of cancer is predicted to jump to 2.4 million, up from 1.6 million in 2014. Investment in biomedical research is imperative to reducing both the human and economic burden of cancer.



Prevalence & Incidence

- There are more than 100 different types of cancer.

National Cancer Institute 2014, *What Is Cancer?*



- Men have nearly a one in two chance of developing cancer in their lifetime. For women, the risk is around one in three.

Howlader et al. 2013, *SEER Cancer Statistics Review, 1975-2011*

- Around 1,658,370 new cancer cases are expected to be diagnosed in 2015.

American Cancer Society 2015, *Cancer Facts & Figures 2015*

- There are nearly 14.5 million people alive in the U.S. who have been diagnosed with cancer.

American Cancer Society 2014, *Cancer Treatment and Survivorship Facts & Figures 2014-2015*

- Around one out of every 25 U.S. citizens is a cancer survivor.

American Cancer Society 2014, *Cancer Treatment and Survivorship Facts & Figures 2014-2015*

Breast Cancer

- Around one in eight women in the U.S. (12 percent) will develop breast cancer in her lifetime. A man's lifetime risk is around one in 1,000.

Howlader et al. 2013, *SEER Cancer Statistics Review, 1975-2011*

- Breast cancer represents 29 percent of all new cancer cases in women in the U.S.

American Cancer Society 2015, *Cancer Facts & Figures 2015*

- In 2015, an estimated 231,840 new cases of invasive breast cancer are expected to be diagnosed in women in the U.S.

American Cancer Society 2015, *Cancer Facts & Figures 2015*

- There are more than 3.1 million American women alive today who have been diagnosed with breast cancer.

American Cancer Society 2014, *Cancer Treatment & Survivorship Facts & Figures 2014-2015*

Lung Cancer

- Approximately 6.8 percent of men and women will be diagnosed with lung cancer at some point during their lifetime.

Howlader et al. 2013, *SEER Cancer Statistics Review, 1975-2011*

- Lung and bronchus cancer represent 13.5 percent of all new cancer cases in the U.S.

American Cancer Society 2015, *Cancer Facts & Figures 2015*

- In 2015, an estimated 221,200 new cases of lung cancer are expected to be diagnosed.

American Cancer Society 2015, *Cancer Facts & Figures 2015*

- There are more than 430,000 Americans alive today who have been diagnosed with lung cancer.

American Cancer Society 2014, *Cancer Treatment & Survivorship Facts & Figures 2014-2015*

Prostate Cancer

- Approximately 15 percent of all men will be diagnosed with prostate cancer at some point during their lifetime.

Howlader et al. 2013, *SEER Cancer Statistics Review, 1975-2011*

- Prostate cancer represents 26 percent of all new cancer cases in men in the U.S.

American Cancer Society 2015, *Cancer Facts & Figures 2015*

- In 2015, an estimated 220,800 new cases of prostate cancer are expected to be diagnosed.

American Cancer Society 2015, *Cancer Facts & Figures 2015*

- There are more than 2.9 million American men alive today who have been diagnosed with prostate cancer.

American Cancer Society 2014, *Cancer Treatment & Survivorship Facts & Figures 2014-2015*

Colorectal Cancer

- Overall, the lifetime risk of developing colorectal cancer is about one in 20.

Howlader et al. 2013, *SEER Cancer Statistics Review, 1975-2011*

- Colorectal cancer represents eight percent of all new cancer cases in the U.S.

American Cancer Society 2015, *Cancer Facts & Figures 2015*

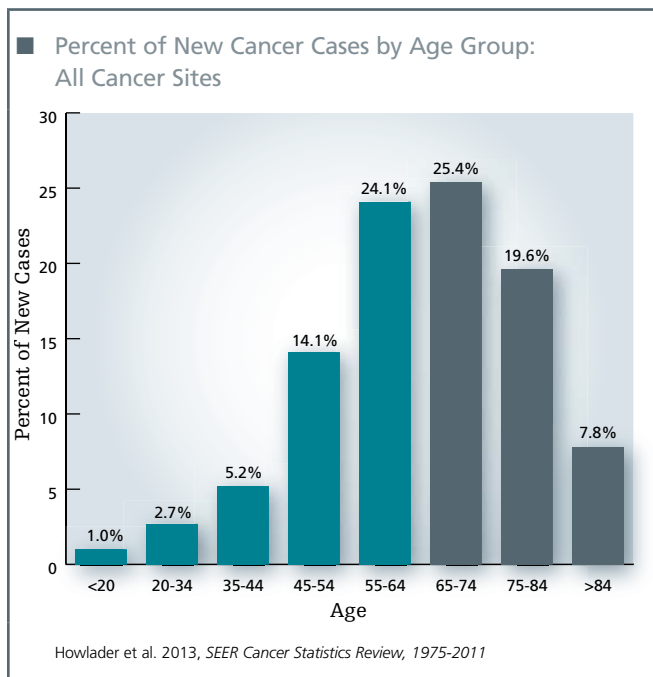
- In 2015, an estimated 132,700 new cases of colorectal cancer are expected to be diagnosed.

American Cancer Society 2015, *Cancer Facts & Figures 2015*

- There are more than 1.2 million Americans alive today who have been diagnosed with colon or rectum cancer.

American Cancer Society 2014, *Cancer Treatment & Survivorship Facts & Figures 2014-2015*

Age—A Major Risk Factor



- Around 78 percent of all cancers are diagnosed in people age 55 and older.

American Cancer Society 2015, *Cancer Facts & Figures 2015*

- Probability of Developing Invasive Cancers Within Selected Age Intervals by Sex, U.S., 2005-2007

	Birth to 39	40 to 59	60 to 69	70 and older
All sites Male	1 in 69	1 in 12	1 in 6	1 in 3
All sites Female	1 in 47	1 in 11	1 in 10	1 in 4

Siegel et al. 2011, *Cancer Statistics: 2011*

- The median age at cancer diagnosis is 66 years old.

Howlader et al. 2013, *SEER Cancer Statistics Review, 1975-2011*

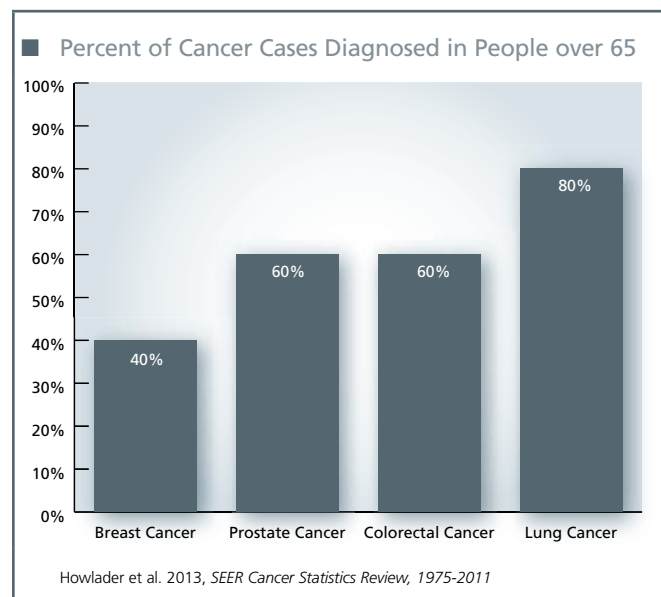
- The most common sites for cancer in Americans age 65+ in 2011 were:

- Lung and bronchus — 140,336 cases
- Prostate — 117,001 cases
- Breast — 96,981 cases
- Colon & rectum — 80,343 cases

Centers for Disease Control & Prevention 2014, *U.S. Cancer Statistics: 1999-2011*

- Approximately 60 percent of cancer survivors are age 65 or older.

Parry et al. 2011, *Cancer Survivors*





The Burden of Cancer

Human Burden

- Cancer was the second most common cause of death in 2014, behind heart disease.

Centers for Disease Control & Prevention, *Deaths: Final Data for 2013*

- An estimated 589,430 people are expected to die from cancer in 2015.

American Cancer Society 2015, *Cancer Facts & Figures 2015*

- Cancer accounts for one out of every four deaths in the U.S.

Centers for Disease Control & Prevention, *Deaths: Final Data for 2013*

- Around 1,620 people die from cancer each day.

American Cancer Society 2015, *Cancer Facts & Figures 2015*

- Estimated Cancer Deaths in 2015 by Cancer Type

Cancer Type	Estimated Deaths
Lung & bronchus	158,040
Colon & Rectum	49,700
Breast	40,370
Prostate	27,540

American Cancer Society 2015, *Cancer Facts & Figures 2015*

- Breast cancer is the second leading cause of cancer death in women in the U.S.

American Cancer Society 2015, *Cancer Facts & Figures 2015*

- Lung cancer is the leading cancer killer of both men and women in the U.S., accounting for around one in four cancer deaths.

American Cancer Society 2015, *Cancer Facts & Figures 2015*

- Prostate cancer is the second leading cause of cancer death in American men.

Howlader et al. 2013, *SEER Cancer Statistics Review, 1975-2011*

- Colorectal cancer is the second leading cause of cancer death when men and women are combined.

American Cancer Society 2015, *Cancer Facts & Figures 2015*

- More than one in four cancer survivors have a high burden from their symptoms at one-year after their diagnosis—even those who are no longer getting treatment.

Shi et al. 2011, *Symptom Burden in Cancer Survivors 1 Year After Diagnosis*

- Around 59 percent of cancer patients in active treatment, 33 percent of survivors, and 64 percent with advanced/metastatic/terminal disease experience pain.

Van den Beuken-van Everdingen 2007, *Prevalence of Pain in Patients with Cancer*

- Depression affects 15 to 25 percent of cancer patients.

National Cancer Institute 2014, *Depression*

- Close to one-third of cancer survivors experience limitations in their ability to perform activities of daily living.

Ekwueme et al. 2014, *Medical Costs and Productivity Losses of Cancer Survivors*

- For those cancer survivors employed at any time since their diagnosis, cancer and its treatment interfered with physical tasks required for the job for 25 percent of people, and mental tasks required for the job for 14 percent. Additionally, almost 25 percent of cancer survivors felt less productive at work.

Ekwueme et al. 2014, *Medical Costs and Productivity Losses of Cancer Survivors*

- Of those cancer survivors employed at any time since their diagnosis, 48 percent of women and 34 percent of men made changes in their work because of the cancer.

Ekwueme et al. 2014, *Medical Costs and Productivity Losses of Cancer Survivors*

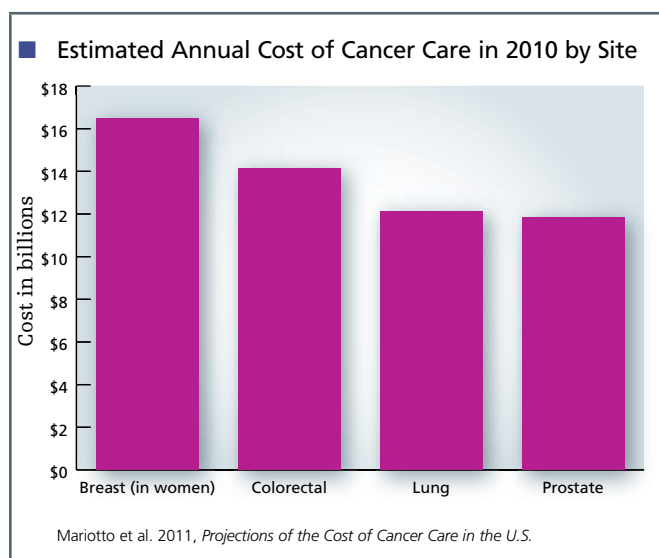
- In one study, 40 percent of cancer caregivers reported spending at least 21 hours a week on caregiving. More than half shouldered the caregiving burden with little or no help from paid or unpaid caregivers.

Van Ryn et al. 2011, *Objective Burden, Resources, and Other Stressors Among Informal Cancer Caregivers*

Economic Burden

- The total cost of cancer in 2009 was \$216.6 billion—\$86.6 in direct medical costs and \$130 billion for indirect mortality costs.

National Heart, Lung, and Blood Institute 2013, *NHLBI Fact Book*



- In 2011, four cancers accounted for nearly half of all Medicare payments for cancer—lung and bronchus (13 percent), breast (11 percent), colorectal (11 percent), and prostate (10 percent).

Stockdale & Guillory 2013, *Lifeline*

- One in 12 Medicare fee-for-service dollars is spent on cancer care.

Stockdale & Guillory 2013, *Lifeline*

- The direct medical costs in 2011 were an estimated \$88.7 billion:
 - 50 percent was for hospital outpatient or office-based provider visits
 - 35 percent was for inpatient hospital stays
 - 11 percent was for prescription medications

AHRQ 2012, *Medical Expenditure Panel Survey*

- Total annual medical expenditures are \$4,187 higher for men with cancer, and \$3,293 higher for women with cancer, compared with individuals without a history of the disease.

Ekwueme et al. 2014, *Medical Costs and Productivity Losses of Cancer Survivors*

- More than 10 percent of cancer patients have annual out-of-pocket costs that are higher than \$18,585, and 5 percent have costs that exceed \$35,660.

Goldman 2006, *Benefit Design and Specialty Drug Use*

- Care for cancer survivors in the U.S. in 2010 cost an estimated \$137 billion in medical expenditures.

National Cancer Institute, *Cancer Trends Progress Report*

- The annual excess economic burden of cancer survivorship, among recently diagnosed cancer survivors, was \$16,213 per survivor age 18 to 64, and \$16,441 per survivor age 65 and older (from 2008 to 2010).

Guy et al. 2013, *Economic Burden of Cancer Survivorship Among Adults in the U.S.*

- Three million cancer patients remain active in the workplace during their treatment, and incur 33 million days of disability each year.

Tang et al. 2012, *Health Care Expenditures, Hospitalizations, and Productivity Associated with Cancer in U.S. Employer Settings*

- Employment disability accounts for about 75 percent of lost productivity among cancer survivors.

Ekwueme et al. 2014, *Medical Costs and Productivity Losses of Cancer Survivors*

- Spending on cancer medicines represented approximately one percent of total national health expenditures in 2011.

IMS Institute for Healthcare Informatics 2013, *Declining Medicine Use and Costs*



- In one study, 42 percent of participants reported a significant financial burden. As a result:
 - 68 percent cut back on leisure activities
 - 46 percent reduced spending on food and clothing
 - 46 percent used their savings to help cover out-of-pocket expenses
 - 20 percent took less than the prescribed amount of medication
 - 19 percent partially filled a prescription
 - 24 percent avoided filling prescriptions

Zafara et al. 2013, *The Financial Toxicity of Cancer Treatment*

- People diagnosed with cancer are at a higher risk of bankruptcy than those without a cancer history.

Ramsey et al. 2013, *Washington State Cancer Patients Found to Be at Greater Risk*

- The value of life lost from all cancer deaths in 2000 was \$960 billion.

Yabroff et al. 2008, *Estimates and Projections of Value of Life Lost from Cancer Deaths in the U.S.*

The Future Cost

- The incidence of cancer in the U.S. is projected to grow from 1.6 million in 2014 to 2.4 million by 2035.

Ferlay 2013, *Cancer Incidence and Mortality Worldwide*

- Over the next 10 years, the number of cancer survivors in the U.S. is projected to grow from 14.5 million to nearly 19 million.

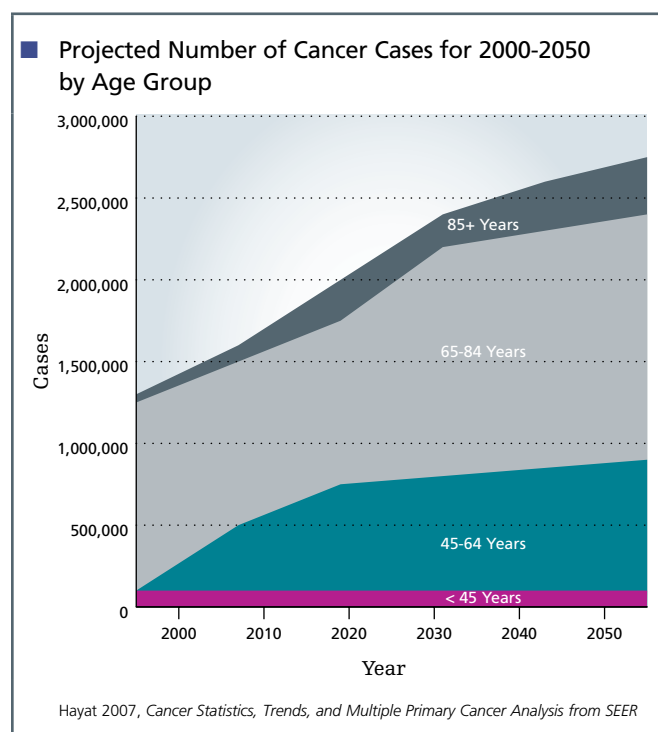
DeSantis et al. 2014, *Cancer Treatment and Survivorship Statistics*

- If cancer trends continue, cancer will soon be the leading cause of death in the U.S.

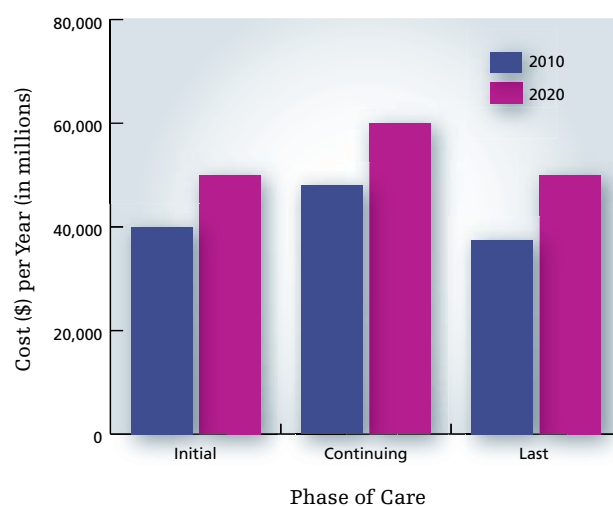
Murphy et al. 2013, *Deaths: Final data for 2010*

- The total cost of cancer in the U.S. is projected to increase from \$290 billion in 2010 to \$458 billion in 2030.

Bloom 2011, *The Global Economic Burden of Non-Communicable Diseases*

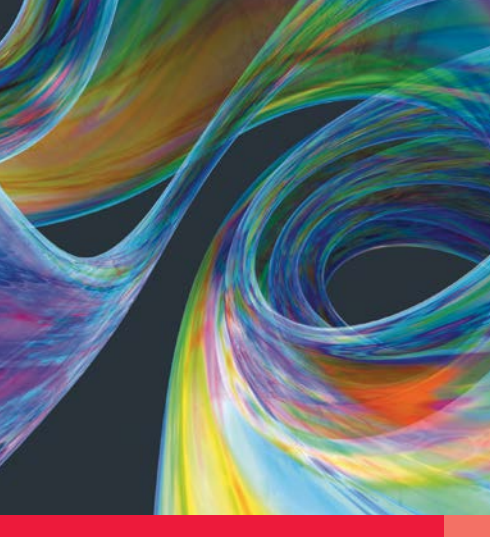


- **Cost of Cancer Care by Phase of Care, All Sites, All Ages, Male and Female, in 2010 Dollars**



- The value of life lost from cancer deaths is projected to reach \$147.6 billion in 2020.

Yabroff 2008, *Estimates and Projections of Value of Life Lost from Cancer Deaths in the U.S.*



Investing in Science

Innovative Medical Research

Since the United States declared war on cancer, the percentage of Americans living with, through, or beyond a cancer diagnosis has more than tripled. Yet, cancer continues to account for one out of every four deaths in the U.S. and has the potential to become the number one cause of death if current mortality trends continue.

Over 80 percent of gains in life expectancy for cancer patients have been attributable to new treatments. However, until as recently as 20 years ago, most of the drugs available to fight cancer that couldn't be treated with surgery and radiation, were limited to traditional chemotherapy drugs—toxic medicines that kill healthy cells along with the cancer.

Fortunately, we have learned more about cancer in the past 10 years than since it was first described in writing in 1600 BC. Much of the recent progress has been in the field of personalized medicine, also known as precision medicine, where medical treatments are tailored to the individual characteristics of each patient. With cancer, tumors can often be tested to identify which genes are turned on and off, and help physicians decide which personalized treatment plan will be the most effective.

The tremendous advances that have been made in mapping the human genome have helped paved the way for personalized medicine. Since the completion of the Human Genome Project in 2003, the medical community has gained access to all of the genes that make up an individual's DNA—a technology that is increasingly accessible since the cost to sequence a human genome as dropped from \$300 million in 2001 to just \$1,000 today.

To date, the FDA has approved dozens of therapeutics that target specific molecules and proteins involved in cancer, as well as anti-hormone therapeutics that treat patients with specific types of breast and prostate cancers.

A particularly exciting emerging area of personalized medicine is immuno-oncology, which leverages the body's inherent ability to launch an immune response against foreign cancer cells. In 2010, sipuleucel-T became the first immunotherapy vaccine approved by the FDA for the treatment of patients with prostate cancer, resulting in a 22 percent reduced risk of mortality, and a 4.2 month increase in median survival. Other advances in this field seem to be coming daily, and investing in these emerging therapies is critical, as just a 10 percent reduction in cancer-related deaths in the U.S. would be worth an estimated \$4.4 trillion to current and future generations.



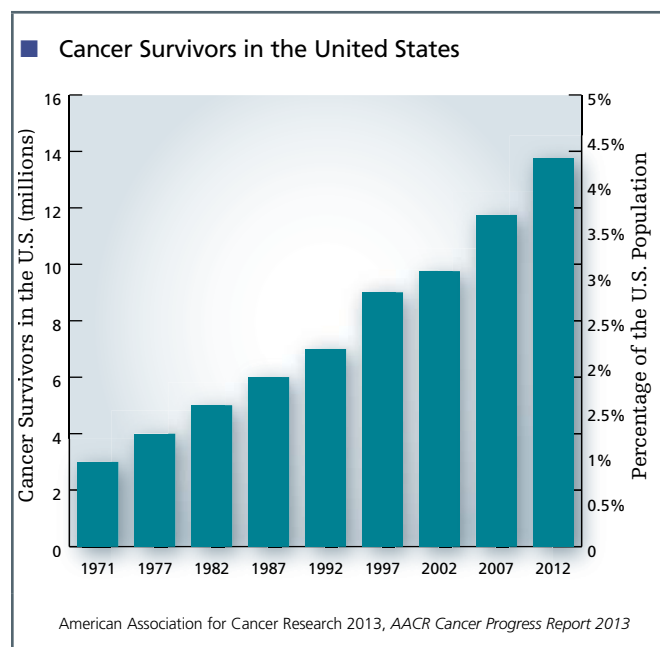
The Human Value

- Since Congress passed the National Cancer Act in 1971, the percentage of the U.S. population living with, through, or beyond a cancer diagnosis has more than tripled.

American Association for Cancer Research 2014, *AACR Cancer Progress Report 2014*

- There are nearly 14.5 million people in the U.S. living with a history of cancer.

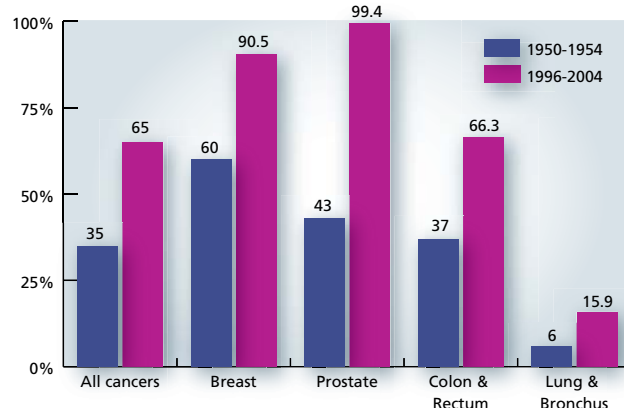
DeSantis et al. 2014, *Cancer Treatment and Survivorship Statistics, 2014*



- The 5-year survival rate for cancer has gone up 40 percent in the last 40 years.

American Cancer Society 2014, *Cancer Facts & Figures 2014*

■ 5-Year Relative Survival Rates for Cancers in U.S.



National Cancer Institute 2013, *SEER Cancer Statistics Review*

- Since 1991 the cancer death rate has fallen by 20 percent.
- Gross et al. 2012, *Recognizing Value in Oncology Innovation*
- Reductions in mortality for lung, female breast, prostate, and colorectal cancers accounted for 60 to 80 percent of the total decrease in all cancer deaths since the early 1990s.
- Jemal 2010, *Declining Death Rates Reflect Progress Against Cancer*
- Since 1980, 83 percent of gains in life expectancy for cancer patients have been attributable to new treatments.
- Sun et al. 2008, *The Determinants of Recent Gains in Cancer Survival*
- From 1975 to 1996, new cancer drugs increased life expectancy of cancer patients by about one year, at an estimated cost of \$3,000—well below the estimated value of a statistical life-year.

Lichtenberg 2004, *The Expanding Pharmaceutical Arsenal in the War on Cancer*

- The increase in the stock of cancer drugs from 1975 to 1995 accounted for about 50 to 60 percent of the increase in age-adjusted survival rates in the first 6 years after diagnosis.

Lichtenberg 2004, *The Expanding Pharmaceutical Arsenal in the War on Cancer*

- Between 1990/1991 and 2008, the overall cancer mortality rates decreased by 22.9 percent in men and 15.3 percent in women—around 1,024,400 deaths avoided—primarily due to reductions in tobacco use among men, increased cancer screening rates, and improved treatments.

Siegel 2011, *Cancer Statistics, 2011*

- Investments in cancer research and development between 1998 and 2000 has generated 23 million additional healthy years of life and \$1.9 trillion of additional social value.

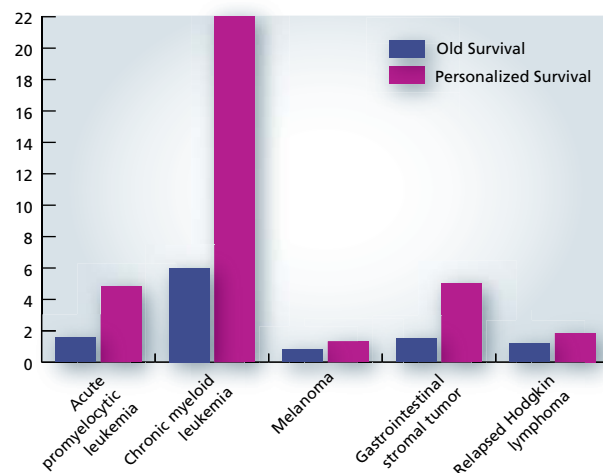
Lakdawala 2010, *An Economic Evaluation of the War on Cancer*

- Fundamental research has led to:

- 45 FDA-approved therapeutics that target specific molecules involved in cancer
- five FDA-approved therapeutics that work by targeting the proteins that modify the epigenome
- 10 anticancer therapeutics that impede the process by which cancer cells stimulate the development of blood and lymphatic vessel networks
- 17 antihormone therapeutics that treat patients with breast and prostate cancers driven by estrogen and testosterone hormones

American Association for Cancer Research 2014, *AACR Cancer Progress Report 2014*

■ The Impact of Personalized Medicine on Cancer Survival in Years



Munoz & Kurzrock 2012, *Targeted Therapy in Rare Cancers*

Breast Cancer

- Since 1975, the five year survival rate for breast cancer patients has increased by 40 percent.

American Cancer Society 2011, *Breast Cancer Facts & Figures 2011-2012*

- The overall five-year survival rate for women with invasive breast cancer is now 89 percent.

American Association for Cancer Research 2014, *Cancer Treatment and Survivorship Facts & Figures 2014-2015*

- Without screening and adjuvant therapy, the death rate for breast cancer would have increased by about 30 percent between 1975 and 2000.

Berry 2005, *Effect of Screening and Adjuvant Therapy on Mortality from Breast Cancer*

- Use of a monoclonal antibody with adjuvant chemotherapy in HER2+ individuals with operable cancer was associated with a 33 percent reduction in risk of death.

Romond et al. 2005, *Trastuzumab plus Adjuvant Chemotherapy for Operable HER2-Positive Breast Cancer*



Lung Cancer

- From 2007 to 2011, lung cancer incidence rates decreased by three percent each year in men and 2.2 percent each year in women.

American Cancer Society 2015, *Cancer Facts & Figures 2015*

- Improvements in surgical techniques and combination therapies increased the 1-year survival rate for lung cancer from 34 percent in 1975-1977 to 45 percent in 2006-2009.

Howlader et al. 2013, *SEER Cancer Statistics Review, 1975-2011*

- After one year, 73 percent of non-small-cell lung cancer patients with the EGFR genetic mutation who were treated with a tyrosine kinase inhibitor had survived, compared to 15 percent who received traditional chemotherapy.

Aspinall 2007, *Realizing the Promise of Personalized Medicine*

Prostate Cancer

- The overall five-year survival rate for men with prostate cancer is 99 percent—up from 43 percent in 1975.

American Association for Cancer Research 2014, *Cancer Treatment and Survivorship Facts & Figures 2014-2015* AND Lichtenberg 2004, *The Expanding Pharmaceutical Arsenal in the War on Cancer*

- The standard treatment for prostate cancer used to require radical prostatectomy. Now, less invasive therapies like brachytherapy have been shown to have equal outcomes with fewer side effects.

Kupelian et al. 2004, *Radical Prostatectomy...* AND Frank et al. 2007, *An Assessment of Quality of Life Following Radical Prostatectomy*

- A prostate cancer vaccine—sipuleucel-T immunotherapy—in men with metastatic castration-resistant prostate cancer, reduced the risk of death by 22 percent compared to placebo, and represented a 4.2 month improvement in median survival.

Kantoff et al. 2010, *Sipuleucel-T Immunotherapy for Castration-Resistant Prostate Cancer*

Colorectal Cancer

- Survival rates for colon cancer went from 41 percent to 63 percent between 1975 and 1995.

Lichtenberg 2004, *The Expanding Pharmaceutical Arsenal in the War on Cancer*

- Use of an epidermal growth factor inhibitor in the treatment of metastatic colon cancer patients without the KRAS gene mutation saw survival rates of 15.6 months, compared to 5.6 months in those without the mutation.

Lievre 2008, *KRAS Mutation as an Independent Prognostic Factor in Patients with Advanced Colorectal Cancer Treated with Cetuximab*



The Economic Value

- Investments in cancer care generated \$598 billion of additional value for cancer patients diagnosed between 1983 and 1999.

Phillipson et al. 2012, *An Analysis of Whether Higher Health Care Spending is "Worth it" in the Case of Cancer*

- Cancer patients in the U.S. experience greater survival gains than those in European countries, and the value of additional gains exceeds the additional cost of care in the U.S.

Phillipson et al. 2012, *An Analysis of Whether Higher Health Care Spending is "Worth it" in the Case of Cancer*

- Investments in research since the 1970s have generated \$1.9 trillion of value to society overall.

Lakdawalla et al. 2010, *An Economic Evaluation of the War on Cancer*

- Between 2008 and 2010, use of colonoscopy for the treatment and prevention of colon cancer saved an average of \$150,364 each year, per person affected.

Chatterjee et al. 2014, *Health Savings*

The Future Value

- Over the next 10 years, the number of cancer survivors in the U.S. is predicted to grow from 14.5 million to nearly 19 million (9.3 million men and 9.6 million women).

American Cancer Society 2014, *Cancer Treatment and Survivorship Facts & Figures 2014-2015*

- Close to one third of all drugs currently in the biopharmaceutical pipeline are for cancer, with around 5,500 potential first-in-class cancer medicines in development.

Long & Works 2013, *Innovation in the Biopharmaceutical Pipeline*

- As of July 2014, 18 anticancer drugs received FDA approval after being designated breakthrough therapies.

American Association for Cancer Research 2014, *AACR Cancer Progress Report 2014*

- Between August 2004 and July 2014, the FDA approved:
 - six new anticancer therapeutics
 - five new uses for previously approved anticancer therapeutics
 - two new uses for imaging agents
 - one new use for a screening test

American Association for Cancer Research 2014, *AACR Cancer Progress Report 2014*

- A one percent reduction in cancer-related deaths in the U.S. would be worth an estimated \$500 billion to society from increased quality of life and increased productivity from longer lives.

Murphy & Topel 2006, *The Value of Health and Longevity*

- A 10 percent reduction in cancer-related deaths in the U.S. would be worth an estimated \$4.4 trillion to current and future generations.

Murphy & Topel 2003, *Measuring the Gains for Medical Research*

- A one percent reduction in lung, colorectal, breast, leukemia, pancreatic, and brain cancer mortality would reduce productivity costs by \$814 million per year.

Bradley et al. 2008, *Productivity Costs of Cancer Mortality in the U.S.*

- More than half of cancer deaths in the U.S. are due to preventable causes.

Colditz & Wei 2012, *Preventability of Cancer*

- Increased use of medical technology, like colonoscopy and sigmoidoscopy for colon cancer screening, could save \$178.2 billion between 2010 and 2035.

Chatterjee et al. 2014, *Health Savings*

- Pathogens cause around two million cancer cases worldwide each year. Ninety percent of these cases are attributable to *Helicobacter pylori* (H Pylori), hepatitis B virus (HBV), hepatitis C virus (HCV), and human papilloma virus (HPV).

De Martel et al. 2012, *Global Burden of Cancers Attributable to Infections in 2008*



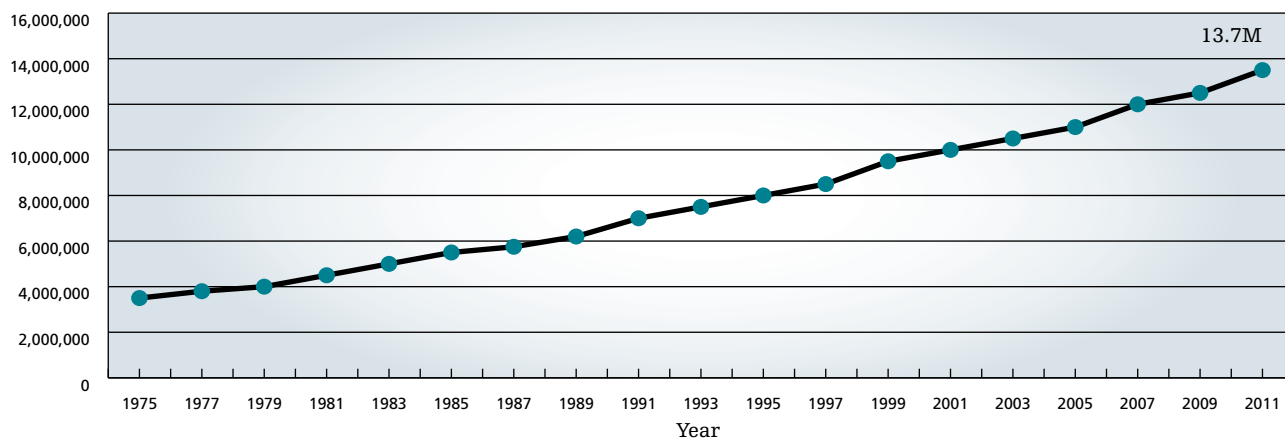
- If the use of recommended colorectal screening increased to 70.5 percent, 1,000 additional lives could be saved each year.

Centers for Disease Control & Prevention 2011, *Vital Signs: Colorectal cancer screening, incidence, and mortality*

- In 1971, one in 69 people was a cancer survivor (three million survivors). In 2014, that number grew to one in 22 people (14.5 million survivors).

American Association for Cancer Research 2013, *AACR Cancer Progress Report 2013*

■ Estimated Number of Cancer Survivors in the United States From 1975 to 2012



Mariotto et al. 2011, *Projections of the Cost of Cancer Care in the U.S.: 2010-2020*



Conclusion

Through numerous facts and figures, *The Silver Book: Cancer* makes a strong case for the value of medical innovation in reducing the burden of cancer, both socially and economically. By investing in basic and translational science that will lead to life-changing advances, the number of new cancer diagnoses can be reduced, and many cancer deaths can be prevented. As cancer is a disease that disproportionately affects older adults, a demographic that is increasing rapidly, finding new ways to prevent and treat cancer is both necessary and urgent.

In addition to increased awareness of prevention and screening, sound policies are required to ensure research and development focused on mitigating the profound effect of cancer remain a top priority. At the heart of all cancer diagnoses, is the patient. All patients should have access to high-quality, patient-centered, and coordinated care.

The fields of immuno-oncology and personalized medicine have shown much promise in treating cancers where routine cancer treatments have failed. Medical innovation often pays for itself through decreased medical expenses and increased human productivity, and is essential to containing the costs of health care as our nation continues to age.

References

- Agency for Healthcare Research and Quality (AHRQ). 2012. *Medical Expenditure Panel Survey*. Available at meps.ahrq.gov/mepsweb. Last accessed March 2015.
- American Association for Cancer Research. 2014. AACR Cancer Progress Report 2014. *Clin Cancer Res* 20 (Suppl):S1-S112.
- American Association for Cancer Research. 2013. AACR Cancer Progress Report 2013. *Clin Cancer Res* 19(Suppl):S1-S88.
- American Cancer Society. 2015. *Cancer Facts & Figures 2015*. Atlanta, GA: American Cancer Society, Inc.
- American Cancer Society. 2014. *Cancer Facts & Figures 2014*. Atlanta, GA: American Cancer Society, Inc.
- American Cancer Society. 2014. *Cancer Treatment and Survivorship Facts & Figures 2014-2015*. Atlanta, GA: American Cancer Society, Inc.
- American Cancer Society. 2011. *Breast Cancer Facts & Figures 2011-2012*. Atlanta, GA: American Cancer Society, Inc.
- American Institute for Cancer Research. 2009. *Policy and Action for Cancer Prevention—Food, Nutrition, and Physical Activity: A global perspective*. Washington, DC: AICR.
- Aspinall, M and R Hamermesh. 2007. Realizing the Promise of Personalized Medicine. *Harvard Bus Rev* 85(10):108-17.
- Berry, D, K Cronin, S Plevritis, D Fryback, L Clarke, et al. 2005. Effect of Screening and Adjuvant Therapy on Mortality from Breast Cancer. *NEJM* 353(17):84-92.
- Bloom, D, E Cafiero, E Jane-Llopis, S Abrahams-Gessel, L Bloom, et al. 2011. *The Global Economic Burden of Non-Communicable Diseases*. Geneva, Switzerland: World Economic Forum.
- Bradley, C, K Yabroff, B Dahman, E Feuer, A Mariotto, et al. 2008. Productivity Costs of Cancer Mortality in the United States: 2000-2020. *J Natl Cancer Inst* 100(24):1763-70.
- Centers for Disease Control & Prevention. Deaths: Final Data for 2013. *National Vital Statistics Reports* 64(2).
- Centers for Disease Control & Prevention. 2011. Vital Signs: Colorectal cancer screening, incidence, and mortality—United States, 2002-2010. *MMWR* 60(26):884-9.
- Chatterjee, A, J King, S Kubendran, and R DeVol. 2014. *Health Savings: Medical technology and the economic burden of disease*. Santa Monica, CA: Milken Institute.
- Colditz, G and E Wei. 2012. Preventability of Cancer: The relative contributions of biologic and social and physical environmental determinants of cancer mortality. *Annu Rev Public Health* 33:137-56.
- De Martel, C, J Ferlay, S Granceschi, J Vignat, F Bray, et al. 2012. Global Burden of Cancers Attributable to Infections in 2008: A review and synthetic analysis. *Lancet Oncol* 13:607-15.
- DeSantis, C, C Lin, A Mariotto, R Siegel, K Stein, et al. 2014. Cancer Treatment and Survivorship Statistics, 2014. *CA Cancer J Clin* 64:252-71.
- Ekwuekme, D, K Yabroff, G Guy, M Banegas, J de Moor, et al. 2014. Medical Costs and Productivity Losses of Cancer Survivors: United States, 2008-2011. *MMWR* 63(23):505-10.
- Ferlay, J, M Ervik, R Dikshit, S Eser, C Mathers, et al. 2013. GLOBOCAN 2012 v1.0, Cancer Incidence and Mortality Worldwide: *IARC CancerBase No. 11*. Lyon, France: International Agency for Research on Cancer.
- Frank, S, L Pisters, J Davis, A Lee, R Bassett, et al. 2007. An Assessment of Quality of Life Following Radical Prostatectomy, High Dose External Beam Radiation Therapy and Brachytherapy Iodine Implantation as Monotherapies for Localized Prostate Cancer. *J Urol* 177(6):2151-6.
- Goldman, D, G Joyce, G Lawless, W Crown, and V Willey. 2006. Benefit Design and Specialty Drug Use. *Health Aff* 25(5):1319-31.
- Gross, T, E Picard, and A Tarab. 2012. *Recognizing Value in Oncology Innovation*. Whitepaper. Boston, MA: Boston Healthcare.
- Guy, G, D Ekwueme, K Yabroff, E Dowling, J Rodriguez, et al. 2013. Economic Burden of Cancer Survivorship Among Adults in the United States. *J Clin Oncol* 31(30):3749-57.
- Hayat, M, N Howlader, M Reichman, and B Edwards. 2007. Cancer Statistics, Trends, and Multiple Primary Cancer Analyses from the Surveillance, Epidemiology, and End Results (SEER) Program. *The Oncologist* 12(1):20-37.
- Howlader, N, A Noone, M Krapcho, J Garshell, D Miller, et al. 2013. SEER Cancer Statistics Review, 1975-2011. Bethesda, MD: NCI. Based on November 2013 SEER data submission, posted to the SEER web site, April 2014.
- Hoyert, D and J Xu. 2012. Deaths: Preliminary Data for 2011. *National Vital Statistics Reports* 61(6).
- IMS Institute for Health Informatics. 2013. *Declining Medicine Use and Costs: For better or for worse? A review of the use of medicines in the United States in 2012*. New York, NH: IMS Institute.
- Jemal, A, E Ward, and M Thun. 2010. Declining Death Rates Reflect Progress Against Cancer. *PLoS One* 5(3):e9584.

Kantoff, P, C Higano, N Shore, E Berger, E Small, D Penson, et al. 2010. Sipuleucel-T Immunotherapy for Castration-Resistant Prostate Cancer. *NEJM* 363:411-22.

Koh, H, A Geller, D Miller, T Grossbart, and R Lew. 1996. Prevention and Early Detection Strategies for Melanoma and Skin Cancer. *Arch Dermatol* 32:436-43.

Kupelian, P, L Potters, D Khuntia, J Ciezki, C Reddy, et al. 2004. Radical Prostatectomy, External Beam Radiotherapy <72 Gy, External Beam Radiotherapy > or =72 Gy, Permanent Seed Implantation, or Combined Seeds/External Beam Radiotherapy for Stage T1-T2 Prostate Cancer. *Int J Radiat Oncol Biol Phys* 58(1):25-33.

Lakdawala, D, E Sun, A Jena, C Reyes, D Goldman, et al. 2010. An Economic Evaluation of the War on Cancer. *J Health Econ* 29(3):333-46.

Lichtenberg, F. 2004. The Expanding Pharmaceutical Arsenal in the War on Cancer. *NBER Working Paper Series* 10328.

Lievre, A, J Bachet, V Boige, A Cayre, D LeCorre, E Buc, et al. 2008. KRAS Mutations as an Independent Prognostic Factor in Patients with Advanced Colorectal Cancer Treated with Cetuximab. *J Clin Oncol* 26(3):374-9.

Long, G and J Works. 2013. *Innovation in the Biopharmaceutical Pipeline: A multidimensional view*. Boston, MA: Analysis Group.

Mariotto, A, K Yabroff, Y Shao, E Feuer, and M Brown. 2011. Projections of the Cost of Cancer Care in the U.S.: 2010-2020. *J Natl Cancer Inst* 103(2):117-28.

Munoz, J and R Kurzrock. 2012. Targeted Therapy in Rare Cancers: Adopting the orphans. *Nat Rev Clin Oncol* 9(11):631-42.

Murphy, S, J Xu, and K Kochanek. 2013. Deaths: Final data for 2010. *National Vital Statistics Reports* 61(4):1-117.

Murphy, K and R Topel. 2006. The Value of Health and Longevity. *J Political Econ* 114(5):871-904.

Murphy, K and R Topel. 2003. *Measuring the Gains for Medical Research: An economic approach*. Chicago, IL: University of Chicago Press.

National Cancer Institute. *Cancer Trends Progress Report*. Available at http://progressreport.cancer.gov/after/economic_burden. Last accessed March 2015.

National Cancer Institute. 2014. *What Is Cancer?* Available at www.cancer.gov/cancertopics/cancerlibrary/what-is-cancer. Last accessed March 2015.

National Cancer Institute. 2014. *Depression*. Bethesda, MD: NCI. Available at www.cancer.gov/cancer-topics/pdq/supportivecare/depression/HealthProfessional/page1. Last accessed March 2015.

National Cancer Institute. 2014. *Accelerating HPV Vaccine Uptake Urgency for Action to Prevent Cancer: A report to the President of the United States from the President's Cancer Panel*. Bethesda, MD: NCI.

National Cancer Institute. 2013. *SEER Cancer Statistics Review, 1975-2005*. Bethesda, MD: NCI. Available at http://seer.cancer.gov/archive/csr/1975_2005/accessible_contents.html. Last accessed March 2015.

National Heart, Lung, and Blood Institute. 2013. *NHLBI Fact Book, Fiscal Year 2012*. Bethesda, MD: NHLBI.

Parkin, D, D Mesher, and P Sasieni. 2011. Cancers Attributable to Solar (Ultraviolet) Radiation Exposure in the UK in 2010. *Br J Cancer* 105(Suppl2):S66-S69.

Parry, C, E Kent, A Mariotto, C Alfano, and J Rowland. 2011. Cancer Survivors: A booming population. *Cancer Epidemiol Biomarkers Prev* 20(10):1996-2005.

Philipson, T, M Eber, D Lakdawalla, M Corral, R Conti, and D Goldman. 2012. An Analysis of Whether Higher Health Care Spending is "Worth it" in the Case of Cancer. *Health Affairs* 31(4):667-5.

Ramsey, S, D Blough, A Kirchoff, K Kreizenbeck, C Fedorenko, et al. 2013. Washington State Cancer Patients Found to Be at Greater Risk for Bankruptcy than People without a Cancer Diagnosis. *Health Aff* 32(6):1143-52.

Romond, E, E Perez, J Bryant, V Suman, C Geyer, N Davidson, et al. 2005. Trastuzumab plus Adjuvant Chemotherapy for Operable HER-2 Positive Breast Cancer. *NEJM* 353:1673-84.

Shi, Q, T Smith, J Michonski, K Stein, C Kaw, et al. 2011. Symptom Burden in Cancer Survivors 1 Year After Diagnosis: A report from the American Cancer Society's studies of cancer survivors. *Cancer* 117(12):2779-90.

Siegel, R, E Ward, O Brawley, and A Jemal. 2011. Cancer Statistics, 2011: The impact of eliminating socioeconomic and racial disparities on premature cancer deaths. *CA Cancer J Clin* 61(4):212-36.

Stockdale, H and K Guillory. 2013. *Lifeline: Why cancer patients depend on Medicare for critical coverage*. Washington, DC: ACS-CAN.



Sun, E, D Lakdawalla, C Ryes, D Goldman, T Philipson, et al. 2008. The Determinants of Recent Gains in Cancer Survival: An analysis of the Surveillance, Epidemiology, and End Results (SEER) database. *J Clin Oncol* 27(15S).

Tang, D, D Alberts, R Nevins, S Sullivan, and G Skrepnek. 2012. Health Care Expenditures, Hospitalizations, and Productivity Associated with Cancer in U.S. Employer Settings. *J Occup Env Med* 54(12):1453-60.

Van den Beuken-van Everdingen, M, J de Rijke, A Kessels, H Schouten, M van Kleef, et al. 2007. Prevalence of Pain in Patients with Cancer: A systematic review of the past 40 years. *Ann Oncol* 18(9):1437-49.

Van Ryn, M, S Sanders, K Kahn, C van Houtven, J Griffen, et al. 2011. Objective Burden, Resources, and Other Stressors Among Informal Cancer Caregivers: A hidden quality issue? *Psycho-Oncology* 20(1):44-52.

Yabroff, K, C Bradley, A Mariotto, M Brown, and E Feuer. 2008. Estimates and Projections of Value of Life Lost from Cancer Deaths in the United States. *J Natl Cancer Inst* 100(24):1755-62.

Zafara, S, J Peppercorn, D Schrag, D Taylor, A Goetzinger, et al. 2013. The Financial Toxicity of Cancer Treatment: A pilot study assessing out-of-pocket expenses and the insured cancer patient's experience. *Oncologist* 18(4):381-90.

■ Facts in silver type deal specifically with older Americans.



Advancing Science. Enhancing Lives.

1700 K Street, NW
Suite 740
Washington, DC 20006
202.293.2856

www.agingresearch.org

 Alliance for Aging Research

 @Aging_Research

The Alliance for Aging Research is the leading non-profit organization dedicated to accelerating the pace of scientific discoveries and their application in order to vastly improve the universal human experience of aging and health.

© 2015 Alliance for Aging Research



Acknowledgements:

The Alliance extends its thanks to the following experts for reviewing *The Silver Book®: Cancer*:

- Graham A. Colditz, MD DrPH, Niess-Gain Professor, Department of Surgery, Washington University School of Medicine
- David H. Howard, PhD, Associate Professor, Department of Health Policy and Management and Winship Cancer Center, Emory University
- Xifeng Wu, MD, PhD, Professor and Chair, Department of Epidemiology, The University of Texas MD Anderson Cancer Center

This volume of *The Silver Book®* supported by an educational grant from:



Produced in partnership with

