The Economic Impact of Cancer in West Virginia

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A report prepared for the American Cancer Society by:

Bureau of Business and Economic Research
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Executive Summary

Cancer impacts families, care providers, and the economy in a variety of ways. This report provides estimates of the cost of cancer-related travel and medical care for West Virginians, the amount of wages that families forego due to cancer-related illness, and the opportunities for increasing economic activity in the state by treating more West Virginia cancer patients at in-state facilities. We estimate that travel and medical costs total more than $1.5 billion for cancer cases diagnosed in 2008. This represents about 2.7 percent of gross state product (GSP). West Virginia bears a disproportionate burden of cancer-related medical costs. Based on national estimates by the National Institute for Health (NIH), cancer-related medical expenditures totaled $103.8 billion for newly diagnosed patients in 2007. Given that West Virginia residents represent 0.6 percent of the national population, the state share of medical expenditures should be about $623 million. Based on our estimates, West Virginia cancer-related medical costs are more than 2.4 times the national average.

Cancer treatment, illness, and mortality affect an individual's ability to work. We estimate that the income of West Virginia families is about $1 billion lower due to new cancer diagnoses in 2008. In the absence of cancer, these wage earnings would represent an increase in GSP of 1.5 percent. The West Virginia forgone wage estimate is about 0.7 percent of the NIH estimated $123.0 billion for indirect mortality costs.

Early diagnosis is one promising strategy for reducing cancer-related medical and foregone wage costs. Focusing on colon cancer, we estimate that the per-patient medical, travel and foregone wage costs are nearly $284,000 for patients diagnosed in the distant stage and costs

are under $137,000 for those diagnosed in the local stage.[1] Utilizing existing inexpensive testing

options, it would be possible to greatly improve survival rates and reduce medical costs. In

addition to the clear economic gains to be made from earlier diagnosis, hard-to-quantify gains in

quality of life for patients and those who care for them are likely.

In 2008, just under 2,100 West Virginians newly diagnosed with cancer received some

type of cancer care at an out-of-state facility. These patients represented about 20 percent of the

2008 new diagnoses in the state. We estimate that about $309 million in travel and medical

spending occurs outside of the state for these patients. Retaining more patients in West Virginia

for care, possibly through the implementation of the West Virginia Cancer Plan, would have a

significant impact on the West Virginia economy.

The above estimates represent direct costs for medical and travel expenses and wages lost

by West Virginia families. To get a more comprehensive picture of the economic costs of

cancer, we estimate the indirect economic impact of investing the money spent on cancer and the

lost wages back into the West Virginia economy.   These indirect effects are estimated to be

about $1.890 billion for individuals newly diagnosed in 2008.[2] When we add indirect economic

impacts, we estimate that economic activity tied to medical and travel expenses represents a total

of about 4.6 percent of GSP, and foregone wages lead to a total effect of about 2.8 percent of

GSP in lost economic activity.

In terms of jobs, we estimate that cancer in West Virginia is directly associated with

about 13,000 jobs in the medical and travel industries. Further there are over 9,000 jobs

indirectly tied to cancer medical and travel expenditures. Wages foregone due to cancer

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[1] Gains from earlier diagnosis are largely driven by medical cost savings, as many individuals are diagnosed with
colon cancer when they are past conventional working ages.
[2] Numbers have been rounded.

mortality represent about 5,529 direct jobs and 2,451 indirect jobs. In comparison to the 2008 West Virginia total employment number of 774,100, cancer-related jobs due to medical and travel expenses represent about 2.9 percent of the workforce.

These economic effects are expected to increase over time. Accounting for trends in medical costs and inflation, we estimate that the total economic impact will increase about 26 percent from 2009 to 2015 to $5.812 billion. The analysis suggests two clear strategies for reducing the economic burden of cancer in the state: 1) increase early diagnoses; and 2) treat more West Virginia cancer patients in state.

Introduction

Cancer impacts the lives of many West Virginians and is the second leading cause of death in the state following heart disease (WV Comprehensive Cancer Program, 2012). If current trends continue, researchers estimate that cancer will be the leading cause of death in West Virginia beginning in 2016 and that about one-third of Americans will be diagnosed with cancer in their lifetimes (West Virginia Cancer Plan, 2007; WV Comprehensive Cancer Program, 2012). Clearly, cancer touches the lives of West Virginia residents in many ways. The purpose of this report is to provide a comprehensive picture of the economic impact of cancer in West Virginia.

Additionally, separate estimates are presented for colon cancer by cancer stage. Colorectal cancer is the third most diagnosed cancer and the third leading cause of cancer-related death in the state.[3] Based on 2007 data, West Virginia had the fourth highest incidence of colon cancer at 53.2 cases per 100,000 people and the second highest death rate at 20.7 deaths per 100,000 people.[4] Incidence and death rates are likely to remain a particular concern in West Virginia as the state has the oldest average population and some of the highest rates of obesity and smoking in the nation. In most cases, prevention and early screening could reduce suffering and prevent death from colorectal cancer. Understanding the economic implications of colon cancer is essential to evaluating cost effective interventions and improving quality of life for West Virginians.

This study addresses economic costs from two perspectives. First, we estimate total costs as the sum of costs to individuals and their families, the public sector (including Medicare and

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[3] American Cancer Society. Colorectal Cancer Facts & Figures 2011-2013, 2011.
[4] CDC, United States Cancer Statistics. Age-Adjusted Invasive Cancer Incidence Rates and 95% Confidence Intervals by State (Table 5.4.1MF) and Age-Adjusted Cancer Death Rates and 95% Confidence Intervals by State (Table 5.1.2M).

Medicaid), private insurers, and overall economic growth (including reductions in wages and tax revenue). Second, we utilize information on the public spending share of total health expenditures to calculate the economic impacts from the state government's perspective. These numbers highlight the high public cost of cancer, as well as serve as a baseline for assessing the public benefits to future intervention activities.

The approach used in this study produces an estimate of the economic cost (including foregone future wages) of all new cancer cases in the base year 2008.[5] Cost estimates for additional years through 2015 are produced using trends in medical expenditures and diagnosis rates, as well as expected inflation rates. Several factors could affect the actual future costs including changes in cancer diagnoses, reductions in medical costs or foregone wages through earlier diagnoses, and the costs of future treatment technologies.

The economic footprint of cancer in West Virginia is estimated in several research steps. First, direct economic costs are divided into two main categories: medical expenditures and travel costs. These costs include amounts spent on treatment, driving for treatment, and lodging to receive treatment. For the case of colon cancer, we produce overall cost estimates as well as estimates by stage of diagnosis. Next, estimates are calculated for the amount of income foregone by West Virginia families due to cancer treatment, illness, and mortality.

Each of these categories—medical, travel, and foregone wages—is used as input information into the Bureau of Business and Economic Research's IMPLAN® software to estimate the indirect and induced costs including the tax revenues that would have been generated by the foregone wage income and additional economic activity generated by medical and travel expenditures. The direct expenditure and foregone wage impacts will be treated separately for the purposes of transparency and because they require different assumptions about

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[5] This is the most recent year for which the cancer statistics are complete.

tax revenues and industry impacts. In the instance of direct care-related expenditures, the implicit assumption is made that if these dollars were not spent on cancer treatment, they would go elsewhere in the economy and generate similar tax revenue, whereas additional earnings from foregone wages would produce new tax revenue. Medical expenditures are allocated to the medical industry (based on NAICS codes), and foregone wages are allocated to general consumption, which essentially means that foregone wages are allocated across the economy in a representative manner. Results for each category are summed to produce an overall estimate of the economic impact of cancer in West Virginia.

Medical Care and Family Income

In the sections below we provide estimates for medical and travel expenses as well as the foregone wage costs of cancer. See Appendix A for more details on data sources and calculations.

Cancer Care from Medical Service Providers

Average medical expenditures for each cancer case are divided into three categories: the amount of spending for initial treatment, continued annual costs, and additional costs associated with a cancer-related death. In equation form:

$$First\ Year\ Cost_{ij} + \sum_{t=2}^{T-1} Continuing\ Cost_{ij} + (Cancer\ Death_{ij} - Other\ Cause)$$

Where T is the number of years from diagnosis to death, i represents an individual, and j represents cancer site. We calculate costs for seven different cancer sites (colorectal, female breast cancer, leukemia, lung and bronchus, non-Hodgkin lymphoma, prostate, and liver) as well as an "other" category. Cost of care estimates are taken from the National Cancer Institute's

Average Annual Costs of Care.[6] The number of years of continuing care is calculated by cancer

site as the difference between average age of death and average age of diagnosis.[7] Our estimates

range from an average lifetime cost (in 2008 dollars) for treating female breast cancer of $96,159

to an average cost of $185,108 for leukemia. We multiply the average cost of care for each

cancer site times the number of newly diagnosed cases in West Virginia during 2008. Our total

estimate (in 2008) dollars of the lifetime cost of cancer care for new diagnoses in 2008 is $1.498

billion (see Table 1 for top-level calculations). This represents about 2.2 percent of West

Virginia's annual economic activity or gross state product (GSP).

Table 1: Medical Expense by Cancer Site

Cancer Site	Medical Expense per Person (2008 dollars)	Cancer Cases (2008)	Total Medical Expense (2008 dollars)
Colorectal	$130,797	1,200	$156,956,242
Female Breast	$96,159	1,150	$110,583,275
Leukemia	$185,108	290	$53,681,378
Lung and Bronchus	$149,549	2,000	$299,098,175
Non-Hodgkin Lymphoma	$165,460	410	$67,838,422
Prostate	$99,128	1,180	$116,971,139
Liver	$115,528	120	$13,863,345
Other	$174,061	3,900	$678,838,658
Total		10,250	**$1,497,830,635**

Travel Costs

Travel costs are calculated as the cost of traveling to receive treatment in the first year

following diagnosis. We do not include costs for future years as we assume that continuing care

can be scheduled along with other routine health services, not requiring an extra trip. To

calculate travel costs, we divide new cancer diagnoses (2008) into two categories, those that

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[6] Estimates are provided in 2010 dollars, which we adjust back to 2008 dollars to match our cancer data.
[7] We calculated a weighted average age of diagnosis and death (the sum of the percent in each age category times the median age in each category; e.g. about 2 percent of colorectal cancer diagnoses occur between the ages of 45 and 49 and we assign 2 percent of colorectal diagnoses to age 47, etc.).

receive treatment out-of-state and those that receive in-state treatment. We assume that the patient will make 25 trips for cancer treatment in the first year of treatment. The number of trips is calculated as the average number of trips indicated in treatment protocols for breast cancer, colorectal cancer, lung cancer and leukemia. We also assume that a working-age adult will accompany the patient.

Out-of-state travel expenditures are calculated based on county of residence. For each county, we collect the distance from the county seat to the nearest major out-of-state cancer treatment center. The cost of each trip is calculated as the roundtrip mileage times the medical travel reimbursement rate ($0.23) plus one night of lodging at the US General Services Administration (GSA) reimbursement rate for the treatment location. We also assume that the patient and the accompanying adult forego two days of work at the mean daily wage rate for the county. For those receiving treatment in West Virginia, we assume that the average round trip is 50 miles, the patient and accompanying adult forego one day of wages at the mean daily wage rate for the county, and there is no expenditure for lodging.[8] We estimate that total cancer-related travel expenses for patients diagnosed in 2008 are $69 million.

Data for our main calculations are presented in Table 2. We estimate that it costs about $46 million for patients receiving in-state treatment and $23 million for patients receiving out-of-state treatment. On average, travel costs are almost 3 times higher for patients who leave the state for treatment.

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[8] We calculated the distance from each county seat to the nearest in-state hospital. The mean distance for all counties is 35 miles each way for a round trip of 70 miles. Because population is greater in more urban areas with hospitals, we chose a more conservative estimate of 50 miles round trip for our analysis.

Table 2: Summary of Travel Cost Calculations

Average Distance to Nearest Out-of-state Hospital (miles)	136
Average Lodging Rate (2008 dollars)	112
Average Daily Wage (2008 dollars)	91
Number of Patients Receiving Out-of-state Care	2,071
Average Annual Out-of-state Cost for First Year Treatment (25 trips)	10,934
Average Annual In-state Cost for First Year Treatment (25 trips)	3,901
Total Out-of-State Travel Costs	22,935,731
Total In-state Travel Costs	45,878,592
Total Travel Costs	**68,814,323**

Impacts on Family Income: Lifetime Foregone Wages

To estimate foregone wages, we assume a retirement age of 65 and add the wages (in 2008 dollars) for each year that a person will not work from diagnosis to age 65 (assuming that patients do not generally work while receiving treatment) due to cancer-related death. For this purpose, we only consider patients diagnosed at age 64 or younger.[9] Average wages are calculated on a state-wide annual average wage rate of $34,992 per year (in 2008 dollars). We utilize five-year survival rates by cancer site and stage[10] to estimate mortality rates and diagnoses by stage from the West Virginia Cancer Registry[11] to estimate the number of cancer-related deaths by stage and by age group.

Total foregone wages are the number of years of work foregone times the annual wage rate. We estimate that lifetime foregone wages for 2008 diagnoses total $915 million, or about 1.5 percent of GSP. Results by cancer site are presented in Table 3.

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[9] Note that some individuals might work past age 65, which biases our estimates downward. However, we count all working years from diagnosis to age 65 as non-working and some patients will work during this period, which biases our estimates upward. Overall, we expect the biases to roughly offset each other.

[10] American Cancer Society, last updated 3/14/2012.

[11] 2011 Annual Report.

Table 3: Forgone Wages by Cancer Site

Cancer Site	Age Group	Working Years Lost per Person (Age 65 - weighted diagnosis age)	Number of Cases	Mortality: Number of Cases	Total Working Years Lost (Number of Cases times Number of Working Years)	Total Forgone Wage ($34,992 per person per year)
Colorectal	0 to 20	0	0	0	0	
	20 to 49	23	50	27	629	
	50 to 64	7	184	100	682	
	Total		234	128	1,311	45,867,707
Female Breast	0 to 20	0	0	0	0	
	20 to 49	23	140	42	951	
	50 to 64	7	303	91	639	
	Total		443	133	1,589	55,618,815
Leukemia	0 to 20	45	11	5	213	
	20 to 49	27	19	8	223	
	50 to 64	7	41	18	120	
			71	31	556	19,454,354
Lung and Bronchus	0 to 20	0	0	0	0	
	20 to 49	21	55	50	1,038	
	50 to 64	6	340	308	1,893	
	Total		395	358	2,930	102,540,508
Non Hodgkin Lymphoma	0 to 20	45	1	0	0	
	20 to 49	25	27	8	199	
	50 to 64	7	74	22	146	
	Total		102	30	346	12,096,507
Prostate	0 to 20	0	0	0	0	
	20 to 49	19	11	0	0	
	50 to 64	6	220	6	36	
	Total		231	6	36	1,264,072
Liver	0 to 20	45	1	0	0	
	20 to 49	19	4	3	64	
	50 to 64	7	24	20	139	
	Total		29	23	202	7,078,016
Other	0 to 20	45	125	68	3,057	
	20 to 49	28	902	490	13,697	
	50 to 64	6	697	404	2,427	
	Total		1724	963	19,180	671,146,818
Total Forgone Wages						915,066,796

Colon Cancer

We provide estimates for colon cancer in Table 4. Travel expenses are allocated based on the number of cases diagnosed in each stage and the relative medical treatment costs for each stage. Medical expenses represent the average annual costs of care from the National Cancer Institute[12] allocated based on Yarbroff (2008). That is, we utilize the most recent estimates of the cost of care and then allocate these total costs across stages based on the estimates of Yarbroff (2008). Our results indicate that per person, medical, wage, and travel costs are more than double for those diagnosed in Stage 4 (distant) than those diagnosed in situ or local stage (these stages could not be separated based on available data). Thus, an intervention that shifts diagnoses from distant to local would yield significant economic gains.

For example, an intervention that succeeds in moving 20 percent of patients (41) from a distant stage diagnosis to a local stage diagnosis would yield a savings of over $11 million. Savings from earlier diagnoses come from both reduced medical costs and expected foregone wages. Medical costs are expected to be about 2.0 times higher with a distant diagnosis and expected foregone wages are 2.2 times higher.

Table 4: Colon Cancer Estimates by Stage

	Local	Regional	Distant	Total
Travel Cost	3,126,457	2,720,845	2,209,008	8,056,311
Medical Expense	60,910,879	53,008,587	43,036,777	156,956,242
Foregone Wages	18,202,041	14,066,193	13,599,474	45,867,707
Total	82,239,377	69,795,625	58,845,259	**210,880,261**
Number of Patients	600	394	207	1,201
Cost Per Patient	137,066	177,146	284,277	175,587

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[12] We adjust the 2010 estimates into 2008 dollars using the Consumer Price Index.

State Budget Costs

To estimate the economic impact of cancer on state government finances, we assess effects on medical expenditures and foregone tax revenue. Tangka, et al. (2010) estimate that, on a national level, 3.7 percent of cancer costs are borne by Medicaid and other public programs in 2005, excluding Medicare (16.8 percent). However, estimates from neighboring Ohio (Koroukian, Bakai, and Raghavan, 2012) suggest that the number is likely closer to 11 percent for West Virginia. Using this second estimate, we calculate the portion of medical expenditures that are likely paid by the state through Medicaid by taking 11 percent of the total $1,498 million to get $165 million in direct medical costs. Next, we add foregone tax revenue due to cancer-related wage losses of $13 million. In total, we estimate that the direct cancer cost to the state budget is about $178 million in medical costs and foregone tax revenue for 2008 diagnoses.

Out-of-State Care for Newly Diagnosed Patients

The above analyses address the medical, travel and foregone wage costs of cancer for West Virginia residents regardless of where they receive their cancer care. Thus, these numbers can be seen as the economic footprint of cancer for West Virginians, although some of this economic activity will occur outside of the state. Based on tabulations from the West Virginia Cancer Registry, just under 2,100 West Virginians newly diagnosed with cancer in 2008 received some type of cancer care in another state. Adding the difference in travel costs (in-state travel versus out-of-state travel) and expected medical expenses, we estimate that $309 million in travel and medical spending occurs outside of the state.[13]

West Virginia providers and state policy makers have the opportunity to significantly increase economic activity and high-wage medical industry jobs in the state by retaining some of

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[13] See Appendix A for detailed information on our data sources and calculations.

these patients in the state for cancer care. As illustrated below, we estimate that medical and travel-related expenditures generate an additional 74 percent in indirect economic activity (e.g. retail and service jobs, retail sales). Thus, the total economic impact of out-of-state treatment is more than half of a billion dollars ($0.537 billion) and represents significant potential for capturing more economic activity within West Virginia.

Economic Impact Estimates

The above estimates represent direct medical and travel costs, as well as lifetime foregone wage costs of cancer in West Virginia. In order to get a more complete picture of how cancer affects the West Virginia economy, or the size of the economic 'footprint' of cancer in West Virginia, we utilize a model (IMPLAN) to estimate the indirect effects. Indirect effects include economic activity such as retail sales and tax revenues. In the case of medical care, about 20 percent of this total activity is occurring out-of-state.

Medical Expenses

In the case of medical expenditures, we estimate the number of non-cancer-related jobs that exist because of cancer-related spending, as well as economic activity, or business volume, associated with this spending. In this case, we do not report tax revenues as part of the economic estimates, as we are assuming that if these funds were not spent on cancer care they would be redirected to other areas of the West Virginia economy and produce similar tax revenues. In short, we estimate the total economic activity associated with medical spending on cancer treatment.

As noted in Table 5, we estimate that the economic impact[14] of cancer-related medical spending would be about $2,613 million in business volume. About $1,004 million of this total would be employee compensation for 21,073 jobs. Of these jobs, 11,947 are from direct expenditures in the medical industry, and 9,127 jobs are created through indirect economic activity. The mean expected annual wage in the medical industry is $62,000, and the mean wage for jobs generated through indirect activity is $29,000.

Table 5: Economic Impact of Cancer-Related Medical Expenditures

	Direct	Indirect & Induced	Total
Economic Activity from Medical Expenditures ($millions)	$1,498	$1,115	$2,613
Employee Compensation ($millions)	$740	$264	$1,004
Employment (jobs)	11,947	9,127	21,073

Travel Expenses

It is useful to note that for medical expenditures and travel, we are estimating the economic impact of cancer for West Virginia residents diagnosed in 2008, regardless of whether they receive treatment outside of the state. Thus, the economic impact estimates represent the total economic impact of cancer for West Virginia residents. This is best viewed as an estimate of the additional economic activity that could potentially occur in West Virginia if there were no cancer cases.

Table 6 contains economic impact estimates for cancer-related travel expenditures. Travel expenditures for cancer-related care (in-state and out-of-state travel) total about $69 million. These expenditures result in about $42 million in indirect economic activity for a total economic impact of $111 million. We estimate that about $32 million goes to employee compensation for 1,654 jobs. The mean salary for travel-related jobs is about $19,000.

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[14] Economic impact analysis conducted using IMPLAN software. Definitions are located in Appendix B.

Table 6: Economic Impact of Cancer-Related Travel Expenditures

	Direct	Indirect & Induced	Total
Economic Activity from Travel Expenditures ($millions)	$69	$42	$111
Employee Compensation ($millions)	$21	$11	$32
Employment (jobs)	1,310	344	1,654

Forgone Wages

Table 7 contains economic impact estimates for cancer-related foregone wages. This is economic activity that we would expect to occur in the absence of cancer. In this case, we include an estimate of tax revenues that would be collected if there were no cancer-related illness. Unlike medical and travel expenses that could only be redirected within the economy, foregone wages represent potential economic activity that would be newly taxed. We estimate that foregone wages represent about $1,647 million in economic activity. If these wages were earned and spent in the West Virginia economy, we would expect about $209 million to go to employee compensation creating 7,980 jobs at a mean wage of about $26,000. Note foregone wages generate about $0.17 in employee compensation per dollar of foregone wages, whereas the ratio is much higher ($0.49) for medical expenditures. This is because forgone wages enter our model as potential increases in consumption and some of these expenditures will flow to companies outside of the state (and country). We estimate that state tax revenue from foregone wages would total $12.8 million, including sales and income tax revenues.

Table 7: Economic Impact of Cancer-Related

	Direct	Indirect & Induced	Total
Economic Activity from Foregone Wages ($millions)	$915	$732	$1,647
Employee Compensation ($millions)	$154	$55	$209
Employment (jobs)	5,529	2,451	7,980
Assorted State Taxes* ($millions)			$13

* Assorted state taxes include sales, use, personal income, business franchise, and corporate net income taxes. Numbers might not add to row totals due to rounding.

Total Economic Impact

In Table 8 we sum the economic impact of direct medical and travel costs with the foregone economic activity due to unearned wages. In total, we estimate an economic impact of $4,371 million. Employee compensation totals $1,244 million for 30,707 jobs, at a mean wage of about $40,500. These numbers represent the total expected costs of new diagnoses among West Virginia residents in 2008.

Table 8: Total Economic Impact of Cancer in West Virginia

	Direct	Indirect & Induced	Total
Total Cancer-related Economic Activity ($millions)	$2,482	$1,889	$4,371
Employee Compensation ($millions)	$915	$329	$1,244
Employment (jobs)	18,786	11,921	30,707
Assorted State Taxes* ($millions)			$13

* Assorted state taxes include sales, use, personal income, business franchise, and corporate net income taxes. Numbers might not add to row totals due to rounding.

Total Colon Cancer Impact

Table 9 contains total economic impact estimates for colon cancer. We estimate that the total impact of colon cancer is $370 million dollars. This represents $274 million from direct and indirect medical costs, $13 million from direct and indirect travel costs, and $83 million in foregone economic activity from unearned wages. We estimate that the state would collect $1 million in additional revenue in the absence of colon cancer.

Table 9: Economic Impact of Colon Cancer in West Virginia

	Direct	Indirect & Induced	Total
Total Colon Cancer-related Economic Activity ($millions)	$210	$160	$370
Employee Compensation ($millions)	$79	$29	$108
Employment (jobs)	1,629	1,035	2,664
Assorted State Taxes* ($millions)			$1

* Assorted state taxes include sales, use, personal income, business franchise, and corporate net income taxes. Numbers might not add to row totals due to rounding.

Estimated Impacts 2009-2015

To estimate impact in years later than 2008, we use expected growth rates[15] in medical costs and cancer diagnoses and adjust for inflation. We implicitly adjust medical expenses and wage rates by using nominal growth rates for medical costs and wages in our calculations (i.e. our growth rates for medical expenses are calculated on data that have not been deflated).[16] We utilized the energy-based Consumer Price Index (CPI) to adjust travel expenses for inflation. The economic impacts of cancer for West Virginia residents are expected to increase to $4.545 billion in 2009 and continue to increase to $5.706 billion by 2015.

Table 10: Future Economic Impacts of Cancer in West Virginia (Millions of Dollars)

Category	2009	2010	2011	2012	2013	2014	2015
Medical Expenses	1,610	1,731	1,852	1,908	1,965	2,024	2,085
Travel Expenses	73	78	82	88	93	99	105
Foregone Wages	938	959	994	1,022	1,051	1,080	1,110
Total Medical, Travel & Foregone Wages	2,621	2,767	2,929	3,017	3,108	3,203	3,300
Overall Growth Rate (percent)	5.6	5.6	5.8	3.0	3.0	3.0	3.0
Business Volume	4,617	4,874	5,158	5,314	5,475	5,641	5,812
Employee Compensation	1,315	1,388	1,469	1,513	1,559	1,606	1,655
Number of Jobs	31,358	33,102	35,032	36,090	37,182	38,308	39,470
Tax Impact	14	14	15	16	16	17	17

Non-quantifiable effects:

The above cancer-related costs lend themselves to quantification. However, there are clearly other factors such as emotional stress, financial stress, changes in work or schooling

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[15] Note that where data are available we use actual growth and inflation rates.

[16] Health Research Institute (2012) is used for medical cost growth rates through 2011 (around 7.5 percent). For later years, we assume a conservative 3 percent growth rate due to the great deal of uncertainty about the effects of health reforms on medical costs. We utilize the CPI for Energy to calculate travel growth rates. Given the extreme volatility in recent energy costs, we use an average growth rate from 2008 to the most recently available rate (July 2012) of 6.2 percent. To adjust foregone wages, we utilize actual growth rates in average weekly wages from Work Force West Virginia's Labor Market Information Tables from 2008 to 2011. For later years, we use the mean growth rate over the 2008-2011 time period.

decisions (e.g. staying in a lower-paying job for health insurance benefits instead of starting a business or delaying college attendance to care for a loved one) that impact West Virginians. Some of these factors might have definite economic consequences (e.g. stress causes health problems that require medical care or missed days from work), while others might not have a clear impact on economic activity, but could seriously affect quality of life for patients, their families, and caregivers. Because we are not able to quantify all of these effects, we view the economic impacts presented above as a lower bound estimate of the true impact of cancer in West Virginia.

Conclusion

Cancer affects West Virginians in a multitude of ways. Medical expenditures make up one component and include all of the support provided to cancer patients and their families by medical providers. Cancer treatment involves a significant number of trips to medical providers—we include travel expenses in our estimates. Families of cancer patients also bear a significant economic burden in the form of lost income due to cancer-related treatment, illness, and mortality. Finally, cancer-related expenses and foregone wages impact the economy indirectly through job creation in the medical industry or reduced household income from foregone wages. This report provides estimates of the economic impact of cancer in terms of medical and travel costs, foregone wages, and indirect economic activity costs. Cancer-related medical and travel costs represent over 2.5 percent of total GSP. Foregone wages represent economic activity that might have occurred in the absence of cancer and are about 1.5 percent of GSP. When one accounts for the indirect economic activity associated with cancer-related costs, medical and travel expenditures represent about 4.6 percent of GSP, while foregone wages represent lost economic activity of about 2.8 percent of GSP.

One promising area to reduce the economic burden of cancer on West Virginia families is to shift more diagnoses to earlier stages of cancer development. In the case of colon cancer, earlier diagnoses would significantly reduce the per-person costs of cancer, primarily by reducing medical costs. In general, West Virginians would benefit from innovative solutions to reduce both the economic burden of cancer-related illnesses and also the harder to quantify effects on quality of life.

Each year, about 20 percent of newly diagnosed West Virginia cancer patients opt to receive their cancer care out-of-state. If cancer providers and policy makers could retain more of these patients in-state, possibly through an NCI designated cancer center or a cancer trial network, West Virginians could benefit from the more than half of a billion dollars of economic activity that is now occurring in other states. Moving these expenditures into West Virginia represents an opportunity to add relatively high income jobs in the medical industry.

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Appendix A: Data Elements and Calculations

Data Elements

NAME OF THE VARIABLE	DESCRIPTION	SOURCE OF DATA	LIST OF MAIN AREAS WHERE THE DATA IS USED
Shortest travel distance in miles	Distance from the county seat to the nearest out of state hospital	Google maps shortest distance calculator	Used to calculate mileage cost for out of state travel expense
Distance for in-state travel	Distance from each county seat to the nearest in-state hospital. The overall state mean was 35 miles each way. A more conservative estimate of 25 miles each way was used in the analysis given that areas around hospitals have higher population rates	Google maps shortest distance calculator	Used to calculate mileage costs for in-state travel expenses.
Average number of treatment trips (25)	Mean number of trips from treatment protocols compiled by the West Virginia University, Mary Babb Randolph Cancer Center for breast cancer, lung cancer, colorectal cancer, prostate cancer and leukemia.	West Virginia University, Mary Babb Randolph Cancer Center treatment protocols.	Used to calculate travel expenses.
Mileage rate	Standard mileage rate at IRS for medical and moving	http://www.irs.gov/taxpros/article/0,,id=156624,00.html	Used to calculate mileage cost for instate and out of state travel expense
Lodging rate	Maximum rate for one night stay from the General Service Administration	http://www.gsa.gov/portal/category/21287	Used to calculate lodging cost for out of state travel expense
Out of state treatment cases by county	The number of out of state cancer cases by county in WV in 2008	Tabulations provided by the West Virginia Cancer Registry and researchers at the Mary Babb Randolph Cancer Center	Used to calculate the number of instate cancer cases, mileage lodging and forgone wage cost for out of state travel expense

NAME OF THE VARIABLE	DESCRIPTION	SOURCE OF DATA	LIST OF MAIN AREAS WHERE THE DATA IS USED
Total cases of cancer	The total number of cancer cases by county in 2008 in WV	West Virginia Cancer Registry 2011 Annual Report http://www.dhhr.WV.gov/oeps/cancer/Documents/Cancer_Incidence_in_WV_2011.pdf	Used to calculate the instate cancer cases, weighted average wage per week and per year and total forgone wage due to cancer.
Average weekly wage data (all industries)	Mean weekly wage rate in 2008	http://workforceWV.org/lmi/EW2008/default.htm	Used to calculate the in state and out of state forgone wage for the travel expense and total forgone wage.
Annual average CPI	The Consumer Price Index compiled by Bureau of Labor Statistics and it is based on 1982 base of 100	http://inflationdata.com/inflation/Consumer_Price_Index/HistoricalCPI.aspx	Used to calculate the medical expense of year 2008 from 2010 estimates
Population of WV in 2008	The population of WV in July 2008 from the Bureau of Labor Statistics	http://www.census.gov/popest/data/state/asrh/2008/SC-EST2008-03.html	Used to calculate the weighted age of death for each cancer type by age group
Age adjusted US mortality rates	US mortality age adjusted rates by age groups by cancer types for all races for 2008 from Surveillance Epidemiology and End results	http://seer.cancer.gov/faststats/selections.php?series=age	Used to calculate the weighted death age for each cancer type by age group
Annualized Mean Net Costs of Care by Age, Gender and Phase of Care (Per Patient). Costs in 2010 US Dollars	Average Annual Costs of Cancer Care in US 2010 Dollars by cancer site and by phase of care: Initial year following diagnosis, Last year of life, and the period between (Continuing). Months of survival are first applied to last year of life, any remaining to initial phase, then to continuing.	http://costprojections.cancer.gov/annual.costs.html	Used to calculate the total medical expense for each cancer site for the year 2010 and then converted into 2008 costs using the CPI

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NAME OF THE VARIABLE	DESCRIPTION	SOURCE OF DATA	LIST OF MAIN AREAS WHERE THE DATA IS USED
Cancer cases by site WV in 2008	The total number of cases of cancer by site in WV for the year 2008	http://www.cancer.org/Research/CancerFactsFigures/cancer-facts-figures-2008	Used to calculate the total medical expense and total forgone wage for all cancer sites in 2008. Also used to calculate the weighted age of diagnosis for each cancer site by age group
Diagnosis rate	The diagnosis rate for each cancer site by age group	West Virginia Cancer Registry 2011 Annual Report http://www.dhhr.WV.gov/oeps/cancer/Documents/Cancer_Incidence_in_WV_2011.pdf	Used to calculate the weighted age of diagnosis for each cancer site by age group for 2008 and the total foregone wage
Five year survival rates	Five-year survival rates at the time of diagnosis by cancer site	American Cancer Society, Detailed Guides, Early Detection, Diagnosis, and Staging. http://www.cancer.org/cancer.	Used to calculate the number of foregone working years by cancer site and stage of diagnosis
Five year survival rate for unstaged colon cancer diagnoses	Five year survival rate for unstaged colon cancer. Stage at diagnosis is classified using SEER Summary Stage 2000	http://seer.cancer.gov/csr/1975_2009_pops09/results_single/sect_06_table.12.pdf	Used to calculate the forgone wage by stages for colon cancer
Relative cost of care by colon cancer stage	The relative net cost of care for colon cancer stage.	"Cost of Care for Elderly Cancer Patients in the United States" by K. Robin Yabroff , Elizabeth B. Lamont , Angela Mariotto , Joan L. Warren , Marie Topor, Angela Meekins ,Martin L. Brown Journal of the National Cancer Institute 2008 Volume 100, 630-641.	Used to create multipliers to estimate the annual cost of care by stage based on the 2010 NCI average annual cost of care by cancer site (adjusted back to 2008 using CPI).
Rate of diagnosis by stage	The percentage of diagnosis in each stage of colon cancer	West Virginia Cancer Registry 2011 Annual Report Cancer Incidence in West Virginia, 1993-2008	Used to calculate the medical expenses by stages for colon cancer in 2008

Underlying Calculations

- <u>Total travel costs are the sum of costs for in-state patients and out-of-state patients.</u>

1. Out-of-state travel cost for each county is the sum of round-trip mileage costs, lodging costs, and foregone wage costs.

   Mileage cost = number of out of state patients times shortest distance in miles to the nearest out-of-state hospital × the medical and moving reimbursement rate for mileage at the IRS (2008). It has been assumed that a patient will have 25 trips. Thus, this mileage cost is further multiplied by 25 trips to the hospital to get the total. The number of trips is calculated as the average number of trips suggested by treatment protocols for breast cancer, lung cancer, colorectal cancer, and leukemia.

   Lodging cost = number of out of state patients ×one night at the GSA reimbursement rate (2008) ×25 trips.

   Forgone wage is represented as the number of out of state patients' × two days for two individuals (patient and companion) at the mean county wage rate for one day (2008) × 25 trips. The mean county wage rate for one day was calculated from the average weekly wage data.

2. In-state travel cost for each county is the $\sum roundtrip\ mileage\ costs\ +\ foregone\ wage\ costs$.

   Mileage cost = the number of instate patients' × fifty miles times the medical and moving reimbursement rate for mileage at the IRS (2008) × 25 trips.

   There is no lodging cost for the instate patients.

   Forgone wage = number of in state patients' × one day for two individuals (patient and companion) at the mean county wage rate for one day (2008) × 25 trips.

- <u>Total medical cost is calculated as [Initial average cost + (Continuing age -1)*Continuing average cost + (Cancer death average cost- Other death average cost)]</u>

   The continuing age is calculated as the difference between the weighted age of death and weighted age of diagnosis for each cancer site.

   The weighted age of diagnosis is calculated in several steps-

   i) There are eighteen age groups and corresponding diagnosis rate for cancer site X.

   ii) A= $\left(Diagnosed\ rate\ by\ \frac{age}{Total}\ of\ diagnosed\ rate for\ X\right) * Total\ no\ of\ cases\ for\ X$

   iii) B=$A/Total\ no\ of\ cases\ for\ cancer\ X$ = percent of cases in each age category

iv) C= the middle age for each age group

v) D= weighted age of diagnosis for each age group= $B \times C$

vi) E= $\sum$ D to get the weighted age of diagnosis for cancer type X

The weighted age of death is denoted by few stages for cancer type X-

i) There are five age groups and the corresponding death rate.

ii) A= $death\ rate * (population\ of\ WV\ for\ 2008/100000)$

iii) B=Total no of death cases for cancer X= $\sum$A

iv) $C = A/B$

v) D= the middle age for each age group

vi) E= weighted age of death for each age group= $C \times D$

vii) F= $\sum$E to get the weighted age of death for cancer type X

The initial average, continuing average, cancer death average cost and other death average cost are calculated by taking the average of female and male cost for 2010 dollars.

The 2010 medical expense for each cancer type X is then converted to medical expense 2008 dollars = $(Medical\ expense\ of\ 2010 \times (2008\ CPI/2010\ CPI))$

The total medical cost is represented by sum of (medical expense for each cancer type X times the number of cancer cases for type X) for 2008.

- Total forgone wage is calculated in the following steps-

Assume a person retires at the age of 65, thirteen age groups up to the age of 65 were considered for each cancer type. These groups are further clustered into three concrete age groups of 0-20, 20-49 and 50-64.

a) To get the weighted diagnosis age for an age group, the following calculations were used-

i) A= (Actual Diagnosed rate or number of cases/Total of diagnosed rate or the total number of cases)

ii) B=the middle age for each age group

iii) C= weighted age of diagnosis = A×B

iv) D= $\sum$C to get the weighted age of diagnosis for each age group of cancer type X

This is repeated for the three age groups for each cancer type.

b) E=65-weighted age of diagnosis for a age group for cancer X

F=Total number of cases in each age group for cancer type X

G=Weighted mortality rate for each age group (weights based on stage at diagnosis)

H=E×F×G for each age group

I=Total forgone wage for cancer type X =$\sum I$ × total weighted average wage for a year**

The total forgone wage for cancer = $\sum H$

**The total weighted average wage for a year is calculated

i) A= Total cases of cancer of each county/the sum of total cases of cancer of all counties

ii) B=Average weekly wage data (all industries) 2008

iii) C=Average weekly wage 2008× A

iv) D=weighted average wage per week =$\sum C$

v) E=Total weighted average wage for a year =$weighted\ average\ per\ week \times 4.33 \times 12$

- To calculate the total cancer expenses for the future years from 2009 to 2015-

i) M_N, T_N and F_N are the corresponding total medical expense, Travel expense and foregone wage expense for year 2008.

ii) Medical expense = $M_{2008} \times (1.075)^N$, N= year 0 to 2 (i.e. year 2008 to 2010), Medical expense = $M_{2010} \times (1.07)^N$, N= year 3, and Medical expense = $M_N \times (1.03)^N$, N= year 4 to 7

iii) Travel expense = $T_{2008} \times (1.062)^N$, N= year 0 to 7 i.e. year 2008 to 2015

iv) Forgone wage expense= $F_N = F_N \times (1+G)^N$, N= year 0 to 7 i.e. year 2008 to 2015, where G is the actual wage growth rate until 2011 and the mean 2008 to 2011 growth rate thereafter (2.8 percent)

vii) $g = ((n+1)\ wage - n\ wage)/\ n\ wage)$

viii) G=$\sum g$ / 3

v) Total Direct Cost$_N$=M$_N$ + T$_N$+ F$_N$ for N= 0 to 7

ix) To find the growth rate for the corresponding years, GG$_{N+1}$ = ((S$_{N+1}$ – S$_{N)}$ / S$_N$), N=0 to 7

<u>For colon cancer the medical cost and the forgone wage is done by stages. The four stages are insitu, local, regional and distant.</u>

- For forgone wage the following calculations were done-

  i) A= 5 year survival rate for each stage

  ii) $B = 100 - A$

  iii) C=$B/100$

  iv) $D = \sum C$

  v) E=C/D

  vi) F$_i$=E × total foregone wages for colon cancer, i= stages namely insitu, local, regional and distant.

- For medical expense the following calculations were done-

  i) A$_i$= diagnosis rate in each stage of colon cancer

  ii) B=$\sum$ A

  iii) C= A/B*100

  iv) D=number of cases in each stage=$C \times 1200$

  v) E=Mean net cost of care for each stage=$Initial\ cost +\ Last\ year\ cost$

  vi) F=$D \times E$

  vii) G=$\sum$ F

  viii) H= $(F/G) \times medical\ expense\ for\ colon\ cancer$

- The travel expense for colon cancer=$Total\ travel\ expense \times colorectal\ cancer\ share$

  Colorectal cancer share=$Total\ cases\ of\ cancer/No\ of\ colorectal\ cancer\ cases$

  Now to get colorectal cancer expenses by stage, we need the travel multipliers (by percent cases and medical cost allocation)

So we need to follow the following steps-

i) $A_i = (\sum Initial\ cost_i + Last\ year\ cost_i)/\sum(Initial\ Cost\ of\ distant\ stage + Last\ year\ cost\ of\ distant\ stage)$, where i= stages of colorectal cancer

ii) Travel multiplier$_i$ = $((Diagnosis\ rate\ for\ i\ th\ stage\ /\ Sum\ of\ the\ diagnosis\ rate) \times 100)\ /\ 100) \times Ai$

iii) H=$\sum Travel\ multiplier_i$

iv) I=$Travel\ expense\ in\ total/H$

v) $Travel\ expense\ by\ stage\ i\ = I \times Travel\ multiplier_i$

- To get total colorectal cancer expense by stages i, the steps were-

i) $Z_i = \sum Travel\ expense\ i + Medical\ expense\ i + Forgone\ wages\ expense\ i$

ii) Per patient expense for colorectal cancer for stage i= $(Zi\ /\ No\ of\ cases\ in\ stage\ i)$

Appendix B: Economic Impact Definitions

Economic Activity:

> Sales plus net increase in finished inventories and the value of intra-corporate shipments. Equals output (see below) plus the cost of goods sold in retail and wholesale trade.

Employment:

> The number of jobs in a business, industry, or region. Also, the number of jobs attributable to an impact (see below). This is a measure of the number of full-time and part-time positions, not necessarily the number of employed persons. Jobs are annual average by place of work. A job year is equivalent to one job for one year.

Employee Compensation:

> Wages and salaries plus employers' contribution for social insurance (social security, unemployment insurance, workers compensation, etc.) and other labor income (pension contributions, health benefits, etc.). By place of work unless otherwise stated.

Impacts:

> The results of the recirculation of funds throughout a regional economy due to the activity of a business, industry, or institution. Estimated by tracing back the flow of money through the initial businesses' employees and suppliers, the businesses selling to the employees and suppliers, and so on. Thus, they are a way to examine the distribution of industries and resources covered in the costs of the initial activity.

Output:

> For most sectors, measured as sales plus net inventories and the value of intra-corporate shipments. For retail and wholesale trade, measured as gross margins (i.e. sales minus cost of goods sold, also equal to the mark-up on goods sold).

Value Added

> A measure of the value created by a business or industry or attributable to an impact (see above). Equal to the value of production minus the cost of purchased goods and services. Also equal to employee compensation plus capital income (profits, interest paid, depreciation charges), and indirect business taxes (e.g. severance, excise). Corresponds to the aggregate concepts of gross domestic product (GDP).