Social Costs of Cancer

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BACKGROUND

- Prior research suggests significant social value associated with increased longevity due to preventing and treating cancer[1]
- Cancer can also lead to increased spending on disability insurance that typically occurs during later stage cancers[2,3]
- Cancer can also lead to lower income[4] and employment,[5] and increased medical spending[6]

RESEARCH OBJECTIVES

- To examine how prior cancer diagnosis relates to the receipt of disability insurance, income, employment, and medical spending
- To use these estimates to calculate the potential social value of detecting cancers at earlier stages

STUDY DESIGN

Data

- Data from the Medical Expenditure Panel Study (MEPS), years 2010-2019
- Adults aged 50-79 to target individuals who are most likely to be screened and diagnosed earlier for cancers
- MEPS is a panel conducted over two years – each respondent answers five waves
  - Waves 3 and 5 (roughly the end of the 1st and 2nd years) ask about cancer history
  - Data on employment, public assistance receipt, disability, and medical expenditures is also captured

Methods

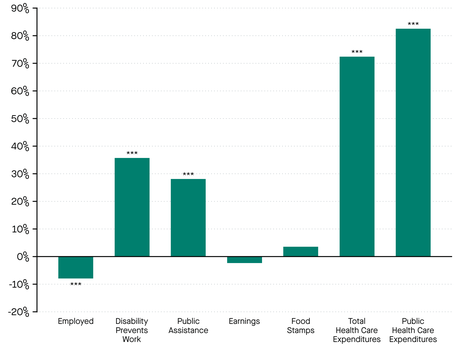
- $Y_i = \alpha + \beta \times EverCancer_i + \delta \times X_i + \epsilon_i$
  - Y_i is our outcome (employment, disability, public assistance, medical expenditures)
  - α is the intercept
  - β is the coefficient of interest while $EverCancer_i$ is the variable for whether the respondent had ever been diagnosed with cancer
  - X_i is our vector of race, ethnicity, age, and age-squared controls
  - ϵ_i is the error term
- Because respondents answer twice, we de-mean the variables (subtract values from the person-level average)
  - This estimates the effect of newly diagnosed cancer

PRINCIPAL FINDINGS: EARLY DETECTION OF CANCER OFFERS POTENTIAL SOCIETAL BENEFITS SUCH AS DECREASED DISABILITY AND INCREASED EMPLOYMENT

Social Value Calculation

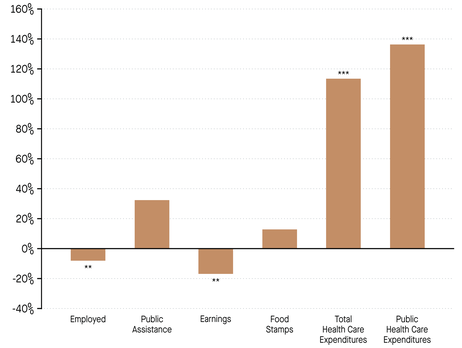
- Approximately 17.7% of cancers are diagnosed at Stage IV
- These cancers, however, represent an estimated 62.75% of long-term disability[7]
- If all cancers were detected before Stage IV, our approach suggests:
  - 500,000 more people would be employed
  - Almost $4 billion would be saved in public assistance spending

Figure 1. Effect of Cancer History as a Percentage of Non-Cancer Survivor Mean



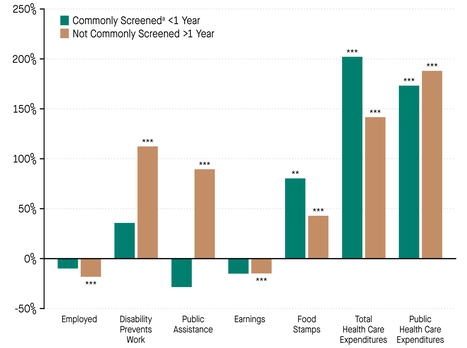
*** p<0.01
Data is from the MEPS 2010-2019. Each bar shows the coefficient (from a regression of the outcome on an indicator for whether someone had ever had cancer) divided by the outcome mean. The outcomes are employment, whether someone has a work-preventing disability, the amount of public assistance income received, total earnings, whether the respondent received food stamps, and total/public health care expenditures. Regressions control for age, age-squared, sex, and race/ethnicity.

Figure 2. Effect of New Cancer as a Percentage of Pre-Cancer Mean



*** p<0.01, ** p<0.05
Data is from the MEPS 2010-2019. Each bar shows the coefficient (from a regression of the de-meaned outcome on a de-meaned variable for whether the respondent has ever had cancer) divided by the 1st year outcome mean for those reporting new cancer in their 2nd year. The outcomes are employment, the amount of public assistance income received, total earnings, whether the respondent received food stamps, and total/public health care expenditures. Regressions control for age, age-squared.

Figure 3. Effect of Cancer History as a Percentage of Non-Cancer Survivor Mean - By Screening and Timing



[a]Commonly screened cancers are breast, cervical, colon, and prostate.
*** p<0.01, ** p<0.05
Data is from the MEPS 2010-2019, keeping only observations from the 2nd year for each respondent. Each bar shows the coefficient (from a regression of the outcome on indicators for whether someone reported having ever had cancer in their 1st year and for whether they hadn't had cancer in the 1st year but had the 2nd) divided by the outcome mean. The outcomes are employment, the amount of public assistance income received, total earnings, whether the respondent received food stamps, and total/public health care expenditures. Regressions control for age, age-squared, sex, and race/ethnicity.

SUPPORTING DATA

Table 1. Descriptive Statistics

Variable	All	Ever Had Cancer	Never Had Cancer
Cancer	0.18		
Commonly Screened	0.06	0.36	
Not Commonly Screened	0.04	0.25	
Skin	0.07	0.41	
Bladder		0.02	
Breast		0.17	
Colon		0.05	
Lung		0.02	
Lymphoma		0.02	
Melanoma		0.08	
Other Kind		0.17	
Prostate		0.11	
Skin (Unsure which kind)		0.11	
Skin - non-melanoma		0.23	
Uterine		0.03	
Cervical		0.04	
Observations, N	283,911	44,547	

Variable	All	Ever Had Cancer	Never Had Cancer
Public Assistance	1,196	1,237	1,187
Earnings	32,746	26,029	34,221
Employed	0.56	0.42	0.59
Disabled	0.13	0.16	0.12
Disabled if not Working	0.27	0.26	0.27
Receiving SNAP	0.08	0.07	0.09
Public Health Care Spending	4,094	7,371	3,375
Total Health Care Spending	8,880	14,342	7,681
Hispanic	0.11	0.05	0.12
Black	0.11	0.06	0.12
American Indian	0.00	0.00	0.01
Asian	0.05	0.02	0.06
Multiracial	0.02	0.01	0.02
Male	0.48	0.46	0.48
Age	61.7	65.5	60.9
Observations, N	283,911	44,547	239,364

The difference in cancer history by race is, in large part, driven by skin cancers. When skin cancers are removed from the cancer category, the Black share of cancer survivors rises to 10% and the Hispanic share rises to 7%.

Table 2. Main Results

Variable	(1) Employed	(2) Disability Prevents Work	(3) Public Assistance	(4) Earnings	(5) Food Stamps	(6) Total Health Care Expenditures	(7) Public Health Care Expenditures
Cancer	-0.0456*** (0.00706)	0.0434*** (0.00580)	$330.9*** (62.51)	-$668.1 (681.8)	0.00272 (0.00379)	$5,507*** (389.2)	$2,743*** (225.0)
Non-Cancer Mean	0.59	0.12	$1,192	$33,977	0.09	$7,621	$3,335
Cost Estimate	-$826,572		$5,998,082,675	-$27,298,617,432		$99,823,032,004	$49,721,186,996
Observations, N	255,108	255,108	255,108	255,108	255,108	255,108	255,108

*** p<0.01
Standard errors in parentheses.
Age, age-squared, sex, and race/ethnicity are included as controls.

Table 3. Effect of New Cancers

Variable	(1) Employed	(2) Public Assistance	(3) Earnings	(4) Food Stamps	(5) Total Health Care Expenditures	(6) Public Health Care Expenditures
Cancer - De-meaned	-0.0335** (0.0130)	$283.6 (260.2)	-$5,011** (2,238)	0.0105 (0.00923)	$10,437*** (1,893)	$5,035*** (1,072)
Pre-Cancer Mean	0.48	$891	$31,091	0.09	$9,254	$3,718
Cost Estimate		$538,840,000	-$9,520,900,000		$19,830,300,000	$9,566,500,000
Observations, N	255,108	255,108	255,108	255,108	255,108	255,108

*** p<0.01, ** p<0.05
Standard errors in parentheses.
Age, age-squared are included as controls.

Table 4. Effect by Screening and Timing

Variable	(1) Employed	(2) Disability Prevents Work	(3) Public Assistance	(4) Earnings	(5) Food Stamps	(6) Total Health Care Expenditures	(7) Public Health Care Expenditures
Commonly Screened[a] <1 Year	-0.0505 (0.0465)	0.0424 (0.0398)	-$323.9 (284.4)	-$4,982 (3,221)	0.0716** (0.0315)	$15,275*** (3,027)	$5,746*** (1,892)
Commonly Screened[a] >1 Year	-0.0372*** (0.0105)	0.0385*** (0.00930)	$209.8** (88.46)	-$1,520 (966.4)	-0.00907* (0.00524)	$4,509*** (749.3)	$1,960*** (388.5)
Not Commonly Screened <1 Year	-0.152*** (0.0464)	0.0973** (0.0425)	$591.6 (362.6)	-$10,253*** (3,196)	0.0806** (0.0381)	$21,882*** (4,203)	$11,891*** (3,289)
Not Commonly Screened >1 Year	-0.102*** (0.0122)	0.134*** (0.0123)	$1,059*** (168.0)	-$4,752*** (1,079)	0.0381*** (0.00818)	$10,731*** (1,289)	$6,235*** (856.1)
Skin <1 Year	-0.000879 (0.0345)	-0.00636 (0.0321)	$235.7 (528.4)	$1,245 (3,524)	-0.0262** (0.0116)	$3,650 (2,514)	-$628.2 (639.0)
Skin >1 Year	-0.0156 (0.0109)	-0.0118 (0.00740)	$4.803 (95.74)	$2,191* (1,305)	-0.0136*** (0.00500)	$2,378*** (536.3)	$941.2*** (350.3)
Non-Cancer Mean	0.59	0.12	1,192	33,977	0.09	7,621	3,335
Observations, N	126,723	126,723	126,723	126,723	126,723	126,723	126,723
R-squared	0.251	0.022	0.020	0.148	0.028	0.029	0.050

[a]Commonly screened cancers are breast, cervical, colon, and prostate.
*** p<0.01, ** p<0.05, * p<0.1
Standard errors in parentheses.
Age, age-squared, sex, and race/ethnicity are included as controls.

LIMITATIONS

- Because MEPS does not ask about cancer stage or metastasis, our analysis of cancer's overall effect is an upper bound for the effect of shifting cancer diagnosis from late to earlier stages
- Survivor bias: Individuals surviving cancer differ from the full set of individuals with cancer
- Unobserved covariates: In our models without person-fixed effects, there may be unobservables that are correlated with cancer risk and our outcomes of interest

IMPLICATIONS FOR POLICY AND PRACTICE

- Cancer was associated with significant societal costs
- Diagnosing early cancers while the disease is still curable has potential benefits to society and the patient in terms of increased longevity
- However, early detection of cancer offers other potential societal benefits that are often overlooked such as decreased disability and increased employment
- Payers should consider societal value impact in the consideration of coverage and payment determinations

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Disclosures

Study funded by GRAIL, LLC, a subsidiary of Illumina, Inc.* ARK is an employee of GRAIL, LLC, a subsidiary of Illumina, Inc.,* with equity in Illumina, Inc. DCG, DL, and DG all received funding from GRAIL, LLC, a subsidiary of Illumina, Inc.,* to conduct this study. All financial relationships disclosed at abstract submission.

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