

# Using Claims to Study Cancer Survivors

# Objectives

- Characterize the burden of cancer survivorship on patients and the healthcare system.
- Quantify and predict excess risks of:
  - Functional impairment
  - Hospitalization for comorbid disease
  - Cost
  - In survivors versus non-cancer controls

# Importance

- Preliminary data portend high morbidity and cost burden from cancer survivors.
- Current data are insufficient for informing policy and clinical interventions.

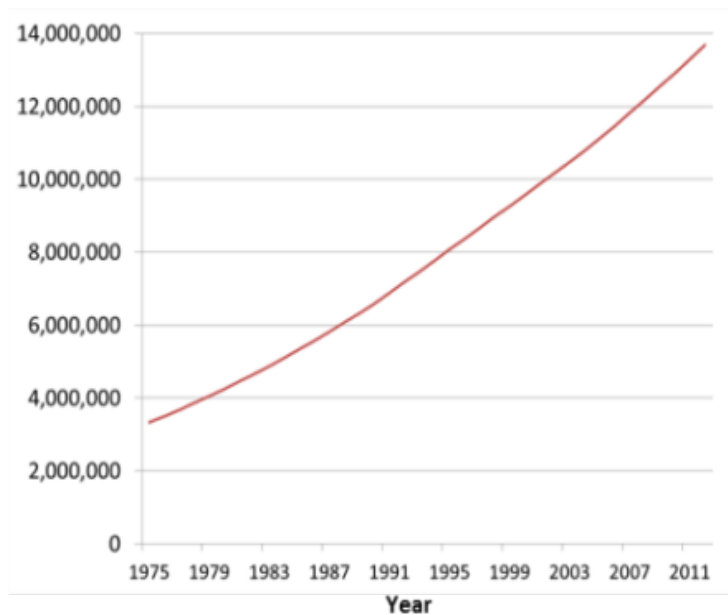
# Importance

- Findings seek to impact 18 million cancer survivors expected by 2022.
- Vulnerable group and priority patient population to study.

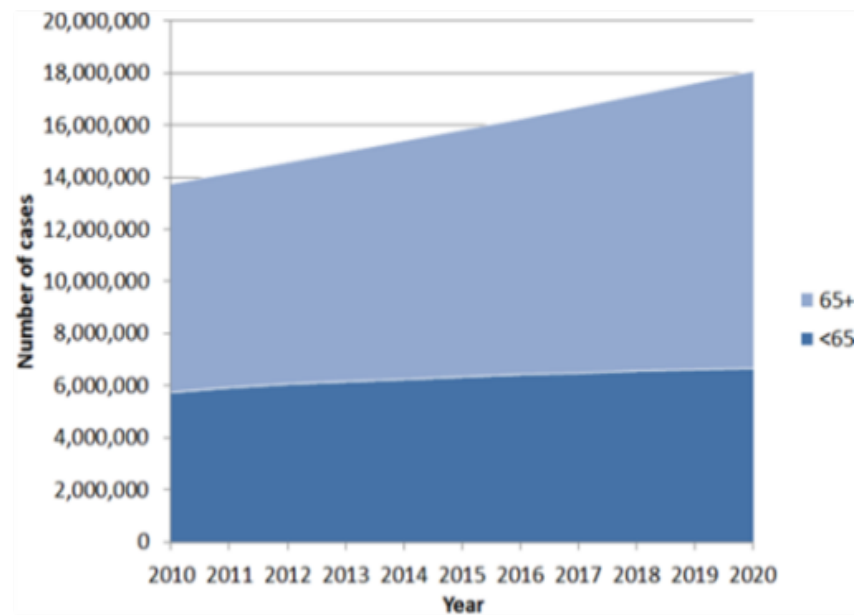
# Background

- The number of cancer survivors is rising.

Historical Rise



Projected Increase



Based on: Mariotto et al. JNCI 2011 103:117 and Parry et al. Cancer Epi Biomarkers Prev 2011 20:1996

# Background

- Cancer survivors exert
  - Disproportionate healthcare costs
  - Decreased economic productivity
- \$4,500 excess per patient per year
- Our pilot data: \$3,500-\$5,000 per survivor per year excluding treatment costs.
- Total: ~\$40 billion excess, 75% hospitalizations

# ASCO has sounded a call...

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A S C O S P E C I A L A R T I C L E

## American Society of Clinical Oncology Statement: Achieving High-Quality Cancer Survivorship Care

*Mary S. McCabe, Smita Bhatia, Kevin C. Oeffinger, Gregory H. Reaman, Courtney Tyme, Dana S. Wollins, and Melissa M. Hudson*

# Obstacles to Research

- Cancer survivors are difficult to study:
  - Heterogeneous cancer diagnoses
  - Heterogeneous treatment histories
  - Non-cancer health characteristics
- Post-treatment trajectory requires longitudinal study
  - Oncologist's insights on history



# “Lost in Transition”

- Non-oncology, usual care
- Survivors understood based on non-oncologic paradigm
  
- Oncologists lack longitudinal feedback
- Prospective strategies to risk-stratify survivors and prevent adverse outcomes

# Current Gaps & Limitations

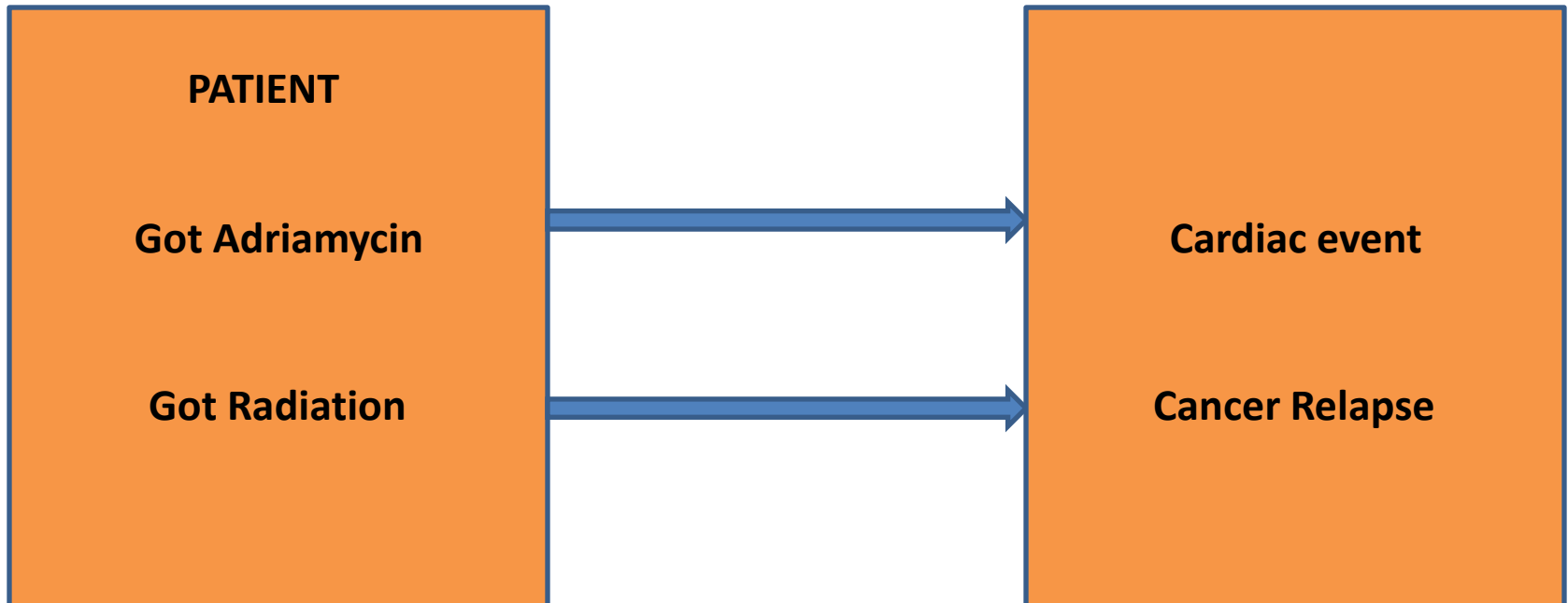
- Limited conceptual approach
- Focuses on *treatment* to predict subsequent adverse outcomes
- Uni-dimensional approaches result in ineffectual risk-prediction models

# An expanded conceptual model...

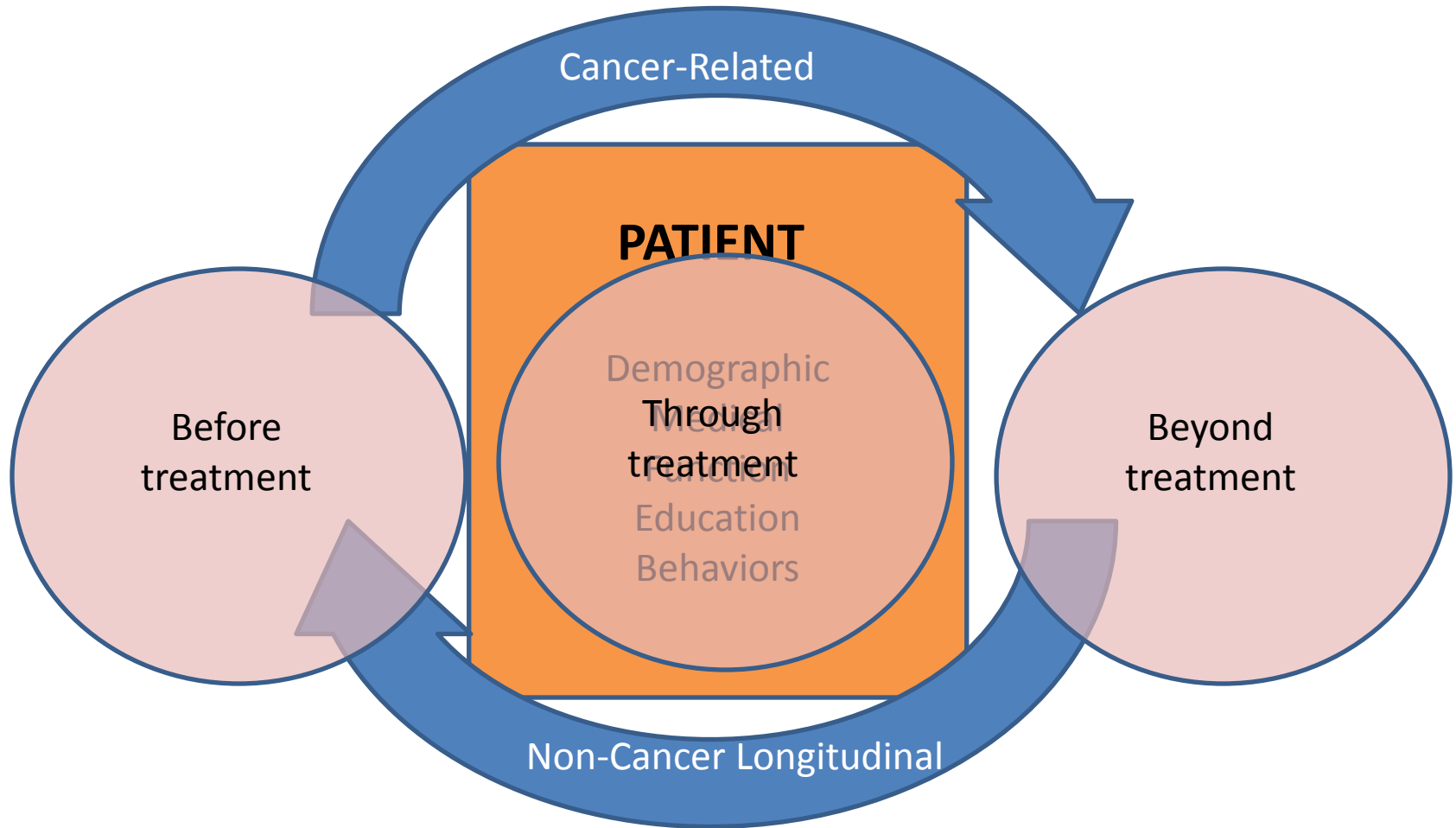


*Hersh et al. J Am Heart Assoc 2013*

# Uni-Dimensional Model...



# Improved model...



# Data source

- Population-based cancer survivor cohort
- Derived using the SEER-Medicare data
- Propensity score matched 1:1 with non-cancer controls.
  
- SEER-Medicare-Health Outcomes Survey (MHOS) linked data?

# Aims: Compare Cancer vs. Controls

*Aim #1: What is the excess risk of hospitalization for commonest, costliest comorbid diagnoses?*

Myocardial infarction, heart failure, stroke, infection

# Aims: Compare Cancer vs. Controls

*Aim #2: What are excess sources of healthcare resource use?*

Total costs, inpatient costs, other measures such as hospital readmission after index, LOS, use of resources such as intensive care and SNF



# Aims: Compare Cancer vs. Controls

*Aim #3: What is the excess risk of functional impairment in cancer survivors, including physical, (cognitive and social function)?*



# Conceptual Issues

- What is a cancer “survivor”?
- What may be the unique value of claims studies in providing insights about survivors?

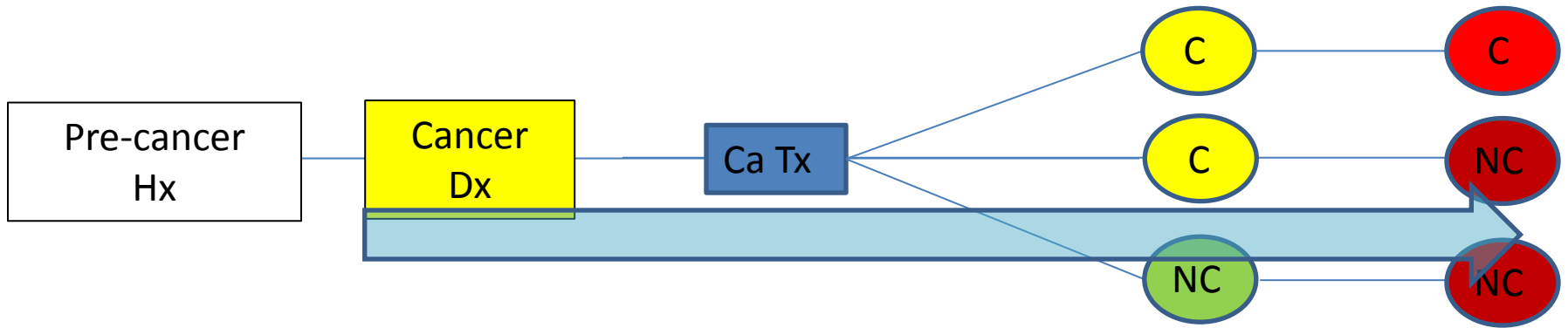
# Conceptual Issues

- What is a cancer “survivor”?
  - Acute: at the time of diagnosis and treatment
  - Extended: immediately after tx completed (usually months)
  - Permanent: after a longer period (usually yrs)

# Conceptual Issues

- What is “survivorship”?
  - “The process of living with, through, and beyond cancer”
  - Survivorship begins at diagnosis
  - Can include recurrence
  - Can include management of cancer as a chronic disease
  - Can include life after cancer

# Survivorship Paradigm

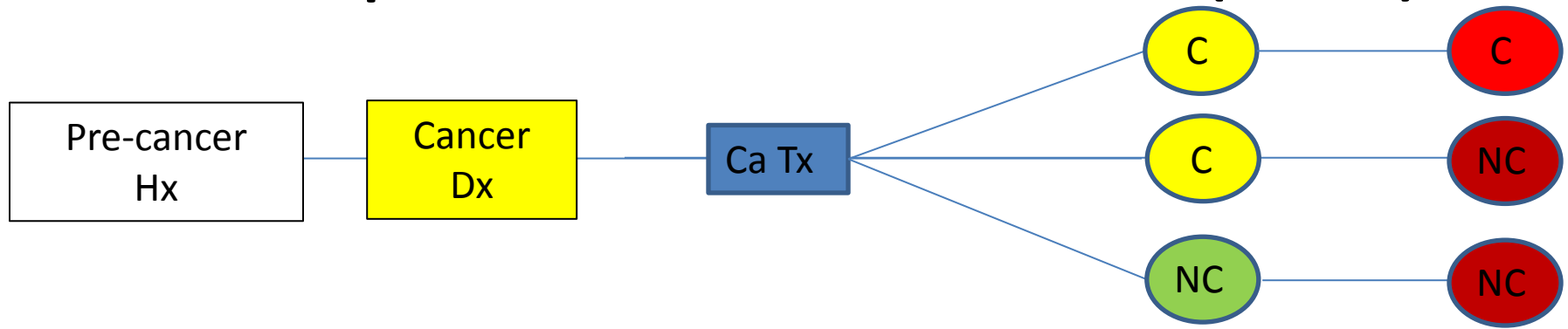


Analytic perspective:



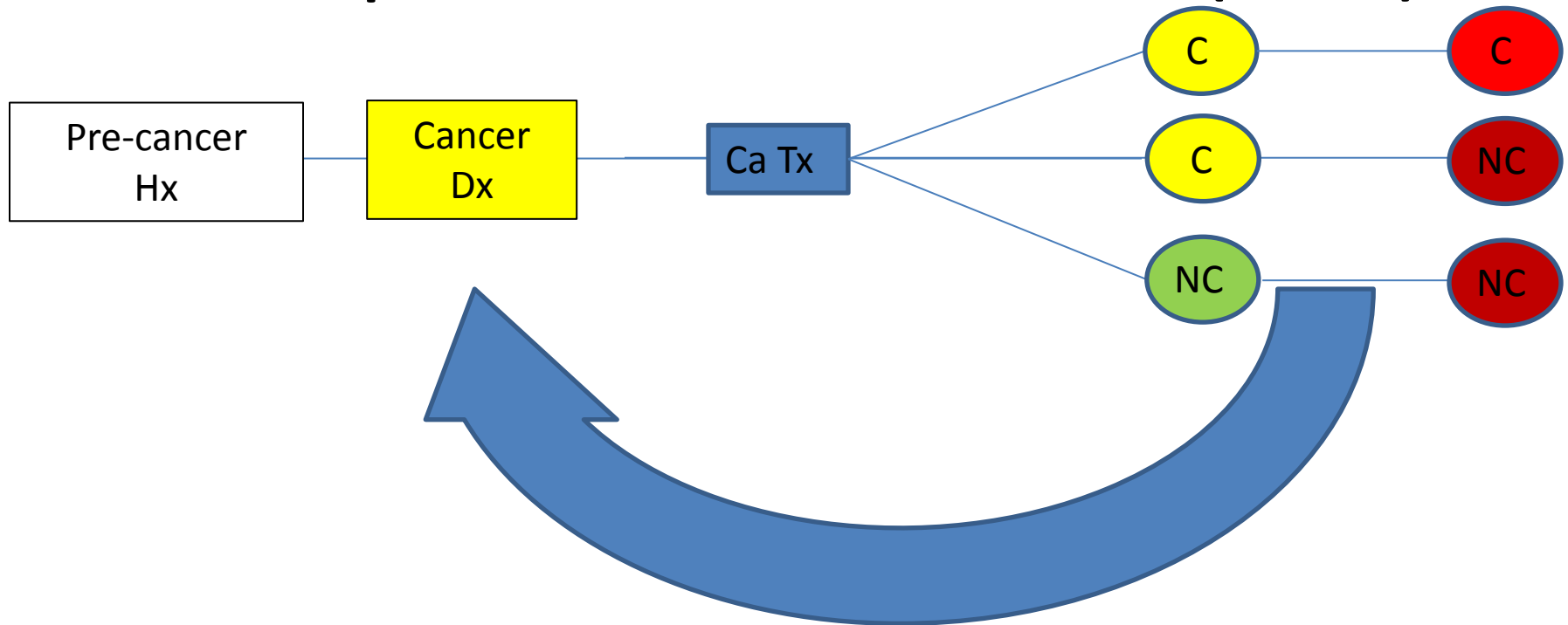
Cancer diagnosis  
A period of follow-up

# Unique value of claims? (S-M)



- Nationally diverse, population-based cohort
- Relatively detailed Cancer Dx, Ca Tx
- Windows: Pre-cancer, Ca Tx, Post-Tx, End of life
- Cost

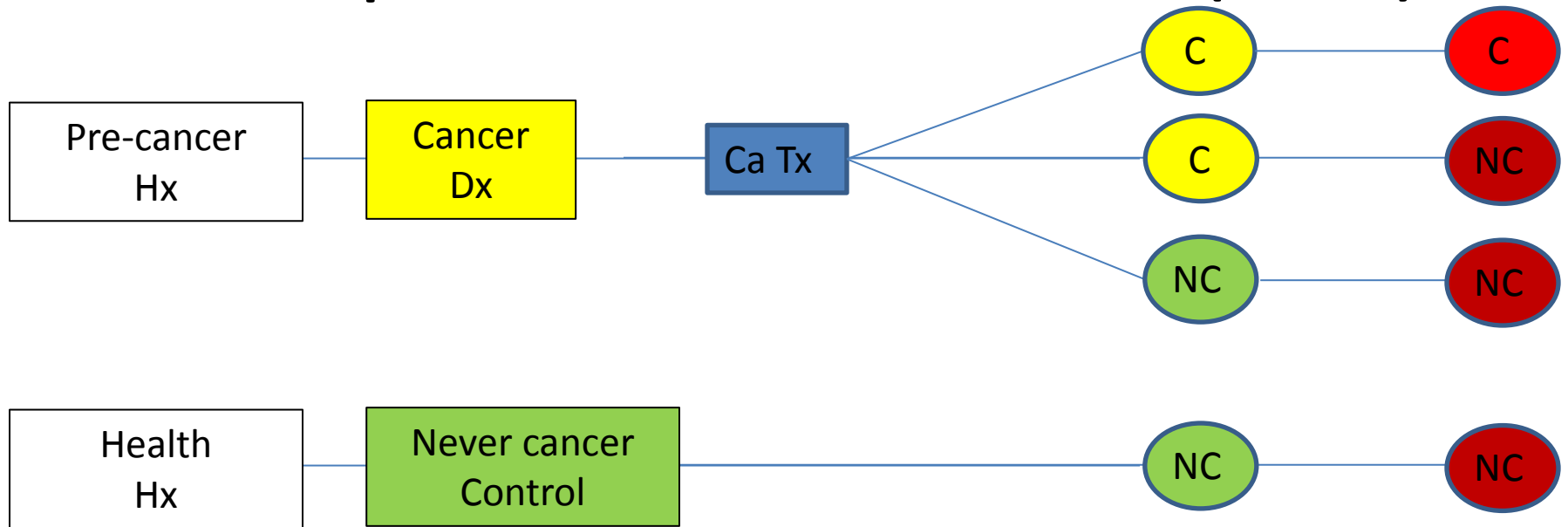
# Unique value of claims? (S-M)



- Can morbidity and/or cost be predicted by variables just before, during, or after cancer tx?
- *Are these preventable outcomes?*



# Unique value of claims? (S-M)



- Are subsequent morbidities and cost(s) in excess of that predicted for never cancer controls?

# Methodological Issues

- Patient selection:
  - cancer survivors
  - matched non-cancer controls
- Measures
  - Functional status
  - Comorbidity
  - Morbidity
  - Cost

# Patient selection

- How to select cancer survivors?

## Obstacles to Research

- Cancer survivors are difficult to study:
  - Heterogeneous cancer diagnoses
  - Heterogeneous treatment histories
  - Non-cancer health characteristics

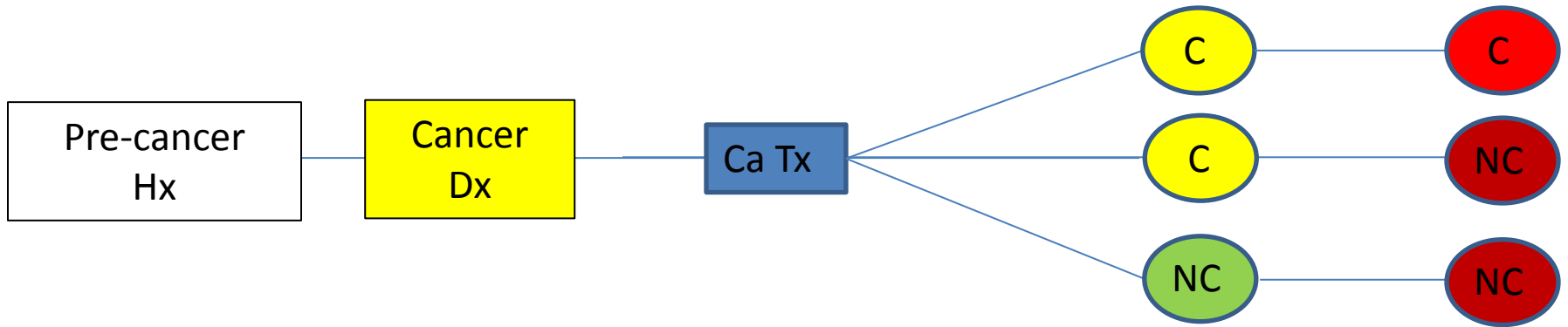
- Include multiple, common cancer diagnoses to reflect heterogeneity

# Patient selection: Pilot group

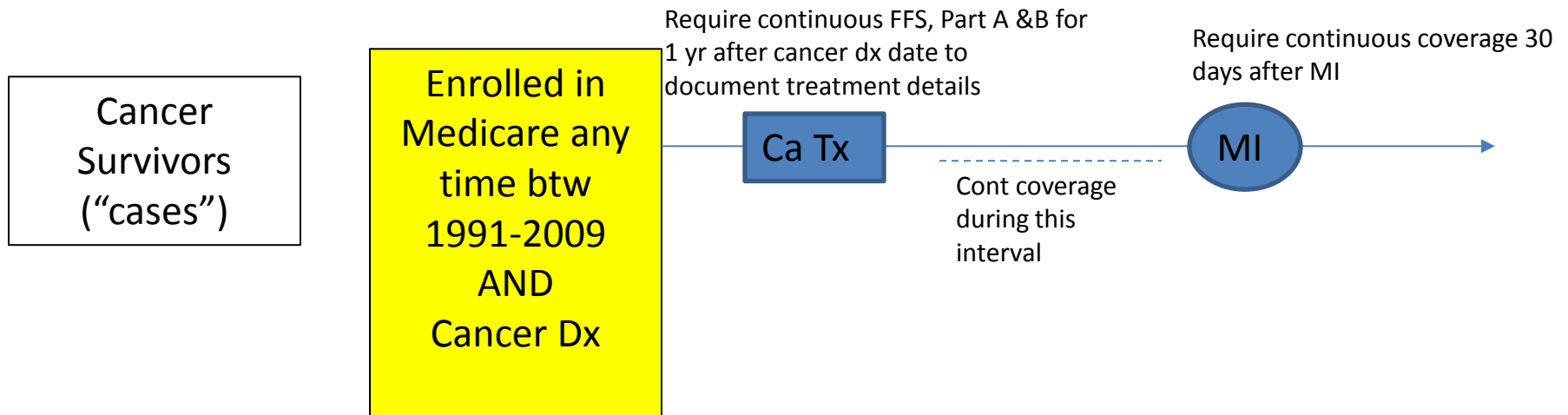
- Breast, prostate, lung included
- Future: lymphoma, others?
- Current selection creates a patient subgroup by cancer diagnosis and matches accordingly.

Vs

- Select all cancer patients and match as one large group



# Survivor selection paradigm



# Sample cancer denominator: Prostate

Diagnosed with prostate cancer, from 1991 to 2009	SEER
Exclude if any second cancer diagnosis	SEER
Exclude if AJCC stage IV at diagnosis	SEER
Age 66+ at diagnosis	SEER
Exclude no pathological confirmation	SEER
Treated cancer: prostatectomy or radiation or hormone therapy within 1 year of diagnosis date	Medicare
Define cancer-free interval after 1 year (primary interval); No chemo, XRT, ?further surgery; ICD diagnosis code for mets	Medicare

# Sample control denominator:

Non-cancer patients	SEER SUMDENOM
Men	SEER SUMDENOM
Medicare enrollment year from 1991 to 2009	Medicare
Reason for entitlement is age (not ESRD, disability)	Medicare
Exclude if patient found in cancer sample	SEER

# Propensity Score Match

- Year of entitlement
- Age
- [Sex]
- Race
- SEER Region
- Dual Eligibility

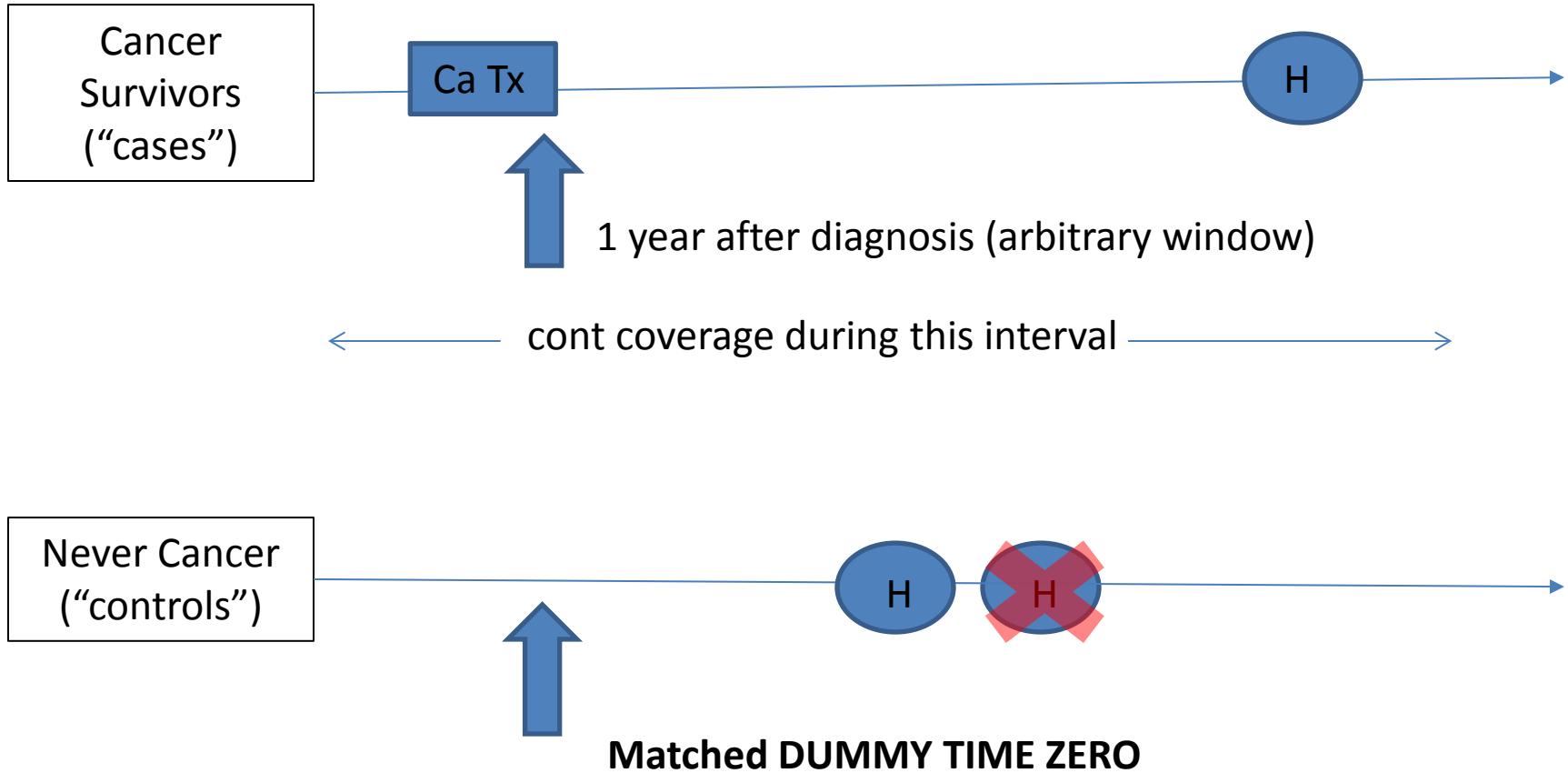


# Propensity Score Match

1. Before Match	Cancer: 111864 Control: 192622
2. After Match	Cancer: 106536 Control: 106536

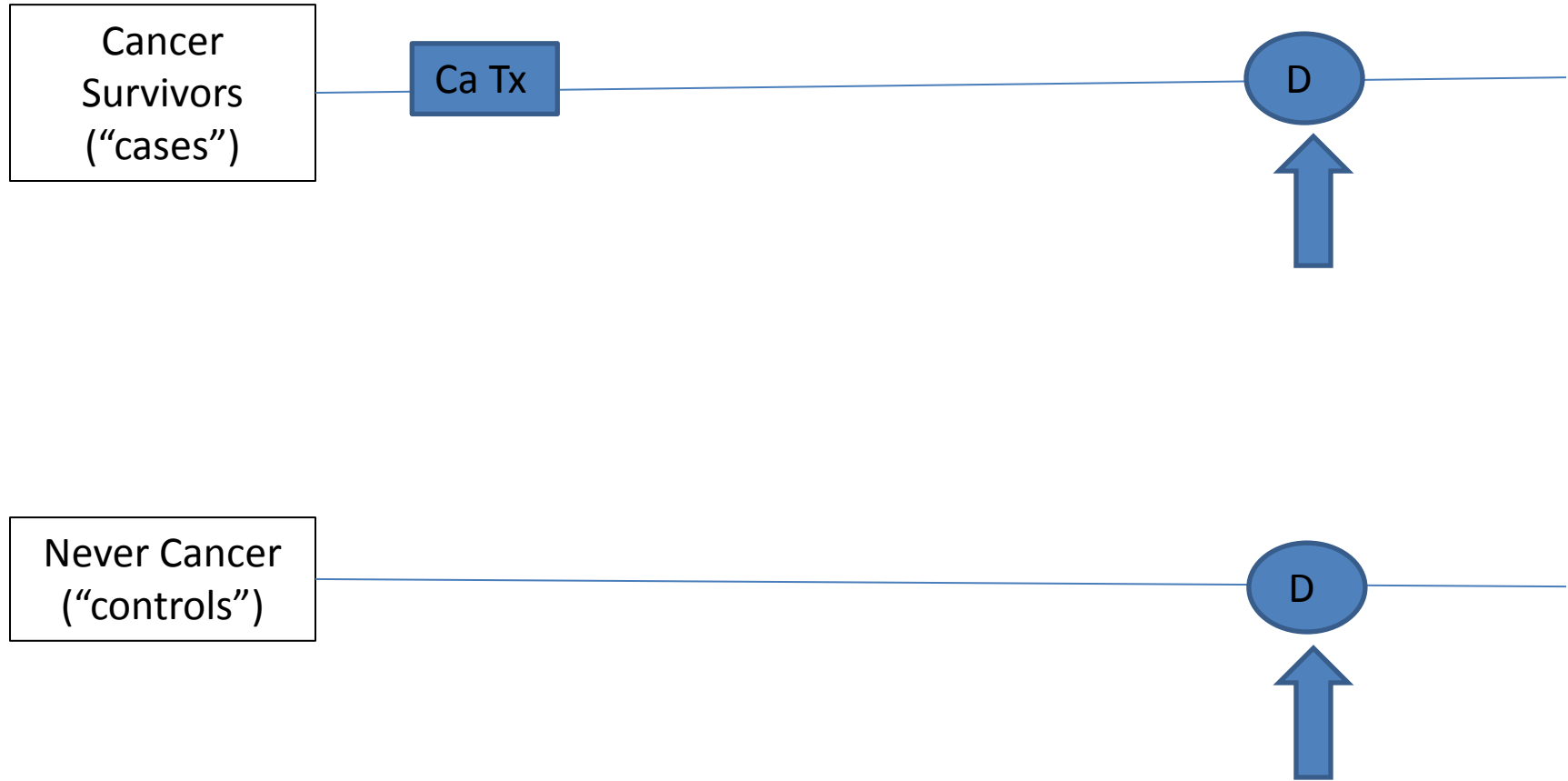
Analytic perspective:  
Cancer diagnosis  
**A period of follow-up**

# How to match index dates?



# A few alternatives

# The last year of life



**Follow backwards for the year before death**

Breast Cancer Survivors (“cases”)

Enrolled in Medicare any time btw 1991-2009 AND Had breast ca in that period

Require continuous FFS, Part A & B for 1 yr after cancer dx date to document treatment details

Ca Tx

± cont coverage during this interval

Require continuous coverage 1 yr prior to MI and 30 days after MI

MI

Identify 1<sup>st</sup> MI admission in claims. Time ZERO

Never Cancer (“controls”)

Enrolled in Medicare any time btw 1991-2009

Require continuous coverage 1 yr prior to MI and 30 days after MI

MI

~~MI~~

± cont coverage during intervals

MI

Identify all MI admissions ever claimed in the patient’s entire claims. All are potential sources of match.

If there was an MI within the last 30 days (or 1 yr? or whatever window seems clinically relevant?) exclude it, because it could represent a “readmission” as opposed to “primary event”.

Create the best match at the time of MI for the Case and Control: Age, Year of Event, Race, and SEER registry (essentially city/state).

\*In this case, the 2<sup>nd</sup> MI was excluded from the match pool because it occurred in close proximity to the initial event.

## Scenario #1: Each Case Contributes 1 Event, Each Control Contributes 1 Event

Breast Cancer Survivors ("cases")

Ca Tx

MI

Identify 1<sup>st</sup> MI admission in claims. Time ZERO for Case 1

Ca Tx

MI

Identify 1<sup>st</sup> MI admission in claims. Time ZERO for Case 2

Never Cancer ("controls")

MI

~~MI~~

MI

Time ZERO for Control 1

Time ZERO for Control 2

Require a minimum period between MI #1 and MI #2, for example, 1 year, or 3 years, or 5 years between events to say that these two MI's, though they come from the same person, can be independently matched to two different Cases' MIs.

**Scenario #2: Each Case Contributes 1 Event, Each Control Contributes Up to Multiple Events**

Breast Cancer Survivors ("cases")

Ca Tx

MI

Time ZERO for CASE 1

MI

Time ZERO for CASE 2

Minimum interval between MI #1 and MI #2, for example, of 1 year, or 3 years, or 5 years would be required here.

Never Cancer ("controls")

MI

~~MI~~

MI

Time ZERO for Control 1

MI

Time ZERO for Control 2

### Scenario #3: Cases Or Controls Can Contribute Multiple Events



Feasibility?

<b>Cancer</b>					
a. Five years for all patients					
	<b>Year 1</b>	<b>Year 2</b>	<b>Year 3</b>	<b>Year 4</b>	<b>Year 5</b>
<b>Total</b>	2702	2544	2491	2421	2424
	4.43	6.83	7.13	0.64	1.42
<b>Inpatient</b>	1842	1874	1888	1874	1905
	0.25	9.95	9.31	8.27	8.54
<b>Percent</b>	68.2%	73.7%	75.8%	77.4%	78.6%

b. Three years, excluding patients who died within 3 years

	<b>Year 1</b>	<b>Year 2</b>	<b>Year 3</b>
<b>Total</b>	19794.7	20386.96	22678.41
<b>Inpatient</b>	14536.9	15150.84	16983.34
<b>Percent</b>	73.4%	74.3%	74.9%

c. Three years, excluding patients who died due to cancer.

	<b>Year 1</b>	<b>Year 2</b>	<b>Year 3</b>
<b>Total</b>	19741.62	20254.26	21939.96
<b>Inpatient</b>	14556.31	15231.06	16879.41
<b>Percent</b>	73.7%	75.2%	76.9%

<b>Control</b>					
a. Five years for all patients					
	<b>Year 1</b>	<b>Year 2</b>	<b>Year 3</b>	<b>Year 4</b>	<b>Year 5</b>
<b>Total</b>	1869	1971	1959	2053	2063
	3.32	0.32	7.15	6.47	6.15
<b>Inpatient</b>	1568	1669	1644	1725	1720
	6.88	4.61	3.97	8.26	7.26
<b>Percent</b>	83.9%	84.7%	83.9%	84.0%	83.4%

b. Three years, excluding patients who died within 3 years

	<b>Year 1</b>	<b>Year 2</b>	<b>Year 3</b>
<b>Total</b>	16103.41	17098.71	18407.19
<b>Inpatient</b>	13338.26	14261.95	15329.33
<b>Percent</b>	82.8%	83.4%	83.3%

		Breast cancer			Prostate cancer			Lung cancer			
		N(PS)	Cancer/control		N(PS)	Cancer/control		N(PS)	Cancer/control		
<b>Any readmission after MI</b>											
Matched with age, race, state	110352	22.00%	22.70%	200748	21.80%	22.50%	44616	27.00%	24.90%		
		(248/1128)	(137/603)		(710/3261)	(359/1595)		(151/560)	(75/301)		
Matched with age, race, state, enrol_year, buyin**	110352	22.00%	21.60%	197452	21.80%	22.10%	44336	27.00%	21.50%		
		(248/1128)	(221/1021)		(695/3183)	(537/2426)		(150/556)	(107/497)		

# Conclusions

- Cancer survivors are a impactful patient population, as they are growing in number and healthcare resource utilization.
- Little studied.
- Claims data may provide unique insights on this patient group.
- Comparing an observational cohort of survivors with matched controls is feasible.

