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Cancer Epidemiology Primer

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What is Cancer Epidemiology?

Epidemiology is the study of the distribution (who, where, and when) and potential causes of specific conditions or events in specified populations

- Cancer epidemiology is a relatively new science, which has matured only in the last half of the 20th century
  - It has already contributed greatly to the understanding of the causes of different types of cancers and evaluating novel treatment options
  - Advances in biology are now providing new tools for epidemiological investigations into the occurrence and distribution of cancer in our population
  - The incorporation of biological markers and the development of genetic epidemiology are just the beginning of the multidisciplinary approach to better understanding these diseases

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The Goals of Cancer Epidemiology

- Cancer epidemiology focuses on understanding cancer within populations to improve detection and treatment, and eventually prevent cancer

Goals of Epidemiology

Tomorrow

Identify risk factors for cancer to create preventative measures

Today

Understand how cancers occur, are distributed across populations, and transform over the course of disease

- Detect cancer early with diagnostics
- Develop more effective treatments
- Incorporate biological markers

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Cancer Epidemiology's Applications

- Cancer epidemiology is generated and forecasted to provide insights and perspectives for different purposes:
  - General size and scale of cancer patients for **public health** purposes
  - **Clinical assessments** focusing on prevention, diagnosis, prognosis, and treatment of disease
  - **Economic issues** focused on resources and costs of cancer, including patient behavior
  - **Genetic factors** and their interplay with environmental factors in the development of cancers
  - Assessment of **cancer heterogeneity** and other pathologic factors
  - **Strategic evaluations** of the current and future cancer market size, accounting for potential changes in populations, treatments, and patient outcomes

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The Foundation of Cancer Epidemiology

- The four main epidemiology concepts are incidence, mortality, survival, and prevalence

Incidence
The number of people diagnosed with a disease
in a given year

Prevalence
*The number (or percent) of people within a population who were previously diagnosed with the disease and are alive on a **particular date***

Mortality
*The death rate, or the number of deaths, in a given population that occur **within one year***

Survival
*Percent of people surviving from the time of diagnosis for a **specified number of years** – 1, 3, 5, 10 years*

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Understanding Cancer Incidence

- Let's consider an example population

= 10,000 women   = 10,000 men

and

Population: 100,000 people

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Crude Incidence

- Crude incidence gives the rate of disease, in a given population, at a given time

Crude incidence is **15,000 per 100,000** or a crude incidence rate of **0.15**

Useful for: *estimating an overall number of people with the disease*

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Age-Specific Incidence

- Age-specific incidence describes the incidence in specific age groups

Crude incidence is **15,000 per 100,000** or a crude incidence rate of **0.15**

0-19	20 to 49	50 to 64	65 to 79	80+
Incidence Rate: **0.00**	Incidence Rate: **0.10**	Incidence Rate: **0.25**	Incidence Rate: **0.35**	Incidence Rate: **0.50**

Useful for: *forecasting incidence for each age group and/or gender, accounting for the impact of changes in both number of cases and population*

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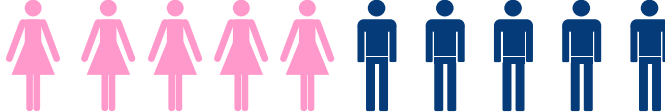
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Mortality

- Mortality describes the death rate, or the number of deaths, in a population for a specific year
  - These rates are derived from death certificates collected by governments

Year-end December 31, 2025

People with the disease in 2025

People who died during 2025

Mortality for 2025 is **35,000 per 100,000** or a mortality rate of **0.35**

Caveat*: Reported mortality is independent of reported survival due to different data sources*

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Observed Cancer Survival

- Observed survival is the proportion of patients who are alive each successive year regardless of cause of death

A 5-year observed survival rate of 80%

Crude (observed) Rate: *excludes patients with death from* <u>any cause</u>

EXCLUDES

John who died of cancer

AND

Jane who had cancer, but died of a heart attack

Caveat*: Reported survival is independent of reported mortality due to different data sources*

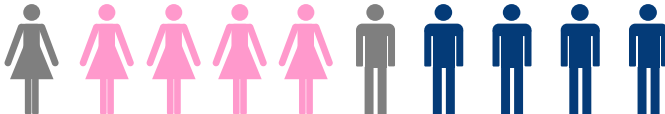Cancer Epidemiology Primer • Epiphany Partners Inc.

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Relative Cancer Survival

- Relative cancer survival is the proportion of patients who are alive each successive year, excluding only patients who died of cancer

A 5-year observed survival rate of 80% converts to a 5-year relative survival rate of 90%

Relative Rate: *only excludes deaths from cancer, using actuarial analysis to "add back" those patients who didn't die of cancer*

EXCLUDES

BUT NOT

John who died of cancer

Jane who had cancer, but died of a heart attack

Caveat: Relative survival is always higher than observed survival given the "add back" of patients

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Using Survival Data

- When considering survival statistics, its always best to use "observed" or "crude" survival
  - "Relative" survival is always higher than "observed" survival and is useful when determining overall risk of cancer-related death, but should **NEVER** be used to calculate epidemiology statistics

Cancer	Observed Survival			Relative Survival			Differential
	1-year	5-year	10-year	1-year	5-year	10-year	5-year
All Sites	82.58%	64.75%	53.20%	84.52%	72.90%	68.99%	8.16%
Gastric	61.54%	31.80%	23.61%	63.15%	36.50%	32.04%	4.70%
Lung	55.30%	26.47%	15.70%	56.91%	30.75%	21.89%	4.28%
Pancreas	40.46%	12.40%	8.46%	41.54%	13.93%	10.81%	1.53%
Prostate	96.68%	84.92%	71.23%	99.40%	98.48%	98.48%	13.55%

Source: SEER*Stat 8.4.3, 8 Registries, NCI, 2024.

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Cancer Survival: Any Progress?

- Overall 10-year cancer survival has increased by almost 21% since 1990

10-year Relative Survival, 1990 vs. 2020
■ 1990 ■ 2020

U.S. 10-Year Relative Period Survival, All Sites, 1990-2020

20.9%

AAGR: 1.21% per year

10-year Relative Survival, 1990 vs. 2020
■ 1990 ■ 2020

Source: SEER*Stat 8.3.4, NCI, 2024; Period Relative Survival Analysis by Epiphany Partners Inc.

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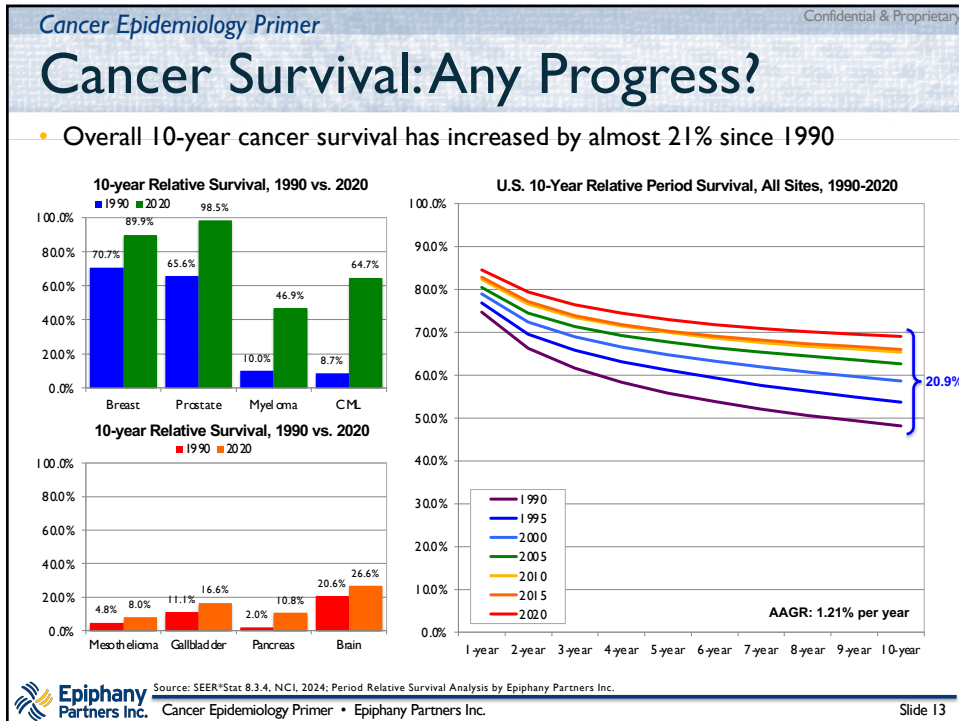**Cancer Epidemiology Primer**

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Advanced Cancer Survival

- Distant cancer survival has increased by almost 20% since 1990, with the majority of improvement seen over the past decade from treatment advances

10-year Relative Survival, Distant, 1990 vs. 2020
■ 1990 ■ 2020

U.S. 10-Year Relative Period Survival, All Sites, Distant, 1990-2020

AAGR: 3.63% per year

19.6%

10-year Relative Survival, Distant, 1990 vs. 2020
■ 1990 ■ 2020

Source: SEER*Stat 8.3.4, NCI, 2024; Period Relative Survival Analysis for Distant Stage by Epiphany Partners Inc.

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Point Prevalence

- Point prevalence describes the number of people with a diagnosis who are alive on a certain date
  - *Most prevalence statistics use "point prevalence"*

People with disease on January 1, 2025

PLUS Incident for 2025   LESS People who died during 2025

Point Prevalence on December 31, 2025

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Standard 5-Year Prevalence

- Standard prevalence includes anyone who has previously had a diagnosis and is still alive **within** a set time period

Useful for: determining the "burden of disease" focusing on patients who may be available for treatment

Year-end December 31, 2025

2025 **5-Year** Standard Prevalence

Includes: NOT   NOT

Mark who is still undergoing treatment and was diagnosed 2 years ago

Mary who was diagnosed 7 years ago (outside timeframe)

Mike who was diagnosed 11 years ago (outside timeframe)

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Standard 10-Year Prevalence

- Standard prevalence includes anyone who has previously had a diagnosis and is still alive **within** a set time period

Useful for: determining the "burden of disease" focusing on patients who may be available for treatment

Year-end December 31, 2025

2025 **10-Year** Standard Prevalence

Includes: Mark who is still undergoing treatment and was diagnosed 2 years ago AND Mary who was diagnosed 7 years ago NOT Mike who was diagnosed 11 years ago (outside timeframe)

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Prevalence by Stage

- Prevalence by Stage describes the total number of people alive at a given point in time who are in a particular stage of their disease

Prevalence by Stage on December 31, 2025

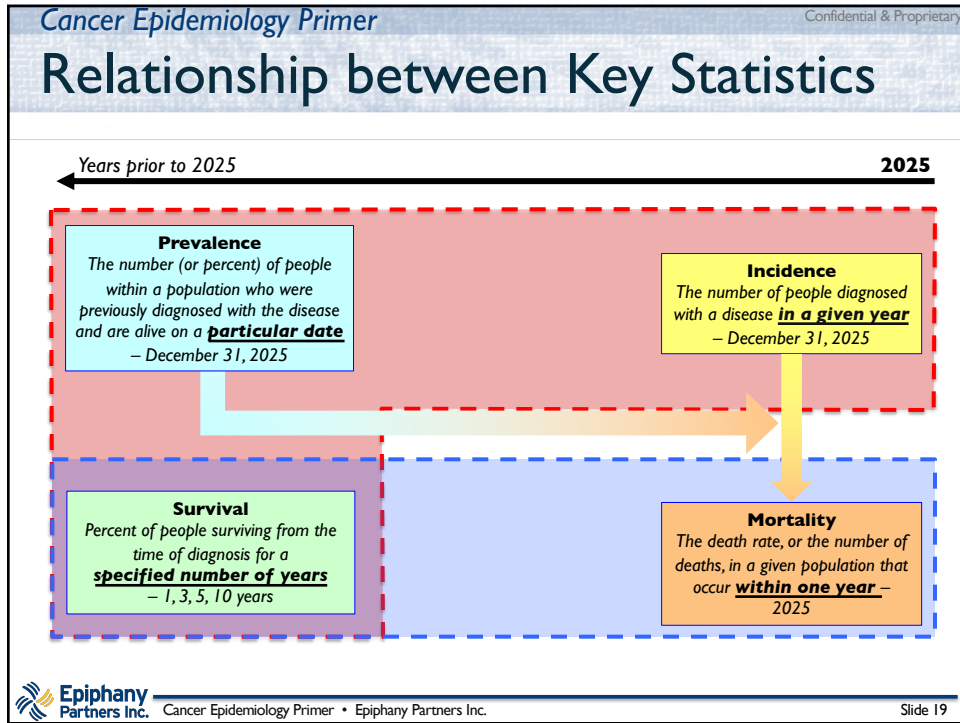Stage I — 8.3%
Stage II — 16.7%
Stage III — 25.0%
Stage IV — 50.0%

KEY METHODOLOGY ISSUE: In order to properly "re-stage" patients, it is important to determine both relapse and progression from early- to late-stage disease over the specified time frame (e.g., 5 years)

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Relationship between Key Statistics

Years prior to 2025   **2025**

Prevalence
*The number (or percent) of people within a population who were previously diagnosed with the disease and are alive on a **particular date** – December 31, 2025*

Incidence
*The number of people diagnosed with a disease **in a given year** – December 31, 2025*

Survival
*Percent of people surviving from the time of diagnosis for a **specified number of years** – 1, 3, 5, 10 years*

Mortality
*The death rate, or the number of deaths, in a given population that occur **within one year** – 2025*

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