Estimating Costs

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National Cancer Institute

Aggregate Costs

- Aggregate estimates **useful for policy and program planning**
  - Current burden
  - Future trends in incidence, survival, and costs

- Evaluate specific services or components of care
  - Hospital
  - Chemotherapy
- Evaluate care trajectory
  - Diagnosis
  - End-of-life

Longitudinal Costs

- Longitudinal per-person estimates **useful for cost-effectiveness analyses**
  - Prevention
  - Early detection
  - Treatment
- Estimates reflect current patterns of care, not idealized care

- Stage of disease at diagnosis-specific estimates
- Treatment-specific estimates
- Provider-specific estimates

Intervention Costs

- Clinical Intervention

- Public Health Intervention

- Sources of Intervention Cost Data

  – Trials

  – Program Cost Accounting

  – Micro-costing Models

Conceptual and Methodological Issues

- In the estimation of costs associated with a disease or health condition

Challenges

- Clinically appropriate definition of episode of care may vary by

  – disease or condition

  – severity of disease

  – nature of disease control intervention (e.g. prevention, screening, treatment)

- Flow of cost may not be constant within episodes of care

- Assignment of mutually exclusive and exhaustive costs to disease entities is not obvious

- Medical technology, practice patterns and costs are dynamic, but health cost data is either cross-sectional or longitudinal over a relatively short period of observation

Alternative definitions of episodes of care

- Prevalence
  - Cross-section of individuals with disease
  - Cost per patient
  - Aggregate costs
- Incidence
  - Longitudinal pattern following diagnosis
  - Cost per period or cost per patient
  - Cumulative: from diagnosis to year x (e.g. 5 years)
- Modeled Phase of Care
  - Costs in initial, continuing, and end-of-life phases applied to survival probabilities
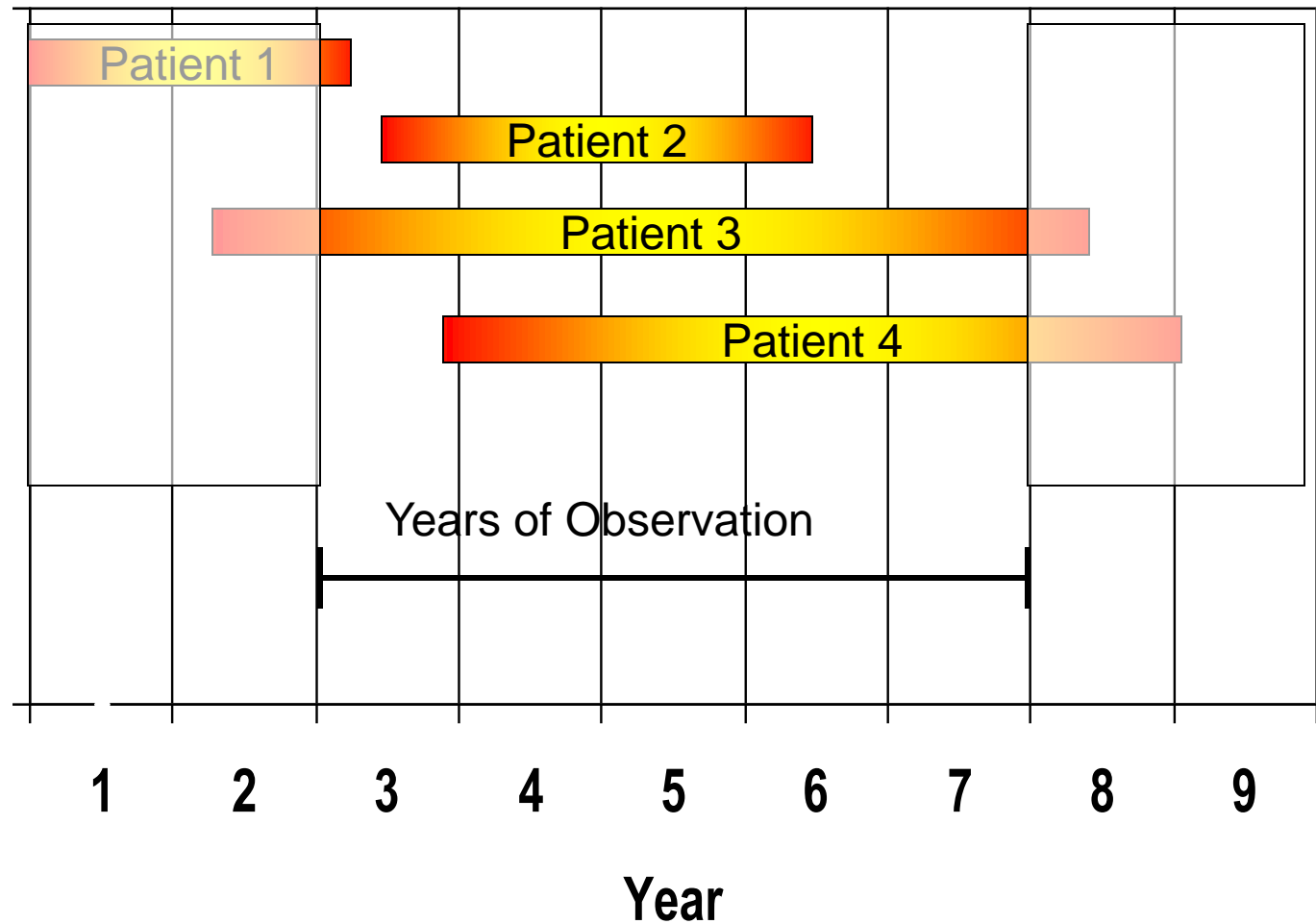 - Long-term estimates from diagnosis to death

Breast Cancer Costs by Month From Diagnosis
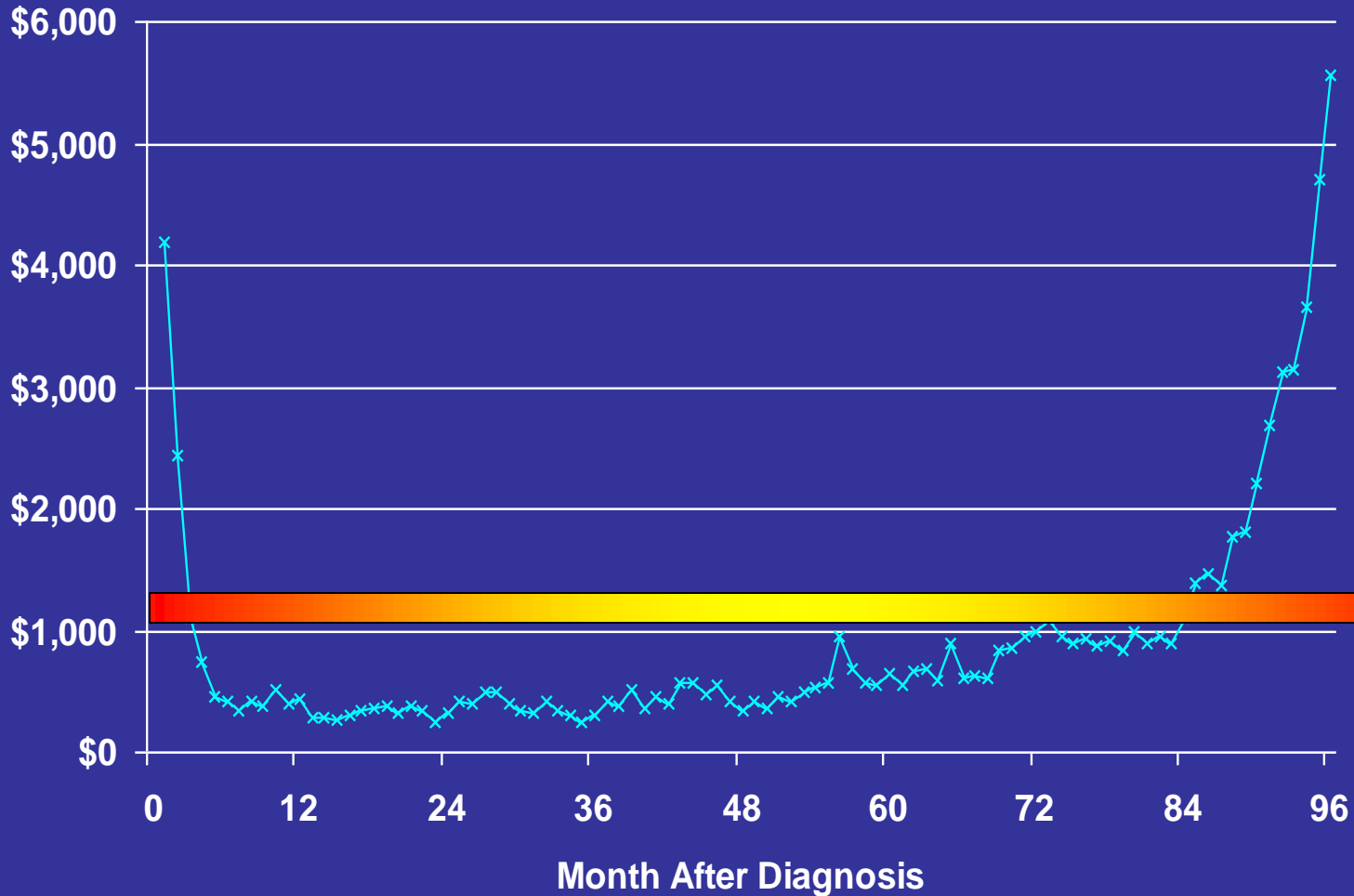
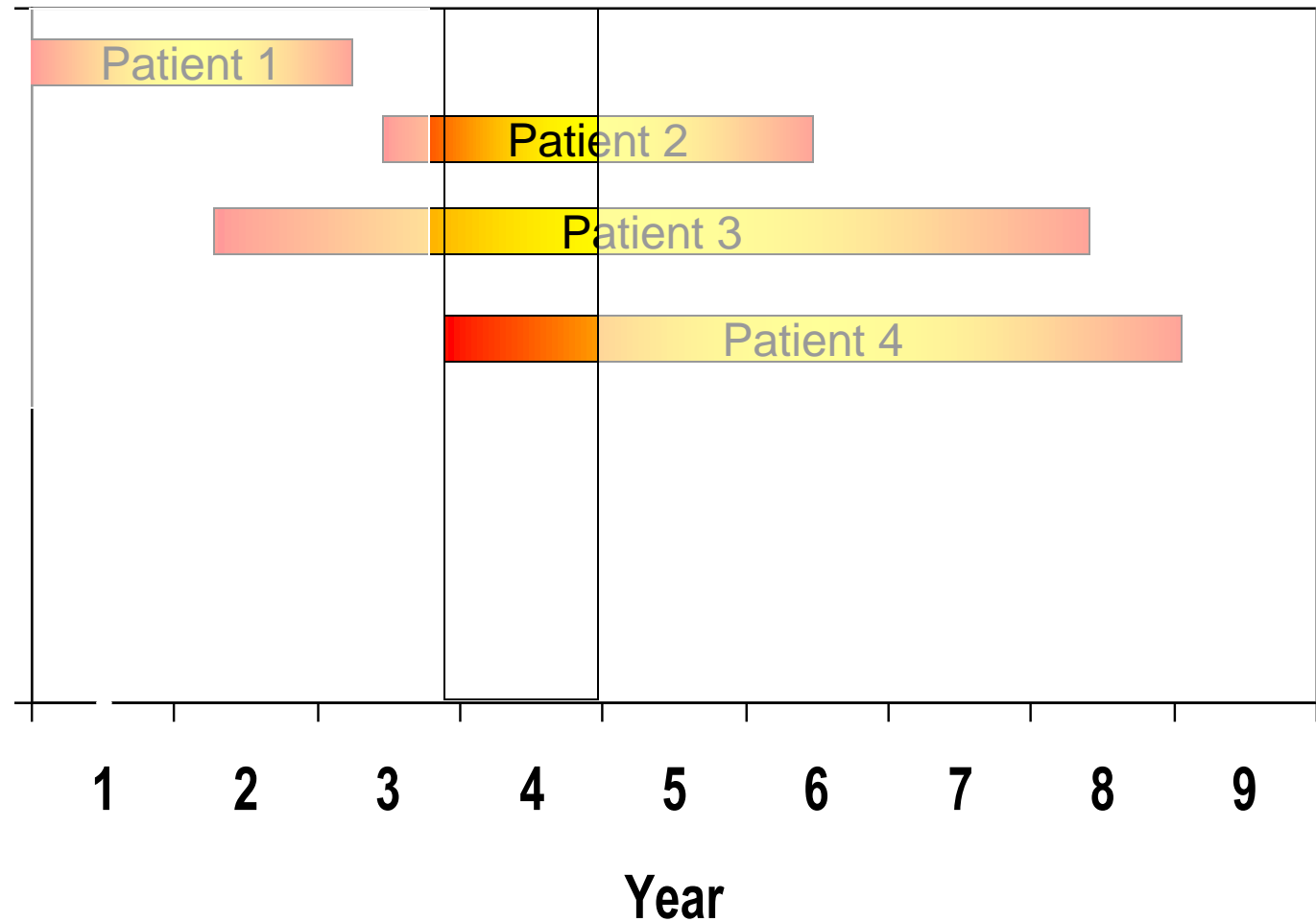
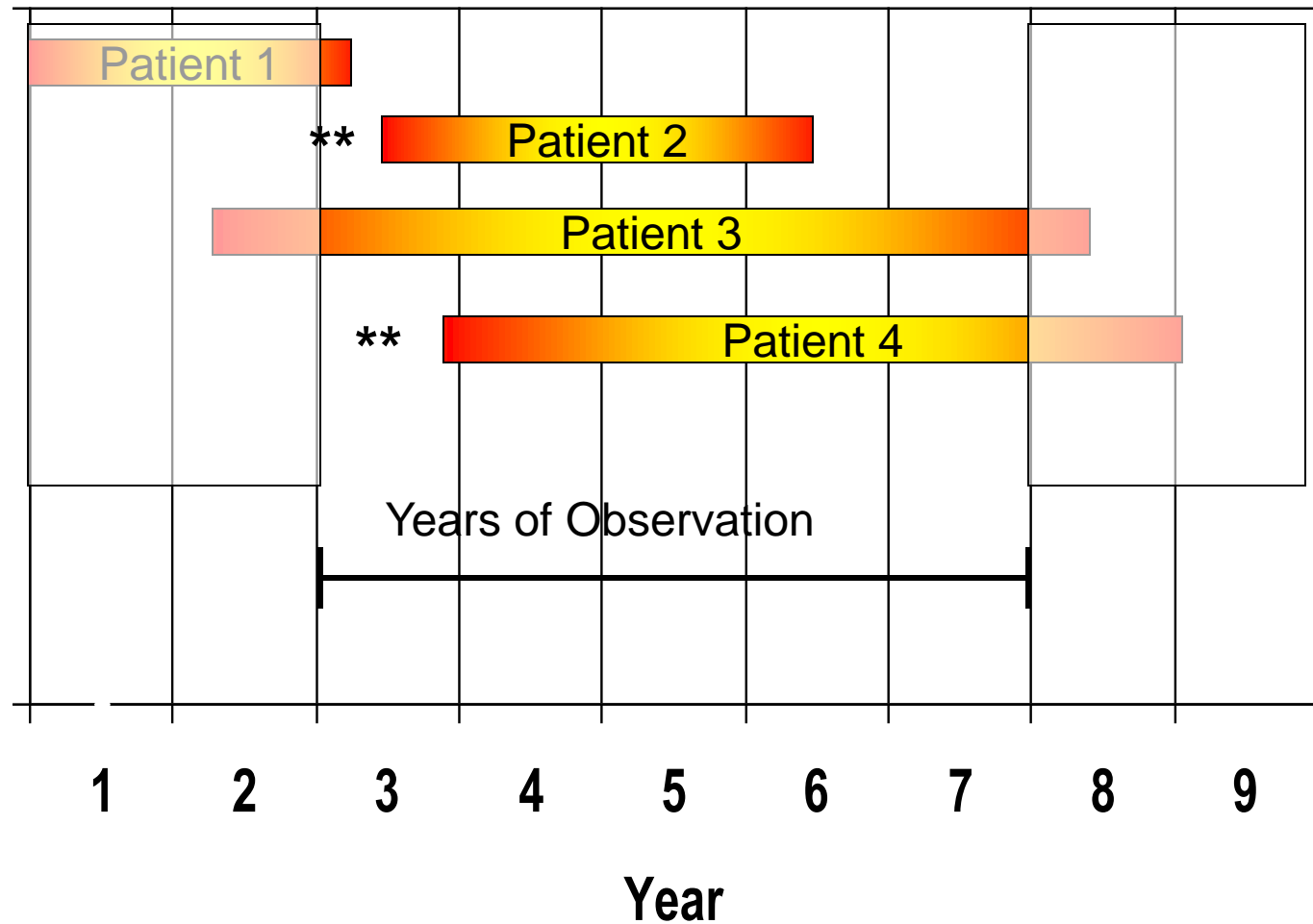Source: Brown et al., Medical Care 2002; 40:IV-104 - IV-117
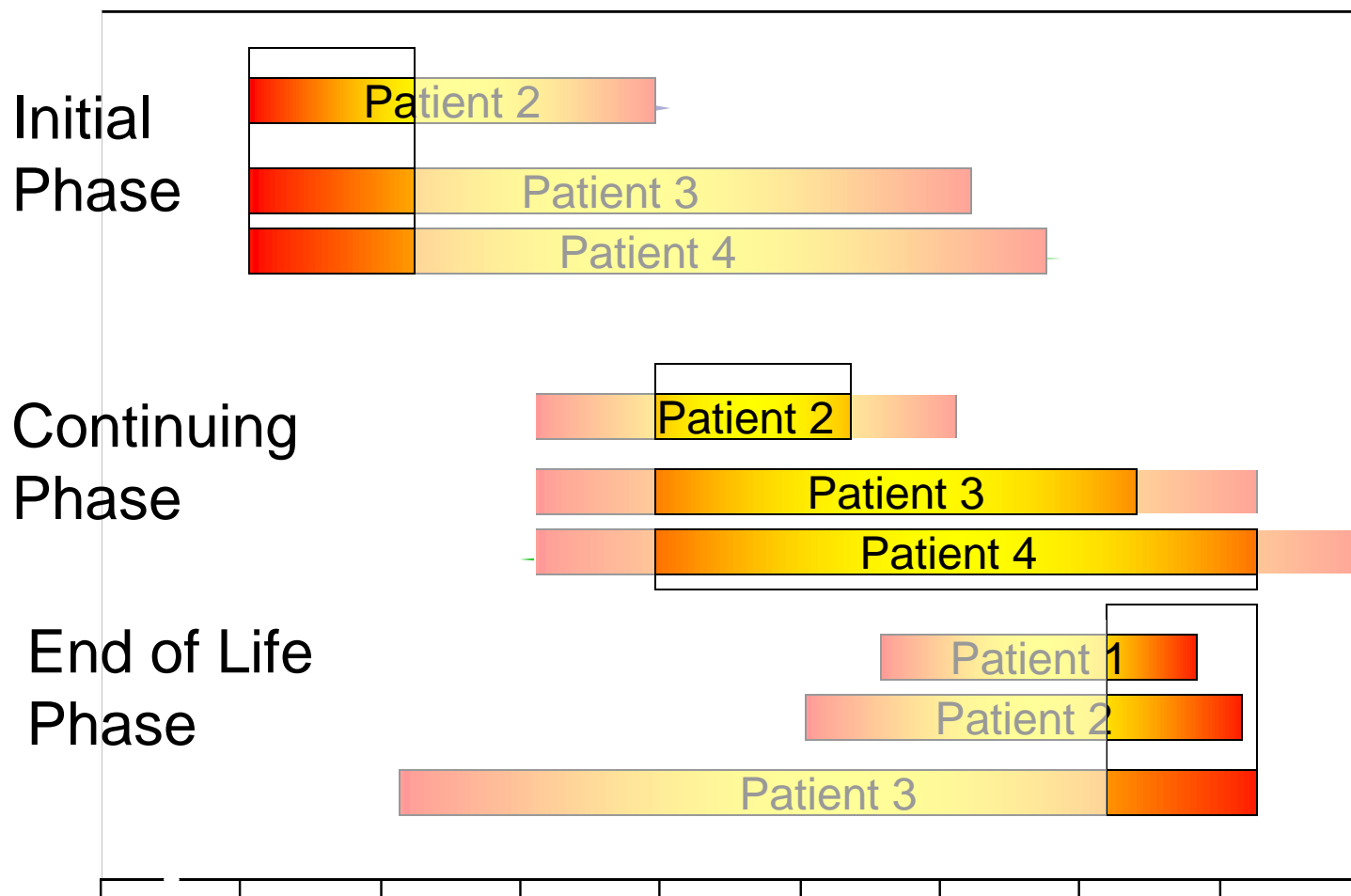
Incidence Costs for Patients 2 and 4

Phase of Care Specific Costs

Incidence Cohort and Phase of Care Costs: Observed and Derived Measures

- Directly observed estimates can be compared:
  - Incidence: cost in year 1 since diagnosis
  - Phase of care: cost in initial phase (different from year 1 cost)
  - Cumulative cost to year X (from cohort)

- Derived estimates can be compared, using survival probabilities
  - Phase of care: cost in year 1 since diagnosis (from phase)
  - Cumulative costs to year X (from both)
  - "Life-time", cumulative cost from diagnosis to death (from both)

Derived Cumulative Cost Estimates

- Incidence cost: Kaplan Meier Sample Average (KMSA)
  - Calculate average cost per month among those still alive at the end of each month
  - Multiply each monthly average by the (crude) survival probability
  - Sum across months (could also apply discounting)
- Phase of Care cost:
  - Analogous to the above, but apply appropriate survival probabilities to estimates from initial, continuing and last year of life phases of care
- When sufficient data is available to apply both methods, the incidence-KMSA and phase-specific approach result in similar estimates of cumulative cost (Etzioni et al. Health Econ 10(3):245-56

Prevalence Cost Estimates

- Observed

OR

- Derived using phase of care approach
  - Estimate phase specific prevalence during observation period using assumptions about incidence and survival (method developed by Angela Mariotto and colleagues)
  - Apply phase specific cost estimates
  - Used to project costs under varying assumptions

Pros and Cons: Prevalence

- – Relative easy to implement from many existing data sources
- – Useful for broad descriptive purposes
- BUT
  - – Composition ("vintage") of prevalence/incidence cases may vary between data sources or be ill-defined
  - – Influenced by cost trajectory (e.g., u-shape vs. -- -shape)
  - – Not very useful for analytical/evaluative purposes, e.g. cost-effectiveness analysis

Pros and Cons: Incidence

- – Useful for analytical/evaluative purposes
- – Can be used to construct prevalence estimates
- BUT
  - – High requirement for data:
    - Date of diagnosis
    - Survival
    - Comprehensive longitudinal costs
  - – Hazard of death differs between disease cases and controls
  - – Need large N if death events rare

Pros and Cons: Phase of Care

- – Efficient use of data
- – Flow of cost is homogeneous within phase
- – Can be used to estimate prevalence cost
- BUT
  - – High requirement for data
  - – Depends on modeling assumptions
  - – May not incorporate changes in practice patterns
  - – Applicable to cancer, but is it feasible/relevant for other diseases?

Attributable Disease Specific Costs

- Case control approach
  - Match with similar control patients without the case condition (e.g., age, gender, region)
  - Match with same patients prior to diagnosis (pre-post)
- "Cost Driver" approach
- Clinical scenario/algorithm approach (e.g. POHEM)
- Macro-accounting approaches (e.g. regression models)

Colorectal Cancer

- Colorectal cancer is common cancer in the U.S.

- Effective primary, secondary, and tertiary prevention

- Incidence increases with age, and prevalence highest in population aged 65+

- Based on population trends in aging, prevalence expected to increase rapidly through 2020

- **What is burden of colorectal cancer care?**
  - **Direct medical costs**
  - **Patient time costs**
  - **Future burden**

Direct Medical Costs of Colorectal Cancer

- Cases and controls aged 65+ from SEER-Medicare

- All claims files

- Observation period 1998-2002

- Non-HMO (fee for service)

- Continuous months of Part A (inpatient) and Part B (outpatient)

- Non-cancer controls frequency matched to cases on

  - 5-year age group

  - gender

  - geographic region

  - phase of care (initial, continuing, last year)

Source: Yabroff et al., Projections of the costs associated with colorectal cancer care
in the United States, 2000-2020. Health Economics 2008

Methods

- Costs estimated for cases and controls by phase of care
  - Initial phase
  - Last year phase
  - Continuing phase
- Used Medicare payments to reflect costs
- Separate estimates for Part A and Part B
- Adjusted for inflation
- Adjusted for geographic variability
- Added estimates of deductibles and coinsurance
- Net costs – difference in costs between cases and controls

Number of Colorectal Cancer Cases and Controls during Observation Period, 1998-2002

	Cases	Controls
Initial Phase	27,769	138,845
Continuing Phase	81,824	245,472
Last year of life Phase	40,400	135,436

Net Costs of Care in Colorectal Cancer Patients

	Men	Women
Initial phase	$35,976	$36,576
Continuing phase	$2,532	$1,644
Last year of life phase – cancer death	$51,012	$51,492
Last year of life phase – non-cancer death	$9,360	$9,552

Patient Time Costs

- Patient time spent seeking medical care
- Recommended for cost effectiveness analyses
- Data not routinely collected
- Prior studies show time costs substantial, but
  - Small convenience samples
  - Only specific aspects of care (e.g., biopsy), and not comprehensive
  - Not compared to "regular" or "routine" care

- **Goal: systematically estimate time costs for cancer patients compared to similar individuals without cancer**

Source: Yabroff, et al., Medical Care 2005; 43:640-648.

Methods Overview

- Use SEER-Medicare to estimate service counts by category
  - Hospitalizations
  - Physician visits
  - Ambulatory surgery
  - Emergency room visits
  - Chemotherapy
  - Radiation therapy
- Phase of Care (initial, continuing, last year of life)
- National estimates of time for specific services by category, transportation to care, and waiting time
- Use hourly wage rate estimate for value of time

Methods – Sources of Time Estimates

Service Category	Data sources
Physician office visits	NHIS 1992; 2001 NAMCS
ER visits	1992 NHIS; 1997 NHAMCS - ED
Chemotherapy	Calculated infusion duration; NHIS 1992
Radiation therapy	Estimated; NHIS 1992
Hospitalizations	LOS; NHIS 1992
Out-patient surgery	1992 NHIS; 2001 MCBS

All time estimates include travel time, waiting time and time spent receiving care and are stratified by MSA/non-MSA

Service Counts by Category of Service Initial Phase of Care

	CRC Cases Estimate (95% CI)	Controls Estimate (95% CI)
MD visits	11.48 (11.30, 11.67)	5.93 (5.86, 6.00)
ER visits	0.45 (0.42, 0.48)	0.23 (0.22, 0.24)
Chemotherapy	1.37 (1.26, 1.48)	0.02 (0.01, 0.02)
Radiation therapy	1.30 (1.20, 1.40)	0.03 (0.03, 0.04)
Hospitalization days	**17.96 (17.45, 18.46)**	**1.89 (1.82, 1.97)**
Ambulatory surgery	1.17 (1.14, 1.21)	0.25 (0.24, 0.25)

Patient Time Cost Estimates

	CRC Cases	Controls	Net
Initial phase	$5335 ($5163, $5507)	$743 ($721, $765)	**$4592 ($4427, $4757)**
Continuing phase (per month)	$84 ($82, $86)	$59 ($58, $60)	**$25 ($23, $26)**
Last year phase	$6582 ($6366, $6797)	$3793 ($3675, $3912)	**$2788 ($2614, $2963)**

Comment

- Time costs are substantial
- Estimates should be generalizable to fee–for-service setting (> 70% of colorectal cancer patients are aged 65+)
- May understate time costs because couldn't include
    – Preparation time or recovery at home
    – Family and caregiver time
    – Cancer–specific travel time (used usual care)
- May understate time cost for younger patients because tend to seek more aggressive care
- Services not reimbursed by Medicare not included
- Home health and hospice care files not service specific in a way that can be converted to visits

NCI/AHRQ/VA Cost Workshop

- AHRQ-NCI-VA Workshop
  - Healthcare costs: standardization methods & estimates for research & policy application
  - http://healthservices.cancer.gov/publications/workshops/hcc/

- Medical Care Supplement
  - Yabroff KR, Brown ML, Lawrence WF, Barnett PG, Lipscomb J, eds. Health Care Costing: Data, Methods, Future Directions. *Medical Care* 2009 July;47(7 suppl 1):S1-S142.