Estimating Costs

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Methods, Research and Policy
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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

Dollars

Month After Diagnosis

Source: Brown et al., Medical Care 2002; 40:IV-104 - IV-117
Observational Data

Year

Years of Observation

Patient 1

Patient 2

Patient 3

Patient 4
Prevalence Cost in Year 4

Year

Patient 1

Patient 2

Patient 3

Patient 4
Incidence Costs for Patients 2 and 4

Years of Observation

Patient 1

Patient 2

Patient 3

Patient 4

Year
Phase of Care Specific Costs

- Initial Phase
  - Patient 2
  - Patient 3
  - Patient 4

- Continuing Phase
  - Patient 2
  - Patient 3
  - Patient 4

- End of Life Phase
  - Patient 1
  - Patient 2
  - Patient 3
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)

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

<table>
<thead>
<tr>
<th>Phase</th>
<th>Cases</th>
<th>Controls</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial Phase</td>
<td>27,769</td>
<td>138,845</td>
</tr>
<tr>
<td>Continuing Phase</td>
<td>81,824</td>
<td>245,472</td>
</tr>
<tr>
<td>Last year of life Phase</td>
<td>40,400</td>
<td>135,436</td>
</tr>
</tbody>
</table>
## Net Costs of Care in Colorectal Cancer Patients

<table>
<thead>
<tr>
<th>Phase</th>
<th>Men</th>
<th>Women</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial phase</td>
<td>$35,976</td>
<td>$36,576</td>
</tr>
<tr>
<td>Continuing phase</td>
<td>$2,532</td>
<td>$1,644</td>
</tr>
<tr>
<td>Last year of life phase – cancer death</td>
<td>$51,012</td>
<td>$51,492</td>
</tr>
<tr>
<td>Last year of life phase – non-cancer death</td>
<td>$9,360</td>
<td>$9,552</td>
</tr>
</tbody>
</table>
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

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

<table>
<thead>
<tr>
<th>Service Category</th>
<th>Data sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physician office visits</td>
<td>NHIS 1992; 2001 NAMCS</td>
</tr>
<tr>
<td>ER visits</td>
<td>1992 NHIS; 1997 NHAMCS - ED</td>
</tr>
<tr>
<td>Chemotherapy</td>
<td>Calculated infusion duration; NHIS 1992</td>
</tr>
<tr>
<td>Radiation therapy</td>
<td>Estimated; NHIS 1992</td>
</tr>
<tr>
<td>Hospitalizations</td>
<td>LOS; NHIS 1992</td>
</tr>
<tr>
<td>Out-patient surgery</td>
<td>1992 NHIS; 2001 MCBS</td>
</tr>
</tbody>
</table>

All time estimates include travel time, waiting time and time spent receiving care and are stratified by MSA/non-MSA.
<table>
<thead>
<tr>
<th>Service</th>
<th>CRC Cases Estimate (95% CI)</th>
<th>Controls Estimate (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MD visits</td>
<td>11.48 (11.30, 11.67)</td>
<td>5.93 (5.86, 6.00)</td>
</tr>
<tr>
<td>ER visits</td>
<td>0.45 (0.42, 0.48)</td>
<td>0.23 (0.22, 0.24)</td>
</tr>
<tr>
<td>Chemotherapy</td>
<td>1.37 (1.26, 1.48)</td>
<td>0.02 (0.01, 0.02)</td>
</tr>
<tr>
<td>Radiation therapy</td>
<td>1.30 (1.20, 1.40)</td>
<td>0.03 (0.03, 0.04)</td>
</tr>
<tr>
<td>Hospitalization days</td>
<td>17.96 (17.45, 18.46)</td>
<td>1.89 (1.82, 1.97)</td>
</tr>
<tr>
<td>Ambulatory surgery</td>
<td>1.17 (1.14, 1.21)</td>
<td>0.25 (0.24, 0.25)</td>
</tr>
</tbody>
</table>
## Patient Time Cost Estimates

<table>
<thead>
<tr>
<th></th>
<th>CRC Cases</th>
<th>Controls</th>
<th>Net</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Initial phase</strong></td>
<td>$5335 (5163, 5507)</td>
<td>$743 (721, 765)</td>
<td>$4592 (4427, 4757)</td>
</tr>
<tr>
<td><strong>Continuing phase</strong></td>
<td>$84 (82, 86)</td>
<td>$59 (58, 60)</td>
<td>$25 (23, 26)</td>
</tr>
<tr>
<td>(per month)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Last year phase</strong></td>
<td>$6582 (6366, 6797)</td>
<td>$3793 (3675, 3912)</td>
<td>$2788 (2614, 2963)</td>
</tr>
</tbody>
</table>
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

• Medical Care Supplement