Economics of palliative care

Key concepts and practical considerations

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Overview

Part 1: Conceptual issues (May)
- Health economic evaluation: what and why?
- Economic evaluation and palliative care

Part 2: Key issues in the evidence base (Aldridge)
- Dying in America study
- Group presentations of key articles

Part 3: Practical considerations (May)
- Economic evidence on palliative care
- Practical considerations in conducting a study
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Economic evaluation

What is economic evaluation?

‘Full’ economic evaluation has two components:

• Measuring treatment effect on costs
  • Formal costs: e.g. hospital, GP, nursing home, out-of-pocket pharma
  • Informal costs: care & help provided by friends, family

• Measuring treatment effect on outcomes
  • Patient outcomes: e.g. survival, HRQoL
  • Family outcomes: e.g. caregiver HRQoL

➢ ‘Cost-consequence’ analysis
  • cost-effectiveness, cost-utility, cost-benefit, etc
Economic evaluation

Cost-consequence analysis

- New treatment less effective
- New treatment more costly
- New treatment more effective
- New treatment less costly

- Green check mark
- Red X
- Question mark

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Economic evaluation

Why do we do economic evaluation?

• A tool for managing scarcity
  • Unrelated to overall budget or who pays - a fact of life
  • Available resources < Cost of health-related demands
    ➢ Decisions in allocation: what do we pay for?
    ➢ Every decision has an “opportunity cost”

• A tool we each use every day
  • Each of us has finite budgets at work and at home
    ➢ Decisions in allocation and “opportunity cost”
Everyday economic evaluation
Everyday economic evaluation

- Sky subscription was €78 per month...
Everyday economic evaluation

- Sky subscription was €78 per month...
  \[ = (78 \times 12) = €936 \text{ per year} \ldots \]
Everyday economic evaluation

- Sky subscription was €78 per month...
  \[ (78 \times 12) = €936 \text{ per year...} \]
  \[ (936 \times 18) = €16,848 \]
Everyday economic evaluation

• Sky subscription was €78 per month...
  = (78 * 12) = €936 per year...
  = (936 * 18) = €16,848

• We can choose to spend €16,848 on Sky over the course of our son’s childhood
  • And if costs < benefits then it might be the right decision
  • **BUT** that decision has an opportunity cost - this money could instead go on a college fund, dental care, trumpet lessons...
Everyday economic evaluation
Cost-consequence analysis

- New option worse outcomes
- New option more costly
- New option better outcomes
- New option less costly

- [ ]
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- [ ]

sky
Everyday economic evaluation
Cost-consequence analysis

New option worse outcomes

New option more costly

New option better outcomes

New option less costly
Everyday economic evaluation
Cost-consequence analysis

- New option worse outcomes
- New option more costly
- New option better outcomes
- New option less costly

- [Image of elephant]
- [Image of snacks]
- [Image of cigarette]
Economic evaluation

Summary

• Economic evaluation is a comparison of different options for their effect on costs and on outcomes

• Our aim is to ensure best care for greatest number of people through wise allocation of resources, which will always be scarce and have alternate uses

• Though abstraction inevitable in practice, principles are familiar & intuitive

• Timeframe is key because unlike many outcome variables costs add up (€78 versus €16,848)
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HE evaluation and palliative care

The QALY problem

Two components to economic evaluation:

• Measuring treatment effect on costs
• Measuring treatment effect on outcomes
HE evaluation and palliative care

The QALY problem

Two components to economic evaluation:

- Measuring treatment effect on costs
- Measuring treatment effect on outcomes

In PC studies, ‘consequence’ part typically fudged through ‘non-inferiority’ assumption
HE evaluation and palliative care

The QALY problem

Two components to economic evaluation:

- **Measuring treatment effect on costs**
- **Measuring treatment effect on outcomes**

In PC studies, ‘consequence’ part typically fudged through ‘non-inferiority’ assumption

- i.e. that outcomes for intervention group patients are at least no worse than those for comparison group patients

➢ Cost analysis (or cost-minimisation analysis)
HE evaluation and palliative care

Why is measuring outcomes so difficult?

- Generic issues in EOL research:
  - Sampling, recruitment and retention
  - Which outcomes, tools, perspectives?

- **Comparability**
  - Remember: our aim is to ensure best care for greatest number of people through wise allocation of resources, which will always be scarce and have alternate uses
  - How to compare all health care interventions on one outcome scale?
Economic evaluation
Cost-consequence analysis

- New option worse outcomes
- New option more costly
- New option better outcomes
- New option less costly

- Option 1: Red cross
- Option 2: Blue question mark
- Option 3: Green check mark
Economic evaluation
Cost-consequence analysis

New option worse outcomes

New option better outcomes

+$120,000
+$90,000
+$60,000
+$30,000

-$30,000
-$60,000
-$90,000
-$120,000
Economic evaluation

Cost-consequence analysis

New option worse outcomes

New option better outcomes

+$120,000

+$90,000

+$60,000

+$30,000

-$30,000

-$60,000

-$90,000

-$120,000
Idea of the QALY

What should we fund?

• How is the *consequence* part of cost-consequence analysis measured?
  
  – Easy to specify a bilateral comparison of the two treatments have the same goal, e.g. ibuprofen and paracetamol
  
  – But how do you compare the effectiveness of, say, hip replacement surgeries versus child vaccinations?
  
  – Allocating a system-wide budget requires a vast number of such comparisons


**Idea of the QALY**

**Quality-Adjusted Life Year:**

A *generic* measure combining HRQoL and survival, where:

- Health can be indexed on y axis, time on the x
- y*x gives QALY total
- One QALY is equivalent to 12 months in perfect health (or 24 months at 50% of perfect health, etc)
Idea of the QALY

Effect on QALYs

Effect on costs

$100,000/1.25 QALYs

=$80,000 per QALY

$100,000/1.25 QALYs

=$80,000 per QALY
Idea of the QALY

Effect on QALYs

Effect on costs

$15,000/2.25 QALYs

=$4,444 per QALY
Idea of the QALY

Effect on QALYs

Effect on costs

$100,000/1.25 QALYs

$80,000 per QALY

$15,000/2.25 QALYs

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Idea of the QALY

Effect on QALYs

Effect on costs

+$120,000

+$90,000

+$60,000

+$30,000

-$30,000

-$60,000

-$90,000

-$120,000

-3  -2  -1  +1  +2  +3
Idea of the QALY

Cost-effectiveness threshold

Effect on QALYs

Effect on costs

+$120,000

+$90,000

+$60,000

+$30,000

-$30,000

-$60,000

-$90,000

-$120,000

-3

-2

-1

+1

+2

+3

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The ‘QALY problem’ in Palliative Care

Problems in the EOL context

QALY approach has controversies, e.g. equity

In addition, there are concerns specific to EOL context.

- General bias: PC may not impact survival, have relatively short-term impact on QoL
- Measurement issues:  
  - QALYs assume additive time
The ‘QALY problem’ in Palliative Care
The ‘QALY problem’ in Palliative Care

Problems in the EOL context

In addition to general limitations to QALY analysis, there are concerns specific to EOL context.

- General bias: PC may not impact survival, have relatively short-term impact on QoL
- Measurement issues:
  - QALYs assume additive time, **but some evidence EOL time is valued differently**
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  - QALYs assume additive time, but some evidence EOL time is valued differently
  - QALYs assume trade-able preferences
Preferences

Indifference curves

Graph showing indifference curves with points A, B, and C. The y-axis represents 'Reading a book' and the x-axis represents 'Walking the beach'.
The ‘QALY problem’ in Palliative Care

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  - QALYs assume additive time, but some evidence EOL time is valued differently
  - QALYs assume trade-able preferences, but some evidence EOL preferences are lexicographical
  - QALYs can’t cope with “states worse than death”
The ‘QALY problem’ in Palliative Care
The ‘QALY problem’ in Palliative Care

Some reading

• There is a small, lively literature on this for those who are interested.

• A good starting point/general overview:


• A hard-nosed economist’s defence of the QALY and lots of references to other viewpoints, is:

Economic evaluation

A note on US realpolitik

- Different systems use EE in different ways
- NHS perhaps the most explicit, via NICE (nice.org.uk)
- In the US, formal use is limited and confusing
  - Some funding bodies forbid EE (‘bureaucratic rationing’)
  - Heightened sensitivity @EOL (“death panels”)
  - PC in US has not grown in a rational, planned way
Economic evaluation

A note on US realpolitik

• However, the intellectual ground is solid:
  • Rationing inevitable in all systems due to scarcity
  • EE therefore essential to ethical health policy
  • Most opposition reflects broader bad faith vs. UHC
  • Foundational textbooks in the US and UK are v. v. similar

➢ US h/care dysfunction may limit impact of highest-quality economic evaluations but do not lose sight of fundamental principles
Economic evaluation in EOL care

Summary

• Cost-consequence analysis is a key gap in current EOL literature
• Mainly reflects practical & methodological issues
• Long-term development of evidence, services demands CCA
• Political controversies do not diminish intellectual and ethical imperatives
End of part one

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Dying in America: Improving Quality and Honoring Individual Preferences Near the End of Life

Commissioned paper: the “Ask”

Provide an analysis of the epidemiology of serious illness and high utilization of healthcare

Synthesize and augment existing evidence to

- Evaluate costs and intensity of healthcare for individuals who have died
- Characterize the population that utilizes the most healthcare (“high cost” group)
- Provide an analysis of the overlap between these two groups

Identify gaps in what is known and how results of the analysis will inform policy
Healthcare reform debate in the context of healthcare costs

1. Discussion of high total healthcare costs and reform proposals on how to decrease total costs

2. Discussion of growth in healthcare costs and reform proposals aimed at “bending” the costs curve

3. Discussion of the highly concentrated healthcare costs among a small proportion of the population and policy proposals to identify and target this “high cost” group
Components of the $2.7 Trillion of National Health Expenditures, 2011

- Government Administration Costs: $189
- Government Public Health Activity: $79
- Investment (Research, Structures, Equipment): $154
- Expenditures for active duty and foreign visitors: $24
- Non-durable medical products (aspirin, band aids): $47
- Other Personal Healthcare (housekeeping): $168
- Non-Patient Care Revenue (gift shop revenue, GME): $106
- Other: $307

Health Expenditures - Patient Care: $1,628

Source: Aldridge, Kelley, 2013: IOM Commissioned Paper: Epidemiology of Serious Illness and High Utilization of Healthcare
Note: Expenditures are in billions; Expenditure components were estimated based on CMS 2011 National Health Expenditures report with adjustments based on estimates from Sing et al, and the 2011 Medical Expenditure Panel Survey data.
Healthcare cost data?

**Population**
- Age
- Residence
- Diagnosis
- Insurance

**Payer**
- Medicare FFS
- Medicaid
- Medicare Adv
- VA
- Private pay/OOP

**Cost category**
- Hospital
- Outpatient
- Nursing home
- Medications (Rx and OTC)
- Home health
- Hospice
Total annual healthcare expenditures

Medical Expenditures Panel Survey (MEPS)

- set of large-scale surveys of families and individuals, their medical providers, and employers across the United States. MEPS is the most complete source of data on the cost and use of health care and health insurance coverage

Annual healthcare expenditures of the non-community dwelling U.S. population, primarily the nursing home population, imputed from National Health Expenditure Data, National Center for Health Statistics data, and peer-reviewed literature
Cumulative Distribution of Personal Health Care Spending ($1.6 trillion), 2011

Top 5% of spenders account for an estimated 60% of spending ($976 billion)

- Source: Aldridge, Kelley, 2013: IOM Commissioned Paper: Epidemiology of Serious Illness and High Utilization of Healthcare
- Note: Total population and healthcare costs obtained from 2011 Medical Expenditure Panel Survey data adjusted to include the nursing home population. The entire nursing home population is estimated to be in the top 5% of total healthcare spending.
Age and Healthcare Costs

- Although individuals aged 65+ are disproportionately in the top 5% of healthcare spenders, almost 2/3rds of the top 5% spenders are younger than 65.
- Older age is a risk factor for higher healthcare costs, but older adults make up the minority of high cost spenders.
Payor and Healthcare Costs

• Similar proportions of healthcare costs in total and for the high cost group for private insurance and Medicaid
• Higher proportion of healthcare costs for the high cost group is paid by Medicare and a lower proportion OOP
Population and Healthcare Costs by Existence of Chronic Conditions and Functional Limitations

<table>
<thead>
<tr>
<th>Total Population</th>
<th>No. People (mil)</th>
<th>Healthcare costs (bil)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No chronic conditions or functional limitations</td>
<td>149.3</td>
<td>$186.3</td>
</tr>
<tr>
<td>Chronic conditions only</td>
<td>112.0</td>
<td>$505.7</td>
</tr>
<tr>
<td>Functional limitations only</td>
<td>6.2</td>
<td>$26.6</td>
</tr>
<tr>
<td>Chronic conditions and functional limitations</td>
<td>44.9</td>
<td>$908.8</td>
</tr>
</tbody>
</table>

Although the presence of chronic conditions is a key driver of healthcare costs, the addition of functional limitations appears to differentiate a high-cost group within those with chronic conditions.

• Source: Aldridge, Kelley, 2013: IOM Commissioned Paper: Epidemiology of Serious Illness and High Utilization of Healthcare
• The percent distribution of population and costs by chronic condition/functional limitation category was obtained from the Lewin Group Report, January 2010; total population and healthcare costs were obtained from the 2011 Medical Expenditure Panel Survey data adjusted to include the nursing home population.
Cost of Care at the End of Life

How much are total healthcare costs for people in their last year of life?

Of the population in the “high cost” group [those we potentially want to target for intervention] how many are in their last year of life? [overlap question]
Proportion of Total Healthcare Costs for Patients at the End of Life

- 87% for patients not at the end of life
- 13% for patients at the end of life

Source: Aldridge, Kelley, 2013: IOM Commissioned Paper: Epidemiology of Serious Illness and High Utilization of Healthcare

Note: The total pie represents total personal healthcare costs of $1.6 trillion
Estimated Overlap Between the Population with the Highest Healthcare Costs and the Population at the End of Life

High Cost Population
18.2 million

End-of-Life Population
2 million
0.5 million

Source: Aldridge, Kelley, 2013: IOM Commissioned Paper: Epidemiology of Serious Illness and High Utilization of Healthcare
Population with the Highest Healthcare Costs (Top 5%) by Illness Trajectory

- 49% Population with persistently high costs
- 40% Population with a discrete high-cost event
- 11% Population at the end of life

Source: Aldridge, Kelley, 2013: IOM Commissioned Paper: Epidemiology of Serious Illness and High Utilization of Healthcare
### Projected Cost Savings of Hypothetical Interventions By Target Population

<table>
<thead>
<tr>
<th>Target Population</th>
<th>Population Size</th>
<th>Total Costs ($bil)</th>
<th>Intervention</th>
<th>% of Population Impacted by Intervention</th>
<th>Potential Reduction in Healthcare Costs (%)</th>
<th>Potential Reduction in Healthcare Costs ($bil)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age &gt;=65 with</td>
<td>22,092,740</td>
<td>$543</td>
<td>A</td>
<td>50%</td>
<td>10%</td>
<td>$27</td>
</tr>
<tr>
<td>chronic conditions</td>
<td></td>
<td></td>
<td>B</td>
<td>50%</td>
<td>5%</td>
<td>$14</td>
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<tr>
<td>and functional</td>
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<tr>
<td>limitations</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>All individuals</td>
<td>44,946,847</td>
<td>$909</td>
<td>A</td>
<td>50%</td>
<td>10%</td>
<td>$45</td>
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<td>with chronic</td>
<td></td>
<td></td>
<td>B</td>
<td>50%</td>
<td>5%</td>
<td>$23</td>
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<td>conditions and</td>
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<tr>
<td>Individuals at</td>
<td>2,468,435</td>
<td>$200</td>
<td>A</td>
<td>50%</td>
<td>10%</td>
<td>$10</td>
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<td>the end of life</td>
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<td>B</td>
<td>50%</td>
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<td>$5</td>
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*Source: Aldridge, Kelley, 2013: IOM Commissioned Paper: Epidemiology of Serious Illness and High Utilization of Healthcare*
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Current evidence

Cost of care for serious illness

- 2001-2011: US healthcare spending doubled
- By 2040, projected to be 1/3 of all economic activity in the US
- Similar, less dramatic trends in other HICs and LMICs
- LYOL is most expensive **BUT** high costs driven those with long-term chronic conditions and functional limitations (Aldridge & Kelley, 2015, Davis et al., 2016)

➤ Lowering costs for those with serious and complex medical illness is key to US health system sustainability
# Current evidence

## Four key systematic literature reviews

<table>
<thead>
<tr>
<th>Review</th>
<th>Key findings</th>
</tr>
</thead>
</table>
| Smith et al. (2014)     | • All settings, study designs; 46 papers  
                          | • General pattern of cost-saving, heterogeneity of everything                                                                                  |
| Langton et al. (2014)   | • Count-back studies of administrative data; 78 (!) papers  
                          | • Lower costs for PC, increasing use of ‘decedent cohort’ design                                                                               |
| Gomes et al. (2013)     | • High quality studies of homecare; 6 economics papers  
                          | • ~15-30% cost-saving                                                                                                                          |
| May et al. (2014)       | • Prospective studies of hospital inpatient PCC; 10 papers  
                          | • ~15-20% cost-saving ([see also May 2018 meta-analysis](#))                                                                                   |
Current evidence

• Together these reviews establish two points of consensus:
  1. Palliative care is associated with lower health care/system costs
  2. Knowledge gaps re:
     • Everything! Few meta-analyses (so far)
     • But in particular **limited scope of enquiry**: 
        i. Analytic framework and the QALY problem
        ii. Timeframe
        iii. Perspective
        iv. Intervention timing (and what is “palliative care” anyway?)
Current evidence

Limitation (ii): Timeframe

• Most evidence is from one of two phases of care:
  • Inpatient hospital stays
  • End of life (decedent count-back studies)

• Both associated with intensive treatment
  • Not representative of full trajectory of serious illness
  • Observational designs (so concerns re: matching)
  • EOL data a concern (Bach et al., 2004; Earle & Ayanian, 2006)
Current evidence

Limitation (ii): Timeframe

Temel (2010): RCT of palliative care from diagnosis for NSCLC

Early palliative care
• improves quality of life
• reduces intensity of treatment
• extends survival
Current evidence

Early PC appears a dominant strategy: better outcomes at lower costs
Current evidence

Limitation (ii): Timeframe

However....

Greer (2016): cost analysis with ~95% of subjects now deceased

Early palliative care
• reduces costs in last 30 days
• increases hospice use
• is associated with higher mean total costs?!
Current evidence

Limitation (ii): Timeframe

Findings such as ‘reduced intensity of hospital treatment’ and ‘lower costs at end of life’ are routinely taken in the literature to mean that “palliative care saves money”

So, how is it possible for PC to:

• reduce initial intensity (weeks 1-12)
• reduce cost in the last 30 days of life
• increase costs overall?
Current evidence

Limitation (ii): Timeframe

Let’s look at a simplified data example of two identical patients: one receives UC, one receives PC from point of diagnosis of a terminal disease.

Data approximate to Temel/Greer reported outcomes but do not reflect specifics.

This is an illustrative exercise not a critical one.
Current evidence

Usual care patient

UC patient:
• Lives ~8mths from diagnosis with spike in costs near end of life.
Current evidence

Usual care patient

UC patient:
- Lives ~8mths from diagnosis with spike in costs near end of life.
Current evidence

Usual care patient

UC patient:
• Lives ~8mths from diagnosis with spike in costs near end of life
• Has a jagged cost curve indicating episodic high-intensity treatment
Current evidence

Usual care patient

UC patient:
- Lives ~8mths from diagnosis with spike in costs near end of life
- Has a jagged cost curve indicating episodic high-intensity treatment
- Accrues formal costs given by A, the area under this curve
Current evidence

Palliative care patient

PC patient:
• Lives ~11mths from diagnosis with spike in costs near end of life
Current evidence

Palliative care patient

PC patient:
• Lives ~11mths from diagnosis with spike in costs near end of life
Current evidence

Palliative care patient

PC patient:
- Lives ~11mths from diagnosis with spike in costs near end of life
- Has few ‘peaks’, i.e. a lack of intensive episodes
Current evidence

Palliative care patient

PC patient:
- Lives ~11mths from diagnosis with spike in costs near end of life
- Has a jagged cost curve indicating episodic high-intensity treatment
- Accrues formal costs given by B, the area under this curve
Current evidence
Observing a full episode of care

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Current evidence
Observing a full episode of care

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- reduce initial intensity (weeks 1-12)
- reduce cost in the last 30 days of life
- increase costs overall?
Current evidence
Observing a full episode of care

@12 weeks Temel (2010) reports less aggressive care for PC patients

PC cost reduction reflected in lower cost curve (difference in costs @ 12 weeks = area between the curves)
Current evidence
Observing a full episode of care

So, how is it possible for PC to:

- reduce initial intensity (weeks 1-12)
- reduce cost in the last 30 days of life
- increase costs overall?
Current evidence

Observing a full episode of care

Greer (2016) reports less aggressive care for PC patients in last 30 days of life

PC cost reduction reflected in lower cost curve (difference in costs = area between the curves)
Current evidence
Observing a full episode of care

So, how is it possible for PC to:

- reduce initial intensity (weeks 1-12)
- reduce cost in the last 30 days of life
- increase costs overall?
Current evidence
Observing a full episode of care

Only when looking across the whole episode of care is the explanation apparent:

Weeks following diagnosis

Cost of healthcare ($)

UC patient  PC patient
Current evidence
Observing a full episode of care

Only when looking across the whole episode of care is the explanation apparent:

• **PC was less intensive and so lower cost for ~8mths following diagnosis** (shown by the area, X, between the two curves)
Current evidence
Observing a full episode of care

Only when looking across the whole episode of care is the explanation apparent:

- PC was less intensive and so lower cost for 6+ months following diagnosis
- **PC patient lived an additional three months and accrued further costs, denoted by area Y**
Current evidence

Observing a full episode of care

If $X < Y$ then the additional costs of extra survival eclipse the savings of reduced intensity.
Current evidence

Important note

- This **does not** mean that we think that an intervention with substantial survival effects is not worthwhile
- Only that it likely won’t be associated with any cost-saving
- This is well understood by ‘fiscal’ economists, not always in health
Current evidence
Cost-consequence analysis

New treatment
more costly

New treatment
less effective

New treatment
more effective

New treatment
less costly
Current evidence

Cost-consequence analysis

- New treatment less effective
  - More costly
- New treatment more effective
  - Less costly

X

?
Current evidence
Limitation (iii): Perspective

• Whose costs?
  • Hospital studies focus on hospital costs
  • Charges studies focus on payer (e.g. Medicare) costs
  • Out-of-pocket and informal costs comparatively ignored

➢ Risk that observed cost-savings are passed on to other parts of the system or to patients and families
➢ Similar issues to survival example – partial viewpoints distort reality
Current evidence

Limitation (iv): Intervention timing and what is “palliative care” anyway?

• Earlier intervention ($I$) has a larger effect on hospital costs
  ➢ Timing must be incorporated or bias to the null

• But how?
  ▪ Currently $I$ within $t$ days of admission
    o No clinical guidelines to define $t$; outliers a problem
  ▪ Optimally a continuous variable
    o Typical dose response assumes normal distribution
    o Skewed exposure and outcome $xvars$
    o More complex still across the disease trajectory!
Summary

• Evidence on **cost** of care for medical complexity is unarguable: costs are high and going higher (particularly in the US)

• Evidence on **PC effect** on these costs sometimes reported as unarguable ("PC saves money") but reality more complicated

• Studies to date have limitations that may lead to overestimation

• Limitations not arbitrary; reflect routine data collection

• Critical for long-term development of policy and services that limits are addressed through expanded scope

• Even if not studying costs, do bear in mind questions
  • **What, when, for whom?**
Summary
One interpretation of current literature

- New treatment more costly
- New treatment more effective
- New treatment less costly
- New treatment less effective

X
Summary

An alternative we should be ready for

New treatment

more effective

less costly

New treatment

less effective

more costly

X
Overview

Part 1: Conceptual issues (May)
• Health economic evaluation: what and why?
• Economic evaluation and palliative care

Part 2: Key issues in the evidence base (Aldridge)
• Dying in America study
• Group presentations of key articles

Part 3: Practical considerations (May)
• Economic evidence on palliative care
• Practical considerations in conducting a study
Defining a research question
What, when, for whom?

• An economic research question will compare the costs (and consequences) of two options

• Most in the literature are broad, e.g.
  • What is the effect of palliative care on costs compared to usual care for adults with serious illness?

• Recent evidence recommends more detailed questions:
  • Intervention
  • Outcome
  • Target population
Defining a research question

Advice

• Consider intervention **timing**:  
  • Earlier intervention more effective for hospital admissions (May & Normand, 2016) and LYOL (Scibetta et al., 2016)

• Consider outcome **perspective**:  
  • PC reduces hospital costs (but CMS costs? Family costs?)

• In both cases, widest view is the best (and the hardest to achieve)
Defining a research question

Advice

• Consider target **population**:
  
  • What is the effect of palliative care on costs compared to usual care for adults with serious illness?

• Early studies assume treatment effect homogeneity but evidence of great heterogeneity (May et al., 2018):
  
  • PCC cost-effects larger for cancer & for more comorbidities

➢ Research populations who are particularly complex and/or understudied (e.g. dementia, multimorbidity)
Distributions typically pose problems for statistical analysis:

- **Non-negativity**: by definition never less than zero
- **Mass of zero-value observations**: in data drawn from populations, a large number of cost data-points will be zero
- **Positive skew**: a minority of patients incur a disproportionately high level of costs, skewing the distribution right
- **Heteroscedasticity**: variability of costs is unequal across a range of values for important predictors
- **Leptokurtosis**: clustering of cost observations for a large number of patients with similar care trajectories may result in high ‘peaked-ness’ of distribution

➢ **Linear regression (OLS) is seldom appropriate**
Statistical model

Awkwardness of healthcare utilization data

Total direct cost of hospital admission

- Skewness: 3.2
  (0 for normal distribution)
- Kurtosis: 17.7
  (3 for normal distribution)
The ‘old’ way to address this was log-transformation, which generally mitigates skew, heteroscedasticity & leptokurtosis.

**Awkwardness of healthcare utilization data**

**Statistical model**

**In(total direct cost) of hospital admission**

- **Skewness:** 0.4  
  (0 for normal distribution)

- **Kurtosis:** 3.4  
  (3 for normal distribution)
However, beware the ‘retransformation problem’:

“Although [log-transformed] estimates may be more precise and robust [than estimates using highly skewed distributions of untransformed costs], no one is interested in log model results on the log scale per se.

“Congress does not appropriate log dollars. First Bank will not cash a check for log dollars. Instead, the log scale results must be retransformed to the original scale so that one can comment on the average or total response to a covariate \( x \).

“There is a very real danger that the log scale results may provide a very misleading, incomplete, and biased estimate of the impact of covariates on the untransformed scale, which is usually the scale of ultimate interest.” - Manning (1998)
Consider instead non-linear alternatives to OLS:

**Generalized linear model**

- Family
  - Gaussian
  - Poisson
  - Gamma
  - Inverse Gaussian

- Link
  - Identity
  - Log
  - Power
Statistical model

Awkwardness of healthcare utilization data

Consider instead non-linear alternatives to OLS:

Generalized linear model

- **Family**
  - Gaussian
  - Poisson
  - **Gamma**
  - Inverse Gaussian

- **Link**
  - Identity
  - **Log**
  - Power
Statistical model

Awkwardness of healthcare utilization data

Consider instead non-linear alternatives to OLS:

Generalized linear model

Exponential conditional mean models

Generalized gamma models

Extended estimation equations

Finite mixture models
Statistical model
Awkwardness of healthcare utilization data

Stata programs available online to evaluate model performance:

- For GLMs only, Stata `glmdiaq.do` from UPenn
  (http://www.uphs.upenn.edu/dgimhsr/stat-cstanal.htm)

- For all models, Stata `AHE_2ed_Ch_3&12.do` from University of York
  (http://www.york.ac.uk/economics/postgrad/herc/hedg/software/)

- These test the appropriateness of specific models to a given distribution
- No model is dominant
  - Evaluating models prior to analysis is essential to maximize accuracy of estimated effects
Statistical model

Advice

• Consider and describe data carefully prior to analysis
• Avoid use of OLS, OLS $\ln(y)$ and ANOVA with healthcare utilization data
• Consider nonlinear alternatives
  ➢ Use available software to understand and evaluate options
  ➢ Report briefly this process in Methods

Further reading:

• *The York*.do file accompanies a book: Jones et al. (2013a)
• *For an overview of why model choice matters, see Jones* (2010)
• *For more technical analyses, see Jones et al. (2013b); Garrido et al. (2012)*
• *Not my true expertise but I am happy to help if I can (peter.may@tcd.ie)*
Additional considerations

Advice

• Do not remove outliers, e.g. define your sample by length of stay, match by length of stay, or use length of stay as a regression variable (May et al., 2016)

• If your cost data come from more than one year adjust for inflation using Consumer Price Index

• If your cost data come from more than one state adjust for cost of living using Medicare Wage Index
Summary

• Economics of palliative care studies require consideration re:
  • Intervention timing
  • Cost perspective
  • Target population

➢ Status quo reflects where data are routinely collected
➢ Priority is expanding scope, i.e. well-funded 1ary research or better linking existing data (Kelley et al., 2014; Maetens et al., 2016)

• Awkward data preclude use of ordinary regression
Final thought

Thomas Carlyle (1795-1881) called economics ‘the dismal science’

Economists might argue that it is reality that is dismal

Rationing inevitable in all health systems; economics merely a decision tool to navigate hard (often unpalatable) choices

Projections of health status and costs make it critical to both improve outcomes and control cost of care to seriously-ill people

➢ An opportunity to make a difference!
Thank You

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References (1/2)


References (2/2)


