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Economics of palliative care

Next steps to improve policy relevance

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Learning outcomes

Economics of palliative care

- **Previous session(s) focused on what we know:**
    - What (cost-consequence analysis) and why (scarcity)?
    - Evidence to date in palliative care:
        - Intervention appears cost-saving, subject to caveats

- **Today focus more on what we don't:**
    - Some heterogeneity/definition problems
        - Addressing these critical to improving policy relevance
        - Hopefully relevant beyond economics

Overview

- **Background**
- **Treatment effect heterogeneity**
  - **By individual factors**
  - **By timing**
- **Discussion**

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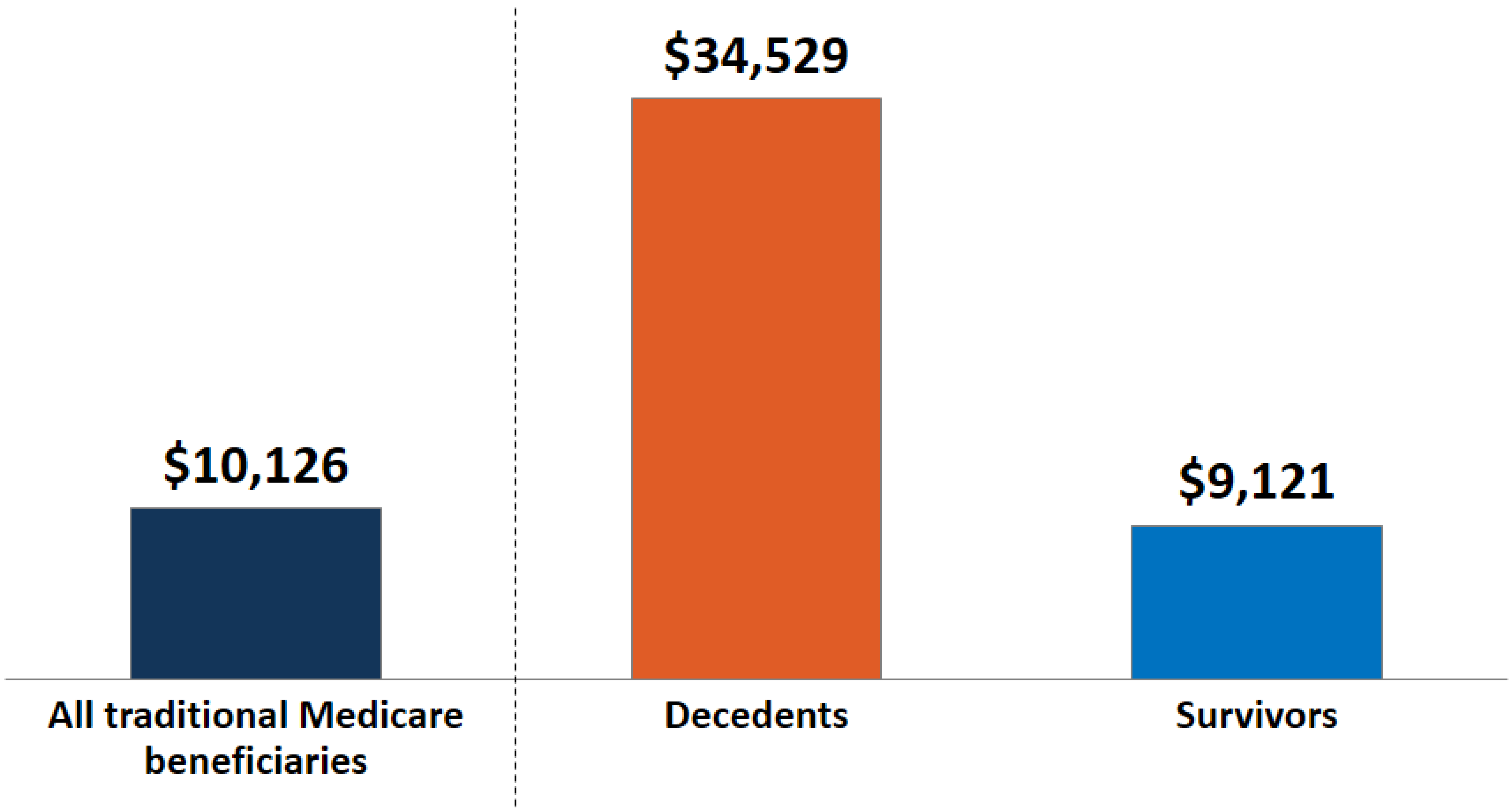
Background

Death and taxes

- **Long-established policy interest:**
  - From 1978-2006
    - 5% of Medicare beneficiaries died annually, accounting for ~25% of total costs (Lubitz & Riley, 1993; Riley & Lubitz, 2010)
  - From 2000-2014
    - Proportion of deaths falling slightly, proportion of costs more so (Cubanski et al., 2016)
  - Nevertheless, LYOL is the costliest

Medicare per capita spending was nearly four times higher for decedents than survivors in 2014

Average Medicare per capita spending for decedents and survivors in traditional Medicare, 2014



NOTE: Excludes beneficiaries in Medicare Advantage.
SOURCE: Kaiser Family Foundation analysis of a five percent sample of 2014 Medicare claims from the CMS Chronic Conditions Data Warehouse.

https://www.kff.org/report-section/medicare-spending-at-the-end-of-life-findings/

Background

Death and taxes

- **Discordance with economic theory:**
  - Marginal cost ≤ Marginal utility (= WTP)
    - Short payback period
    - Limited capacity for QoL improvement

      - Questionable use of scarce resources

Background

Death and taxes

- Economists have interpreted high LYOL cost data as reflecting rational use of resources when time is limited:
    - Theory: Becker et al. (2007); Philipson et al. (2010)
    - Empirical proof: Fischer et al. (2018)
- Wealth has no opportunity cost @EOL
- Rational people faced with death will spend what they have to extend life

Interesting implications:

- ‘QALY problem’ and EOL utility measurement (Round, 2014)
- Specific case of out-of-pocket costs (e.g. Banegas et al 2016)

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<u>**However, limited face validity for high costs in LYOL**</u>

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Background

Death and taxes

- Empirical study of EOL care finds:
  - Patient preferences ≠ High-intensity care* (Huynh et al, 2013)
  - Poor outcomes for patients and families (Teno et al, 2013)
  - Poor integration of patient preferences (Downey et al, 2013)
  - Highest costs managing multiple chronic disease (Davis et al, 2016)

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Death and taxes

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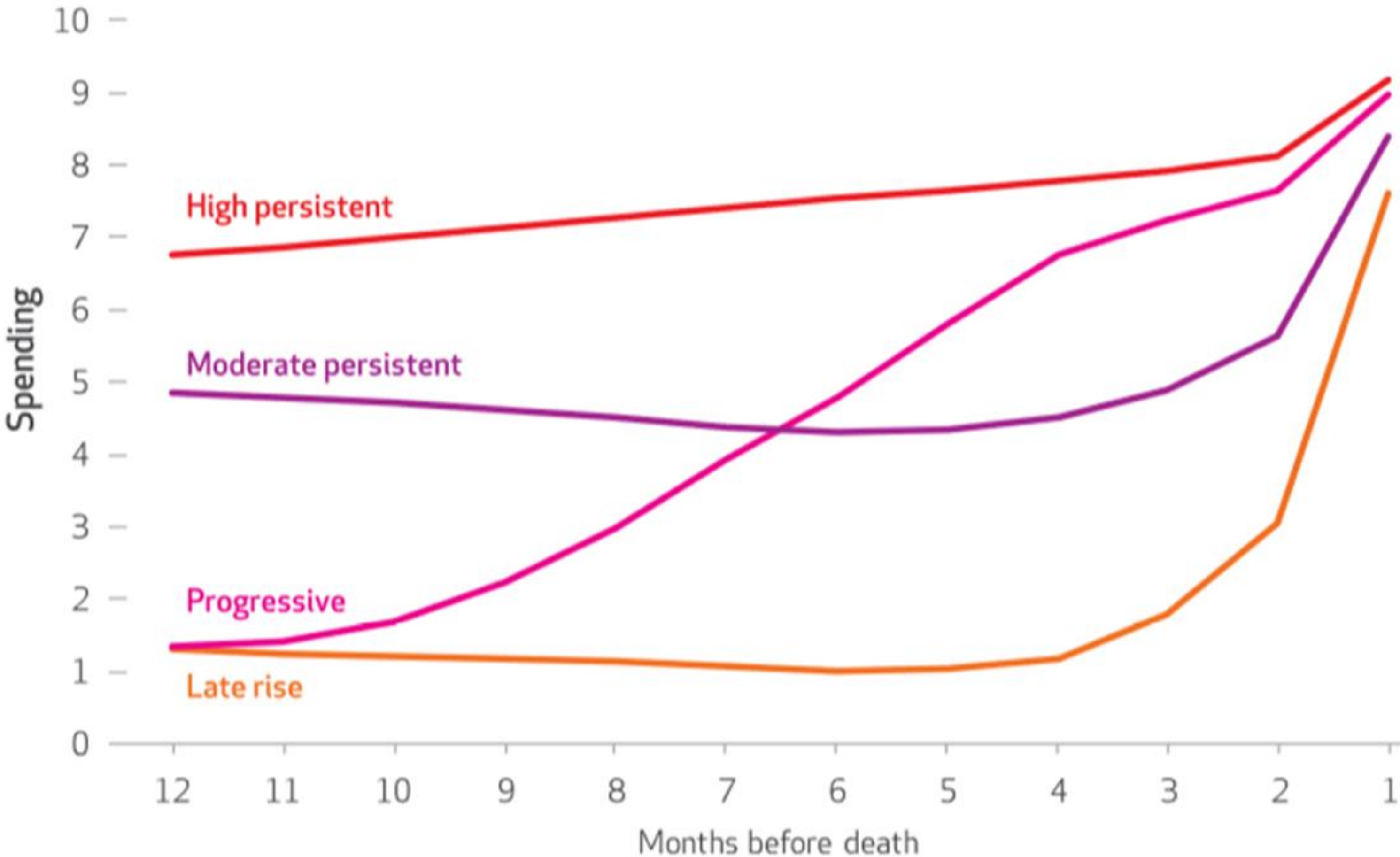
  - **Highest costs managing multiple chronic disease (Davis et al, 2016)**

Background

Health care spending trajectories of Medicare decedents in the last year of life



Half of Medicare decedents have persistent high costs through last year of life

Not defined by specific disease but by high comorbidity counts

Patterns pre-date LYOL

Source: Davis et al (2016)

Background

Health care spending trajectories of Medicare decedents in the last year of life

No empirical basis at aggregate population level for economists' assumptions:

- Patient preferences for high-intensity treatment*
- High utility yielded by patients and families
- Informed, autonomous choices by microeconomic agents
- 'Explosive' response to short, sharp shocks

Rather, high costs represent system failure:

- Systems originally designed to provide acute, episodic care
- High EOL costs really a subset of high multimorbidity costs

Background

Economics of PC: state of the science

- **Meanwhile in palliative care literature, a typical economics study looks something like this:**
  - **P**opulation: adults with a life-limiting illness
  - **I**ntervention: ‘palliative care’
  - **C**omparison: ‘usual care’
  - **O**utcome: payer costs
  - **S**tudy design: Hospital inpatient stays or last year of life

(Smith et al., 2014; Langton et al., 2014)

Background

Economics of PC: state of the science

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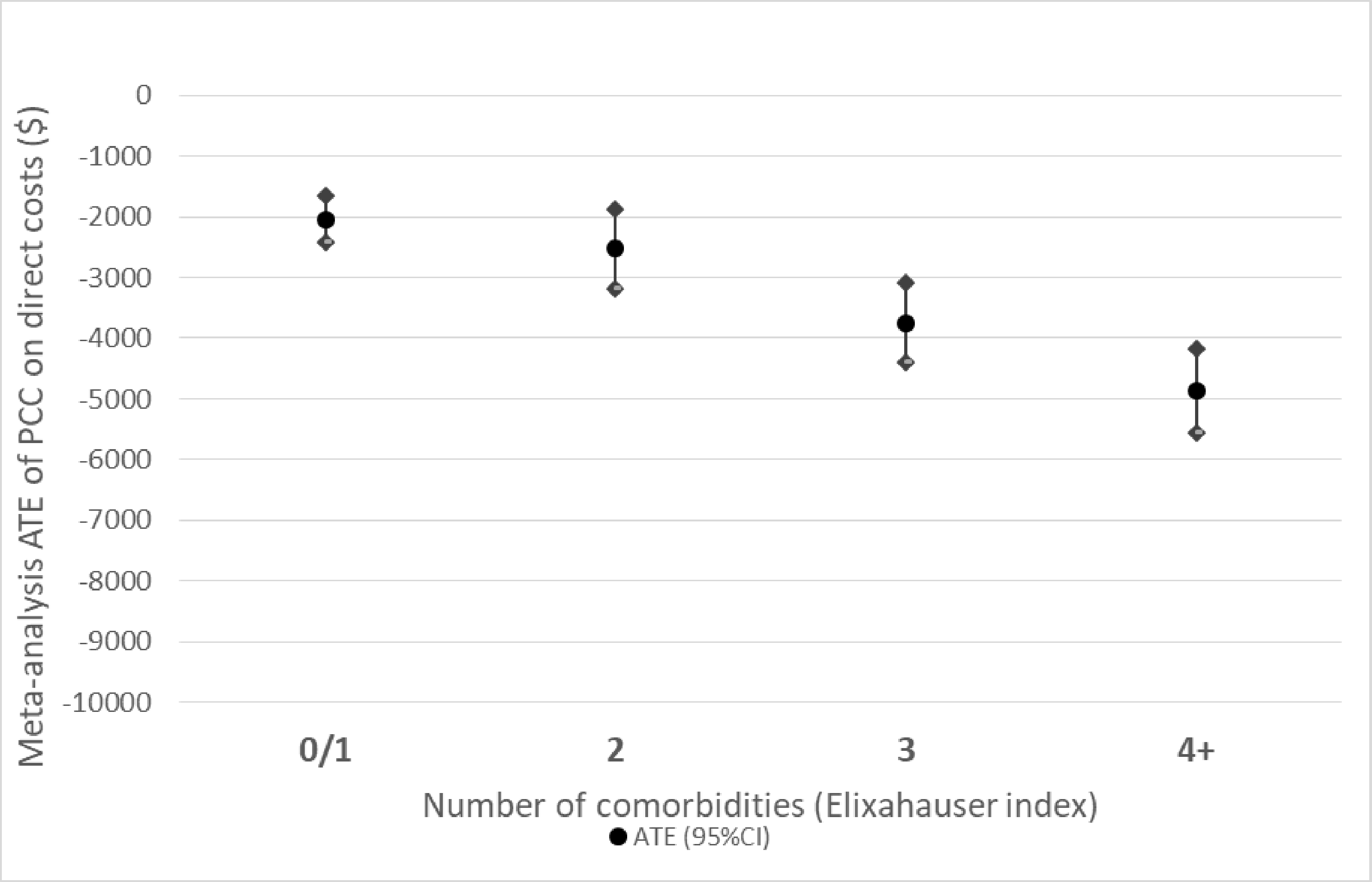
Background

Estimated effect of PC on hospital utilization varies by comorbidities



Significant differences for 3+ versus 0/1

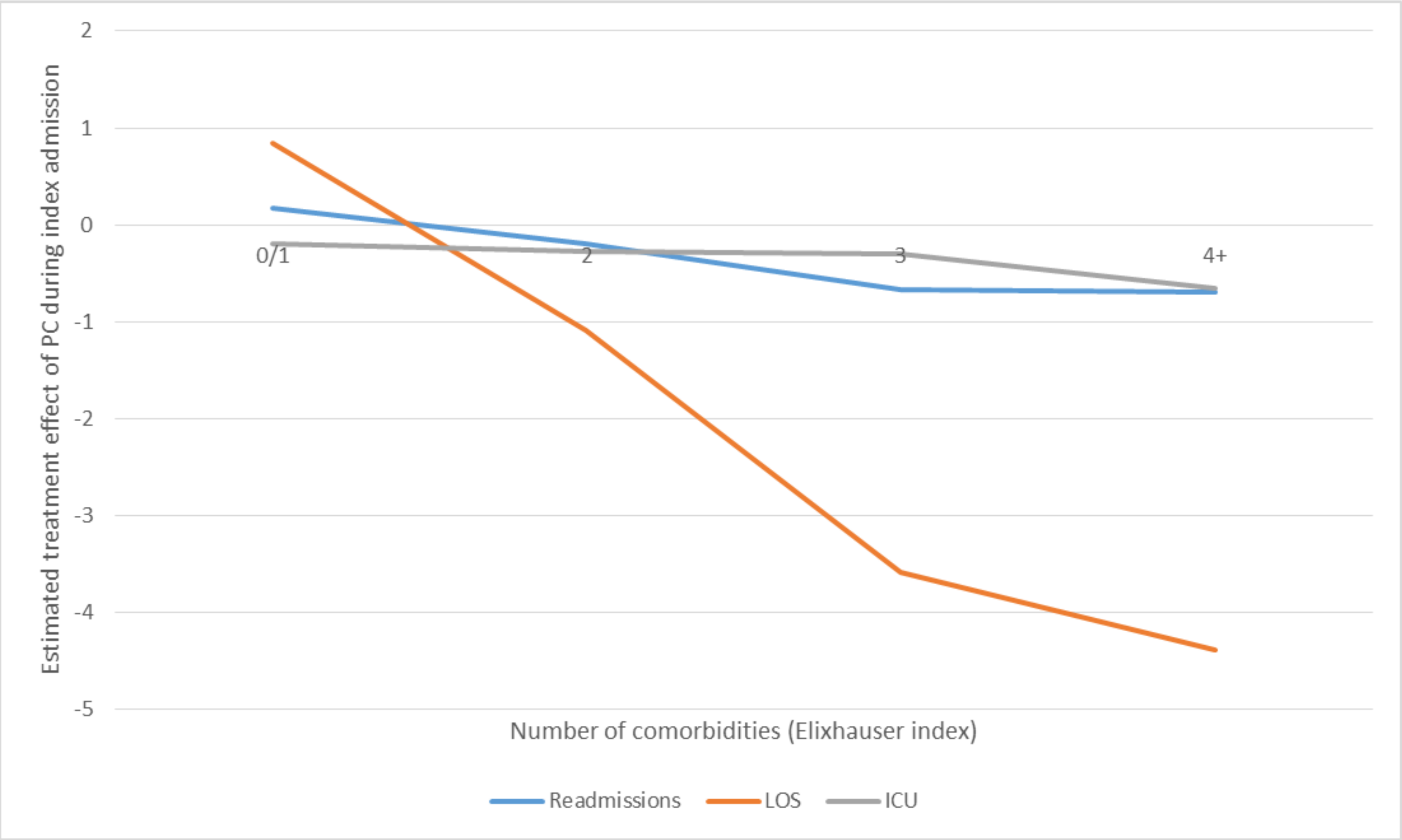
Adjusted *inter alia* for age, gender, race, insurance, ED admission

N=133,188

Source: May et al (2018)

Results

Estimated effect of PC on post-discharge hospital inpatient days varies by comorbidities



Adjusted for age, gender, race, insurance, ED admission

N=37,402

Source: unpublished; May & Cassel 2019

Summary

Background

- Economic literature interpretation of high EOL costs is weakly related to population-level reality
- Alternative interpretation is:
  - Health care systems ill-equipped and unresponsive to complex needs and multimorbidity
    - High costs less reflect rational patient <u>decision-making</u> than incoherent and fragmented provision of care
- Few palliative care economics studies have embraced this either:
  - Homogenous approach to population and treatment, and narrow windows of analysis
    - Scope to improve policy relevance

Overview

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Target populations

One interpretation of multimorbidity findings

- Palliative care is more impactful on treatment pathways for people with more comororbidities
- More complex are more vulnerable to poor clinical decision-making, e.g.:
  - Territoriality among specialisms;
  - Polypharmacy and ADRs;
  - Preference mismatches;
  - Etc.
- Palliative care is improved <u>decision-making</u>

Target populations

Complex care for complex illness

- Critically, this has been **<u>hypothesis-driven</u>**:
  - 'Medical' interpretation: combinations and totals of serious conditions can be mined using big data to identify those most amenable to PC
  - **<u>But</u>** multimorbidity is not the only marker of (poor?) end-of-life experience from contemporary health systems, e.g.
    - Racial and ethnic differences (e.g. Orlovic et al., 2019)
    - Socioeconomics factors (e.g. Howard et al., 2015)
    - Age, proximity to death and the 'red herring' debate (e.g. Werblow et al, 2007)

Target populations

Complex care for complex illness

- What if interdisciplinary decision support improves standard (acute, episodic) care along other dimensions*?

* As well as, or instead of, the comorbidity findings we have

- Revisit data using data-driven ("latent class") approach, finite mixture modelling

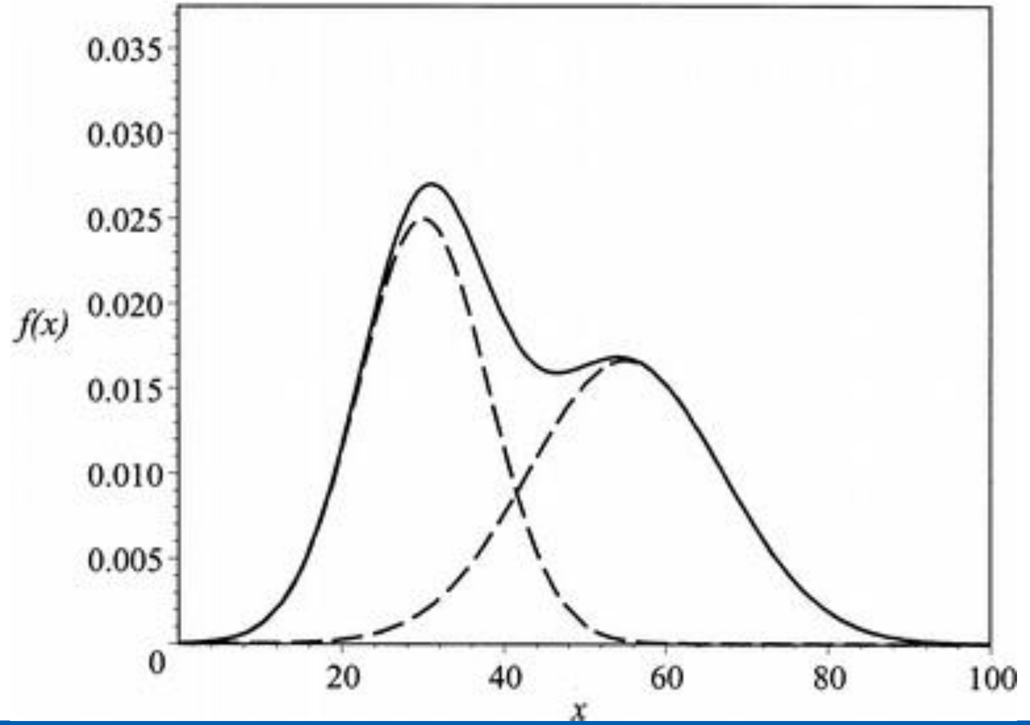
Target populations

Finite mixture modelling

- What if interdisciplinary decision support improves standard (acute, episodic) care along other dimensions*?

* As well as, or instead of, the comorbidity findings we have

- Revisit data using data-driven (“latent class”) approach, finite mixture modelling
- Identify heterogeneity in multiple latent classes
- Use Bayesian principles to assign every subject to a class based on calculated probabilities



Target populations
Palliative care for Cancer (PC4C) study

Population: Adult patients admitted to hospital with an advanced cancer diagnosis (N=1020)

Intervention: PCC, first within three days of admission (n=232)

Control: Usual care only (n=788)

Outcome: Direct cost of hospital stay ($\bar{Y}$=$11,000)

Study design: Prospective cohort at 4 US hospitals; rich set of possible predictors; 2007-2011

Target populations

Complex care for complex illness

Source: unpublished work in progress;

May et al.

- Two-component model has best fit
- Treatment is 'effective' for one class, not the other

```
Class           : 1
Response        : direct_cost
Model           : glm, family(gamma)
```

	Coef.	Robust Std. Err.	z	P>|z|	[95% Conf.	Interval]
direct_cost						
1.pal_care3	-.4079434	.0700915	-5.82	0.000	-.5453203	-.2705665

```
Class           : 2
Response        : direct_cost
Model           : glm, family(gamma)
```

	Coef.	Robust Std. Err.	z	P>|z|	[95% Conf.	Interval]
direct_cost						
1.pal_care3	-.0475587	.3416169	-0.14	0.889	-.7171155	.621998

Target populations

Finite mixture model output

Evidence of substantive treatment effect heterogeneity:

- In Class 1 (75% of the sample), PC is associated with a significant cost-saving effect
- In Class 2 (25%), no association

What factors are associated with class membership?

Target populations

Finite mixture model output

Source: unpublished work in progress;

May et al.

What factors are associated with class membership?

	Class 1	Class 2	Standardised Diff
Elixhauser (mean)	3.5	3.3	10%
Charlson (mean)	2.0	1.8	16%
Multimorbidity	83%	73%	25%

Source: unpublished work in progress;

May et al.

Target populations

Finite mixture model output

What factors are associated with class membership?

	Class 1	Class 2	Standardised Diff
NH White	66%	70%	-10%
African American	27%	22%	12%

- African American patients more likely to be in Class 1 (where cost-effect is significant)

Target populations

Finite mixture model output

Source: unpublished work in progress;

May et al.

What factors are associated with class membership?

	Class 1	Class 2	Standardised Diff
College graduates	48%	58%	-20%
Medicaid	18%	11%	18%

- High socio-economic status less likely to be in Class 1

Target populations

Finite mixture model output

Source: unpublished work in progress;

May et al.

What factors are associated with class membership?

	Class 1	Class 2	Standardised Diff
Van Walraven index	17.0	18.4	-16%
Died in hospital	5%	7%	-12%

- Predicted mortality (at admission) and in-hospital death both negatively associated with Class 2

Summary

Multimorbidity effects may be the tip of the iceberg

- Reconsidering treatment effect heterogeneity with data driven approaches suggests multiple possible dynamics, e.g.:
    - Racial and ethnic differences
    - Socioeconomic differences
    - Proximity to death differences

- Plenty of caveats (unfinished work, small dataset, collinearity of some dynamics)
- Nevertheless, clear indications that clinical factors are not the only issue in treatment effect heterogeneity

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Intervention timing

Hospital inpatient admissions

Source: May et al. 2015

Treatment defined as within _____ days of hospital admission	UC (n=)	PCC (n=)	All (n=)	Estimated incremental effect (95% CI)	P value	Implied saving
Any time	734	286	1020	-117 (-1780 to +1546)	0.89	1%
20	742	278	1020	-902 (-2201 to +397)	0.17	10%
10	750	270	1020	-1062 (-2339 to +214)	0.10	12%
6	767	253	1020	-1664 (-2939 to -389)	**0.01**	19%
2	811	209	1020	-2719 (-3917 to -1521)	**<0.01**	30%

- Earlier treatment>larger effect
- This relationship is systematic, bulletproof (& ex post kinda obvious)
  - **<u>Incorporate treatment timing in evaluation, or bias to the null</u>**

Intervention timing

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- Earlier treatment>larger effect
- This relationship is systematic, bulletproof (& ex post kinda obvious)
  - ➢ **Incorporate treatment timing in evaluation… OK, but how?**

Intervention timing

Hospital inpatient admissions

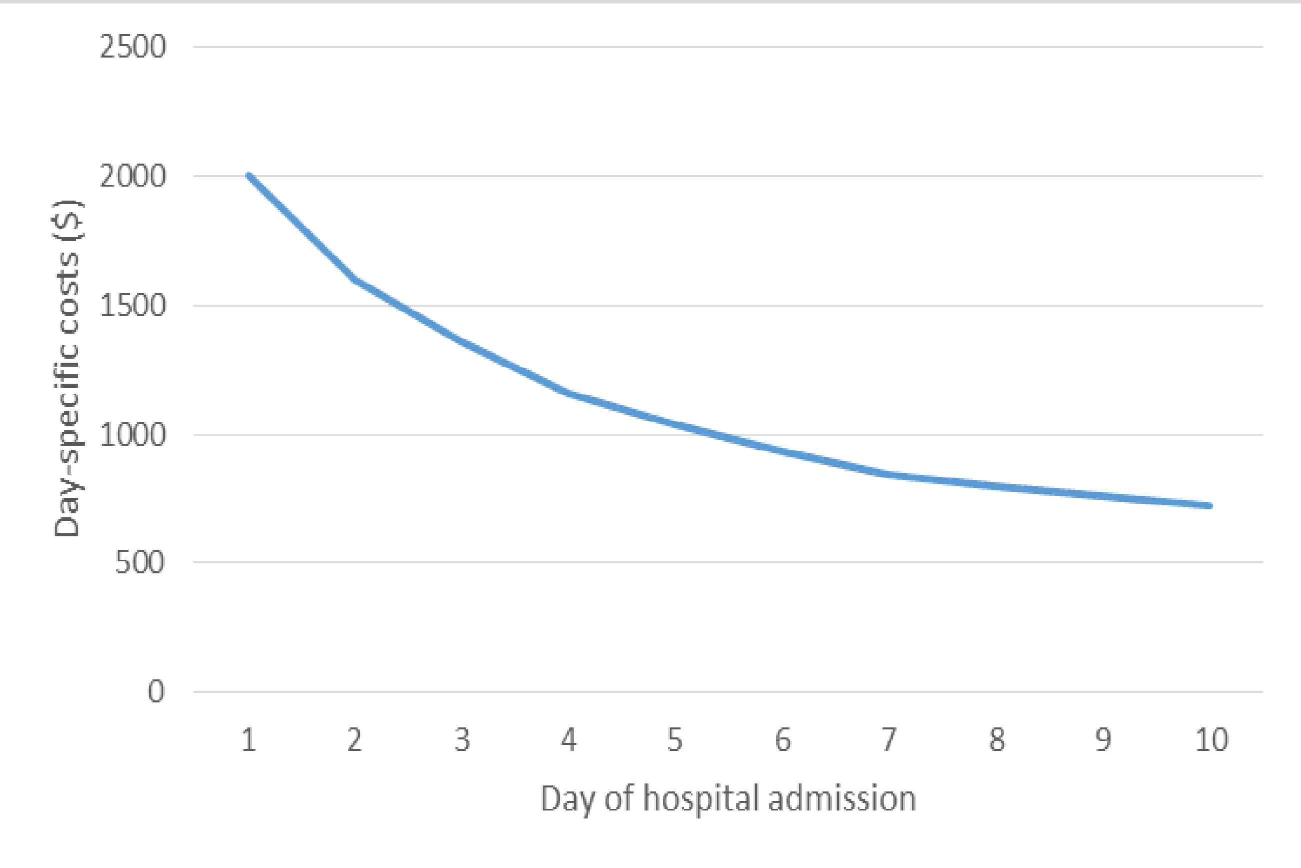
- Currently intervention receipt within *t* days of admission
    - No clinical guidelines to define *t*
    - Outliers may bias in either direction

- Optimally a continuous variable based on *t* <u>capturing the capacity of the intervention to effect the outcome, *y*</u>

- What would that look like?

Intervention timing

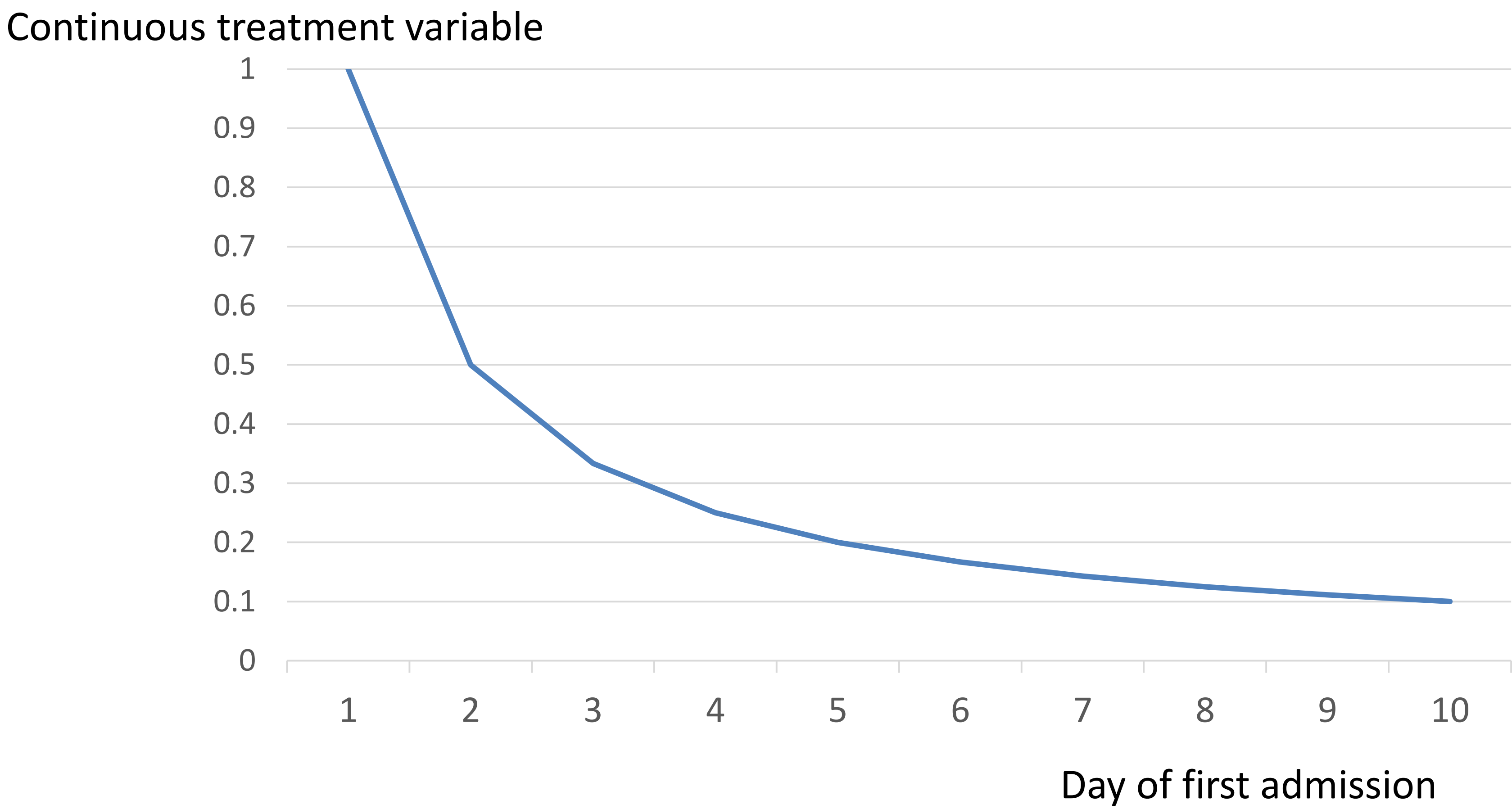
Typical day-by-day costs for a hospital admission



Day	Cost ($)
1	2000
2	1600
3	1360
4	1156
5	1040
6	936
7	843
8	801
9	761
10	723
Σ	11219

Current evidence

Capacity of PC to impact inpatient costs, by day of admission [illustrative]



Intervention timing

Hospital inpatient admissions

- Cost data not distributed equally over episode of care
- Graph does not show when decisions are made (but surely left-hand mass)

- Capacity of the intervention to effect the outcome is not normally distributed across the episode of care
  - <u>Very early involvement likely key</u>

- When modelling treatment according to timing, this needs to be taken into account (tricky given distribution)

Intervention timing

Across the disease trajectory

- Now the really bad news…
- Hospital admissions are the easy part!
- Palliative care now recommended as routine across disease trajectories (e.g. ASCO, WHO)
- Distribution of costs (and therefore capacity for *I* to impact outcome) different

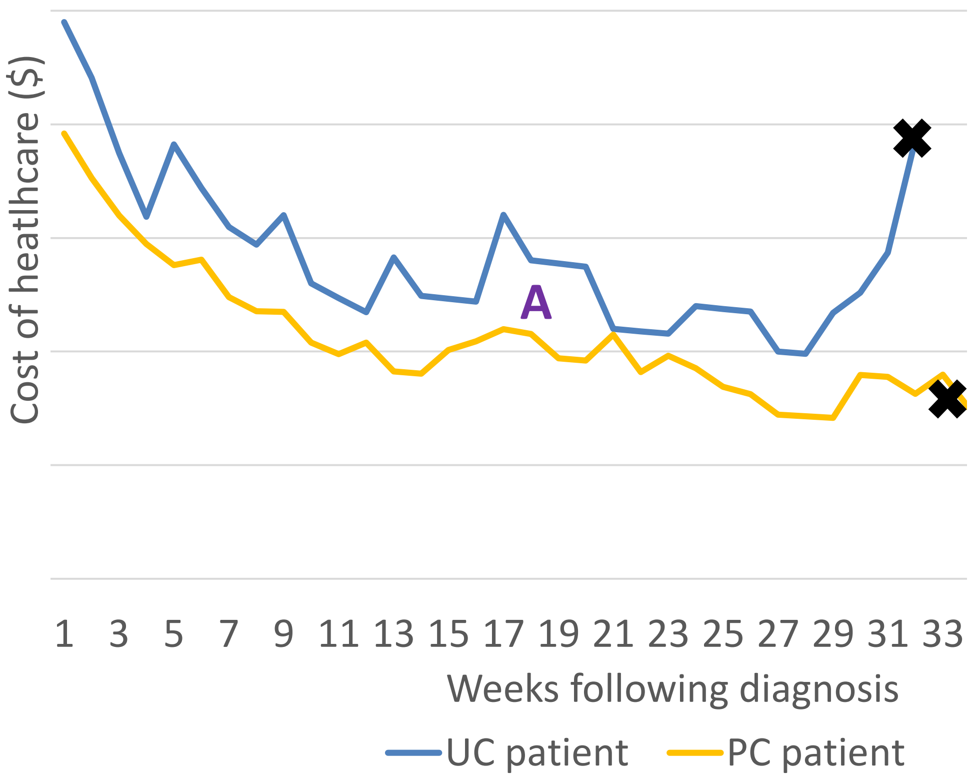
Intervention timing

Across the disease trajectory

- For cancer this may be relatively straightforward

Costs across the disease trajectory

Example of cancer



Source: illustrative data

Two cancer patients, one receiving UC and one PC

No survival effects; ✖ is death

Cost savings from PC given by A

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Intervention timing

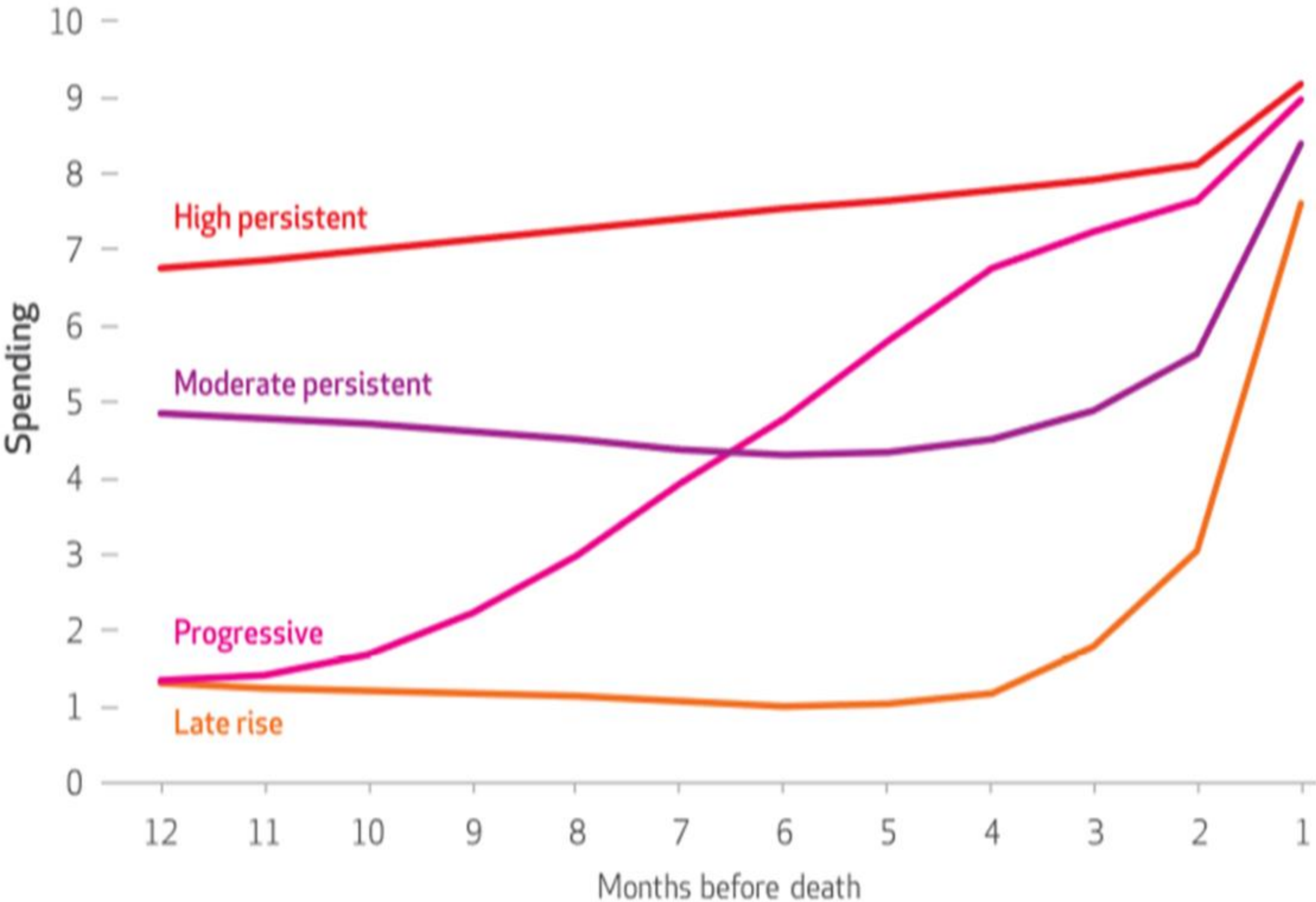
Across the disease trajectory

- For cancer this may be relatively straightforward
- ASCO recommends receipt of PC from diagnosis, so follow from diagnosis
- (though requires understanding of how PC involvement changes over the course of the disease)

- What about noncancer and multimorbidity?

Intervention timing

Health care spending trajectories of Medicare decedents in the last year of life



The high persistent group are the policy priority

Not defined by specific condition but by disease burden

High costs (and poor outcomes) pre-date this LYOL window

When does PC first become involved, how does it change over time, how would we evaluate that?!

Figure: Davis (2016)

Intervention timing

Implied capacity of PC to impact total costs for persistent high costs

Continuous treatment variable

Summary

- Intervention timing in a hospital admission is quite mechanistic:
  - In this controlled environment, capacity to effect outcome is key principle
  - Earlier is better, disproportionately so

- Intervention timing across the disease trajectory is a can of worms, especially in chronic disease/multimorbidity:
  - Costs are accumulated in unpredictable ways
  - Costs reflect disease, which reflect life course factors
  - Costs also reflect non-clinical factors to a much greater extent

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Summary

- Economists have long-standing interest in high EOL costs but limited understanding
- Most costs driven not by rational choices but persistently high-need/high-cost groups
- Palliative care studies have repeated a set formula hiding much heterogeneity
  - Intervention effects may also differ by non-clinical factors, e.g. socioeconomic
  - Earlier interventions will always have greater capacity to impact outcome, but outside hospital this capacity is heavily mediated by other factors

Discussion

Economics of PC: state of the science

- **To economists (and policymakers?) this is quite restricted**:
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Summary

- Evidence on **<u>cost</u>** of care for medical complexity is unarguable: costs are high and going higher (particularly in the US)
- Evidence on **<u>PC effect</u>** on these costs sometimes reported as unarguable ("PC saves money") but reality more complicated
- Growing question is: we understand *treatment effect heterogeneity* somewhat, but what about *treatment heterogeneity*?
- 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
  - <u>What, when, for whom?</u>

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Thank You

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References (1/2)

P. B. Bach, D. Schrag, C. B. Begg. (2004) *JAMA*, 292, 2765-70.

M. P. Banegas et al. (2016). *Health Aff (Millwood).* 2016 Jan; 35(1): 54–61.

A. E. Barnato et al (2009). *J Gen Intern Med*, 24(6), 695-701.

G. S. Becker, K. M. Murphy, T. Philipson (2007) National Bureau of Economic Research, New York. Available at: https://www.nber.org/papers/w13333

D. Carr, (2012). *J Aging Health*, 24(6), 923-947.

J. Cubanski, T. Neuman, S. Griffin, A. Damico (2016) Available at: https://www.kff.org/report-section/medicare-spending-at-the-end-of-life-findings/

M. A. Davis et al. (2016) *Aff (Millwood),* 35, 1316-23.

L. Downey et al. (2013) Life-sustaining treatment preferences: matches and mismatches between patients' preferences and clinicians' perceptions. *J Pain Symptom Manage*, 46, 9-19.

B. Fischer, H. Telsera, P. Zweifel (2018) *J Health Econ* 60, 30–38.

D. H. Howard et al. (2015) Cancer Causes and Control, 26, 657-668.

References (2/2)

T. Huynh et al. (2013) *JAMA Intern Med*, 173, 1887-94

J. D. Lubitz, G. F. Riley (1993) *N Eng J Med*. 328(15):1092–6.

P. May et al. (2015). J Clin Oncol. 33(25):2745-52

P. May et al. (2018) *JAMA Intern Med* doi:10.1001/jamainternmed.2018.0750

T. Philipson, G. S. Becker, D. Goldman, K. M. Murphy (2010) Available at: https://www.nber.org/papers/w15649

J. Round (2014) Is a QALY still a QALY at the end of life? *J Health Econ* 31, 521–527

G. F. Riley, J. D. Lubitz (2010) *Health Serv. Res*. 45, 565–576.

J. Teno et al. *JAMA*. Feb 6; 309(5): 470–477.

A. Werblow et al. (2007) J Health Econ. 16(10); 1109-1126.

World Health Organization (2018) Definition of Palliative Care. Available at: http://www.who.int/cancer/palliative/definition/en/