Are Medical Care Prices Still Declining? A Systematic Examination of Quality-Adjusted Price Index Alternatives for Medical Care

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Introduction

Health care is a large and growing sector of most developed economies

Quality adjustment of the measurement of the output of health care is challenging
- Rapid technological change
- Heavy use of third-party reimbursement

Health care is nearly half of the overall bias for overall PCE deflator from quality adjustment
- Groshen, Moyer, Aizcorbe, and Bradley (2017)

Previous work on quality adjustment in health care in a price index framework

Currently BLS measures prices of individual medical services

First step: move to treatment-based indexes (National Research Council 2010)
◦ BEA: Health Care Satellite Account

Quality-adjusted or quality-constant condition-based indexes
◦ Cutler et al. 1998: Heart attacks
◦ Berndt et al. 2002: Major depression
◦ Frank et al. 2004: Schizophrenia

Multiple methods used in this and subsequent literature
◦ Recently, popular to measure price per quality-adjusted life-year (QALY)
  ◦ Lucarelli and Nicholson 2009, Howard et al. 2015, Hult et al. 2017

Goal of today's paper

Analyze alternative methods of producing quality-adjusted price indexes in medical care

◦ Theoretical differences between methods

◦ Empirical application of methods for three acute conditions from 2001-2014

Contribution:

◦ Systematic comparison of methods applied to same data and medical conditions

Findings

Quality adjustment has a significant impact on measured inflation
- Conservative quality-adjusted inflation rates are 5 percentage points below the unadjusted estimates

Results are sensitive to what method of quality adjustment is used

Benchmark cost of living indexes lead to much lower price growth than other methods
- Most popular approach in recent years (pricing QALYs) can lead to understatement of magnitude of price decreases when quality improves

Cutler, McClellan, Newhouse and Remler (1998)

Created cost-of-living index based on net value of spending on heart attacks from mid-1980s to mid-1990s

$$COLI = \frac{Y_0 - (\Delta LE - \Delta\$)}{Y_0}$$

Benefits are measured by monetized change in life expectancy.

Unadjusted episode-based index rises 2.3%/year.

Adjusted index falls 1.5%/year.

Berndt, Bir, Busch, Frank and Normand (2002)

Quality-constant price index for treatment of major depression.

Measure **incremental price per expected remission (relative to no treatment)** for each treatment and overall, aggregating across treatments.

Data: Medical claims with treatment details.

Employ expert panel approach: present combinations of patients and treatments to clinical experts and elicit probability of remission from major depression for that particular combination.

Frank, Berndt, Busch and Lehman (2004)

Quality-constant price index for schizophrenia

Classified patients into treatment baskets based on medical literature

Run separately for each year:

$$Y_i = \alpha + X_i\beta + Z_i\gamma + \varepsilon_i.$$

Y = avg spending, X = demographics, Z = indicators for treatments

Laspeyres index: $\hat{Y}_{01} = \widehat{\alpha_t} + X_{01}\hat{\beta}_t + Z_{01}\hat{\gamma}_t$ for each t 2001-14

Paasche index: Similarly with 2014 data

Fisher index: Geometric average of two

Quality is held constant assuming quality of individual treatment baskets is held constant

Resource cost adjustment

◦ Standard method for producer price indexes (PPI)
◦ Adjusts based on cost to producer, not benefits to consumers
◦ Practical difficulties in health care
  ◦ Attributing costs to quality change is challenging
◦ Approach applied by BLS
  ◦ Hospital PPI
  ◦ Nursing home PPI

Summary of indexes

Life expectancy (LE) index: Adjust index with estimate of increased benefit of medical treatment (e.g., value of increased life expectancy): $\frac{S_1 - \Delta B}{S_0}$

Treatment endpoint (TE) index: Measure price of quality-constant output (achievement of treatment endpoint or [QA-]LY).

Basket price (BP) index: Hold quality constant by holding market shares of quality-constant treatment baskets constant (but allowing prices of baskets to change)

Resource cost (RC) index: Adjust index with estimate of cost of quality change

Results of simple model relating indexes

LE index is benchmark index
- Requires fewest assumptions and therefore gives accurate results in the most situations

Validity of BP and RC indexes both rest on assumption that quality changes are reflected in changes in spending
- In general, relationship between quality and costs often very unclear in health care

Life expectancy index vs. treatment endpoint index

Simple model relates indexes in a scenario where one more effective and more expensive treatment is replacing another less effective and expensive treatment over time.

◦ More effective = achieves endpoint with a higher probability

Algebraic result: LE index and TE index are only equal when

Monetized medical value of achieving the endpoint = price of achieving that endpoint

Life expectancy index vs. treatment endpoint index (con.)

Intuitively, LE index is only index to capture full value of change in health outcomes resulting from improved treatment.

Another way (Sheiner and Malinovskaya 2016): LE index captures **marginal** benefit and **marginal** cost but TE index measures **average** price of purchased health so far

◦ Marginal benefit > marginal cost (price drop) but average price can rise at the same time.

Treatment endpoint index can diverge widely from LE index when value ~= cost.

Empirical application

Three conditions
◦ Acute myocardial infarction (AMI or heart attack)
◦ CHF (congestive heart failure)
◦ PNE (pneumonia)

Serious, acute conditions requiring hospitalization and with high mortality

Data

Medicare fee-for-service (FFS) claims (5 percent sample)

In general, following Romley, Goldman, and Sood (2015) to identify admissions and unplanned readmissions for three conditions

Additional selection rules:

◦ full year of FFS enrollment prior to the index admission (for risk adjustment based on diagnoses)

◦ full year after the admission or death within the year after the admission, to measure outcomes
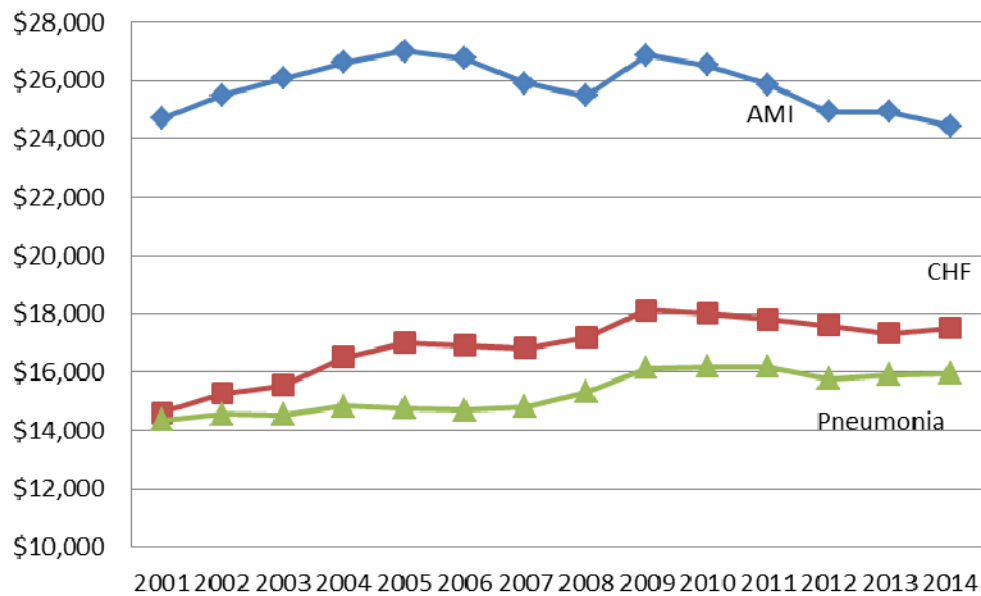
Limitations

Only elderly

No outpatient drug spending

Only measuring mortality
◦ Quality of life may be big issue for this population with these conditions
◦ Estimate of value of life may be overstated
  ◦ May also be understated
  ◦ LE index very sensitive to value of life

Trends in spending and mortality 2001-2014

Figure 1A. 30-Day Risk Adjusted Spending

Figure 1B. Risk-Adjusted Mortality Rate, 30-Day
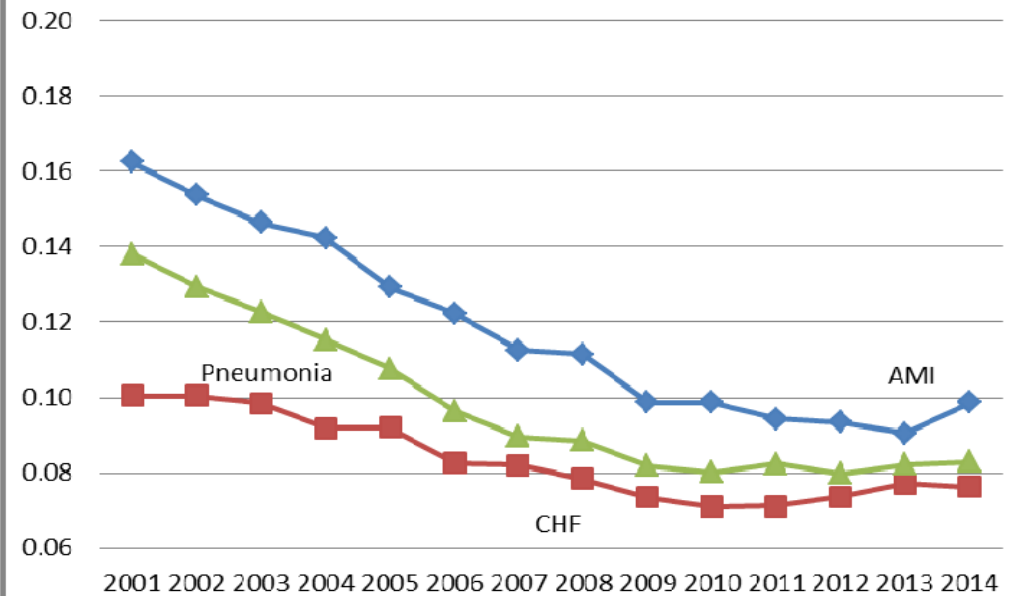
Life expectancy (LE) Index

Unadjusted index + monetary change in benefit measure

$$COLI_{disease} = \left(\frac{S_1}{S_0}\right) - \left(\frac{\Delta B}{S_0}\right) = \frac{S_1 - \Delta B}{S_0}$$

How to measure ΔB?

Two issues:
- ◦ Value of a life assumption
  - ◦ Range around $100,000
  - ◦ Well studied, but controversial
- ◦ Isolating contribution of treatment
  - ◦ Our approach: Measure mortality in short windows in time around the event (e.g., 30, 60 or 90 days).

Measuring benefits of treatment to life expectancy

$$LE_{MC,t} = m_t LE_{\gamma,t} + (1 - m_t)LE_{pA,t}|\gamma$$

Assumption:
- First term affected by medical care for condition
- Second term is not
  - Once you live to certain point, changes in mortality are unaffected by changes in treatments in initial hospitalization.

Hold second term constant at 2001 level
- Cohort observed for thirteen years

Table 5
Annual growth rates of LE indexes across different assumptions

Window length	30 days			60 days			90 days		
Annual value of life	$50,000	$100,000	$150,000	$50,000	$100,000	$150,000	$50,000	$100,000	$150,000
Acute myocardial infarction									
Unadjusted index	-0.1%			-0.1%			-0.1%		
COLI	-4.8%	-9.8%	-15.1%	-5.1%	-10.5%	-16.2%	-5.5%	-11.3%	-17.5%
Congestive heart failure									
Unadjusted index	1.4%			1.5%			1.5%		
COLI	-0.4%	-2.3%	-4.4%	-0.2%	-2.1%	-4.2%	-0.1%	-2.0%	-4.1%
Pneumonia									
Unadjusted index	0.8%			0.9%			1.0%		
COLI	-4.4%	-9.9%	-15.8%	-4.3%	-10.0%	-16.1%	-4.1%	-9.6%	-15.6%

Notes: Estimates are computed as compound annual growth rates. The COLI estimates are computed by rebasing the amounts in each year. The price indexes are calculated with dollars deflated to 2014 values with the GDP deflator.

TE Index

$$\mathrm{TE} = \frac{S_1}{\sigma_1} \Big/ \frac{S_0}{\sigma_0}$$

S_t = total spending on condition

σ_t = fraction of treatments that reach a successful endpoint **relative to no treatment**

Endpoint = survival to X days without an unplanned readmission

X = 30, 60, or 90

Rate of successful endpoint without treatment: 0%, 20% or 40%

Table 7
Annual growth rates of treatment endpoint index under alternative assumptions

	Window length								
	30 days			60 days			90 days		
	Assumed success rate of untreated cases								
	0%	20%	40%	0%	20%	40%	0%	20%	40%
Acute myocardial infarction									
Unadjusted index	-0.1%			-0.1%			-0.1%		
Quality-constant index	-1.0%	-1.4%	-2.1%	-1.3%	-1.8%	-3.3%	-1.5%	-2.2%	-4.4%
Congestive heart failure									
Unadjusted index	1.4%			1.5%			1.5%		
Quality-constant index	1.0%	0.8%	0.5%	0.9%	0.6%	-0.1%	0.8%	0.5%	-0.8%
Pneumonia									
Unadjusted index	0.8%			0.9%			1.0%		
Quality-constant index	0.2%	0.0%	-0.5%	0.1%	-0.3%	-1.2%	0.1%	-0.4%	-1.8%

Notes: Estimates are computed as compound annual growth rates. Price index is based on dollar figures deflated to 2014 dollars with the GDP deflator.

BP Index

Run regression for each year:

$$Y_i = \alpha + X_i\beta + Z_i\gamma + \varepsilon_i$$

- Y_i — patient spending
- X_i — patient-level severity controls
- Z_i — technologies or evidence-based treatment

Are we able to select the "correct" technologies?

Technologies for AMI
- Catheterization (CATH), Percutaneous Coronary Intervention (PCI) , and Coronary Artery Bypass Grafting (CABG)

Technologies for Congestive Heart Failure
- Implantable Cardioverter Defibrillator (ICD), Cardiac Resynchronization Therapy Defibrillators (CRT-D), and Cardiac Resynchronization Therapy Pacemaker (CRT-P)
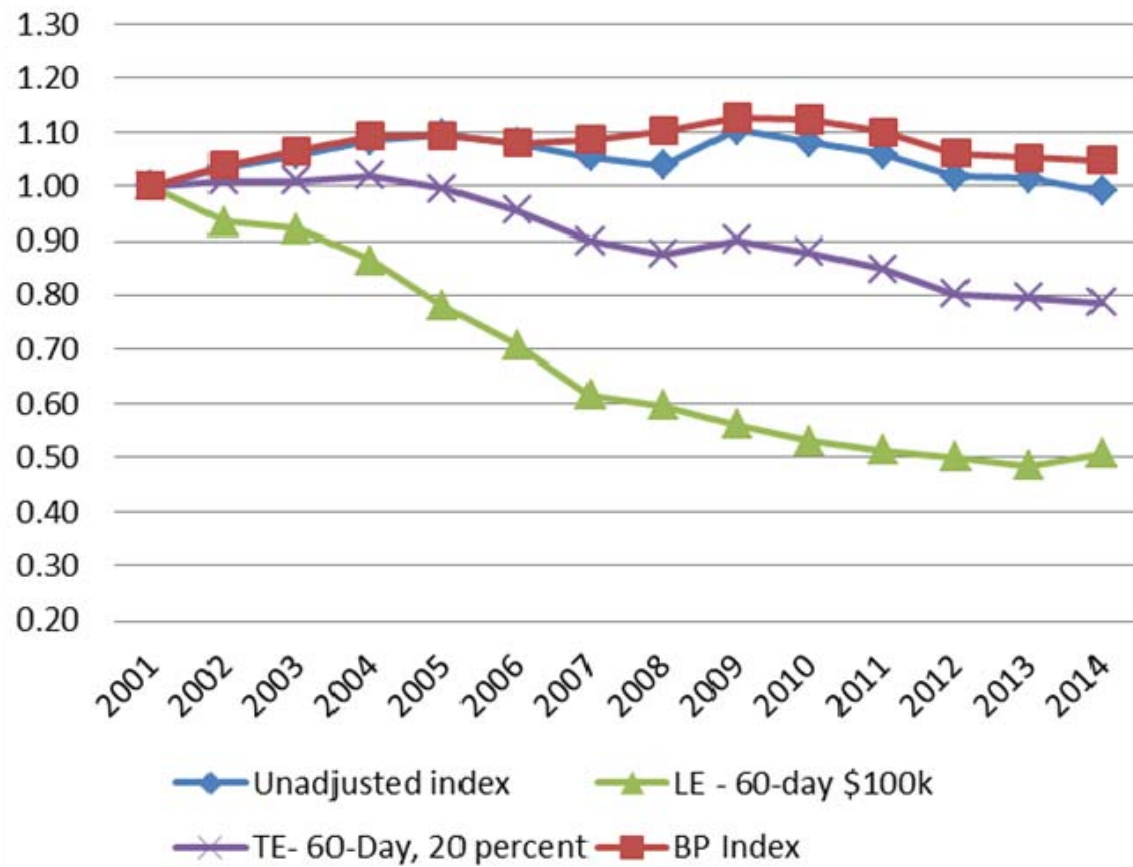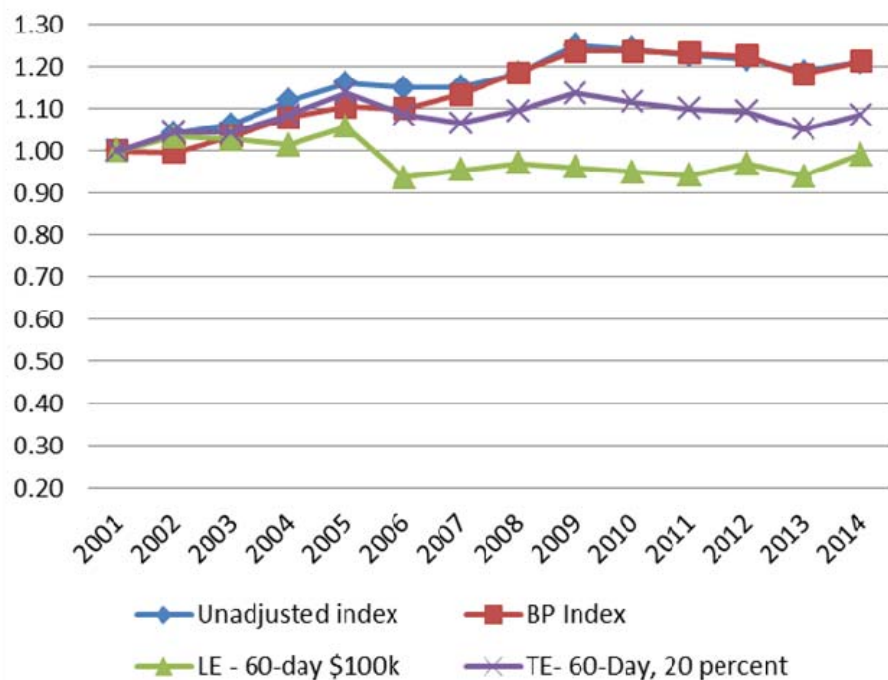
RC Index

At this point, we don't calculate RC index separately.

Derivation by Sheiner and Malinovskaya (Brookings, 2016): RC index equivalent to TE index under assumptions of costs linear in quality.
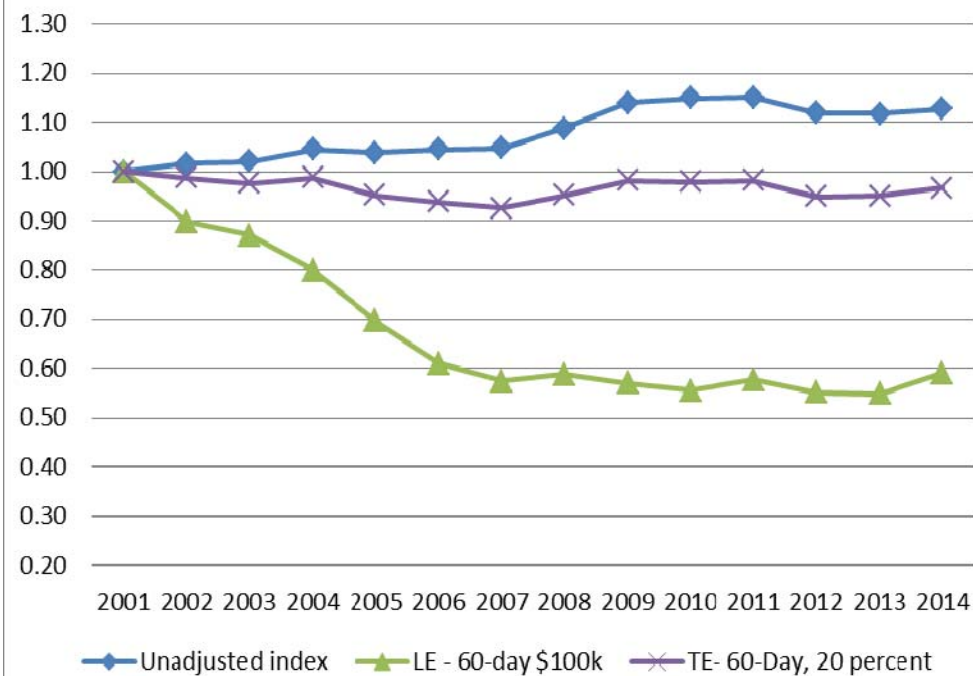
Figure 2. Acute myocardial infarction

Figure 3. Congestive heart failure

Figure 4. Pneumonia

Comments

LE index shows much steeper declines than others
- Increase in benefits substantially different from increase in costs.
  - AMI:
    - Increased benefits are ~$39,000 ($100,000/life year)
    - Average spending (measured through 60 days) decreased slightly

BP index virtually identical to unadjusted index
- We may not have identified treatment baskets correctly.
- Hard to know a priori what changes in treatments drive changes in outcomes.

Conclusion

Quality adjustment methods indicate an upward bias when not adjusting for quality for these conditions

COLI method suggests that average medical care price for the selected conditions are declining substantially over 2001-14

Other indexes diverge from LE index when changes in benefits are different from changes in costs

◦ In our example, differences are substantial

Estimates sensitive to assumptions; hard to choose among them