Medical Technology and Health Care Spending

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Introduction

- Spending on HC is rising faster than GDP
- HC prices are rising faster than the CPI
- These two trends have lead for many to bemoan the "high cost" of medical care
- Robert Wood Johnson Foundation
  - *Perhaps most critically, the need to constrain health care costs is an overarching theme of many health reform proposals.*

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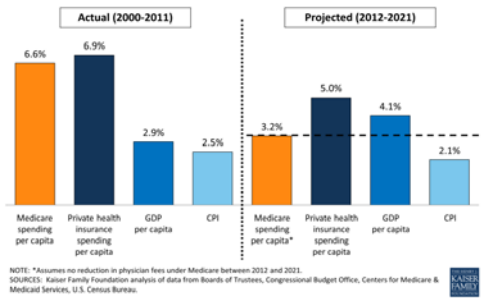
Historical and Projected Average Annual Growth Rate in Medicare Spending Per Capita and Other Measures



NOTE: *Assumes no reduction in physician fees under Medicare between 2012 and 2021.
SOURCES: Kaiser Family Foundation analysis of data from Boards of Trustees, Congressional Budget Office, Centers for Medicare & Medicaid Services, U.S. Census Bureau.

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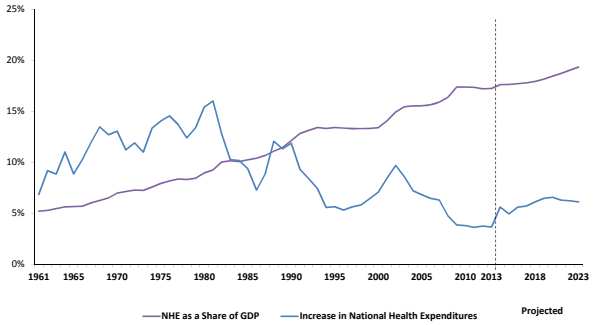
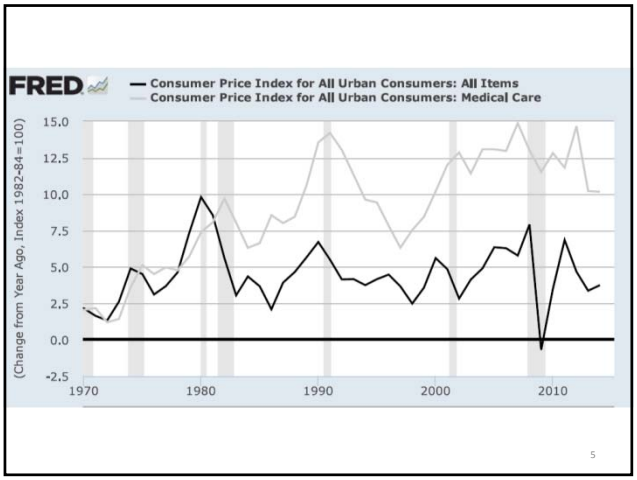
Annual Increase in National Health Expenditures and Their Share of Gross Domestic Product, 1961-2023



SOURCE: Kaiser Family Foundation calculations using NHE data from Centers for Medicare and Medicaid Services, Office of the Actuary, National Health Statistics Group, at http://www.cms.hhs.gov/NationalHealthExpendData/ (For 2012 data, see Historical; National Health Expenditures by type of service and source of funds, CY 1960-2012; file nhe2012.zip. For 2013-2023 data, see Projected; NHE Historical and projections, 1965-2023, file nhe65-23.zip). Gross Domestic Product data from Bureau of Economic Analysis, at http://bea.gov/national/index.htm#gdp (file gdplev.xls).



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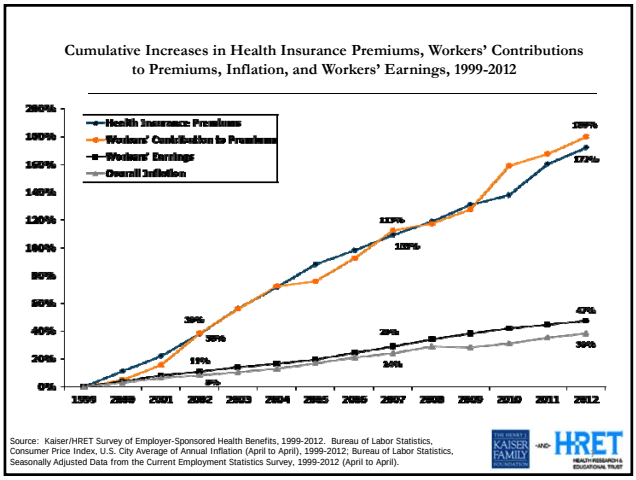

Health care spending

- Spending = $\Sigma_i p_i q_i$ where i indexes products
- Has spending increased because
  - Using health care more (increased q)
  - Prices have increased (increased p)
  - More products
- In many cases, observers use "spending" "costs" and "prices" interchangeably

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A couple of questions to consider?

- Are we spending too much on health care? How would we know?
- To answer these questions ask yourself
  - Why do expenditures increase?
  - Why do prices for a product rise?
  - Do not think of HC in particular – answer these questions for any particular product

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Why we should not worry

- Ebbs and flows
- Is it quality adjusted?
- Who is paying the cost?

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Why we should worry

- Excess burden of taxation
- Intergeneration equality
- Excess burden of moral hazard

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Newhouse

- Why have expenditures (P*Q) increased so rapidly in health care
- Simple decomposition
  - Expenditures = price*quantity
  - $E=PQ$
  - $\Delta E = P\Delta Q + \Delta PQ$
  - How much due to ΔP , how much to ΔQ

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Candidate reasons for increase in health care expenditures

- Aging of the population
- Increased insurance
- Increased income (income effects)
- Supplier induced demand
- Factor productivity in service sector
- End of life care

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Aging

- Average age of the population has been increasing for past half century
  - Population over 65 represented 8% in 1950
  - 12 percent today
  - 20 percent by 2040
- Newhouse: hold 1950's spending constant, increase share of elderly
- Explains only 15% of the increase

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- Let θ_i be fraction of people in group i
  - 3 groups <18, 19-64, 65+
- S_i be average spending per capita in group
- Total spending is a weighted average of spending across groups
- Hold spending per group constant but impose 1950's population weights

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- $S^{50} = \theta_1^{50}S_1^{50} + \theta_2^{50}S_2^{50} + \theta_3^{50}S_3^{50}$
- $S^{87} = \theta_1^{87}S_1^{87} + \theta_2^{87}S_2^{87} + \theta_3^{87}S_3^{87}$
- $S^{*50} = \theta_1^{50}S_1^{87} + \theta_2^{50}S_2^{87} + \theta_3^{50}S_3^{87}$ ← 1987 spending at at 1950 population shares
- $(S^{87} - S^{*50})/S^{*50} = 0.15$, only 15%

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Insurance

- Over time, fraction of people with insurance increased considerably
  - 1940, 10%
  - 2000, 85%
- Average coinsurance rate went from 67% to 27% between 1950 and 1987
- RAND HEI:
  - Movement from 95% to 0% coinsurance increases demand by 31%

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TABLE 3—VARIOUS MEASURES OF PREDICTED MEAN ANNUAL USE OF MEDICAL SERVICES, BY PLAN

Plan	Likelihood of Any Use (%)	One or More Admissions (%)	Medical Expenses (1984 $)
Free	86.7 (0.67)	10.37 (0.420)	777 (32.8)
Family Pay			
25 Percent	78.8 (0.99)	8.83 (0.379)	630 (29.0)
50 Percent	74.3 (1.86)	8.31 (0.400)	583 (32.6)
95 Percent	68.0 (1.48)	7.75 (0.354)	534 (27.4)
Individual Deductible	72.6 (1.14)	9.52 (0.529)	623 (34.6)

Big change in The probability Of use, 21% decline

25% reduction In hospitalization

31% reduction In costs

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- 95 percentage drop in price generated a 31 percent increase in use for an elasticity of demand of roughly -0.32
- 1950-1980 saw a (27-67)/67 = -0.60 or a 60% drop in price (coinsurance)
- Which means demand should have increased by 18% (-0.6)(-0.3)
- Use increased by a factor of 5, so < 3%
- What does this reasoning miss?

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Income effects

- 1940 and 1990, real GDP/capita increased by 180%
- Income elasticity of demand for medical care is 0.2 to 0.4
- Demand should have increased by 36% to 72%
- Actual use increased by 780% over this time period, about 10% of total

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End of life care

- Those nearing death have incredibly high medical costs
  - 6% of seniors die each year in Medicare
  - Represent 27.9% of all expenses in 1999
  - Average Medicare spending for person in last year of life, $25,000 in 1999
  - about $3,000 for survivors
- This fraction has been pretty stable over time. Was 28% in 1978

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Technology

- All of the factors so far, probably about 25% of the increase in medical care use over time
- What explains the rest? Technology
- MRIs, open heart surgery (CABG), angioplasty, CT scans, anti-psychotropic drugs, hip-knee replacements, neo-natal intensive care All **not** available 40 years ago. Now, commonplace

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Some evidence for Technology

- Rate of increase in medical costs similar across countries – suggests something broad based like technology
- Next table: If these other factors were important, we would see big increase in hospital admissions over time and length of stay. We don't. What we see is an increase in price/admission

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Table 3
Utilization of Short Stay General Hospitals

Year	*Adm / 1000*	*Length of Stay (days)*	*Days / 1000*	*Adjusted Cost / Day (1982 dollars)*
1950	110.5	8.1	895.1	n.a.
1960	128.9	7.6	980.0	$114[a]
1970	144.9	8.2	1188.1	$172
1980	160.4	7.6	1219.2	$282
1986	135.4	7.1	961.3	$437
1989	134.6	n.a.	n.a.	n.a.

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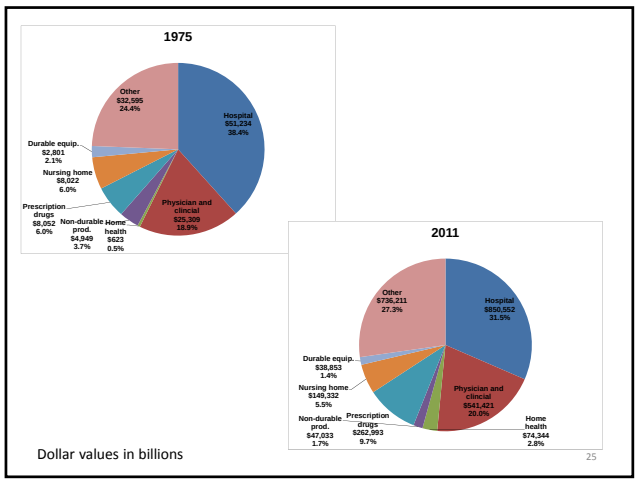

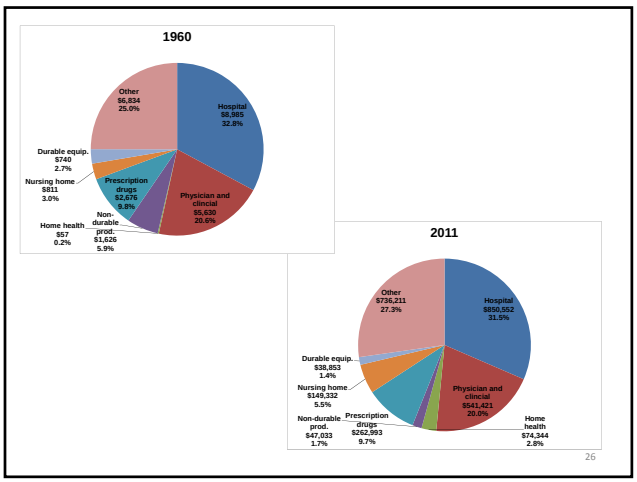

How technology generates spending

- New product to consume
  - Could displace current spending
  - Could reduce spending in other areas (offset)
- Many new products treat the symptoms and not the disease
  - Lipitor, HBP medication, Viagra, HRVs
  - In these cases, drugs work but one uses the Rx forever
- Mechanical relationship: Increase spending by expanding life

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Example: HIV/AIDS Drugs

- Early 1990s, quarterly mortality rates for patients w/ AIDS of 7.5%, annual rates of roughly 30%
- 1995:4, 1996:1, three new drug introduced to fight virus
  - Work by preventing the virus from replicating in the host
- Use rates increase immediately and aggregate mortality falls 70% in 18 months

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Figure 5: Quarterly Mortality Rate and Use of PI/Epivir

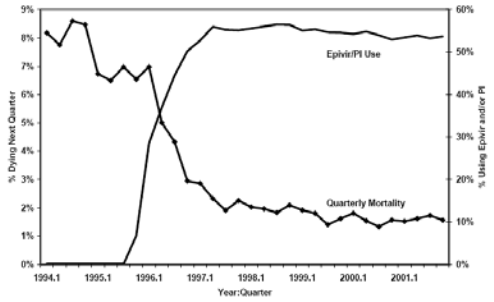

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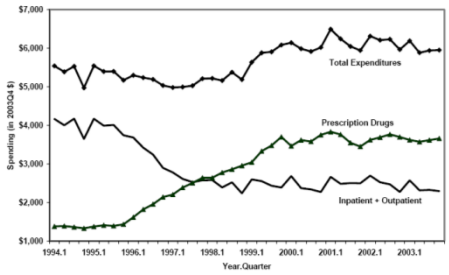
Figure 6: Average Quarterly Spending in the Medicaid HIV/AIDS Sample



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- AIDS drugs are expensive, $12K/year in some cases
- AIDS patients are expensive, $20K/year
- ARVs extend life considerably
- This medical advance, by construction, increases lifetime spending by a considerably amount

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Lifetime costs of treating AIDS patient w/out ARVs

Real price increase per quarter

$$(6)\ LT_{wo} = \sum_{t=0}^{\infty} M_0[(1+\rho)/(1+r)]^t\ (1-\delta)^t$$

Medical cost per period at diagnosis

Discount rate

Period mortality rate

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- Let r=ρ, so lifetime costs are now M_0/δ
- After ARVs, assume costs increase to M_a and period mortality rates falls to δ_A
- Change in life expectancy is $(1/\delta_A) - (1/\delta)$
- Quarterly mortality falls from 7.5 to 2.2 percent
  - life expectancy after diagnoses goes from 3.6 to 11.2 years
- M_0 is \$6242 and ARVs increase spending by 16% to \$7241
- Lifetime costs increase from \$83K to \$329K

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- Cost per life saved is (\$329K-\$83K)/(11.2-3.6) =\$33K/life year saved (2005 \$)
- Amazing lifesaving potential
- Although expensive, it is cheap in relative terms
- So although costs are increasing a lot, this is a cost-effective program

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What are some costs/life saved?

- Tengs et al., 1994. Review 587 life saving interventions
- Range: some save costs and save lives, others cost \$10 billion per life saved (1993 \$)
  - CPI in 1993 =144.5
  - CPI in 2014=236.7
  - Ratio = 236.7/144.5= 1.638, so these numbers should be increased by about 64%

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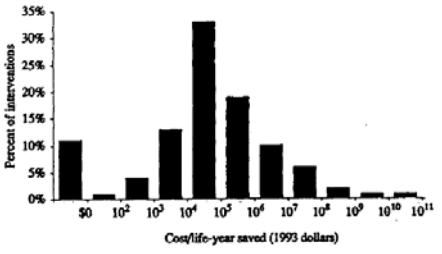

Fig. 1. Distribution of cost/life-year saved estimates (n = 587).

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What values are "worth it"

- Compare CLS (cost per life saved) to what people are willing to pay (Value of a statistical life)
- Currently, EPA uses $7.4 million VSL ($2006)
  - http://yosemite.epa.gov/ee/epa/eed.nsf/pages/MortalityRiskValuation.html#whatvalue

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- VSLY =value of a statistical life year
- Sum VSLY over all year for VSL
- VSL = Σ_t VSLY/$(1+r)^t$
- Example:
  - VSLY = $150,000, r=0.03, 80 years VSL=$4.5 million
  - VSLY = $150,000, r=0.03, 30 years VSL=$3.5 million
  - VSLY = $250,000, r=0.03, 80 years VSL=$7.5 million

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The Difficulty of Measuring Prices in Health Care

- Price indexes must keep 'all else constant'
  - Difficult to do when quality is changing rapidly (e.g., medical)
  - Boskin commission CPI overstates true inflation by
    - All good by 1.1 percentage points per year
    - Medical care growth by 3 pp/yr
- CPI only uses OOP spending as prices
  - With health care reform, OOP will decline and will make it seem that prices have fallen

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Laspyeres Price Index

$$SPI_{t_1} = \frac{\sum_{i=1}^{n} P_i(t_1)Q_i(t_0)}{\sum_{i=1}^{n} P_i(t_0)Q_i(t_0)}$$

n *number of products*

t_0 *original period*

t_1 *new period*

P_i *prices product i*

Q_i *quantity product i*

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Cutler and McClellan

- Construct price index for treatment of AMI (heart attack)
- One procedure with rapidly changing costs and outcomes
- Need to "hold all else constant"
- Solution: What is the cost of saving "one more life year"
  - Aggregates costs
  - Allows quality adjustments (declining)
  - But holds quality constant

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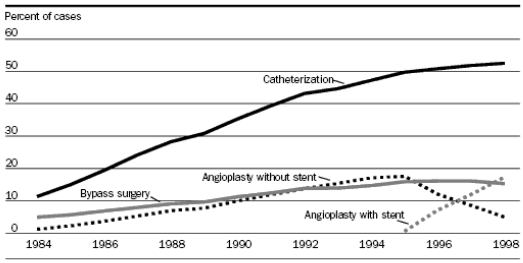
EXHIBIT 2
Changes In The Surgical Treatment Of Heart Attacks, 1984–1998



SOURCE: Authors' analysis of Medicare claims records for all elderly patients with a heart attack.
NOTES: Procedure use is within ninety days of the initial admission for the heart attack. See references in text for more detail.

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EXHIBIT 1
Accounting For The Increased Cost Of Heart Attack Treatments, 1984 And 1998

	1984	1998	Annual change
Total spending (billions)	$3.0	$4.8	3.4%
Number of cases	245,687	221,133	−0.8
Average spending per case	$12,083	$21,714	4.2

SOURCE: Authors' analysis of Medicare claims records for all elderly patients with a heart attack in 1984 and 1998.

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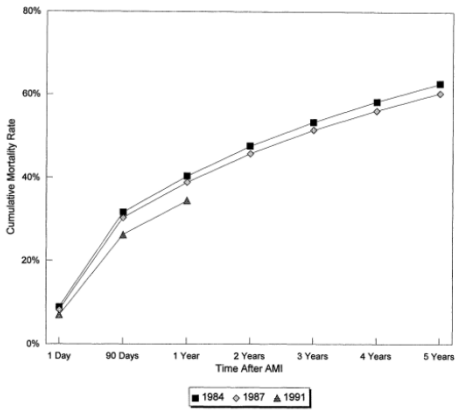

FIGURE IV
Changes in Mortality Rates After AMI

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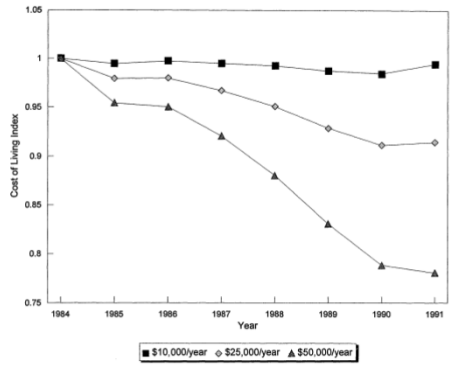

FIGURE V
Cost of Living Index

EXHIBIT 3
Summary Of Research On The Value Of Medical Technology Changes

Condition	Years	Change in treatment costs	Outcome Change	Value	Net benefit
Heart attack[a]	1984–98	$10,000	One-year increase in life expectancy	$70,000	$60,000
Low-birthweight infants[b]	1950–90	$40,000	Twelve-year increase in life expectancy	$240,000	$200,000
Depression[c]	1991–96	$0	Higher remission probability at some cost for those already treated		
		<$0	More people treated, with benefits exceeding costs		
Cataracts[d]	1969–98	$0	Substantial improvements in quality at no cost increase for those already treated		
		<$0	More people treated, with benefits exceeding costs		
Breast cancer[e]	1985–96	$20,000	Four-month increase in life expectancy	$20,000	$0

Table 1. Life Expectancy According to Age Group and Year, 1960–2000.

Age	Life Expectancy					Cumulative Change (1960–2000)
	1960	1970	1980	1990	2000	
				years		
Newborn	69.90	70.76	73.88	75.37	76.87	6.97
15 Yr	57.33	57.69	60.19	61.38	62.62	5.29
45 Yr	29.50	30.12	32.27	33.44	34.38	4.88
65 Yr	14.39	15.00	16.51	17.28	17.86	3.47

Table 3. Present Value of Average Medical Spending per Person According to Age Group and Year.*

Age	Average per Capita Spending					Cumulative Change (1960–2000)
	1960	1970	1980	1990	2000	
				$		
Newborn	13,943	25,528	37,085	56,120	83,307	69,364
15 Yr	18,700	32,704	47,155	69,457	102,490	83,790
45 Yr	17,141	35,266	63,275	100,983	148,014	130,873
65 Yr	11,495	34,526	69,819	116,097	158,549	147,054[7]

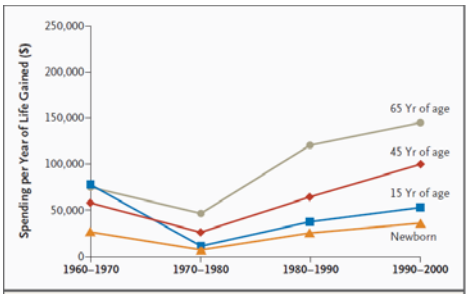

Figure 1. Longitudinal Trends in the Costs per Year of Life Gained in Four Age Groups.
Spending per year of life gained was defined by the change in spending over the decade divided by the change in expected years of life over the decade.

Simple calculation

- 1950-1990 PV of lifetime medical payments increased by $35,000
- Over the same period, life expectancy increased by 7 years
- PV of these benefits is $130K (tacked on at the end of life, assume 2% real IR -- $100K CLYS)
- Even if health care can explain only 1/4 of these benefits, medical care pays for itself

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- Assume 80 year life span, tack-on the 7 years at the end, discount back to present

$$\sum_{t=81}^{87} 100,000/(1.02)^t = \$132,746$$

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