Mgmt 444

Cost Effectiveness Analysis in Health Care

Economists have produced startlingly large numbers for the value of life - individuals are willing to sacrifice millions to save just one life

Many in the health care community are reluctant to embrace these methods

- As we will see, these figures seem to justify decades-long increases in health care spending

- Some challenge the basic premise of the exercise on ethical grounds and worry that it might lead to rationing

- There are also challenges to internal validity – is the theory valid? Are estimates from different data sources consistent?

Can we have a value-based healthcare system without explicitly putting a dollar value on life?

- Perhaps we need not measure health on a dollar yardstick

- We can still compare merits of different interventions, assuring that we properly allocate scarce health care resources.

This is really a matter of whether we are to be guided by Cost Benefit Analysis (CBA) or Cost Effectiveness Analysis (CEA)

- CBA is used to arrive at a go/no-go decision for a particular project/plan, such as a marketing campaign

- To perform a CBA, costs and benefits must be measured on the same yardstick

    - Invariably, the yardstick is dollars -- we might compare the profits from new sales against the marketing expense
    - Application of CBA to health care requires placing a dollar value on health. Not all are willing to do so

- CEA is used to rank alternative uses of scarce funds

    - Alternative promotional tools
    - Alternative pollution abatement programs

- To perform a CEA, benefits of each program must be measured on a common yardstick

    - Increased market share
    - Reductions in effluents

A study by the Harvard School of Public health entitled "500 Life Saving Interventions and their Cost-Effectiveness..." suggests how much can be gained by CEA

- They identified CE studies in five categories

- They report the following median costs per life year saved (in 1993 dollars) by category

Median costs per life year saved by category of intervention

Category	**Median cost per life year saved**
Health	$19,000
Residential	$36,000
Transportation	$56,000
Occupational	$346,000
Environment	$4,207,000
All studies	$42,000

- This masks considerable variation within each category. Here are some CE ratios for health care interventions:

Median costs per life year saved for selected health care interventions

Intervention	**Median cost per life year saved**
Childhood immunizations	Net savings
Defibrillators in emergency vehicles	$400
Influenza vaccinations	$1000
Beta-blocker following AMI	$2000
Hypertension drugs	$15,000
PTCA (angioplasty)	$16,000
Renal dialysis	$46,000
Alpha antitrypsin replacement therapy	$91,000
Annual cervical cancer screen	$216,000
Endoscopy for gastric cancer	$360,000

The authors reach two conclusions:

- We (individually and collectively) are grossly misallocating money spent to improve our health

- If we use CE as the basis for allocation, we can save billions of dollars and tens of thousands of lives annually.

The first step to CEA/CBA: Selecting the *Point of View*

- There are many valid points of view for CEA/CBA

- What is a benefit to some may be a cost to another

- The optimal decision will often depend on the viewpoint

Consider performing an analysis of an asthma medication that reduces the incidence of asthma attacks.

- There are many potential points of view: The patient, the doctor, insurer, employer, society, …

- Let's list some of the effects of the medication, and consider them from different points of view. Are these benefits or costs?

Effect	Patient	Doctor	Insurer	Employer	Drug maker
Improved Health					
Cost of drug					
Productivity					

Q: Would efficient markets resolve some of these conflicts?

Most CE research takes society's viewpoint. (Recall the International Society for Pharmacoeconomics and Outcomes guidelines.) The U.S. Panel on Cost-effectiveness lists the following factors to include:

1) *Changes in use of health care resources*.

- Health care resources include personnel, materials, and equipment used during the course of treatment.

- Additional use of some resources may be offset by reductions in use of other resources

. For example, if hospice use is associated with a decline in inpatient hospital utilization, the savings from the latter should be deducted from the cost of the former.

2) *Changes in the use of non-health care resources*.

- This largely refers to the value of the time invested by the patient and family members. This detracts from both workplace productivity and leisure and these should be counted as part of the cost of care.

- Putting a dollar value on time can be tricky. Reduced workplace productivity can be equated to lost wages. Values for household production or leisure are often pegged at $12-$20 per hour for the typical American

3) *Quality and Quantity of Life.*

- The ultimate goal of most health care interventions is to improve the patient's quality and quantity of life. This is what goes on the benefit side of the ledger

- We will see that considerable progress has been made in quantifying the health benefits of medical care

What is not included?

- In principle, payments from patients/insurers to providers should not be included, if actual provider costs are included.

. These are considered resource neutral *transfers of wealth*.
. Any payments in excess of costs are captured as profits by the providers; from society's viewpoint, these profits count

- Exception: When considering drug costs, most analyses use prices, rather than marginal costs.

- Put another way, drug company incremental profits are not included in CBA, even when taking society's perspective

. One rationalization is that incremental profits generate future research, and should be included in the cost of current drugs

Measuring Costs

Issue 1: Measuring provider costs

- Hospital Costs

. These are tricky to measure because 40-60 percent are allocated fixed costs and allocation is often arbitrary
. In the U.S., there are several popular hospital cost accounting methodologies. None are perfect and they require the cooperation of hospitals if an independent researcher wants to gather the data
. Other methods rely on publicly reported hospital cost data. These are less accurate but have the virtue of completeness

- Measuring costs at other providers is more difficult. Payments to providers are often used as a measure of societal costs (and countries other than the U.S. often do this to measure all provider costs.)

Issue 2: Discounting

- Everyone understands the need to discount future costs. This is best done by trying to project out future costs in nominal dollars and then adjusting using a discount rate such as the real cost of capital

  . As a shortcut, one might assume that costs will inflate at a rate equal to the cost of capital, so that the two cancel out

- This is an appropriate time to discuss the idea of *discounting future benefits*

Q: Should benefits be discounted? Put another way, are lives in the future worth less than lives today?

- Here is a formal analysis of the problem

  . Let V denote the value of a life saved when measured in the year the life is saved. Let us suppose this is always the same.
  . Should we discount V if the life is saved in some future period?

- Additional notation

  - C = current cost of an intervention
  - r = cost of capital (used to discount costs)
  - ρ = discount rate for benefits (possibly zero)

- Suppose that there is an intervention that will cost C dollars today and save one life five years from now.

  . From the perspective of decision makers five years from now, the intervention has benefit = V and cost = $C\cdot(1+r)^5$
  . Decision makers five years hence will be indifferent to what we did today if $V= C\cdot(1+r)^5$. Rearranging yields: $\mathbf{V/(1+r)^5 = C}$

- Never mind what our future selves think. What do we think today?

  . The cost today = C. The benefit = $V/(1+\rho)^5$.
  . We will be indifferent if $\mathbf{V/(1+\rho)^5 = C}$

- If we want our decisions to be consistent over time, then we will want our decision rule today to exactly match the decision rule we would have wished we had used when we look back five years from now.

. This implies that we would want $\mathbf{V/(1+r)^5 = V/(1+\rho)^5}$.
. Thus, $\boldsymbol{\rho = r}$.
. In other words, *the only way to have time consistent decisions is if we set the discount rate for future lives equal to the discount rate for costs*

- The standard approach in CEA is to use the same real discount rate for costs and benefits, in the range of 3-5 percent, and perform a sensitivity analysis

Issue 3: Accounting for future costs

- E.g. Suppose a CABG patient requires home care. Everyone agrees that the cost of home care be included in the cost of the surgery

- Q: Suppose the surgery leads to other health problems in the future. Should we include future health care costs triggered by the surgery?

. Perhaps surprisingly, the answer is yes
. To be fair, if the surgery reduces future health costs, these should be subtracted from the costs of the surgery

- More surprising still, it is also appropriate to include future *non-health spending*

. If someone lives longer, their spending on food, etc. should be included on the cost side of the ledger
. This spending is necessary for them to enjoy the benefits
. Failure to include future non-health spending can introduce bias that *favors life extending interventions over life enhancing innovations* (e.g. liver transplant versus hip replacement)
. Life-extending interventions use up more of societal resources, all else equal

Researchers have developed adjusters based on this ratio

- Handout goes through the economic argument and some numerical illustrations; I will summarize the illustrations in class

- Unlike discounting benefits, there is no consensus on this matter, and the practice is left to the discretion of the analyst

Measuring Benefits in CEA

Some benefits can be measured in dollars

- If an intervention allows the worker to return to work, we can measure the benefits in terms of the corresponding wage. (Valuing household productivity is more controversial)

- This amount is usually deducted from the medical cost to obtain a net cost, rather than included in the benefit side of the ledger

Direct health benefits are not readily measured in dollars

- We could use lives saved or years of life saved

- This ignores enhancements to the quality of life

- Different interventions may produce different types of health improvements that are not easily placed on the same scale

    . Consider prostatectomy versus medicinal treatment of prostate cancer
    . In addition to saving lives, each has different implications for pain, incontinence, and potency

Critical question: Can health care quality be reduced to a single dimension to facilitate CEA?

Researchers have developed several uni-dimensional scales to permit CEA of health care interventions. They go by names like DALY, QALY, QWB, and HYE

- All scales measure health states on continuum from 0 to 1. Improvements in health are measured along this scale.

- E.g., if "visually impaired" scores 0.67 on the QALY scale, then a cure for macular degeneration yields a benefit of 0.33

There are two basic methods for constructing the scales

- One method, exemplified by Quality of Well Being (QWB) and the EuroQoL, combines expert opinion with consumer surveys.

- Step 1: physicians rate diseases from 1 to 3 (or 1 to 5) on several dimensions such as mobility, physical activity, and social activity. Here is an example:

Quality of Well Being Scale

Attribute	**Level**	**Score**
Physical function	No limitations	1
	Mild or moderate limitations	2
	Severe limitations	3
Social function	No limitations	1
	Mild or moderate limitations	2
	Severe limitations	3
Emotion well-being	No limitations	1
	Mild or moderate limitations	2
	Severe limitations	3
Pain	No pain	1
	Mild or moderate pain	2
	Severe pain	3
Cognitive ability	No limitations	1
	Mild or moderate limitations	2
	Severe limitations	3

- Each condition gets a five digit "score", such as 22212

- Step 2: Regular folks rate five digit scores on a scale from 0 to 1. (By using regression analysis, respondents need not rate every score).

- To construct a QWB score for a particular condition, researchers combine the MD ratings with the individual evaluations

. E.g., MDs give "needs a walking stick" (NWS) a score of 22212
. Patients give the five digit score of 22212 a QWB score of 0.8.
. Thus, NWS scores 0.8 on the QWB scale

QALYs

The second approach, exemplified by Quality Adjusted Life Years (QALY), has greater acceptance than the QWB

- Individuals respond to a series of survey questions about specific medical conditions

- Based on these responses, researchers give scores for each condition

QALYs are derived from assumptions about individual decision making.

- These assumptions, which are associated with the esoteric topic of utility axioms, are often challenged by psychologists

. E.g., the "independence of irrelevant alternatives" assumption is sometimes violated in carefully constructed experiments

- The most critical assumption is that societal benefits are the simple sum of each individual's benefits

. This can be challenged on philosophical grounds (e.g., Rawls)

- I will spare you the details of the decision theoretic foundations of QALYs

If we accept the assumptions, QALYs are easy to use

- One computes the aggregate QALY gain from an intervention, mainly through clinical trials and statistical modeling

- Compare this with the cost to obtain the "cost per QALY"

- Pick those interventions that provide the biggest QALY gain per buck

Here is how QALYs are measured

There are three different methods used to place health states on the QALY scale. The first is easiest to implement, but least well tied to theory

1) *Relative Scale*: Suppose that you gave a "score" of 20 points to "complete health." Imagine some condition that you consider to be only half as healthy as complete health. You give a score of 10 points to this condition.

Let X denote the score you would give to the condition: "Needs a walking stick, but otherwise in complete health"? What is X?

Your answer: X = _____ points Your QALY score = X/20 = _____

2) *Standard Gamble*: Due to an injury, you require a walking stick for the rest of your life. There is a free, painless operation that can restore your complete health, but will cause your immediate (painless) death if unsuccessful.

· Suppose that the operation is successful only Y% of the time.

· Obviously, if Y is 100, then you would agree to go ahead with the operation. If Y is 0, you would surely forego the operation.

For what value of Y would you be undecided about receiving the operation?

Your answer: Y = _____% Your QALY score = Y/100 = _____

3) *Time Trade Off*: You have a choice between living 40 more years with a walking stick (and then dying a painless death), or living Z more years in complete health.

How big must Z be so that you are *indifferent* between the two choices? (Presumably, Z <= 40).

Your answer: Z = _____ years Your QALY score = Z/40 = _____

Researchers have produced thousands of QALY scores for use by drug makers, regulators, and other CEA analysts.

Here are some examples from published studies:

Some QALY Scores

Condition	Relative Scale	Standard Gamble	Time Trade-off
Needs walking stick (NWS)	.65	.85	.78
Needs walking frame	.47	.81	.58
Needs assistant to walk	.18	.55	.28
Needs wheelchair	.37	--	.36
Tired, sleepless	.74	.92	--
In bed/poor memory	.30	.30	--
Visual impairment/ Limited activities (blind)	.50	--	.42
In house, vomiting	.47	.66	--
Moderate pain/ Depressed	.71	--	--
Moderate pain/ Depressed/Can't work	.30	--	--

These scores are used to compute costs per QALY for different interventions

Here is a highly stylized example

- Consider total hip replacement and corneal transplant

  . Suppose $QALY_{NWS} = .8$ $QALY_{blind} = .5$
  . THR costs $36,000, permits normal walking for 12 years, and has a 75 percent success rate
  . CT costs $63,000, permits normal vision for 6 years, and has a 70 percent success rate

- We can compute the cost per QALY as follows:

  . For THR, QALY gain is $0.2 \cdot 12 \cdot .75 = 1.8$ QALYs. Thus, the cost per QALY gained is $20,000.
  . For CT, QALY gain is $0.5 \cdot 6 \cdot .7 = 2.1$ QALYs. Thus, the cost per QALY gained is $30,000.
  . In this case, THR is preferred

- A general rule of thumb among decision makers is to accept the intervention if cost/QALY < $20,000 and reject if cost/QALY > $60,000.

  . These methods lead to creation of "league tables"
  . These are rarely published. Here is a link to a comprehensive NICE league table:

http://www.herc.ox.ac.uk/research/decisionmaking/QALYleaguetable

Here is a shorter example from 1995

Health Intervention	*Cost/QALY Gained*
CABG for left main coronary artery	$4,200
Neonatal ICU (1000-1499 g)	4,500
Treatment of severe hypertension	9,400
Treatment of mild hypertension	19,100
Estrogen therapy (post-menopausal)	27,000
Neonatal ICU (500-999 g)	31,800
CABG for single vessal disease (with severe angina)	36,300
School tuberculin testing	43,700
Hospital hemodialysis	54,000

Issues in QALY analysis

Needless to say, QALY implementation is far from easy. Here are some concerns:

1) Computing the QALY gains

- The field of "outcomes research" is devoted in large part to modeling how interventions affect outcomes.

- Analysts use decision trees to compute probabilities of different health states and the ultimate distribution of outcomes and expected health states

. Each outcome gets assigned a probability and a QALY score.
. It is a simple matter to compute the expected QALY score

- If actual outcomes cannot be predicted from studies, then researchers use information relating intermediate measures (e.g. blood pressure) to the ultimate outcomes (e.g. heart attack)

2) QALY approach assumes all individuals to have the same utility for a given health state

- Responses to survey questions vary by culture and by experience with the condition

- Some individuals may have greater distaste for a health state than others

- Q: In a market system, individuals would allocate money to cure those ailments that matter the most to them. Why don't we do this in the QALY system?

3) QALYs necessarily discriminate by age

- Q: Is this acceptable?

4) Measurement of scales

- Under traditional CE, there is a fixed budget and you go down the league table until you exhaust the funds.

- In practice, government agency budgets are not fixed. Instead, they use a cutoff to evaluate each new intervention. The cutoff is generally around $20,000-$60,000 per QALY

- Wide "grey area" recognizes room for manipulation, through selection of scale, discount rate, accounting for future costs, survey respondents, etc.

- But grey area could easily be set at $120,000-$200,000 or $2,000-$6,000

- The cutoff was historically set to be roughly budget neutral. But is this the right cutoff from the perspective of CBA?

Q: Can we do without CBA?