Costs I

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Cost-Effectiveness Analysis
HSMP 6609
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Outline

- Micro 101: Cost definitions (lots of new terms you need to learn)
- Rules for thinking about which costs to include or exclude
- Examples
- More on perspective
- The difficult parts (cost versus charges, opportunity costs versus prices, etc)
- Discounting

Department of Forest and Trees

- As usual, keep in mind that we want to calculate the ICER, which is: $\frac{C_2 - C_1}{E_2 - E_1} = \frac{\Delta C}{\Delta E}$
- We'll get a number that compares the incremental (marginal) costs to the incremental (marginal) effectiveness (natural units or QALYs)
- This number doesn't tell us if an intervention is cost effective. We need to compare it to something else
- It doesn't tell us either if an intervention is **affordable**
- Much less if it's **equitable**

Microeconomics 101

- **Total** cost, **average** costs, and **marginal** cost

$$TC = p_1 * q_1 + p_2 * q_2 + ... + p_n * q_n = \sum_{i=1}^{n} p_i * q_i,$$

where TC is total cost and p is price and q is quantify for **inputs**

$$AC = \frac{TC}{X},$$

where AC is average costs and X is the level of **output**

Microeconomics 101

- Remember, because we want to make decisions between alternatives, we think "**at the margin**"
- The **marginal cost** is the cost associated with producing additional unit(s) of output

$$MC = \frac{TC(X2) - TC(X1)}{X2 - X1},$$

  where $TC(Xi)$ is the cost of producing Xi units.
- Usually, $X2 - X1 = 1$ so MC is the extra cost of producing an additional unit, which usually depends on the number of units
- Another way of saying the same (for a small change) is using calculus: $MC = \frac{dTC(X)}{dX}$

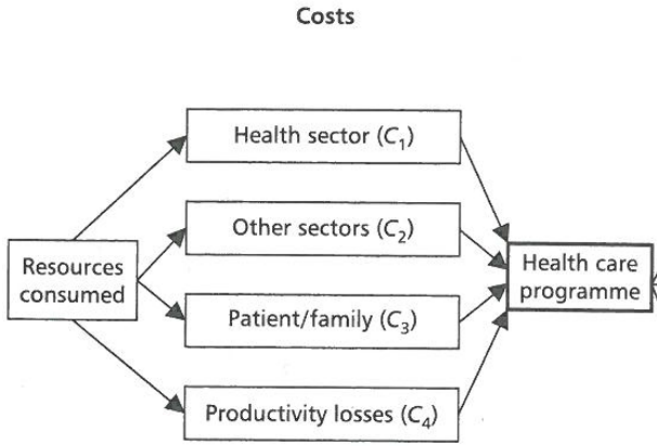
Microeconomics 101

- **Fixed costs**: Do NOT vary with the level of output, X (i.e. rent)
- **Variable costs**: Do vary with the level of output (i.e. medications in a hospital)
- **Alert**: "Fixed" costs **can change over time**
- Example: You signed up for a marathon but the day before you aren't sure if you want to do it. Your friend tells you that you **should** because you already paid the $100 registration fee, which you'll "lose" if you don't run
- What would a *normal* person say? What would an *abnormal* person (i.e. economist) say?
- **Sunk cost**: cost that has already been incurred and cannot be recovered regardless of the current decision
- **Sunk costs are irrelevant for decision making** (they are, well, sunk)

Microeconomics 101

- **Financial costs** are the money outlays for resources; **economic costs** are the opportunity costs of the resources used to implement an intervention
- **Opportunity costs**: the loss of potential gain from other alternatives when one alternative is chosen, or "the value of the forgone benefits because the resource is not available for its **best** alternative use"
- Examples:
  - What are the opportunity costs of getting a MPH?
  - You had to do your HSMP 6609 homework this past Sunday night. Your opportunity cost was missing the Super Bowl (opportunity cost can be negative; maybe you don't like one of the teams)
  - For a hospital, the opportunity cost of spending $300,000 in a party are the 3 nurses that they won't hire (and the profits they may lose)
- **Transfer payments**: No resource utilization and from the point of view of the society they are not costs (e.g. welfare, social security, workers compensation)

Which costs should be considered in EEs?

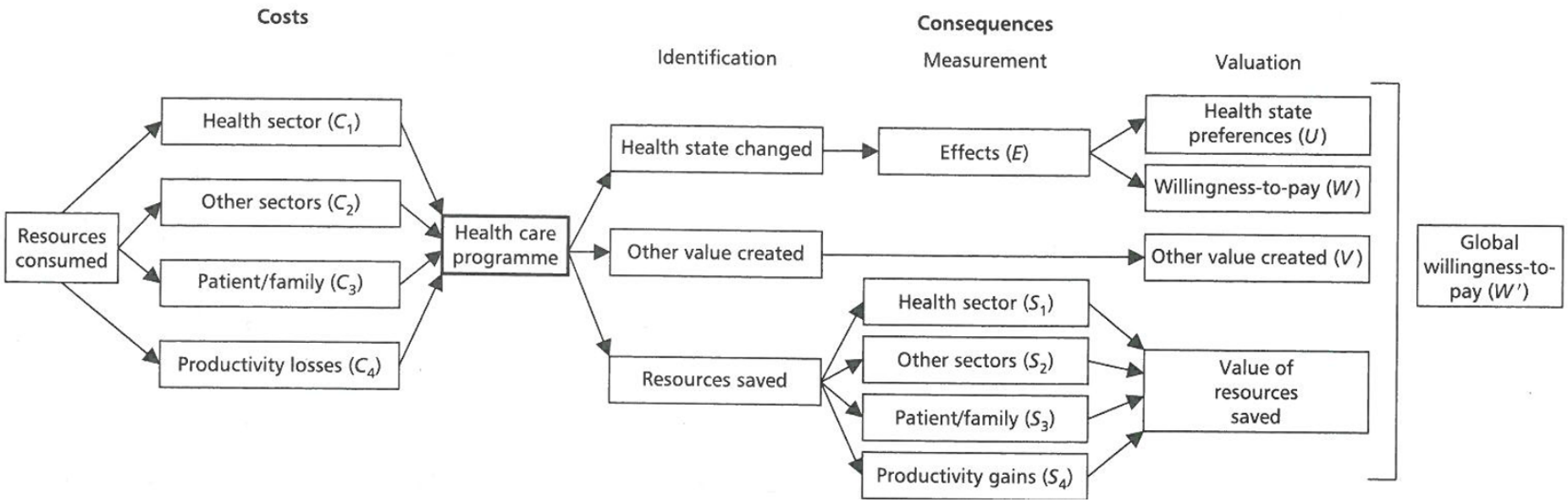


- Older terminology that it's still around:
- **Direct costs**: Changes in resource use attributable to the intervention
- **Indirect costs**: Productivity gains or losses related to illness or death
- Problem is that "direct" and "indirect" are not consistently used. In accounting indirect costs are **overhead** costs. People still use direct and indirect costs. When you encounter these terms, think about the above figure instead

By category

- **Health sector**: cost of therapy, hospital (inpatient and outpatient), medication, physician time, and so on...
- **Other sectors**: Social services, shelters, government services, or any cost of the intervention that is not provided by the health care sector
- **Patient/family**: Transportation, accommodation, caregiver time
- **Productivity losses**: Days off, not working or disable

What about cost savings?



- This will be in your final:
- Cost savings **are not benefits**
- Cost studies **are not** cost-benefit studies

From your textbook

Table 1.1 Measurement of costs and consequences in economic evaluation

Type of study	Measurement / valuation of costs in both alternatives	Identification of consequences	Measurement/ valuation of consequences
Cost analysis	Monetary units	None	None
Cost-effectiveness analysis	Monetary units	Single effect of interest, common to both alternatives, but achieved to different degrees	Natural units (e.g. life-years gained, disability days saved, points of blood pressure reduction, etc.)
Cost–utility analysis	Monetary units	Single or multiple effects, not necessarily common to both alternatives	Healthy years (typically measured as quality-adjusted life-years)
Cost–benefit analysis	Monetary units	Single or multiple effects, not necessarily common to both alternatives	Monetary units

Which costs should be considered in EEs?

- Remember: key considerations are a) **viewpoint** of the analysis, b) **time horizon**, and c) **relevance** of cost item for the decision
- Example adapted from Byford et al (2003). I changed some numbers. See a similar example on Chapter 7
- 480 patients with a history of recurrent deliberate self-harm randomized into cognitive-therapy (CBT) or usual treatment (UT). Time horizon: 1 year
- Patients were sent to several treatment sessions. Some of the patients were hospitalized or in prison or needed accommodations
- **Possible perspective**: 1) Provider, 2) Payer, 3) Society (following the new recommendations from the Panel on CEA)
- What cost should be included? To simplify, let's pretend they were veterans covered by the VA

Byford et al (2003)

- Cost table (per person, average) adapted from paper:

	Cognitive Therapy	Usual Treatment
Cost item		
a) Hospital services	1,548	1,796
b) Outpatients services	678	566
c) Medication	169	140
d) Criminal justice	126	600
e) Social services	252	470
f) Living expenses	10,369	10,570
g) Productivity	294	450

Byford et al (2003)

- Use categories to combine costs

	Cognitive Therapy	Usual Treatment
Cost item		
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Using textbook categories		
Health sector (a+b+c)	2,395	2,502
Other sectors (d+e)	378	1,070
Patient/family (f)	10,369	10,570
Productivity (g)	294	450

Byford et al (2003)

- Now, different perspectives

Using textbook categories			
Health sector (a+b+c)	2,395	2,502	
Other sectors (d+e)	378	1,070	
Patient/family (f)	10,369	10,570	
Productivity (g)	294	450	
Perspective			UT-CBT
Medical payer (a+b+c)	2,395	2,502	107
Society (a to g)	13,436	14,592	1,156

- Note that we need to know the **context**. We are assuming that the patient/family is covering living expenses. If for some reason the VA covers those expenses, then we would need to add (f) to the payer perspective

Perspective of the study, again

- Note that the perspective **is not the viewpoint** of the authors, funders, journal editors, their family members or pets
- It is the **analysis perspective**. The broadest perspective is the *societal perspective*:
- "In a CEA conducted from a societal perspective, the analysts considers **all parties affected** by the intervention and counts **all significant outcomes and costs** that flow from it, **regardless of who experiences the outcomes of costs**. The original panel also noted that to address specific decision contexts analysts might also conduct CEAs from narrower perspectives, such as that of the healthcare sector, to reflect the view of a decision maker whose responsibility rests only within that sector." (Neumann et al, 2016)
- Gold book: Who is affected? On whose behalf are decisions made? Who pays for it?

Perspective of the study, again

- When we think about the perspective, we think about the **costs**. The outcomes (consequences, benefits) are from the perspective of those receiving the intervention (usually patients)
- Suppose the state of Colorado did the CB vs UT study and we wanted to use the state perspective. We would need to to figure out what is paid by the state of Colorado
- If the participants were on Medicaid, some of the medical care is paid by the federal government. So a study from the perspective of Colorado would need to subtract the federal share

From Neumann (2009)

- The **societal perspective** can be fuzzy sometimes. Some studies measure costs from a narrower perspective but measure QALYs from a societal perspective (and argue that the study was from a societal perspective; this is how the CEA registry defines societal perspective) (see Neumann, 2009)

TABLE 2. Perspective Used in Published CUAs, 1976 to 2005

	As Stated By Author	As Stated By Reviewer
Societal	473 (40.6%)	341 (29.3%)
Health care payer	382 (32.8%)	799 (68.6%)
Not stated/could not be determined	298 (25.6%)	16 (1.4%)
Other	11 (0.9%)	8 (0.7%)
Total	1164	1164

Source: Center for the Evaluation of Value and Risk in Health. Tufts Medical Center. "CEA Registry." Available at: www.cearegistry.org. Accessed May 15, 2008.[19]

From Neumann (2009)

- What are the most common cost components included in CUAs?

TABLE 1. Cost Components Included in Published CUAs, 1976 to 1997

Cost Components Included	n = 228
Direct health care costs	226 (99.1%)
Intervention	222 (97.4%)
Hospitalization	199 (87.3%)
Outpatient visits	167 (73.2%)
Long-term care	28 (12.3%)
Other health care	165 (72.4%)
Direct nonhealth care and time costs	38 (16.7%)
Patient time	22 (9.6%)
Transportation	11 (4.8%)
Family/caregiver time	13 (5.7%)
Social services	6 (2.6%)
Productivity costs	19 (8.3%)
Other	5 (2.2%)

Source: Stone PW, Liljas B, Chapman RC, et al. Variations in methods to estimate costs in cost-effectiveness analyses. *Int J Technol Assess Health Care.* 2000;16:111–124.[3]

Impact inventory

- This is the motivation behind the **impact inventory** (part of the new new recommendations from the Panel on Cost Effectiveness)
- It's a **checklist** that journals will (hopefully/maybe/who knows) require authors to submit
- Also a nice reminder of the items that you could consider
- See Sanders et al.(2016) for more details

Impact inventory

Sector	Type of Impact (list category within each sector with unit of measure if relevant)[a]	Included in This Reference Case Analysis From...Perspective?		Notes on Sources of Evidence
		Health Care Sector	Societal	
Formal Health Care Sector				
Benefits -> Health	Health outcomes (effects)			
	Longevity effects	☐	☐	
	Health-related quality-of-life effects	☐	☐	
	Other health effects (eg, adverse events and secondary transmissions of infections)	☐	☐	
	Medical costs			
	Paid for by third-party payers	☐	☐	
	Paid for by patients out-of-pocket	☐	☐	
	Future related medical costs (payers and patients)	☐	☐	
	Future unrelated medical costs (payers and patients)	☐	☐	
Informal Health Care Sector				
Health	Patient-time costs	NA	☐	
	Unpaid caregiver-time costs	NA	☐	
	Transportation costs	NA	☐	
Non–Health Care Sectors (with examples of possible items)				
Productivity	Labor market earnings lost	NA	☐	
	Cost of unpaid lost productivity due to illness	NA	☐	
	Cost of uncompensated household production[b]	NA	☐	
Consumption	Future consumption unrelated to health	NA	☐	
Social Services	Cost of social services as part of intervention	NA	☐	
Legal or Criminal Justice	Number of crimes related to intervention	NA	☐	
	Cost of crimes related to intervention	NA	☐	
Education	Impact of intervention on educational achievement of population	NA	☐	
Housing	Cost of intervention on home improvements (eg, removing lead paint)	NA	☐	
Environment	Production of toxic waste pollution by intervention	NA	☐	
Other (specify)	Other impacts	NA	☐	

Big picture

- In general, **identifying** costs and **measuring/counting** costs are **not** the difficult parts (**valuation** is)
- Where do we get data from?

  - In EEs that are performed along a clinical trial, there are **case report** forms

  - **Case notes** from clinical records or **claims** data or **electronic medical records**

  - **Interviews** of patients about other quantities (days off taken, assistance from family, etc)

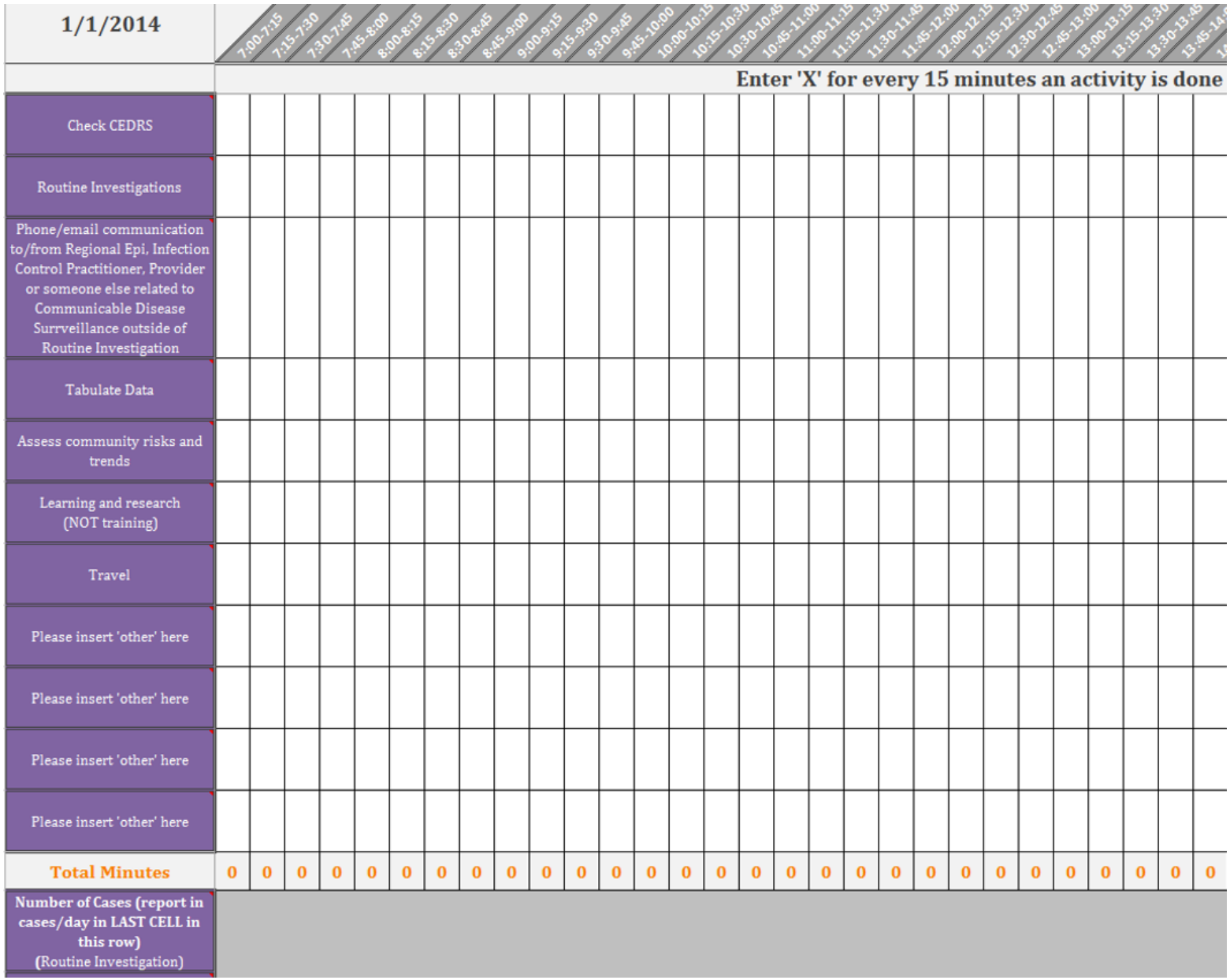
  - **Diaries**

How precise do cost need to be?

- No clear answer except to say that it should not bias the comparison
- Two extremes

  Micro costing: count every unit and price it
  Gross costing: aggregate (DRG, cost per day, or from medical literature)
- In the CFPI, we got average cost per person from different state agencies
- Perraillon et al (2019) has an example of leveraging electronic health records, nurse assignment, and financial data to more accurately measure nursing costs

Examples: CDC Communicable disease cost log and survey



1/1/2014	7:00-7:15	7:15-7:30	7:30-7:45	7:45-8:00	8:00-8:15	8:15-8:30	8:30-8:45	8:45-9:00	9:00-9:15	9:15-9:30	9:30-9:45	9:45-10:00	10:00-10:15	10:15-10:30	10:30-10:45	10:45-11:00	11:00-11:15	11:15-11:30	11:30-11:45	11:45-12:00	12:00-12:15	12:15-12:30	12:30-12:45	12:45-13:00	13:00-13:15	13:15-13:30	13:30-13:45	13:45-14:
	Enter 'X' for every 15 minutes an activity is done																											
Check CEDRS																												
Routine Investigations																												
Phone/email communication to/from Regional Epi, Infection Control Practitioner, Provider or someone else related to Communicable Disease Surrveillance outside of Routine Investigation																												
Tabulate Data																												
Assess community risks and trends																												
Learning and research (NOT training)																												
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Number of Cases (report in cases/day in LAST CELL in this row) (Routine Investigation)																												

Examples: Screening time log

Screening location:

Number of screeners:

Number of patients/siblings screened simultaneously:

Activity	Start time	End time
Recruitment		
Consenting		
Completing screening questionnaire		
Sample collection		

Type of sample collection (mark one; if more than one, please indicate the number):

__ Finger prick

__ Intravenous

__ IV fluid line

Relevance of cost for the decision

- **Reminder**: this is an important tool to figure out what to include
  1. If both alternatives have the same costs, then they can be ignored
  2. If some costs are not going to change the decision and are complicated to obtain, they could be ignored. Should provide some justification, though (that's the purpose of the impact inventory)
- Each case is different; determining which costs are relevant requires some thinking
- Sometimes you know that costs are not relevant **only after you measure them**

Now the **complicated** parts

1. The distinction between prices and costs
2. How to value items: charges or costs?
3. How do we value things for which there is no market?
4. Should health care costs unrelated to the program or intervention be included?
5. Should related or unrelated *non-health care* costs be included?
6. How should overhead costs be calculated?
7. How do we discount costs and why?
8. How do we measure productivity losses?

Some of these issues are complicated in theory but not in practice, while others are clear in theory but complicated in practice

Prices and costs

- We need some basic yet advanced economics here (**Department of Yogi Berra Statements**)
- In EEs we want to compare the resources consumed to the outcomes obtained
- In markets resembling **perfectly competitive markets, prices would be a good measure for costs** –in the economics sense of costs: opportunity costs
- Perfectly Competitive markets:
  1. Firms sell identical products
  2. Firms are price takers (they have no power to set prices)
  3. Each firm has a small market share (limits their power)
  4. Both firms and consumers have perfect information (everybody knows everything, including what the others know)
  5. No barriers to entry (no permits, regulations, certifications, etc)

Prices and costs

- Firms produce until marginal cost equals marginal revenue, which equals price. In the long run, profits are zero (remember, no barriers to entry)
- Consumers consume to maximize utility until marginal utility equals marginal price (consuming one more unit is not worth it anymore)
- Out of this process, at a market level, the idea of supply and demand curves arise
- In real life, **PERFECTLY COMPETITIVE MARKETS DO NOT EXIST**, although some are closer than others
- It's an analytica simplification that is amazingly powerful
- Easy example: monopoly. If there is a monopoly, price is higher than marginal costs and profits in the long run are greater than zero

Prices and costs

- The health care sector **looks nothing like a perfectly competitive market**
- As a consequence, **prices are not a good guide for costs**
- Think of the five characteristics of perfectly competitive markets and how they don't apply to the health care sector
- See Arrow (1963). Health economics is all about **market failure** (technical term, nothing to do with a criticism of free markets)
- Example: What is the price of a CAT scan? A private payer (uninsured) may pay $4,000, an insurance company may give just $1,000 to the hospital because the insurance company has more power to negotiate. Is any of those prices close to the cost of providing a CAT scan? Nope

Prices and costs

- Another example From Muenning (2008): In a NYT article, a gynecologist in NYC said that he charges $175 for a routine visit for uninsured patients but accepts $25 from an insurance company
- So which price should we use for CEA? Ideally, neither. We should figure out the **actual cost** of a routine visit (doctor time, tests, receptionist time, medications use)
- This is not very easy to do in practice
- However, there are some conventions to the rescue to simplify economic evaluations
- In a perfectly competitive market, we wouldn't need to do this because the **price of the product would be the cost of the product**

Drug costs

- What is the cost of a drug (not the price charged)?
- We would need manufacturing and distribution costs (hard to obtain)
- Usual solution: **average wholesale price** (AWP)
- Not perfect solution: AWP does not reflect the actual costs. Some argue that CE ratios of drugs are overestimated (Garrison et al, 2008)
- New recommendations: VA prices since the VA negotiates price
- But for the Nth time: **perspective matters a lot**!! If you are conducting a study from the point of view of a provider with the objective of informing the provider about the cost of an intervention, *what matters is the price that the provider pays*
- From the societal perspective, we ideally want the actual costs (i.e. opportunity costs). Read Chapter 7, section 7.1.2.2

Adjusting costs

- Your textbook suggests two guidelines for when to modify prices
  1. To leave prices unadjusted would introduce substantial biases
  2. There is clear and objective way of making adjustments
- Typical case: **costs** versus **charges** for hospitalizations
- Sadly, more definitions... (The health care section is complicated)

Hospitals: List prices, costs, charges, payments, expenditures, chargemasters

- **Price** is the general term: "the amount of money expected, required, or given in payment for something"
- **Charges/list prices**: What the hospital sets to charge for thousand of "services," however they are defined. The *collection* of these prices is sometimes called the "chargemaster." **Charges/list prices mean nothing**. Medicare requires hospitals to submit charges. In the words of a famous health economist: "Prices from a chargemaster are "what a drunken billionaire would pay a hospital if his wife were not around to control the bastard."
- **Costs**: Expenses incurred by a hospital in providing patient care. For many products, hospitals do not know the actual cost
- **Payments**: The amount a hospital actually receives for providing patient care. Sometimes called **expenditures**

Example

- Based on a true story: You are happily running outside and a car runs you over. You decide to go to the ER. After waiting for two 12 hours, they take some x-rays and tell you that you have a broken shoulder, cracked ribs, and a big toe broken in several pieces. You are NOT about to die so they tell you to make an appointment with an orthopedic surgeon next week.
- There are several services here (x-rays, pain meds, ER doctor time, nurse time...)
- Your price is \$1,000 in co-payments. The insurance company pays (**payment**) \$5,000 to the hospital
- The cost of providing the services? We can only get an approximation (more in one second)
- The **charge or list price**? Most likely, a lot more than \$5,000

Cost to charges

- Studies assessing the effects of costs versus charges in hospitals found that using one or the other does not change CEA conclusions
- Remember that we are comparing alternatives
- In the US, there are cost-to-charge ratios published so researchers tend to adjust hospital charges
- Cost to charge ratios vary by setting and years, about 0.4 or 0.67 (or the inverse, 2.5 or 1.5)

Data

- The Medical Expenditure Panel Survey (MEPS) has great data on expenditures (`http://meps.ahrq.gov/mepsweb/`)
- MEPS data includes co-pays ("out-of-pocket" costs). The MEPS is representative of the non-institutionalized US population
- Healthcare Cost and Utilization Project (HCUP) has hospitalization data and cost and charges (`http://hcupnet.ahrq.gov/`)
- Medicare also has cost to charge data. Medicare claims have payments and co-pays
- You'll use HCUP data in your homework

How do we value non-market items?

- Typical cases: volunteer time and patient and family time
- This could be C_3 (patient/family)
- Remember that the objective of EEs is to inform decisions that are applicable to other settings
- One intervention may have used volunteer time to do something that normally would be done by employees
- One simple approach: use wages for similar activities. The Bureau of Labor Statistics has this information (`http://www.bls.gov/bls/blswage.htm`)
- Another source: Current Population Survey (`http://www.census.gov/programs-surveys/cps.html`)
- For interventions that require family time, could use same approach (some argue for **extra time** wage rates)

Summary

- Three steps for dealing the cost side of EEs
  1. Figure out the items that you need to include, which depend on perspective, time horizon and relevance of the costs
  2. Count units
  3. Value units
- For those of you who are going to be in management and want to do EEs from a provider perspective, make friends in the accounting department
- For physicians who are going to do EEs using interventions, treat RAs and project managers nicely (you may need friends in the accounting department too)
- For those of you who will read EEs, think about the cost categories and whether things were left out that should be included (no need to make friends)
- Next class: more on the thorny issues plus discounting and overhead costs