Estimating Intervention Costs

Todd Wagner, PhD

September 2012

Objectives

- At the end of the class, you should
  - Understand what micro-costing means
  - Be familiar with different micro-costing methods
  - Understand that the method you use will affect your future analyses

Perspective

- The talk is focused on estimating costs for a CEA using the societal perspective

- Implementation researchers may need to vary these methods

Outline

1. Introduction
2. Micro-costing methods
   - Direct Measurement
   - Cost Regression
3. An important assumption: Efficient production and economies of scale
4. Example

Focusing Question

- What is the cost of a new health care intervention?

What does it cost to:

1. Labor: use outreach workers to improve cancer screening?
2. Capital: use a robot for stroke rehab?

Outreach workers

- A local county hospital routinely performs Pap smears in the ED.
- Problem: Low rates of follow-up among abnormal Pap smears (~30% follow-up)
- Question: what is the cost of using an outreach worker to improve follow-up?

Robots

- Engineers have developed robotic devices to enhance rehabilitation
- Robots offer precise, repetitive actions to help the patient with impairment
  - Direction
  - Speed
  - Control
- What is the cost of robotic enhanced rehab?

How do we find the answer?

- To answer these questions, we can use micro-costing methods

Outline

1. Introduction
2. Micro-costing methods
   - Direct Measurement
   - Cost Regression
3. An important assumption: Efficient production and economies of scale
4. Example

Micro-costing

- This term refers to a set of methods that researchers use to estimate costs

- Methods are needed because costs* are not readily observable

*cost resulting from a competitive market

Micro-cost Methods

- Direct measure: measure activities and assign prices to them
- Pseudo-bill: capture services using billing codes. Assign costs to billing codes
- Cost regression: use statistical techniques to identify marginal costs

Selecting a Method

- Data availability
- Method feasibility
- Appropriate assumptions
- Precision and Accuracy

Direct Measurement

- Four steps
  1. Specify the production processes
  2. Enumerate the inputs for each process
  3. Identify price for the inputs
  4. Sum (quantity*price) across all inputs

- Level of precision is critical!

Imagine microcosting a cup of coffee






- Growing
- Harvesting
- Distribution
- Roasting
- Enjoying

Keep in mind:
- Scale of production
- Quality

Luckily, the cost of a cup of coffee is observable and sellers compete on price and quality.

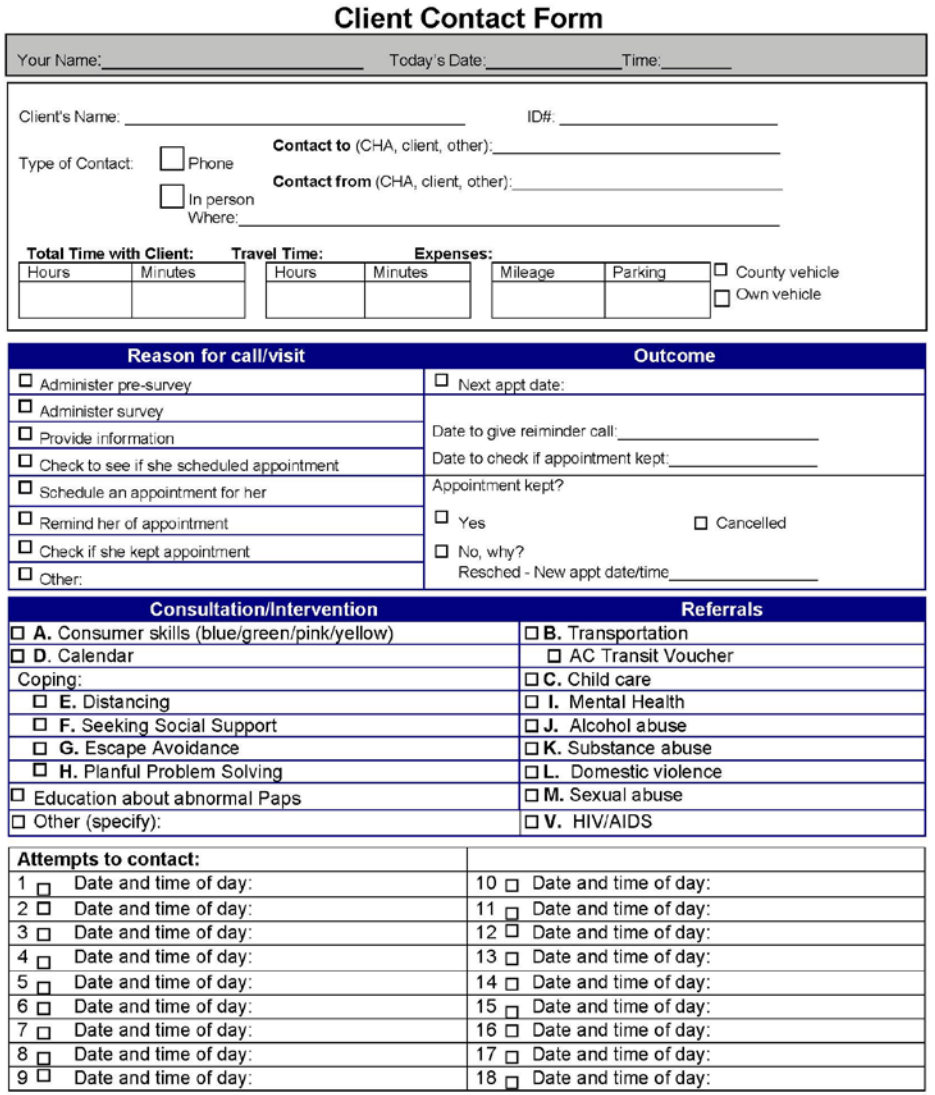
Precision

- Intervention used 2 FTE outreach workers for 1000 participants
- Total labor cost is $100,000 for a year

- Less Precise Method: Labor cost per participant is $100,000/1,000 or $100
- More Precise Method: Track intervention time per participant. Use time estimates as a relative value to apportion labor costs.

Precision is Expensive

- It is time consuming to track staff activities
- Form was created with input from outreach workers
- Manager reviewed them for accuracy each week



Client Contact Form

Your Name:_____ Today's Date:_____ Time:_____

Client's Name: _____ ID#: _____

Type of Contact: ☐ Phone ☐ In person Where:_____

Contact to (CHA, client, other):_____

Contact from (CHA, client, other):_____

Total Time with Client:		**Travel Time:**		**Expenses:**		
Hours	Minutes	Hours	Minutes	Mileage	Parking	☐ County vehicle ☐ Own vehicle

Reason for call/visit	**Outcome**
☐ Administer pre-survey	☐ Next appt date:
☐ Administer survey	
☐ Provide information	Date to give reiminder call:_____
☐ Check to see if she scheduled appointment	Date to check if appointment kept:_____
☐ Schedule an appointment for her	Appointment kept?
☐ Remind her of appointment	☐ Yes ☐ Cancelled
☐ Check if she kept appointment	☐ No, why?
☐ Other:	Resched - New appt date/time_____

Consultation/Intervention	**Referrals**
☐ **A.** Consumer skills (blue/green/pink/yellow)	☐ **B.** Transportation
☐ **D.** Calendar	☐ AC Transit Voucher
Coping:	☐ **C.** Child care
☐ **E.** Distancing	☐ **I.** Mental Health
☐ **F.** Seeking Social Support	☐ **J.** Alcohol abuse
☐ **G.** Escape Avoidance	☐ **K.** Substance abuse
☐ **H.** Planful Problem Solving	☐ **L.** Domestic violence
☐ Education about abnormal Paps	☐ **M.** Sexual abuse
☐ Other (specify):	☐ **V.** HIV/AIDS

Attempts to contact:	
1 ☐ Date and time of day:	10 ☐ Date and time of day:
2 ☐ Date and time of day:	11 ☐ Date and time of day:
3 ☐ Date and time of day:	12 ☐ Date and time of day:
4 ☐ Date and time of day:	13 ☐ Date and time of day:
5 ☐ Date and time of day:	14 ☐ Date and time of day:
6 ☐ Date and time of day:	15 ☐ Date and time of day:
7 ☐ Date and time of day:	16 ☐ Date and time of day:
8 ☐ Date and time of day:	17 ☐ Date and time of day:
9 ☐ Date and time of day:	18 ☐ Date and time of day:

Precision and Accuracy

- The center of the target represents perfect accuracy
- A and B are equally accurate
- A is more precise than B

Accuracy

- SCI-VIP program developed a CPRS app so that time spent providing supportive employment was gathered as part of the EMR documentation

- This improved data accuracy

The Precision Payoff

Example at end of lecture
About subgroup analysis

Direct Measurement: Personnel Activities

- Research staff can produce several "products"
  - Exclude development cost
  - Exclude research-related costs
  - Should measure when program fully implemented

Personnel Costs

- Pay can affect quantity and quality; attracts different types of people
- Need to include benefits (when appropriate)
- Need to include direct/productive and indirect/non-productive costs (e.g., meeting times)

- Assumption: changing personnel pricing will not affect the quality or effectiveness of the intervention

- VA Labor costs

  http://www.herc.research.va.gov/resources/faq_c02.asp

Outline

1. Introduction
2. Micro-costing methods
   - Direct Measurement
   - Cost Regression
3. An important assumption: Efficient production and economies of scale
4. Example

Cost Regression

- Use a regression model to understand the marginal effect of an intervention
- Caveats
  - Only works when there are existing cost data
  - Not a good method for a new technology (e.g., secure messaging) where cost accounting may be underdeveloped

Ex: Cost of Telephone Care

- We conducted a RCT to examine whether telephone case monitoring improves substance use care relative to usual care.
- Intervention averaged 9.1, control averaged 1.9 calls (difference=7.2, $p<.001$)
- DSS tracks SUD telephone care costs in clinic stops (543, 544, 545)
- We summarized the cost data per person

Regression

	Linear Regression
Number of phone calls	10.53
	[2.32]**
Female	-4.14
	[22.47]
Site 1	-2.92
	[14.73]
Age	0.87
	[0.86]
other covariates omitted for brevity	
Observations	667

Robust standard errors in brackets

Each additional call cost an average of $10.53

Assumptions

- Cost and workload data are accurately captured
- Accuracy could vary by location
- Costs are biased toward 0 if the workload is not being captured

Cost Regression

- Large literature on analyzing cost data
- Cost data are frequently skewed
  - Skewed errors violates assumptions of Ordinary Least Squares
  - Error terms not normally distributed with identical means and variance
  - Transformation
    - Typical method: log of cost
    - Can make OLS assumptions more tenable

Duan, N. (1983) Smearing estimate: a nonparametric retransformation method, Journal of the American Statistical Association, 78, 605-610.
Manning WG, Mullahy J. Estimating log models: to transform or not to transform? J Health Econ 2001 Jul;20(4):461-94.
Basu A, Manning WG, Mullahy J. Comparing alternative models: log vs Cox proportional hazard? Health Economics 2004 Aug;13(8):749-65.

Outline

1. Introduction
2. Micro-costing methods
   - Direct Measurement
   - Cost Regression
3. An important assumption: Efficient production and economies of scale
4. Example

Important Assumptions: Scale Economies

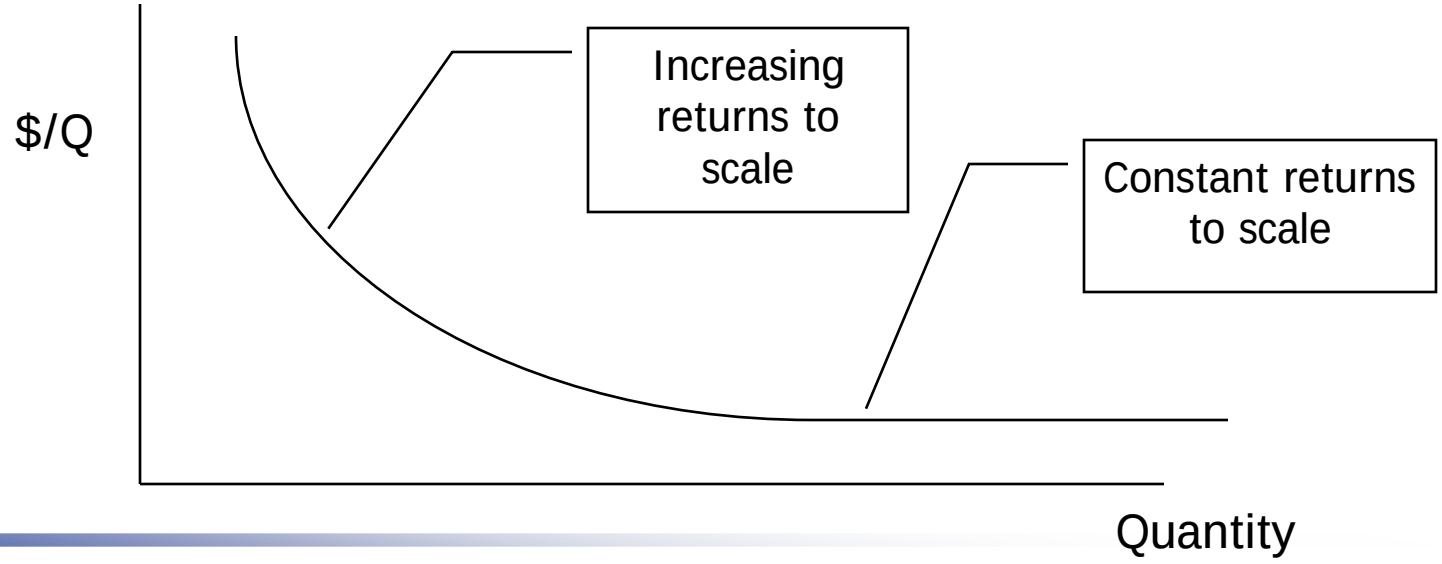
- We created a health guide for a RCT
- We paid $14 per guide for 1000 guides
- If we ordered more, the cost per guide would decrease, eventually reaching $3
- Which cost estimate should you use for the CEA?

Poll

- Which method should you use?
  - #1 or
  - #2

Economies of Scale

- If the unit costs ($/Q) of producing a good decrease as the quantity (Q) of goods increase, use the unit cost when there are constant returns to scale.



Outline

1. Overall approaches
2. Direct Measurement
3. Cost Regression
4. An important assumption: Efficient production and economies of scale
5. Example

Example: Estimating Labor Costs by Direct Measurement

Wagner, T. H., Engelstad, L. P., Mcphee, S. J. & Pasick, R. J. (2007) The costs of an outreach intervention for low-income women with abnormal Pap smears, *Prev Chronic Dis*, 4, A11.

Wagner TH, Goldstein MK. Behavioral interventions and cost-effectiveness analysis. Prev Med 2004;39:1208-14.

Outreach workers

- A local county hospital routinely performs Pap smears in the ED.
- Problem: Low rates of follow-up among abnormal Pap smears (~30% follow-up)
- Question: what is the cost of using an outreach worker to improve follow-up?

Objective

- We evaluated the cost-effectiveness of usual care (a mailed postal reminder) with a tailored outreach intervention compared to usual care alone.
- Does CEA vary by disease risk?

Study Overview

- Randomized, controlled trial
- Usual care: notified by telephone or mail, depending on the degree of abnormality. Provided intervention after 6 months.
- Intervention: Usual care plus outreach and tailored individual counseling
- Estimated costs using direct measurement

Methods

- Method 1: Sum all the intervention costs and divide by number of participants (easy)
- Method 2: Estimate the cost of the intervention for each patient (hard)

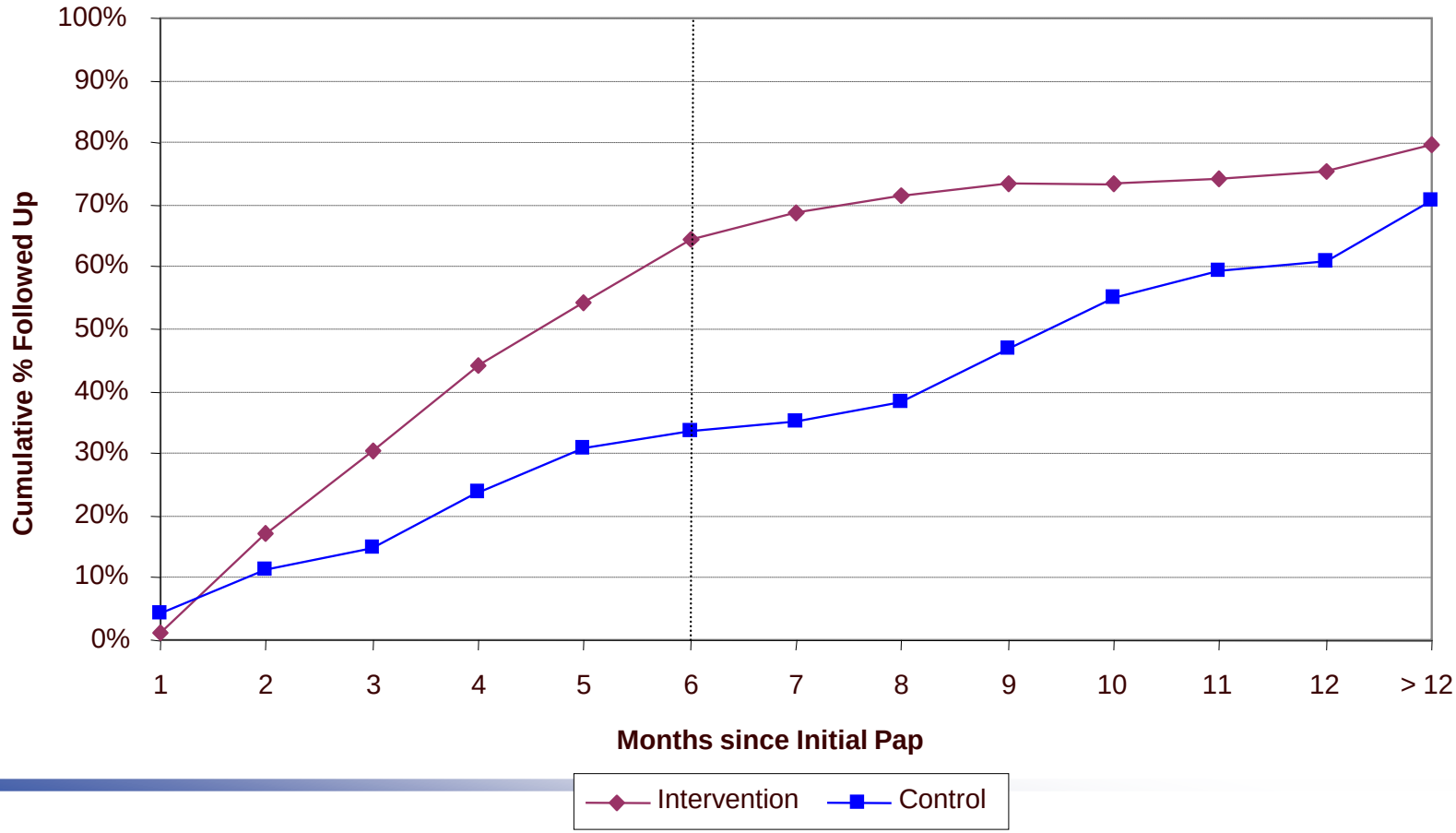
- If you want to ask, “was the intervention more cost-effective for subgroups?”, then you need to use method 2?

Unit Costs (2002 dollars)

	Intervention (n=178)	Usual care (n=170)
Outreach worker costs	$142	$0
Travel costs at $.365 per mile	$4	$0
Office space and supplies	$28	$0
Outreach worker quality assurance	$19	$0
Usual care	$1	$1.00
Subtotal	$47	$0
Patient Travel Costs for Follow-up	$19	$9.9
Total unit cost from societal perspective	$214	$10.9
Cost to add intervention from provider perspective	$194	$0

Effectiveness

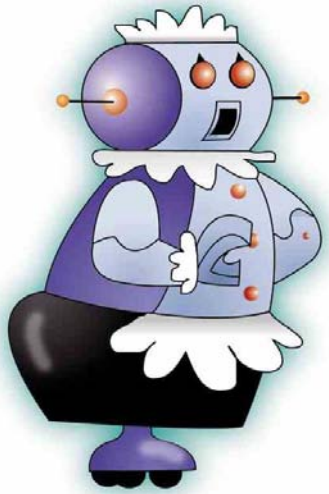
Abnormal Pap Follow-up at Highland Hospital
non-OB Patients



Cost per follow-up

	Cost	Incremental cost	Probability of follow-up	Incremental follow-up	Incremental cost per follow-up
Overall					
Control	$77		0.32		
Intervention	$355	$278	0.61	0.29	$959
Bootstrapped 95% CI					(787-1367)
By severity					
ASCUS/AGUS	$75		0.32		
	$347	$272	0.57	0.25	$1,090
LGSIL	$74		0.30		(813-1658)
	$374	$300	0.64	0.34	$882
HGSIL	$105		0.43		(579-4584)
	$405	$300	0.87	0.44	$681
					(486-1989)

Example 2: Estimating cost of using robots for stroke rehab



Wagner TH, Lo AC, Peduzzi P, et al. An economic analysis of robot-assisted therapy for long-term upper-limb impairment after stroke. *Stroke. 2011;42(9):2630-2632.*

MIT-Manus

- The robot can assist the patient to initiate movement towards the target.
- The robot can “guide” the movement, making certain that the patient is practicing the movement the correct way.
- As the patient gains movement control, the robot provides less assistance and continually challenges the patient.
- The robot provides quantifiable feedback on progress and performance.

www.interactive-motion.com/technology.htm

Robot Costs

- Robot
  - $230,750 purchase price
  - Need to include financing (6.015%)
  - Robot needs overhead– a room, separate circuit
  - Annual maintenance contract ($15,000 in yrs 2-5)
  - Depreciates over a 5 year-life span
- Net present cost for 5 years of robot therapy $422,532

Costs per Rehab Unit

- A site could offer 7 session per robot
  - Each session lasts 75 minutes
  - 2 patients per session (using different components)
- Number of slots over five years: 21,500
- Robot cost per session: $19.65
- Therapists run the robot: $120 per session
- Total cost per robot session: ~$140

Results

	Robot (n=49)		ICT (n=50)		UC (n=28)	
	Average	**SD**	**Average**	**SD**	**Average**	**SD**
Intervention costs						
Per session	$140		$218			
Robot cost per session	$20	--	--	--	--	--
Therapist cost per session	$120	--	$218	--	--	--
Average number of completed sessions	32.8	8.2	32.1	8.0	0	0
Travel costs	$561	$596	$389	$372	0	0
Average intervention cost	$5,152	$1,421	$7,382	$1,845	0	0

Note: Robot therapy is significant less expensive than ICT ($p<0.001$)
ICT is intensive comparison therapy

Resources

- Converting time into money
  - Smith M, Barnett P, Phibbs C, Wagner T, Yu W. Micro-cost methods of determining VA health care costs: Health Economics Resource Center, VA Palo Alto, Menlo Park CA.; 2005.
  - Smith M, Cheng A. A Guide to Estimating Wages of VHA Employees - FY2008 Update. Menlo Park CA: Health Economics Resource Center; 2010.
- Converting travel distance into money.
  - Phibbs CS, Luft HS. Correlation of travel time on roads versus straight line distance. Med Care Res Rev. 1995;52(4):532-542.
  - $.19 per mile travel reimbursement is US tax code for health care reimbursement http://www.irs.gov/newsroom/article/0,,id=232017,00.html
  - PSSG has VAST dataset on travel times (VA intranet site) http://vaww.pssg.med.va.gov/
- Caregiver costs (if needed)
  - US Bureau of Labor Statistics http://www.bls.gov/oco/ocos326.htm
  - Russell LB. Completing costs: patients' time. Med Care. Jul 2009;47(7 Suppl 1):S89-93.

Resources

- When we estimate the cost of labor, we need to add employee benefits (30%) and overhead (the "back office" components of an organization that keep it running such as HR and IT)

- Calculating overhead costs
  - 33%-- Arthur Andersen. The costs of research: examining patterns of expenditures across research sectors.

    http://www.aau.edu/WorkArea/DownloadAsset.aspx?id=2842.
  - Estimating overhead costs empirically
    - Barnett PG, Berger M. Indirect Costs of Specialized VA Mental Health Treatment. Technical Report 6. Menlo Park: Health Economics Resouce Center; 2003.
    - Barnett P, Berger M. Cost of Positron Emission Tomography: Method for Determining Indirect Cost. Technical Report 5. Menlo Park: Health Economics Resource Center; 2003.

Questions

Next HERC Course

October 3, 2012
Inpatient and Outpatient Costs from DSS
Jean Yoon, Ph.D.