

# Estimating Intervention Costs

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# 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 ability to conduct meaningful subgroup analysis
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# Focusing Question

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

## Examples:

1. Supportive employment intervention for veterans with a spinal cord injury
  2. Outreach workers to improve cancer screening
  3. A new therapy for stroke patients
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# Outline

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

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# 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
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# Selecting a Method

- Data availability
  - Method feasibility
  - Appropriate assumptions
  - Precision and Accuracy
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# Combining Methods

- No single method can fill every need, even within a single study
  - Multi-method may be best, for example
    - Direct method utilization most affected by intervention
    - Cost regression for other utilization
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# 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!
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# 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.*

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# Examples of 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.
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# 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:	<input type="checkbox"/> Phone	Contact to (CHA, client, other): _____			
	<input type="checkbox"/> In person	Contact from (CHA, client, other): _____			
Where: _____					
<b>Total Time with Client:</b>		<b>Travel Time:</b>		<b>Expenses:</b>	
Hours	Minutes	Hours	Minutes	Mileage	Parking
				<input type="checkbox"/> County vehicle	
				<input type="checkbox"/> Own vehicle	
Reason for call/visit			Outcome		
<input type="checkbox"/> Administer pre-survey			<input type="checkbox"/> Next appt date: _____		
<input type="checkbox"/> Administer survey			Date to give reminder call: _____		
<input type="checkbox"/> Provide information			Date to check if appointment kept: _____		
<input type="checkbox"/> Check to see if she scheduled appointment			Appointment kept?		
<input type="checkbox"/> Schedule an appointment for her			<input type="checkbox"/> Yes <input type="checkbox"/> Cancelled		
<input type="checkbox"/> Remind her of appointment			<input type="checkbox"/> No, why?		
<input type="checkbox"/> Check if she kept appointment			Resched - New appt date/time _____		
<input type="checkbox"/> Other: _____					
Consultation/Intervention			Referrals		
<input type="checkbox"/> A. Consumer skills (blue/green/pink/yellow)			<input type="checkbox"/> B. Transportation		
<input type="checkbox"/> D. Calendar			<input type="checkbox"/> AC Transit Voucher		
Coping:			<input type="checkbox"/> C. Child care		
<input type="checkbox"/> E. Distancing			<input type="checkbox"/> I. Mental Health		
<input type="checkbox"/> F. Seeking Social Support			<input type="checkbox"/> J. Alcohol abuse		
<input type="checkbox"/> G. Escape Avoidance			<input type="checkbox"/> K. Substance abuse		
<input type="checkbox"/> H. Planful Problem Solving			<input type="checkbox"/> L. Domestic violence		
<input type="checkbox"/> Education about abnormal Paps			<input type="checkbox"/> M. Sexual abuse		
<input type="checkbox"/> Other (specify): _____			<input type="checkbox"/> V. HIV/AIDS		
Attempts to contact:					
1	<input type="checkbox"/>	Date and time of day:	10	<input type="checkbox"/>	Date and time of day:
2	<input type="checkbox"/>	Date and time of day:	11	<input type="checkbox"/>	Date and time of day:
3	<input type="checkbox"/>	Date and time of day:	12	<input type="checkbox"/>	Date and time of day:
4	<input type="checkbox"/>	Date and time of day:	13	<input type="checkbox"/>	Date and time of day:
5	<input type="checkbox"/>	Date and time of day:	14	<input type="checkbox"/>	Date and time of day:
6	<input type="checkbox"/>	Date and time of day:	15	<input type="checkbox"/>	Date and time of day:
7	<input type="checkbox"/>	Date and time of day:	16	<input type="checkbox"/>	Date and time of day:
8	<input type="checkbox"/>	Date and time of day:	17	<input type="checkbox"/>	Date and time of day:
9	<input type="checkbox"/>	Date and time of day:	18	<input type="checkbox"/>	Date and time of day:

# Precision and Accuracy

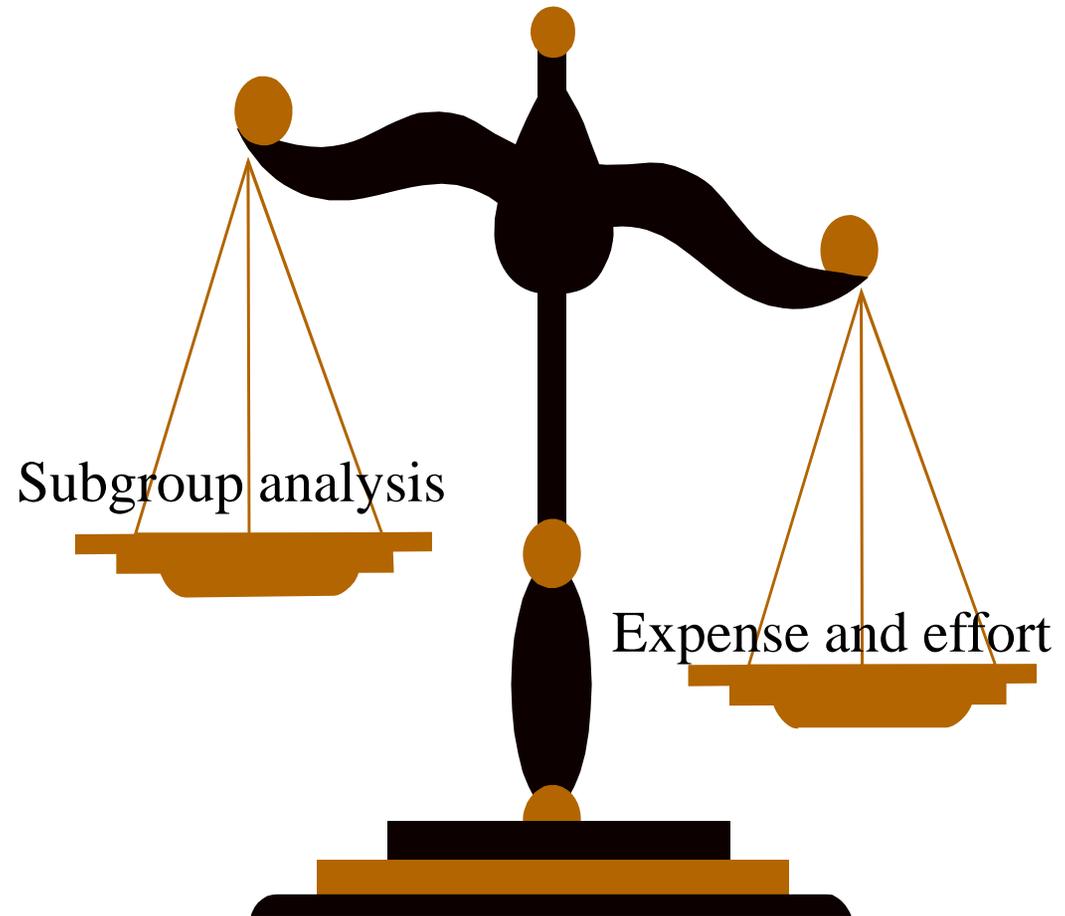
- The center of the target represents perfect accuracy
- A and B are equally accurate
- A is more precise than B



# 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
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# 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
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# 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](http://www.herc.research.va.gov/resources/faq_c02.asp)

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# Cost Regression

- Use a regression model to understand the marginal effect of an intervention
  - Possible method when examining existing care for which cost data exist
  - Not a good method for a new technology (e.g., secure messaging) where cost accounting may be underdeveloped
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# Ex: Cost of Telephone Care

- We used 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
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# Regression

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	Intent to treat	Instrumental Variables
Group effect	79.882 [14.640]**	
Number of phone calls		10.53 [2.32]**
female	0.477 [0.161]**	-4.14 [22.47]
site 1	2.404 [34.201]	-2.92 [14.73]
Age	-2.047 [15.771]	0.87 [0.86]
<i>other covariates omitted for brevity</i>		
Observations	642	667

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Robust standard errors in brackets

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# 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
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# 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

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# 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?
-

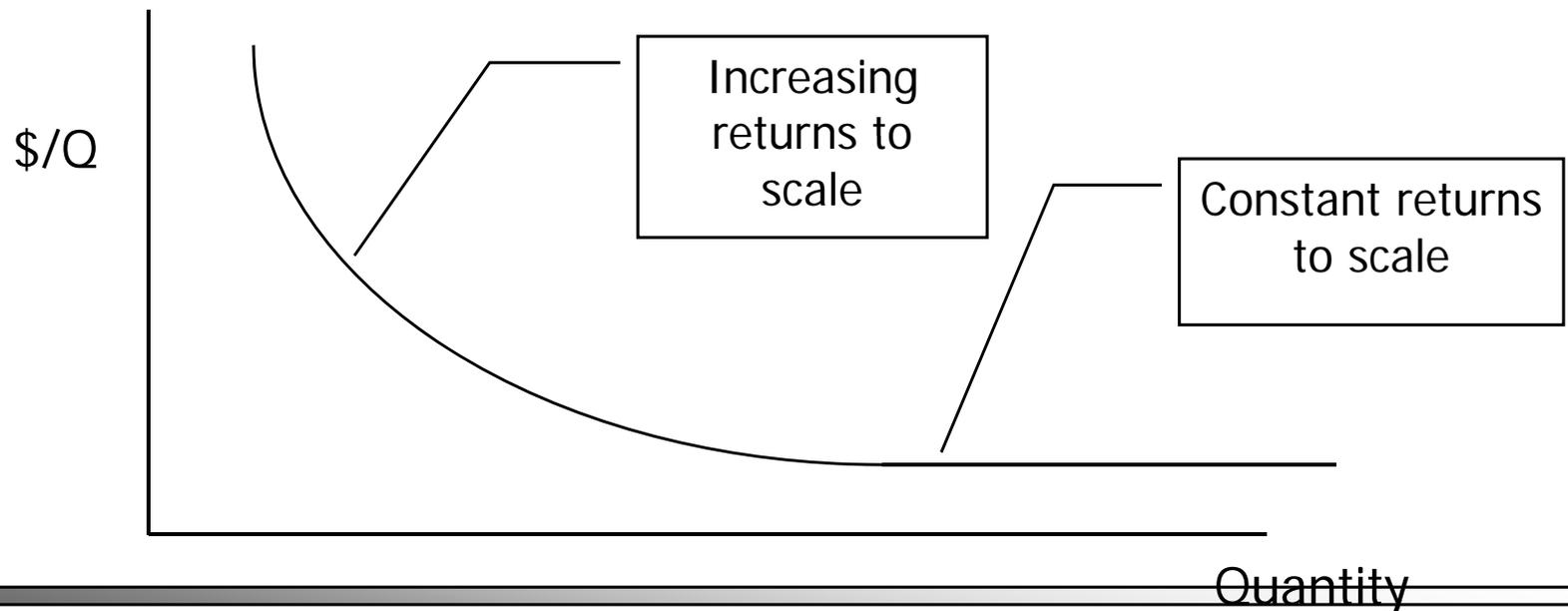
# Poll

- 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.



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-

# Example of Direct Measurement and the Importance of Precision

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.

# Background

- Highland Hospital (Oakland CA) treats a lot of low-income people. Routinely performs Pap smears in the ED.
  - Problem: Low rates of follow-up among abnormal Pap smears (~30% follow-up)
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# 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.
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# Pap Abnormality

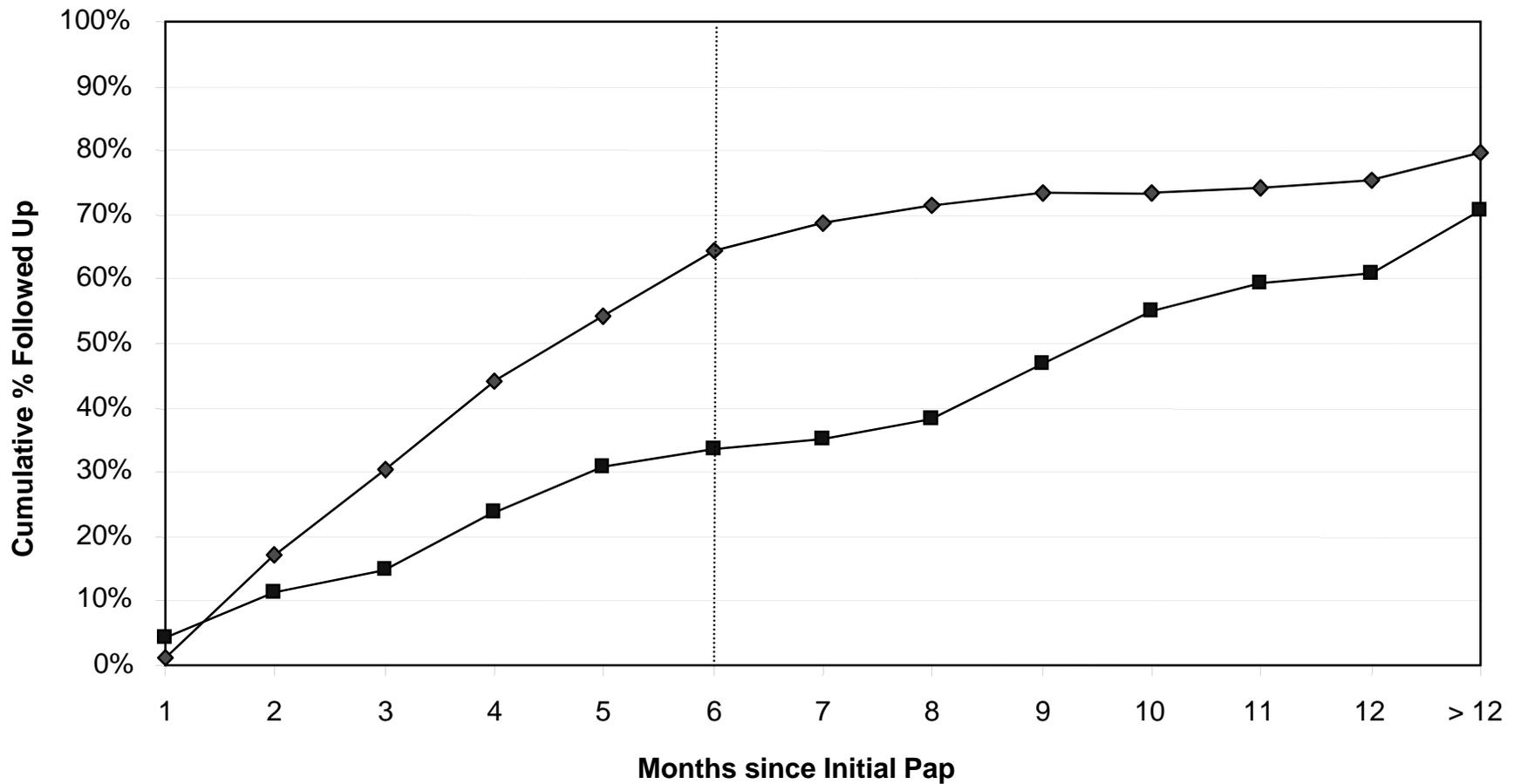
- Atypical squamous cells of undetermined significance (ASCUS)
- Atypical glandular cells of undetermined significance (AGUS)
- Low-grade squamous intraepithelial lesion (LGSIL)
- High-grade squamous intraepithelial lesion (HGSIL)

# 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
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# Effectiveness

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



—◆— Intervention —■— Control

# 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
<b>Total unit cost from societal perspective</b>	<b>\$214</b>	<b>\$10.9</b>
<b>Cost to add intervention from provider perspective</b>	<b>\$194</b>	<b>\$0</b>

# Intervention Costs

- 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?

# Cost per follow-up

	Cost	Incremental cost	Effectiveness	Incremental effectiveness	Incremental cost-effectiveness
<b>Societal Perspective</b>					
Control	\$77		0.32		
Intervention	\$355	\$278	0.61	0.29	\$959
Bootstrapped 95% CI					(787-1367)
<b>Payer Perspective</b>					
Control	\$67		0.32		
Intervention	\$335	\$268	0.61	0.29	\$926
Bootstrapped 95% CI					(754-1333)
<b>Societal Perspective</b>					
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)

\* Effectiveness is proportion of women in group who received follow-up for the abnormal Pap smear.

# Poll 1

- Do you understand what micro-costing means?
    - Yes
    - No
    - Don't know until I get more coffee
-

# Poll 2

- Do you feel more familiar with micro-costing methods?
    - Direct measurement
      - Yes
      - No
    - Cost Regression
      - Yes
      - No
-

# Poll 3

- Could you explain to a colleague the relationship between micro-costing precision and subgroup analysis?
    - Yes
    - No
    - I don't have any colleagues
-

# 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. <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.
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# 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 Resource 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.
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# Questions

