Cost Estimation

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VA
U.S. Department of Veterans Affairs
Veterans Health Administration
Health Services Research & Development Service

Outline

1. Defining costs
2. Where to get cost data
3. What if there is no cost information
4. Stepping back: what are we trying to measure?

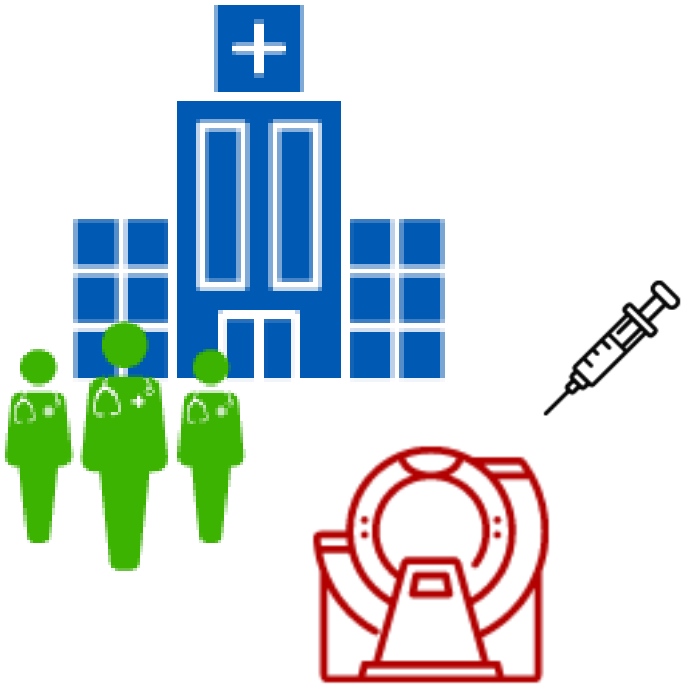
Cost, Charges, Payments

- Poorly known and often confused.

"It's long been hard for health-care consumers to learn how much doctor visits or hospital stays will cost them."

- Health care isn't a commodity
- Considerable variation in costs

The Cost of Producing Care



- Health care organizations combine inputs (labor and capital) to produce health care services.
- Each input has a price.

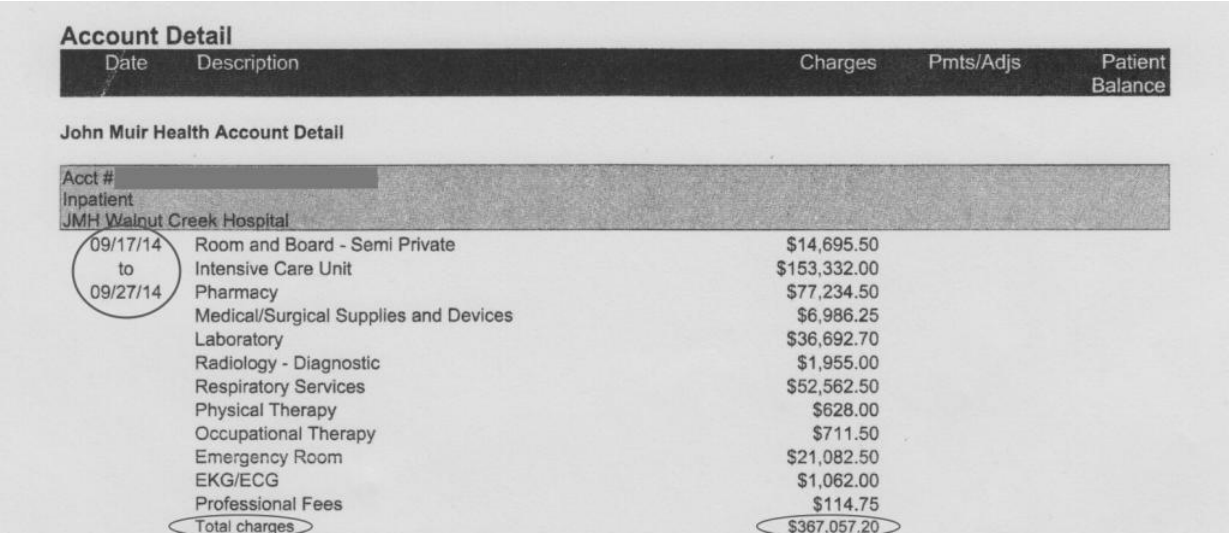
- Cost=$\sum_j (pricej * quantityj)$

Production Costs

- Most of the time we don’t observe production costs

- We typically observe charges or payments

Charges



Account Detail

Date	Description	Charges	Pmts/Adjs	Patient Balance
John Muir Health Account Detail				
Acct # [redacted]				
Inpatient				
JMH Walnut Creek Hospital				
09/17/14 to 09/27/14	Room and Board - Semi Private	$14,695.50		
	Intensive Care Unit	$153,332.00		
	Pharmacy	$77,234.50		
	Medical/Surgical Supplies and Devices	$6,986.25		
	Laboratory	$36,692.70		
	Radiology - Diagnostic	$1,955.00		
	Respiratory Services	$52,562.50		
	Physical Therapy	$628.00		
	Occupational Therapy	$711.50		
	Emergency Room	$21,082.50		
	EKG/ECG	$1,062.00		
	Professional Fees	$114.75		
	Total charges	$367,057.20		

- Charges: the amount listed by the provider as the “price to be paid”

- Some degree of fiction
  - Profits
  - Future negotiations

Examples of Charges from Medicare

MS DRG		Charges
470	major hip and knee	65,951
280	AMI	70,627
312	syncope & collapse	31,190
247	PCI	87,685
287	circulatory dis	38,690
313	chest pain	19,542
682	renal failure w MCC	45,045
871	septicemia	61,234
293	heart failure	16,224

Cost to Charge Ratio (CCR)

- You can adjust charges using a hospital-specific cost-to-charge ratio
  - Theory: charge includes profit and some degree of fiction
- CMS summarizes hospitals' costs and charges in the Medicare Cost Report
- In 2016, unweighted average CCR was 0.31; Stanford's CCR was 0.15

Payments

- A transfer of funds, typically from an insurer to a provider, to cover services rendered.

- Pros:
  - Someone is actually paying these amounts

- Challenges:
  - May not represent the actual resources used
  - These payments reflect pre-specified coverage limitations.
  - These payments can also reflect negotiated discounts.

Example: post acute care

- Medicare payments for a person in post acute care
  - Patient A, LOS 82 days: $51,919
  - Patient B, LOS 135 days: $56,985
  - The additional 53 days cost: $5,065

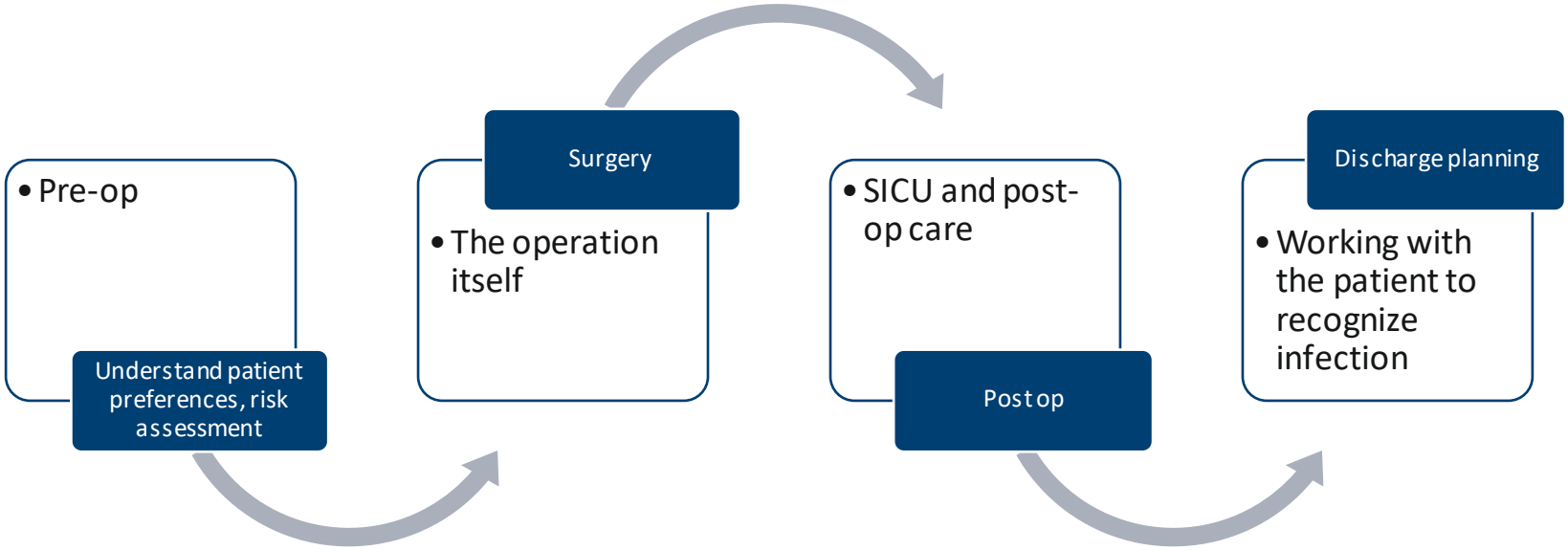
- What is going on here?

Activity Based Costing (ABC)

- Identify all the activities / resources that a patient uses when they receive care
- Estimate unit costs for each resources
- Multiply quantity of resources by unit costs

- Uses accounting rules to estimating production costs.

ABC Example: CABG



Resources
- Personnel
- Space
- Supplies
- Contracts

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  - Space
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ABC Data

Pros

- Precise
- Offers opportunities to understand inefficiencies in the system
- Perhaps the best approximation of the cost of producing the care

Cons

- Precision errors can lead to outliers
- Costs reflect context that may be idiosyncratic to a specific site
- Few organizations invest in this; some don't provide access to it

ABC Example from VA

Compared two "close substitutes" for CABG surgery

Table 4. Adjusted Costs From Log-Transformed Regression[a]

Variable	n	Adjusted Cost ($)[b]	*p* Value
Costs in surgical suite			
On-pump	1,092	14,885	0.001
Off-pump	1,094	15,377	
CABG hospitalization			
On-pump	1,092	36,046	0.158
Off-pump	1,094	36,536	
Post-CABG through 1 year			
On-pump	1,092	18,147	0.102
Off-pump	1,094	21,169	
Adjusted cost at 1 year			
On-pump	1,092	56,023	
Off-pump	1,094	59,623	0.046

Wagner, TH., et al. "On-Pump versus Off-Pump coronary artery bypass surgery" *ATS* 96.3 (2013): 770-777.

ABCs still have imperfections

- They don’t track every minute of a day with a provider.
- They don’t tell you whether a provider is acting efficiently or inefficiently.
- They don’t have information on the quality of care.

Summary

- Cost data are hard to find
- Medicare payments and ABC costs are generally preferred to charges.
- Triangulation from multiple sources may be best.

Outline

1. Defining common cost data
2. Where to get cost data
3. What if there is no cost information
4. Stepping back: what are we trying to measure?

Where to get Cost Data

- Published literature
- Billing offices
- Websites
- Claims or administrative data

Published Literature

- Transparent sources (mostly)
- Someone kicked the tires (hopefully)

- Questions
  - Are the data representative?
  - How old are the data?
  - Is inflation adjustment appropriate?

Inflation

Objective of Analysis	Recommended Index				
	GDP[1] or PCE[1]	CPI[2]	PHCE[3] or PCE-Health[1] Total	PHCE[3] Component	CPI-M[4]
Trends in Expenditures	X				
Trends in Out of Pocket Expenditures Only		X			X
Pooling Total Expenditures			X		
Pooling Out of Pocket Expenditures					X
Pooling Expenditures by Type of Service (e.g. prescription medications)				X	
Trends with Income Measures		X			

[1] See https://www.bea.gov/data/gdp/gross-domestic-product#gdp for more information on the Gross Domestic Product (GDP) and Personal Consumption Expenditures (PCE).

[2] See http://www.bls.gov/cpi for more information on the Consumer Price Index (CPI).

[3] See https://www.cms.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and-Reports/NationalHealthExpendData/downloads/dsm-16.pdf for more information on the Personal Health Care Expenditure (PHCE) component of the National Health Expenditure Accounts.

[4] See https://data.bls.gov/cgi-bin/surveymost?cu for data on the Consumer Price indices for medical care (CPI–M).

https://meps.ahrq.gov/about_meps/Price_Index.shtml

Billing Offices

- Easy
- Contemporary

- Questions
  - Are the data representative?
  - Are the data valid?

Transparency Laws

- 2019 CMS Hospital Price Transparency Regulation (45 CFR §180.50).
  - A hospital must establish, update, and make public a list of all standard charges for all items and services online in the form and manner specified in this section.
  - Description of each item or service provided by the hospital.
  - Gross charge.
  - Payer-specific negotiated charge.
  - De-identified minimum negotiated charge.
  - De-identified maximum negotiated charge.
  - Discounted cash price.

- Single file on the provider's website
- Vendors, such as Turquoise Health, have scraped this and make it available

Websites

"On the Internet, nobody knows you're a dog."

Inpatient

- https://www.hcup-us.ahrq.gov/
- https://hcupnet.ahrq.gov/

- A very handy website that allows you to query hospital discharge data.

- They report institutional “costs”, but in the fine print they acknowledge that this is cost adjusted charges.

- No provider payment

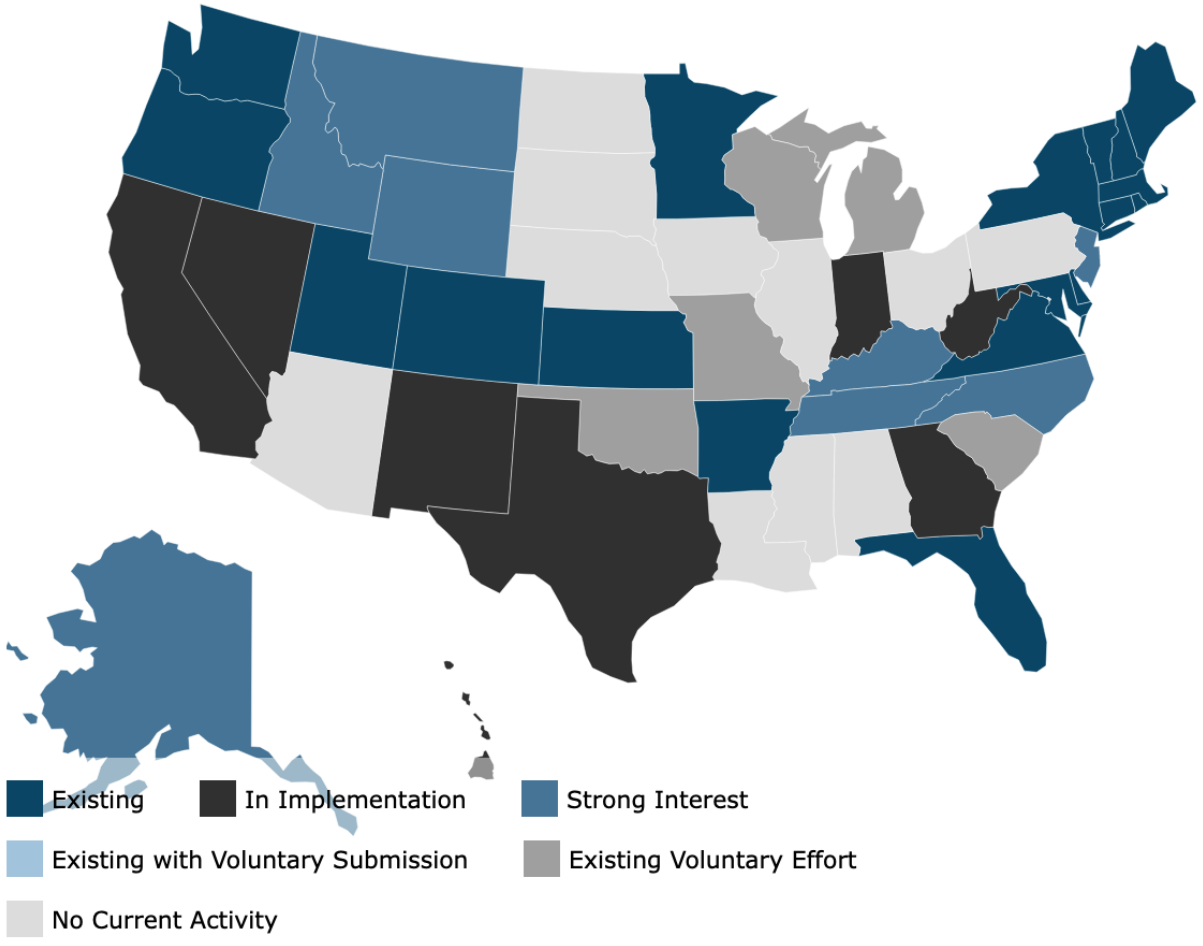
Provider Payments by CPT

- https://www.medicare.gov/procedure-price-lookup/
  - Prices shown don't include physician fees
  - Treatment may include more than one procedure

Administrative Data

- Publicly Financed
  - Medicare
  - Medicaid
  - VA
  - DoD / TriCare
- Private
  - Optum
  - Truven
  - Health Care Cost Institute (currently closed)
- All Payer

All Payer



FFS Payments in Medicare A/B

- Nationally inclusive for people over age 65.
- Payments based on prospective amounts
  - Diagnostic related groups (MS-DRG) for inpatient
  - APCs for outpatient
- Payments are limited by reimbursement rules and benefit caps
  - E.g., CMS has a 90-day lifetime NH benefit cap
- Stanford PHS has Medicare data, but access is slow

Other Claims & Administrative Data

- Medicare Advantage

- VA researchers have access to VA data
  - ABC costs
  - Estimated national costs in VA.

- Cons: Access is slow. Requires careful analysis.

Total cost

	Facility	Provider	Total
Medicare (ABD)	X	X	X
Optum	X	X	X
HCUP website	X (inpatient)	--	--
Medicare website	X (outpatient)	--	--
VA	X	X	X
Subtotals (ABC)	X	X	X

Optum no longer available for academic researchers

Pharmaceuticals

- Historically, people went to the “Redbook”, which listed average wholesale price.
  - Publishers wrongfully inflated AWP in the Redbook
  - Sued for fraud and price fixing

- The Federal Supply Schedule (FSS) and “Big Four” pricing (VA, DoD, PHS and, Coast Guard)

https://www.va.gov/opal/nac/fss/pharmPrices.asp

- Injections vs Other drugs (e.g., orals)

www.cms.gov/Medicare/Medicare-Fee-for-Service-Part-B-Drugs/McrPartBDrugAvgSalesPrice/2019ASPFiles.html

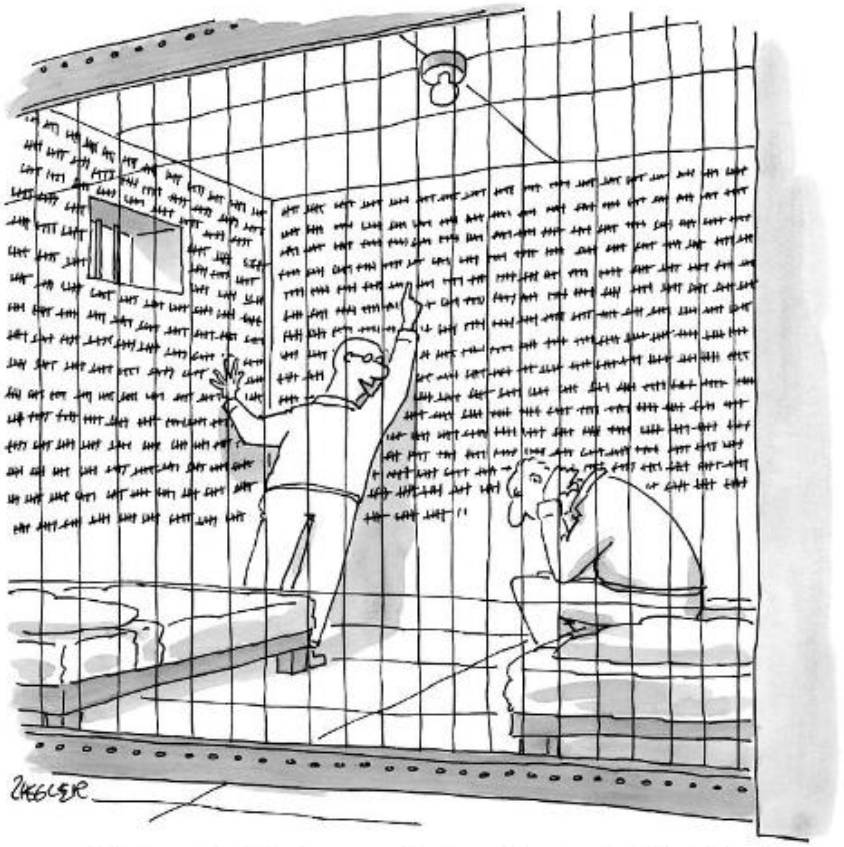
www.herc.research.va.gov/include/page.asp?id=pharmaceutical-costs

Common Problems with Cost Data

- Total cost
  - Facility
  - Provider payment
- Date of service vs entire service
  - Pre-op / post-op
- Claim lines vs Payment Bundles
  - DRGs / APCs

Validate your Costs

- Get cost estimates from multiple sources.
- You need information on average and variation.



"What a couple of clucks we are. Here's another mistake right up here."

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What if Cost Data Don't Exist

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

What does it cost to:

1. Use outreach workers to improve cancer screening in a public hospital?
2. Use a robot to enhance arm rehabilitation?
3. Use a telephone case monitoring program for people in substance use recovery?

Micro-costing

- Methods
  - You identify the production inputs
  - Link inputs with unit costs

- Common inputs
  - Labor
  - Supplies
  - Space (capital)

An example outside of health

- What is the process of producing a meal?

Get ingredients

Use equipment

Cook the meal

Clean up

A natural sequence of events in the production process

Cost of Cooking

Buy ingredients

Buy/rent equipment and space

Cost of Cooking

Cost of clean up

Efficiency and Quality

Buy ingredients

Buy/rent equipment and space

Cost of Cooking

Cost of clean up

The same process may yield different outcomes
The same effort may yield different outcomes

Skilled labor
Learning by doing (volume)
Specialization (skills and foods)
Improving customer experience

These issues transfer to medicine

What is unique to health care is risk and uncertainty.

Micro-costing

- Micro-costing methods typically yield a program cost

- Example: The hospital's cost of using outreach workers to improve cancer screening in a public hospital
  - 2 FTE for 1000 participants
  - Total labor cost is $130,000 for a year
  - Supplies, space, etc =$20,000
  - Total cost=$150,000
- For a CEA, we need those costs at the person level

Precision

- Total cost is $150,000 for a year
- Intervention used provided to 1000 participants

Less Precise Method: Cost per participant is $150,000/1,000 or $150

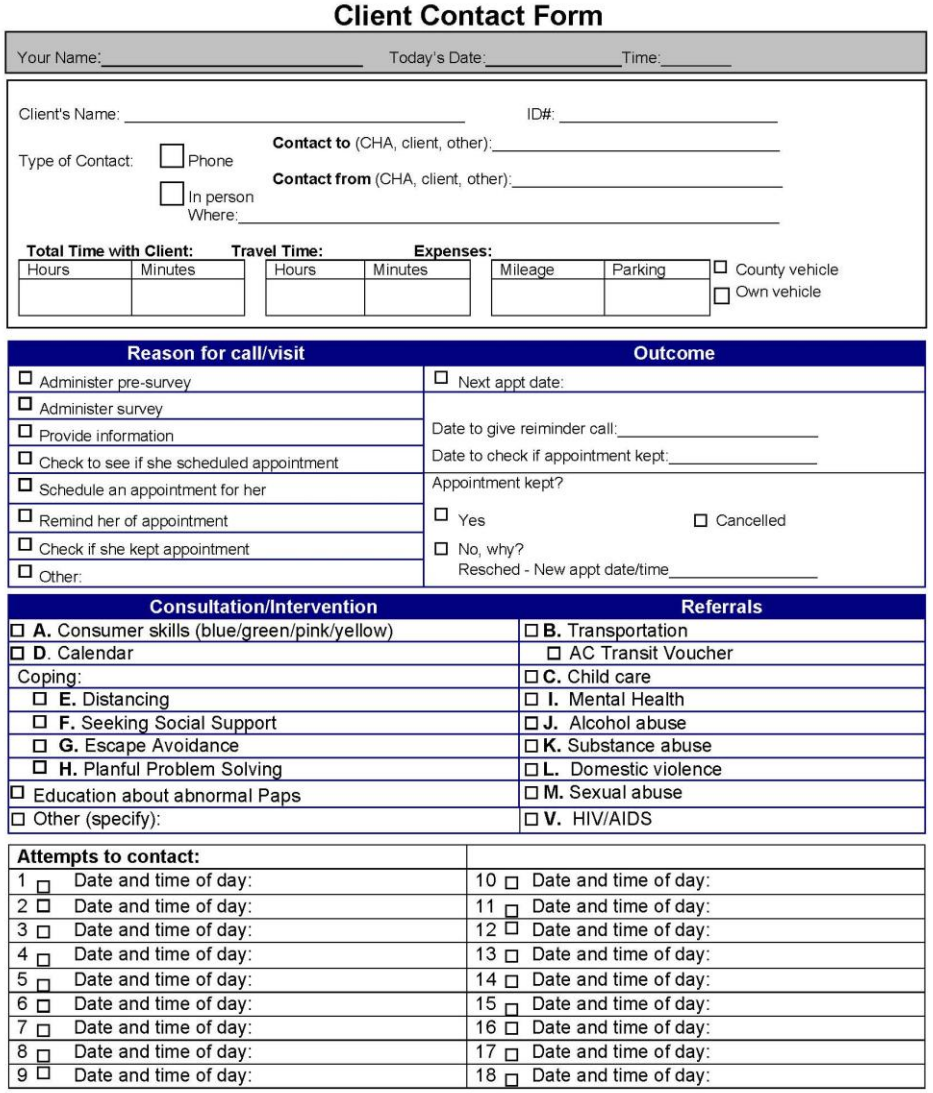
More Precise Method: Track the relative resources spent per participant. Use time estimates to apportion costs.

More 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

Contact to (CHA, client, other):_____

Contact from (CHA, client, other):_____

Where:_____

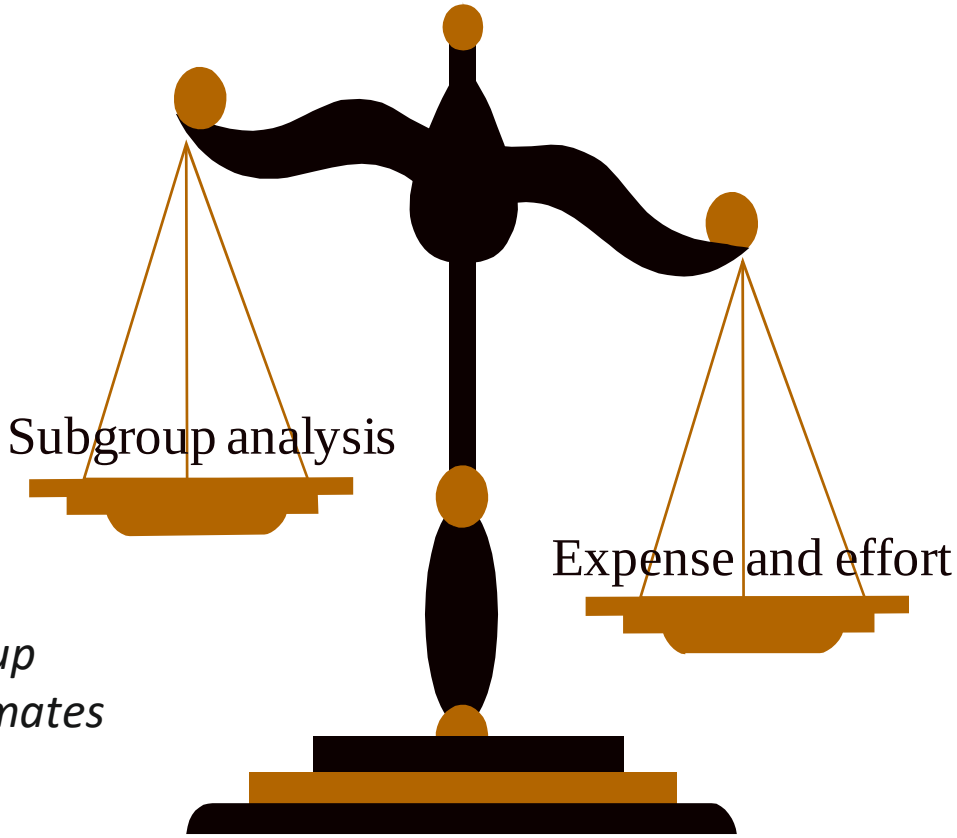
Total Time with Client:		**Travel Time:**		**Expenses:**		
Hours	Minutes	Hours	Minutes	Mileage	Parking	☐ County vehicle ☐ Own vehicle

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:

The Precision Payoff



You can only do subgroup analyses if the cost estimates vary by subgroup

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Big Picture Issues

- Theory
  - Opportunity Costs
  - Efficiency
- Application
  - Perspective
  - Time horizon

Opportunity Costs

- Costs are the benefits foregone because the resources were not used in the next best alternative—this is the opportunity cost (WHO, 2003)

- Opportunity costs are theoretical, but they should be driving what we want to measure.

What is your opportunity cost?

- I have some health care consulting work that pays per hour. It will take about 10 hours over the next 2 weeks. Do you want to help me?

- Opportunity cost is the price of the trade-offs.
  - You can't do it all; if you make a choice, you forgo other options for now.

Opportunity Cost in Health Care

- There are different ways to assign values (i.e., costs) to health care utilization.

- Accounting costs often differ from opportunity costs*
  - Time horizon
  - Perspective

- What is the cost of a “no show”?

*Palmer S, Raftery J. Economic Notes: opportunity cost. Br Med J. 1999;318(7197):1551-1552.

Efficiency

- The term *allocative efficiency* is discussed in most economic evaluation and CEA books
- Assuming that health care organizations are allocatively efficient makes economic evaluations much easier.
- The costs we observe from one hospital are a fair approximation for the costs for other hospitals.

Luce BR, e tal. Estimating Costs in Cost Effectiveness Analysis. In: *Cost-Effectiveness in Health and Medicine.* Oxford; 1996:176-213.
Basu A. Estimating Costs and Valuations of Non-Health Benefits in Cost-Effectiveness Analysis. In: *Cost-Effectiveness in Health and Medicine*. Oxford Press; 2016:201-235.
Drummond MF, et al. *Methods for the Economic Evaluation of Health Care Programmes*. Second Edition. Oxford University Press.

Is Allocative Efficiency Valid?

- Health care is not perfectly competitive
- Considerable evidence that health care organizations are not efficient
- Many economic models would not be practicable without this assumption.
- Unknown whether sensitivity analysis helps
  - Matters less with an evaluation that take a societal perspective and a long-time horizon
  - Matters more with an evaluation that take a specific perspective and a short-time horizon

Application

- Perspective
- Time horizon
- What question do you want to inform and what behavior do you want to change?
  - Adoption
  - Implementation

Perspective

- Between 1990-2010:
  - Increasing evidence that substance use treatment was cost effective from a societal perspective.
  - Large contraction in substance use treatment programs.

- Ettner et al[1] suggested that substance use treatment is cost-effective due to savings in criminal justice.
- We found no evidence that VA investments in substance use treatment paid for itself, with the exception of opiate agonist treatment programs.[2] (A “wrong pockets” problem)

1. Ettner SL, et al. Benefit-cost in the California treatment outcome project: does substance abuse treatment "pay for itself"? Health Serv Res 2006;41(1):192-213.
2. Humphreys K, Wagner TH, Gage M. If substance use disorder treatment more than offsets its costs, why don't more medical centers want to provide it? A budget impact analysis in the Veterans Health Administration. J Subst Abuse Treat 2011;41(3):243-51.

Perspective

- We’ve seen an increasing number of economic evaluations from narrower perspectives
  - Payer perspective
  - Provider perspective
  - Patient perspective

Time Horizon

- In the long run, all inputs are variable
- In the short run, costs can be *fixed* and *variable* with the scale of production
  - Fixed costs: the input was chosen and the cost is fixed across scale of production
  - Variable costs: the inputs can change relatively quickly
- If you take a short run perspective, the distinction between variable and fixed costs are important

Time Horizon

- Many papers report a short-term time horizon, but they don't exclude costs fixed in that short-term horizon.

- Why not?
  - Data availability
  - Preference
  - Worried about myopia
  - Fixed cost can become variable
    - Supplies are variable
    - Labor is sometimes variable and sometimes fixed (e.g., contracts)
    - Equipment has a lifespan, but you can resell equipment
    - Buildings have long lifespans, but you can remodel, repurpose or sell them

Inpatient VA data

ms drg	n	tot variable	total cost	% variable	type	title
871	14,815	21,437	39,465	54%	MED	septicemia or severe sepsis
392	10,829	5,671	10,681	53%	MED	esophagitis
189	12,105	15,481	29,038	53%	MED	pulmonary edema
291	10,591	14,402	27,170	53%	MED	heart failure & shock w mcc
292	11,053	9,550	18,214	53%	MED	heart failure & shock w cc
897	45,916	9,497	18,782	52%	MED	alcohol/drug abuse or dependence w/o rehabilitation
885	37,138	16,647	33,432	52%	MED	psychoses
882	14,427	12,877	26,466	50%	MED	neuroses except depressive
895	11,879	15,369	31,649	49%	MED	alcohol/drug abuse or dependence w rehabilitation
483	1,379	20,199	29,212	67%	SURG	major joint/limb reattachment procedure of upper extremities
470	12,165	17,119	28,361	60%	SURG	major hip and knee joint replacement
254	1,353	18,337	32,016	57%	SURG	other vascular procedures w/o cc/mcc
253	1,653	25,825	46,158	56%	SURG	other vascular procedures w cc
853	1,509	56,427	102,839	55%	SURG	infectious & parasitic diseases w o.r. procedure w mcc
236	1,371	38,864	71,802	54%	SURG	coronary bypass w/o cardiac cath w/o mcc
330	2,176	27,071	50,289	54%	SURG	major small & large bowel procedures w cc
331	1,385	18,313	34,241	53%	SURG	major small & large bowel procedures w/o cc/mcc
708	1,392	13,445	25,356	53%	SURG	major male pelvic procedures w/o cc/mcc
247	2,637	10,996	20,819	53%	SURG	perc cardiovasc proc w drug-eluting stent w/o mcc

Outpatient VA Data

clinic	n	Average Cost			Median Cost	
		total	direct	% direct	total	direct
pharmacy	88,750,503	93	75	81%	23	19
laboratory	17,434,129	99	62	63%	65	38
primary care	12,799,244	355	208	59%	332	196
prosthetics	8,228,523	361	286	79%	94	74
tele PC	6,052,224	158	93	59%	137	80
MH individ	5,698,900	379	213	56%	323	183
x-ray	3,169,142	228	138	61%	164	100
Audiology	2,215,604	176	100	57%	156	88
ED	2,213,914	765	450	59%	719	421
Tele triage	2,200,503	101	61	61%	67	41
optometry	2,105,982	173	98	57%	164	94
podiatry	1,585,342	185	107	58%	168	97
opthamology	1,321,077	316	203	64%	250	153
orthopedics	898,556	349	209	60%	300	180
urology	873,906	346	205	59%	286	170

Applications

- CEA is helpful in coverage and purchase decision, especially with regard to drugs or simple procedures (cancer screening)
- CEA often do not change clinician behavior
- Helping health care systems make better decisions (implementation science) is really nuanced
  - Wagner TH. Rethinking how we measure costs in implementation research. Journal of General Internal Medicine. 2020;35(2):870-874.
  - Wagner TH, Dopp AR, Gold HT. Estimating downstream budget impacts in implementation research. Medical Decision Making. 2020;40(8):968-977.
  - Wagner TH, Yoon J, Jacobs JC, et al. Estimating Costs of an Implementation Intervention. Medical Decision Making. 2020;40(8):959-967.
  - Gold HT, McDermott C, Hoomans T, Wagner TH. Cost data in implementation science: categories and approaches to costing. Implementation Science. 2022 Dec;17(1):1-2.

For your computations

- Define the time horizon. Focus on costs that are variable in that time horizon.
- Define the perspective– whose costs?
- Consider how changing the time horizon and the perspective would change those costs.
- Is the accounting data a good approximation of opportunity cost?

Final Words

- Resource use is easy to observe
  - length of stay or visits
  - Hours of caregiver effort
- Putting a dollar value on resource use is much harder
- Cost, charges and payments
  - Costs, charges, and payments are distinct.
  - ABC systems provide the most precise measure of costs (often allow you to see the variable and fixed costs)
- Keep the concept of opportunity cost in your mind as you go
- Costs are tied to quality and efficiency, but usually not in observable ways