

# What is Efficiency?

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# Objectives

- Explain why efficiency is the key to understanding the economics of implementation
- Describe efficiency frameworks from more traditional “neoclassical models” to more contemporary behavioral economic models.
- Highlight implementation strategies that have been employed in the past.
- Describe options for the matching implementation strategy to the underlying causal problem.

# Implementation and Economics

- Organizational leaders frequently ask whether investing in a new “technology” will improve organizational efficiencies and whether any gains offset the costs incurred to develop and execute the technology.<sup>1</sup>
- Increasingly leaders are turning to us for help.
- This is the “learning health care system.”<sup>2</sup>

1. Hoomans T, Severens JL. Economic evaluation of implementation strategies in health care. *Implement Sci* 2014;9(1):168.

2. Smith M et al. *Best Care at Lower Cost: The Path to Continuously Learning Health Care in America*. Washington, D.C.: The National Academies Press; 2012.

# Paradox in Substance Use Tx

- Between 1990-2010
  - Increasing evidence that substance use treatment was cost effective
  - Large contraction in substance use treatment programs
- Ettner et al<sup>1</sup> found that substance use treatment was cost-effective due to savings in criminal justice.
- VA investments in substance use treatment do not save the hospital money.<sup>2</sup>
- Implementation is often a local decision and so identifying the right perspective is important.

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.

# Timing Is Important

- We say good value, but value might be based on a societal perspective with a long-term horizon.
- Decision makers in organizations often face a different perspective—their budget has a short-term horizon and is finite.
- Changing the perspective and time horizon has some notable implications.

# Bridging the Gap

- I reached out to colleagues.
- Are others seeing the same gap? How do we close the gap?
- Connected with Heather Gold (NYU) and Gila Neta (NCI) and we started having a monthly call. That turned into an informal “Economics of Implementation working group”
- Currently 108 members and a number of papers <https://www.biomedcentral.com/collections/EconomicEvaluation>
- Developed examples showing the challenges

## Economic evaluation in implementation science

Collection published in *Implementation Science*, *Implementation Science Communications*

Organized by Heather T. Gold, *NYU Grossman School of Medicine, USA*; Gila Neta, *National Cancer Institute, USA*; Todd Wagner, *Stanford University, USA*

Economic evaluation compares the costs and benefits among distinct courses of action. Understanding the costs of evidence-based practices (e.g., interventions, policies, programs, tools) and the associated efforts that ensure their delivery and sustainment is critical for decision makers. Although many implementation science frameworks include costs as a key construct, relatively little guidance exists on how best to measure







# Implementing Change

- Hospital CEO offers you a job to reduce costs and improve care in the ICU.
- The base pay isn't that great, but there is a huge bonus if the hospital's costs decrease in the next 2 years.
- Do you take the job?

# Luckily, you're smart

Search Google  
Scholar



Call your friend who  
is a critical care nurse

# ICU Care

- More than 51,000 ICU beds in the US in 2015
- ICUs usually have three types of patients
  - Those who need life sustaining care
  - Dying patients (end of life care)
  - Lower acuity patients where the clinician wants extra monitoring of vitals
- Many hospitals are adding ICU beds, yet up to 40% of ICU admissions are not for life sustaining care.

# ICU Care is Expensive

- Expensive staff
- Fancy equipment
- Lots of additional care, especially early on
  - Tests
  - Medications
  - Scans
  - Additional monitoring

	Cost Per Added Day (VA 2018)	
Day of Stay	Total Cost	Variable Costs
1	9,605	5,210
2	6,838	3,692
3	7,250	3,951
4	7,914	4,303
5	7,332	4,050
6	7,826	4,362
7	6,458	3,541

# Two Short Term Strategies

- Option 1: Divert low acuity patients away from the ICU (diversion)
- Option 2: Transfer low acuity patients out of the ICU earlier (expedited transfer)

# What is the winning bet?

- Option 1: Divert low acuity patients out of the ICU (diversion)
- Option 2: Transfer low acuity patients out of the ICU earlier (expedited transfer)



# Option 1: Diversion

- This means that some ICU beds will go unfilled.
  - ↓ in tests, tubes, monitoring, scans, etc.
  - Possible ↓ in labor costs
  - No decrease in space and other fixed costs
- Net effect is unclear
- Bonus seems unlikely; depends on your labor costs and how quickly you can redeploy staff

# Option 2: Expedited Transfer

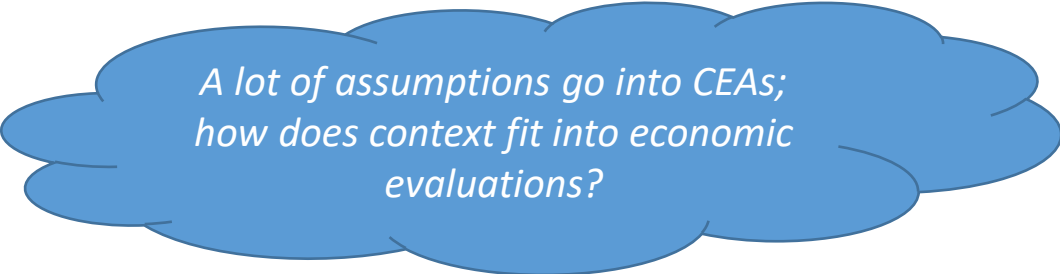
- Keeps ICU beds occupied
  - Same staff
  - Same space costs
- But, more day 1 admissions
  - With more day 1 admissions, there is an increase in tests, tubes, monitoring, scans, etc.
- Net effect is  $\uparrow$  average cost per patient
- Definitely no bonus





# Right Answer

- In the short term: diversion is better than expedited transfers
- In the long-term: continue to divert and turn the unused ICU beds into a more productive capacity.
- For decision makers:
  - The time horizon is important
  - Multiple decisions may be needed
  - Context and efficiency matters



*A lot of assumptions go into CEAs;  
how does context fit into economic  
evaluations?*

# Assumptions in Economic Evaluations

$$\text{Value} = \frac{\text{Change in costs}}{\text{Change in effects}}$$

## Drugs with perfect implementation

- Cost of the Rx is known
- Predictable fidelity
- Efficiency only affects cost via bargaining
- Distribution network is established. Marginal cost is 0.

## Implementation Science

- Cost is unknown
- Unpredictable fidelity
- Efficiency affects cost and effectiveness
- Changing the system can have profound effects

Efficiency is the key to understanding the  
economics of implementation

# Improving Efficiency

- Efficiency — upheld as a cornerstone of high-quality health care — is a common target for measurement and improvement efforts



Agency for Healthcare  
Research and Quality

## Six Domains of Healthcare Quality

A handful of analytic frameworks for quality assessment have guided measure development initiatives in the public and private sectors. One of the most influential is the framework put forth by the Institute of Medicine (IOM), which includes the following six aims for the healthcare system.<sup>[1]</sup>

- **Safe:** Avoiding harm to patients from the care that is intended to help them.
- **Effective:** Providing services based on scientific knowledge to all who could benefit and refraining from providing services to those not likely to benefit (avoiding underuse and misuse, respectively).
- **Patient-centered:** Providing care that is respectful of and responsive to individual patient preferences, needs, and values and ensuring that patient values guide all clinical decisions.
- **Timely:** Reducing waits and sometimes harmful delays for both those who receive and those who give care.
- **Efficient:** Avoiding waste, including waste of equipment, supplies, ideas, and energy.
- **Equitable:** Providing care that does not vary in quality because of personal characteristics such as gender, ethnicity, geographic location, and socioeconomic status.

# How Important is Efficiency?

- “Productivity isn't everything, but, in the long run, it is almost everything.” Paul Krugman
- "The political problem of mankind is to combine three things: economic efficiency, social justice and individual liberty." John Maynard Keynes

# What is Productivity and Efficiency?

- We use this term daily in many different contexts, yet clear definitions remain elusive.<sup>2</sup>
- “Waste” is sometimes used.
- In health care, recent estimates suggest that efficiency losses totaled approximately \$340 billion annually (\$1030 per capita) in the United States in 2019.<sup>1</sup>

1. Shrank WH, Rogstad TL, Parekh N. Waste in the US Health Care System: Estimated Costs and Potential for Savings. JAMA 2019

2. Burgess Jr JF. Innovation and efficiency in health care: does anyone really know what they mean? Health Syst 2012;1(1):7–12.

**Table 2. Cost Estimates by Waste Domain**

Domain	Costs, \$US Billion	
	Annual Estimates	Total Range
<b>Failure of Care Delivery</b>		
Hospital-acquired conditions and adverse events <sup>18-22</sup>	5.7-46.6	<b>102.4-165.7</b>
Clinician-related inefficiency (variability in care, inefficient use of high-cost physicians) <sup>27,28</sup>	8.0	
Lack of adoption of preventive care practices (obesity, vaccines, diabetes, hypertension) <sup>23-26</sup>	88.6-111.1	
<b>Failure of Care Coordination</b>		
Unnecessary admissions and avoidable complications <sup>19,29</sup>	5.9-56.3	<b>27.2-78.2</b>
Readmissions <sup>30,31</sup>	21.25-21.93	
<b>Overtreatment or Low-Value Care</b>		
Low-value medication use <sup>12,32-35</sup>	14.4-29.1	<b>75.7-101.2</b>
Low-value screening, testing, or procedures <sup>14,36,37</sup>	17.2-27.9	
Overuse of end-of-life care <sup>38</sup>	44.1	
<b>Pricing Failure</b>		
Medication pricing failure <sup>8</sup>	169.7	<b>230.7-240.5</b>
Payer-based health services pricing failure <sup>39,40</sup>	31.4-41.2	
Laboratory and ambulatory pricing <sup>41</sup>	29.7	
<b>Fraud and Abuse</b>		
Fraud and abuse in Medicare <sup>42-44</sup>	58.5-83.9	<b>58.5-83.9</b>
<b>Administrative Complexity</b>		
Billing and coding waste <sup>45</sup>	248	<b>265.6</b>
Physician time spent reporting on quality measures <sup>10</sup>	17.6	
<b>Total</b>		<b>760-935</b>

**Delivery Failure  
~\$200-340 B**

# Definitions

- Productivity is the relationship between inputs and outputs of a process
  - “Is the production process efficient?”
- Productivity can be measured at different levels.
  - A country’s gross national product
  - An organization’s production process
- We focus on the “health care organization” -- any entity, large or small, that produces patient services while managing its budget and resources.
  - This could be a hospital
  - This could be a small primary care clinic



# Productivity vs Efficiency

- Efficiency places a value judgement on the organization's productivity relative to the most efficient possible state of production, known as the production possibility frontier.
- An inefficient organization could produce more products and services with the same inputs.

# Competition

- In a well-functioning market, competition creates incentives for organizations to improve quality while lowering prices.
  - The market sustains the efficient production of desirable goods and services, and extinguishes the production of non-desirable goods, which may be low quality or too expensive.<sup>1</sup>
  - An organization producing non-desirable goods or services, absent any improvements, will cease to exist in time, thereby optimizing social welfare.
- Health care is not a well functioning market;<sup>2</sup> inefficient health care organizations will not necessarily know they are inefficient nor face an existential threat.

1. Bator FM. The anatomy of market failure. Q J Econ 1958;72(3):351–79.

2. Arrow KJ. Uncertainty and the welfare economics of medical care. Am Econ Rev 1963;53(5):941–73.

# Measuring Efficiency

- Two common neoclassical frameworks for measuring an organization's productive efficiency (aka, technical efficiency)
- Output maximization: given the organization's inputs, how much outputs is it making.
- Cost minimization: given the organization's outputs, how many inputs did it use, keeping in mind that these inputs have different prices.

# Comparing the Frameworks


## Output maximization

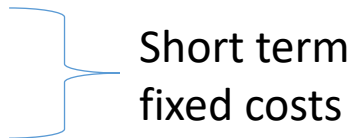
- $\text{Output} = f(w, y, r, u)$
- **Output** is the quantity of outputs produced
- **w** is a vector of input labor quantities (e.g., full time equivalent employees)
- **y** is a vector of input capital quantities (e.g., number of bed days, equipment, and supplies)
- **r** is a vector of regulatory factors
- **u** is a vector of patient differences (e.g., age, gender, clinical risk, social risk).

## Cost minimization

- $\text{Cost} = f(p, o, r, u)$
- **Cost** is the organization's total operating cost
- **p** is a vector of input prices (i.e., cost of labor and capital) at the local-market level. Most models assume that these prices are set by market forces.
- **o** is a vector of outputs, such as the number of outpatient visits and inpatient stays produced
- **r** is a vector of regulatory factors
- **u** is a vector of patient differences (e.g., age, gender, clinical risk, social risk).

# Time Horizon

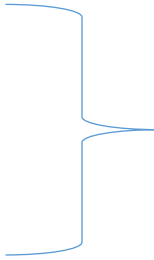
- Decisions have time implications
- Organizations can change some inputs with their scale of operation
  - Supplies
  - Labor

Variable costs
- Other inputs are fixed in the short term and only variable in the long run
  - Space
  - Major equipment (e.g., MRI or CT scanners)

Short term fixed costs

# Measurement

- Most health care organizations produce many outputs
  - Number of services
  - Patient experience
  - Quality of care
  - Access
- Output maximization cannot be easily analyzed using standard regression models— can use linear programming, but not straightforward.
- Cost minimization is generally preferred
  - Cost data are noisy
  - Some people object to focusing on costs



*The ultimate goal is to produce health, but we don't have good measures of health*

# The Social Benefits of Efficiency

- Organizational leaders may be motivated to optimize their organization's productive efficiency because it affects outcomes they care about.
- Policy makers, regulators, and the people who live in the communities also care about efficiency.
  - They want organizations to be efficient
  - They want organizations to produce the right kinds of services, aka “high value services”

# Social Welfare Maximization

## “the invisible hand”

- The market, which is driven by consumers, informs organizations about what services to produce.
- Organizations respond by efficiently providing those services. Thus, perfectly competitive markets result in efficient resource allocations for society (i.e., allocative efficiency).<sup>1</sup>
- Without a well-functioning market, however, the tight connection between productive efficiency and social welfare is lost. A health care organization can minimize its costs of production, but still produce too much specialty care or overinvest in technologies that may have little societal value.<sup>2</sup>

1. Stiglitz JE. Pareto optimality and competition. J Finance 1981;36(2):235–51.

2. Devers KJ, Brewster LR, Casalino LP. Changes in hospital competitive strategy: a new medical arms race? Health Serv Res 2003;38(1p2):447–69.



# Why Doesn't the Market Work?

- The model assumes
  - Producers are well informed, and able to freely enter and exit the market.
  - Prices reflect the total costs of production and are set by the market. The market is free of monopolies or oligopolies that could distort prices.
  - Consumers also make fully informed decisions, and they cannot benefit from the good without purchasing it.
- Health care is notorious for not meeting these requirements.<sup>1</sup>

1. Arrow KJ. Uncertainty and the welfare economics of medical care. Am Econ Rev 1963;53(5):941–73.

# Allocative Efficiency

- Two conditions must hold:
  1. Health care organizations must be productively efficient.
  2. They must produce the right services: organizations must be informed and sometimes persuaded about what services to produce to maximize value for society.
- Frequently when we say something is inefficient in health care it is because the system isn't improving allocative efficiency.

# Behavioral Economics

- Decision makers may not be fully informed and making decisions that adhere to rational expectations
- Behavioral economics examines how organizations perform when there is uncertainty, competing demands that can change over time (short vs. long-term goals), and the psychology of decision making.

# Behavioral Economic Examples

- Behavioral economics introduces other ways of conceptualizing inefficiencies that may be particularly appealing for implementation scientists.
  - For example, Freedman and colleagues<sup>1</sup> examined provider behavior when providers encountered unexpected time pressures.
  - Time pressures increased the likelihood that providers took “shortcuts”
    - Documented less (fewer Dx codes)
    - Increased their use of follow-up care (i.e., pushing care onto future visits), and
    - Provided less preventive care.
- Note: the short cut is efficient for the provider but not efficient for the patient or society

1. Freedman S, et al. Docs with their eyes on the clock? the effect of time pressures on primary care productivity. J Health Econ 2021;77:102442.

# Other Examples

- Neprash and Barnett<sup>1</sup> found that providers were more likely to prescribe opiates later in their shifts
- Chan<sup>2</sup> found that emergency room physicians spent less time with patients near the end of their shift, resulting in higher costs.

1. Neprash HT, Barnett ML. Association of Primary Care Clinic Appointment Time With Opioid Prescribing. *JAMA Netw Open* 2019;2(8):e1910373–e1910373.

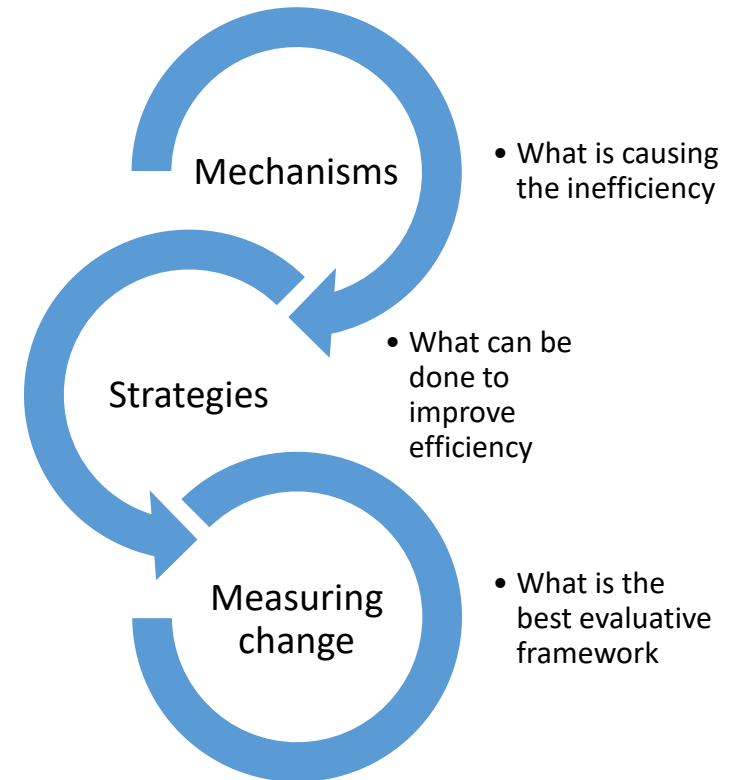
2. Chan DC. The efficiency of slacking off: Evidence from the emergency department. *Econometrica* 2018;86(3):997–1030.

# Measuring Efficiency

- Segue into measuring efficiency
- I've skimmed through micro-economics, skipping many issues
- Trainees interested in this space may find great value in studying micro-economics

# How Do You Improve Efficiencies?




- What are the mechanism(s) causing the inefficiency?
- Strategies for improving efficiency
- Measuring efficiency improvements



# Mechanisms



# Neoclassical Mechanisms

- $\text{Cost} = f(p, o, r, u)$
- $p$  is a vector of input prices (i.e., cost of labor and capital) at the local-market level.  *Are we using the right mix of inputs at the right prices?*
- $o$  is a vector of outputs, such as the number of outpatient visits and inpatient stays produced  *Are we producing the right mix of outputs? Maybe our PCP teams are overusing / overproducing specialty care.*
- $r$  is a vector of regulatory factors  *Do we need new policies or to eliminate bad policies?*
- $u$  is a vector of patient differences (e.g., age, gender, clinical risk, social risk).

# Common Neoclassical Mechanisms

- Misallocation of labor
- Economies of scale: expanding the scale of production reduces the average unit cost
  - Merge two clinics and the resulting clinic is less expensive than the two independent clinics
- Economies of scope: re-organizing results is a decrease in the total cost of operation
  - creating multispecialty group practices has been linked with breaking down “silos” and creating efficiencies.
- Buying unnecessary equipment

1. Panzar JC, Willig RD. Economies of scope. *Am Econ Rev* 1981;71(2):268–72.

2. Hillson SD, Feldman R, Wingert TD. Economies of scope and payment for physician services. *Med Care* 1992;822–31.

# Rules and Regulations (R&R)

- R&R alter how organizations allocate their resources
- R&R increase the organization's cost of production relative to no regulations
- R&R may enhance allocative efficiency even if they decrease the organization's technical efficiency.
  - Preventing monopolies or oligopolies to lower prices
- However, sometimes R&R exist and they no longer add value

# Behavioral Economic Mechanisms

- Are we creating incentives whereby the provider's efficiency is inefficient for society?
  - Overburdening providers
    - Shortcuts at the end of the shift
    - Provider burnout
- Are internal policies irrational?
  - When hospitals invest large amounts, sometimes they are overly protective of those investments for fear of losing the investment (prospect theory)

# Example

- Investigators built an EHR application to promote smoking cessation treatment.
- The intervention was highly effective in one hospital
- The goal was to implement at 2 other hospitals
  - Hospital 1 is a suburban community hospital. The hospital rely on the EHR vendor when they want to add or turn on new functionalities.
  - Hospital 2 is a large health care system. They recently invested over \$1 billion to update the EHR system. Any EHR changes must to undergo extensive review that often takes up to 24 months.
- Is either approach more efficient?

# Strategies

# Strategies

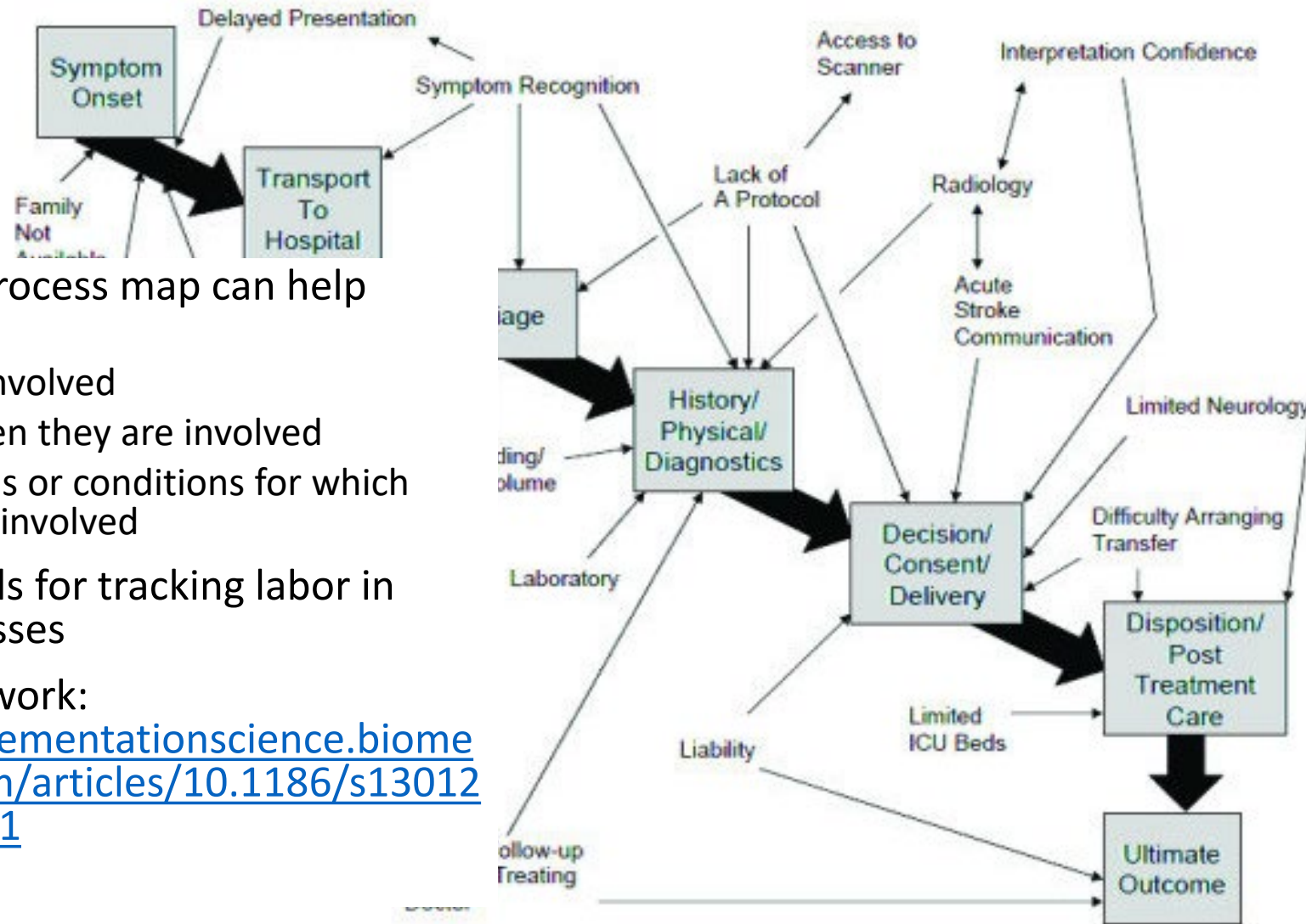
- **Misallocated labor**

- **Wait:** some inefficiencies (misallocation of labor that results in idle staff) may be easily identified and remedied with little or no external effort.
- Create a process map of the actors, actions and time involved in the process. Similar to the Action, Actor, Context, Target, Time (AACTT) model described by Presseau and colleagues.<sup>1</sup>
- Create patient reminders if idle labor is from no-shows.

1. Presseau J, McCleary N, Lorencatto F, Patey AM, Grimshaw JM, Francis JJ. Action, actor, context, target, time (AACTT): a framework for specifying behaviour. *Implement Sci* 2019;14(1):1–13

# Process Map for Stroke

- Creating a process map can help identify:
  - Who is involved
  - How often they are involved
  - Situations or conditions for which they are involved
- Develop tools for tracking labor in these processes
- Ex: Cidav's work: <https://implementationscience.biomedcentral.com/articles/10.1186/s13012-020-00993-1>





# Rules and Regulation

- Do rules help or are rules the problem?
  - Too often we treat existing rules as fixed
  - De-implement rules that don't add value
- Strategies include voting, lobbying, and other avenues of persuasion

FDA NEWS RELEASE

## **FDA Finalizes Historic Rule Enabling Access to Over-the-Counter Hearing Aids for Millions of Americans**

*More Affordable Hearing Aids Could Be in Stores as Soon as Mid-October*

Original Investigation | Anesthesiology



May 6, 2021

# Variability and Costs of Low-Value Preoperative Testing for Cataract Surgery Within the Veterans Health Administration

Seshadri C. Mudumbai, MD, MS<sup>1,2,9</sup>; Suzann Pershing, MD, MS<sup>1,3</sup>; Tom Bowe<sup>1</sup>; [et al](#)

[» Author Affiliations](#) | [Article Information](#)

*JAMA Netw Open.* 2021;4(5):e217470. doi:10.1001/jamanetworkopen.2021.7470

## Key Points

**Question** To what extent are low-value preoperative tests used before cataract surgery in the US Veterans Health Administration, and what is the variability and cost of these tests?

**Findings** In this cohort study including 69 070 cataract procedures performed among 50 106 patients, almost half were preceded by at least 1 low-value test. Compared with low-complexity facilities, higher facility-level complexity was associated with higher odds of receiving a 4-test bundle.

**Meaning** Despite the dissemination of Choosing Wisely guidelines surrounding cataract surgery within a large, integrated health care system, these results suggest that low-value tests continue to be widespread, and that more intensive deimplementation approaches are required.

# Provider Shortcuts

- Provider education
- Reduce work rate at end of shifts
- Schedule less-complex patients at end of shift, if possible
- Audit and feedback
- Pay for performance

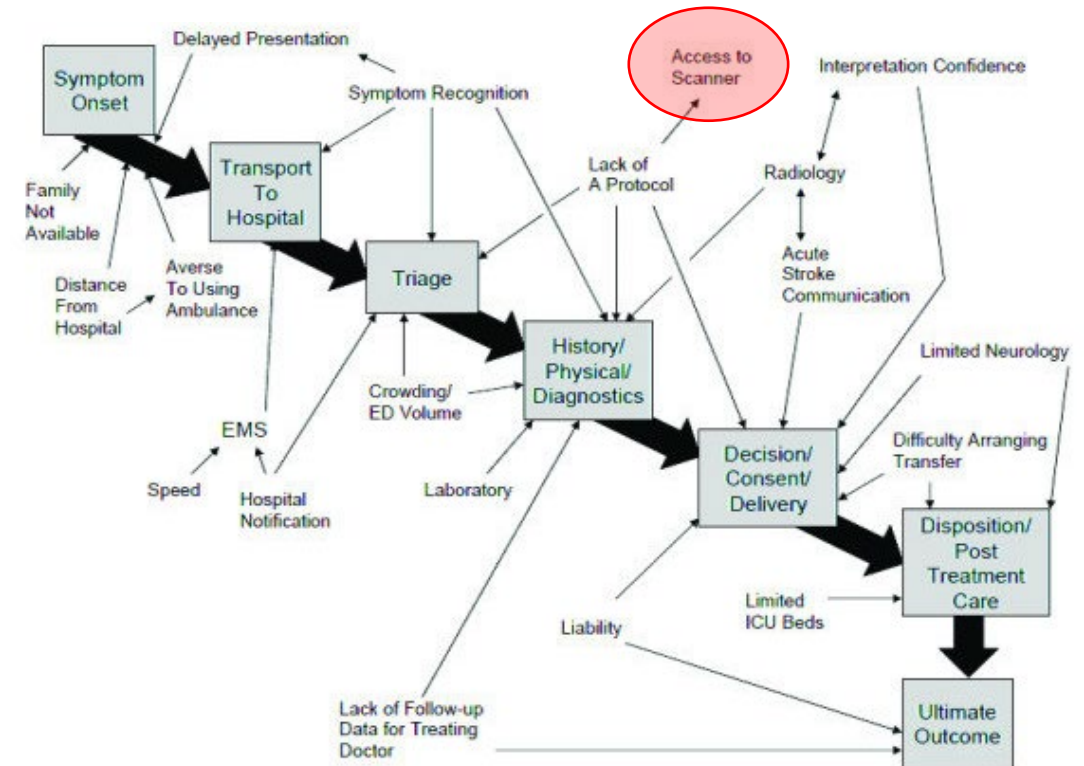
# Measuring Change

# Measuring Change in Efficiency

- Define the unit of analysis
  - Organization
  - Department
  - Provider shift
- Challenges
  - Need large samples
  - To statistically control for underlying assumptions
- Does an improvement in one Dept. help or hurt another Dept.?

# Local or Global Improvement

- You might find local bottlenecks
- Does the fix for your situation hurt others in the organization?
- The only way to test this would be through an experimental design (need large n)



# Measuring Efficiency

- Measuring inefficiencies with a behavioral economics lens may be easier than a neoclassical lens
- Define the outcome: when is the provider's behavior inefficient for society?
- May have large enough sample size, even within a single hospital (e.g., unit is provider work shifts).

# Conclusions

- Pressure to improve efficiency has always been there and it is likely to increase with rising costs, inflation and competing demands
- Improving efficiency in health care will be facilitated by a common language
- Matching the implementation strategy to the causal mechanism will be important for success
- De-implementation of rules and regulations can improve efficiency



# Thanks

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