

Cost-Effectiveness Analysis

Sherry Glied, Ph.D.

Mailman School of Public Health

Columbia University

What is CE?

- Traditionally used to evaluate government interventions
 - roads
 - vaccines
- Now -- medical interventions
 - 8000+ Medline cites since 1997
 - clinical trials

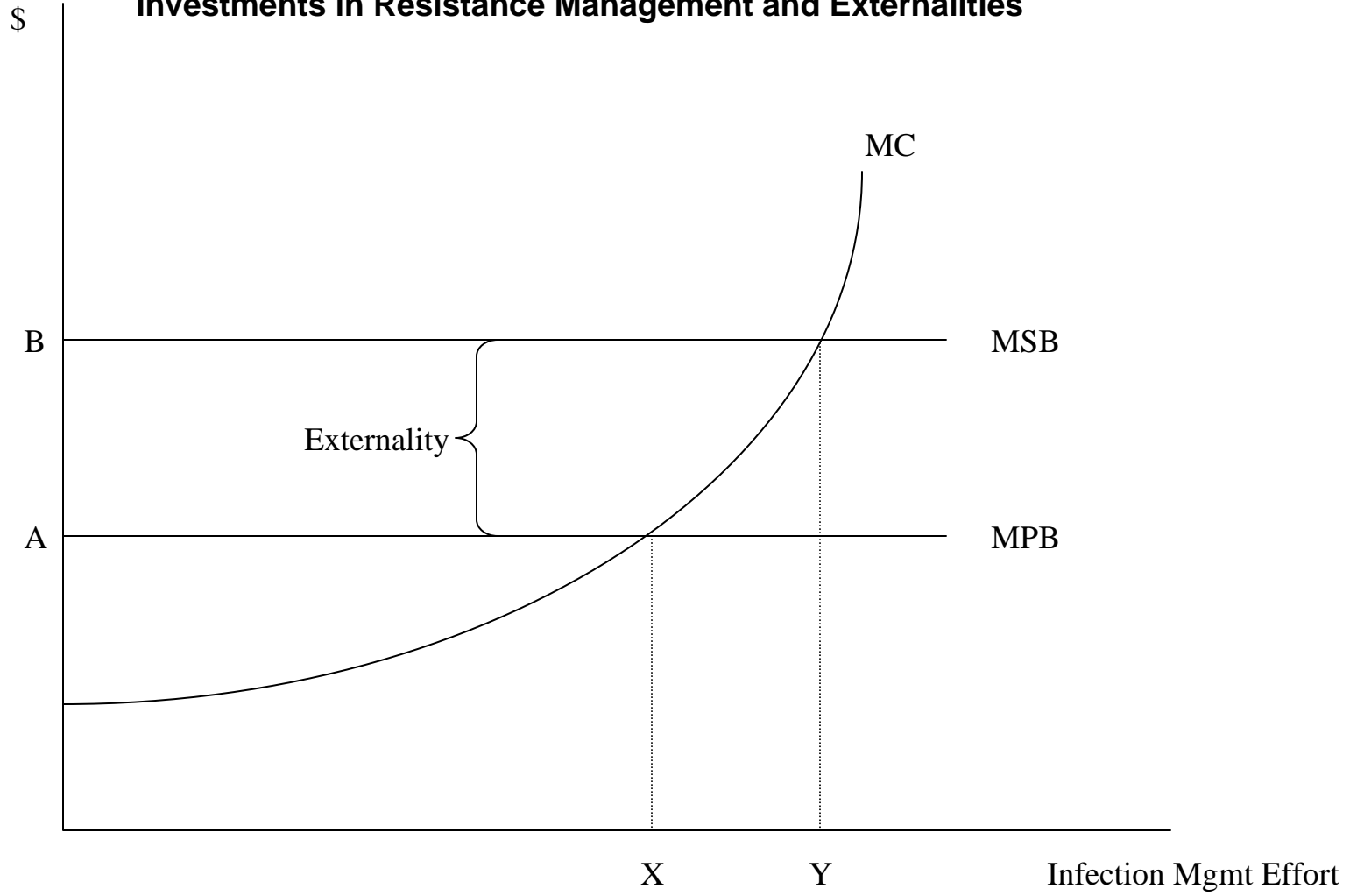


Why?

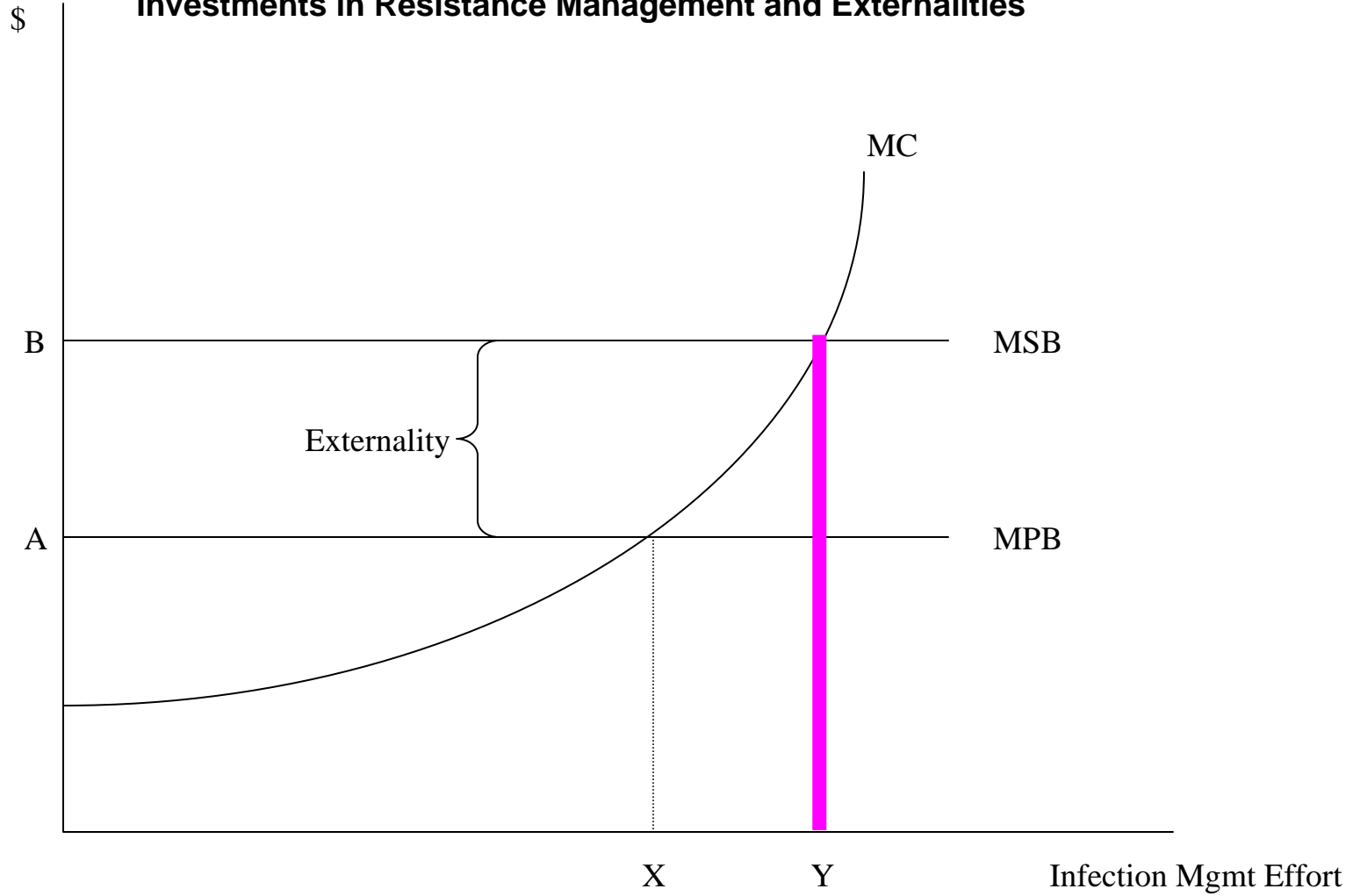


- More health care choices
 - Use new antibiotics? Do additional tests?
- Increasing costs of health care
 - \$4 billion cost of treating drug resistant strains in 1995
- Insurance
- Externalities
 - Person making decision may not reap full benefit

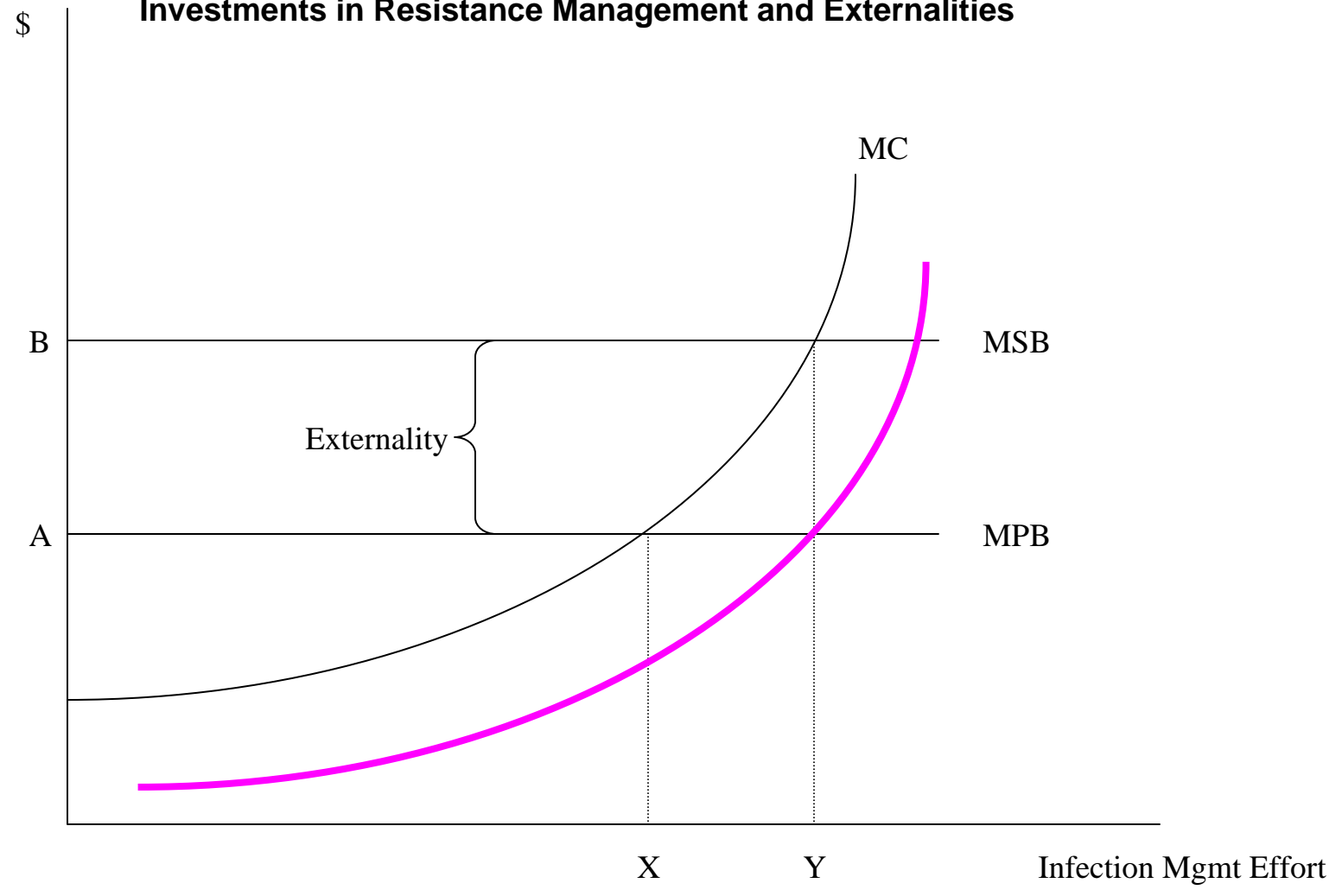
Investments in Resistance Management and Externalities



Investments in Resistance Management and Externalities



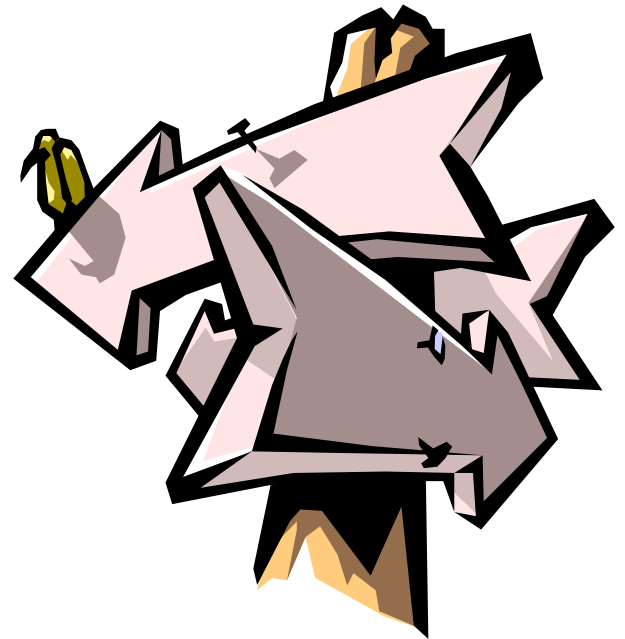
Investments in Resistance Management and Externalities



What is the “Right” level?

- The level that is most “cost-effective”
- Cost-effectiveness criterion for setting standards, subsidies, etc.

- Explicit part of health service decision making
 - UK
- Medicare coverage decisions
 - pneumococcal vaccine
- Private Insurers
 - one element in decisions



What is CE?

- A ratio
 - incremental costs/incremental outcomes
- A tool
 - evaluate tradeoffs
- A summary statistic
 - combine utilization and broad outcome

The Key Economic Question

- Relative to what??

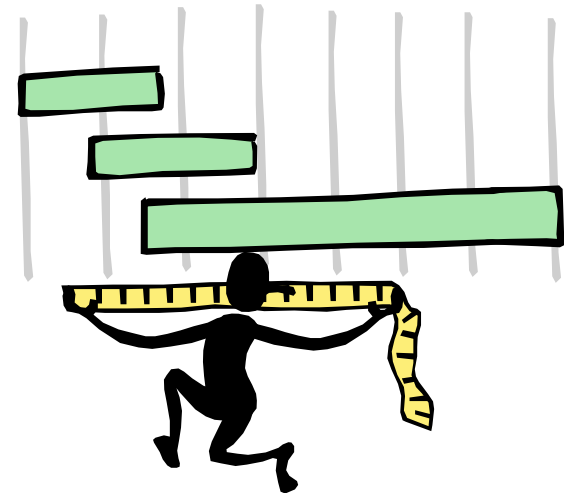
tradeoffs



CE Always Compares:

- New treatment to alternative treatment
 - BUT: Could be
 - no treatment
 - could be standard care
 - could be yet another alternative

What It Isn't



- Cost-effective \therefore cheaper
- Cost-effective \therefore cheaper per life saved
- Cost-effective ratio = how much
ADDITIONAL cost per ADDITIONAL
outcome gained?

Consider new treatment X relative to standard of care Y:

	Less \$	More \$
Worse Outcome	A?	B
Better Outcome	C	D?

Focus on More Costs, Better Outcomes

- CE asks first
 - How much more does X cost than Y?
- Suppose, for a population of 2000 patients:

X	Y
\$15,000,000	\$5,000,000

\$10,000,000

- CE asks next
 - How much better outcomes does X achieve than Y?
 - Suppose intervention saves one year of life if it works

- Suppose, for this population:

X	Y
500 deaths	1000 deaths

500 life years saved

CE Ratio

$$\frac{\$15,000,000 - \$5,000,000}{1000 - 500}$$

$$= \frac{\$10,000,000}{500}$$

= \$20,000 per additional life year saved

Note

- Treatment Y is cheaper (\$2500 vs. \$7500 per patient treated)
- Treatment Y costs less per life saved
(15,000,000/1500) for X = \$10,0000
(5,000,000/1000) for Y = \$5,000

Is Treatment X Cost-Effective?

- Recall CE ratio:

Relative to treatment Y, treatment X cost
\$20,000 per life year saved

Is That Too Much?

- No simple answer
- Well within range of other interventions in wide use



Cost-Effectiveness of Life-Saving Interventions

<u>Intervention</u>	<u>Cost per Life-Year</u>
Polio Vaccination	<\$0
Mammography at 50	\$ 810
55 MPH Speed limit	\$ 6,600
2 vessel CABG	\$28,000
Pneumonia vaccine for healthy adults <56	\$66,000
Hypertension screening for asymptomatic 20 year old women	\$87,000

- Now suppose instead for this population:

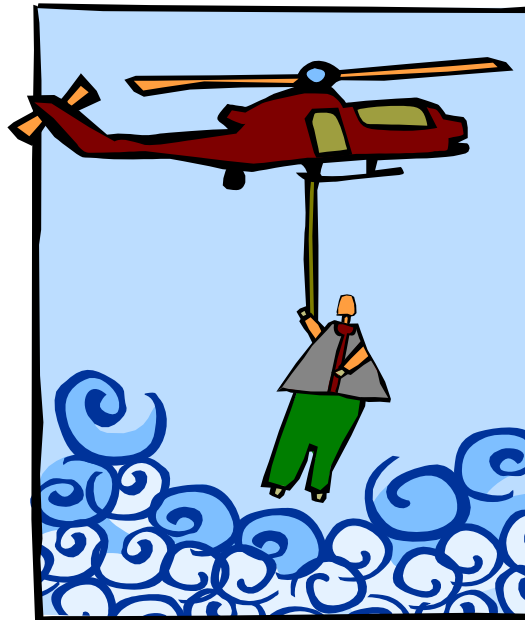
X

500 deaths

Y

501 deaths

1 life year saved



CE Ratio

$$\frac{\$15,000,000 - \$5,000,000}{501-500}$$

$$= \frac{\$10,000,000}{1}$$

= \$10,000,000 per additional life year saved

Cost-Effectiveness of Life-Saving Interventions

<u>Intervention</u>	<u>Cost per Life-Year</u>
Polio Vaccination	<\$0
Mammography at 50	\$ 810
55 MPH Speed limit	\$ 6,600
2 vessel CABG	\$28,000
Pneumonia vaccine for healthy adults <56	\$66,000
Hypertension screening for asymptomatic 20 year old women	\$87,000

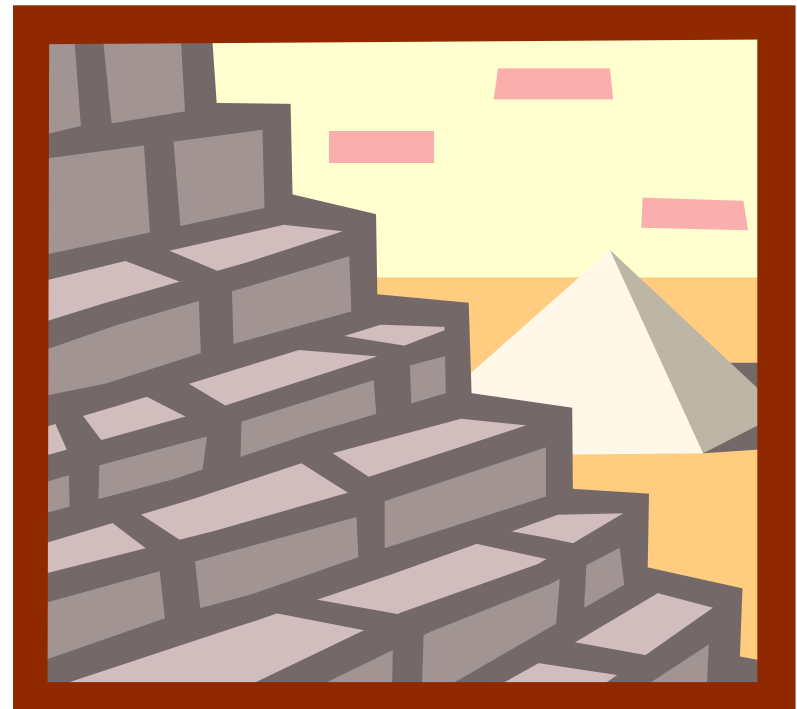


What does this mean?

- CE doesn't say “DON'T DO IT!!”
- CE says -- “CONSIDER THE TRADEOFFS”

Walk Through Steps

- Identify two alternatives
- Choose perspective
- Define population
- Measure costs
- Measure outcomes
- Compare
- Assess

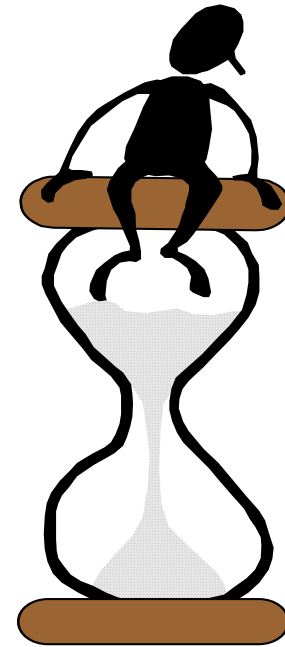


Alternatives

- Generally, choose options that address:
 - similar outcomes
 - similar population
- Well suited to clinical trial

Perspective

- Patient
 - What will it cost me?
 - What will happen to me?
- Provider
 - How much will providing service cost?
 - What benefit from better outcomes?



Perspective

- Payer
 - Insurer or Medicare
 - What does it cost me to provide this now...
 - rather than treat it later
 - » if the person still belongs to my health plan etc...



Societal Perspective

- Preferred choice
- All costs -- no matter where incurred
- All outcomes -- no matter who they happen to (this patient + others)
- All time periods -- now and in the future
- Critical in case of externalities

Population

- Best to compare costs and outcomes in statistically similar populations
 - want the true effect of the interventions
- Can look at incremental analyses within population:
 - cost-effectiveness of X vs. Y for women vs. men

Costs

- Health care utilization
 - drugs, hospital, physician visits, nursing homes
- Other directly incurred costs
 - home aide, transportation costs
- Time costs
 - patient, family members
- Work losses (?)



Outcomes

- Want these to be:
 - broad
 - generalizable

Outcome options

- clinical endpoints
 - ~~Cases of resistant disease~~
- Lives saved
 - ~~1 year vs. 10 years~~
- Life years saved
 - ~~pain vs. no pain~~
- Quality-adjusted Life-Years saved

QALYs

- Subjective assessment of health state at each point in time
- How long and how well do you live?



Ask directly

- Questions about tradeoffs
 - Live 1 year in good health, then die instantly

OR

- Live 10 years in condition A, then die instantly

Infer from Survey

- Construct QALYs based on validated survey instruments

Compare

- Intervention A

- Intervention B

Cost = x

Cost = y

QALYs gained = q

QALYs gained = p

CE: A vs. B =

$x-y/(q-p) =$

\$ per QALY

What is learned?



- Were outcomes confined to clinical endpoints or was quality of life, from subjective perspective, improved?
- Did we achieve outcomes at enormous cost or at moderate cost?
- Did some groups gain more than others?
- What is the best way -- in terms of “bang for the buck” -- to target intervention?

Whose CE Anyway?

- CIRAR
- Societal vs. hospital CE
- Interventions exist, but often not implemented
- One reason is mismatch between costs and benefits

External Benefits

- Subsequent admissions of same patient
- Other patients
- Reduced spread of resistance to future susceptibles
- Payers

Payer/Provider

- “Despite the evidence that poor quality costs money, however, health care organizations and professionals have not adopted quality-based process management to compete in today’s marketplace. Indeed, a variety of barriers embodied in current payment methods prevent health care organizations from pursuing quality improvement.” (IOM, Chasm Report, p. 191)

Aims

- For a range of organisms across two distinct hospital campus sites:
 - [Estimate the hospital costs of resistant infections for the index patient]
 - Estimate the hospital costs of resistant cases external to the index patient
 - Estimate the distribution of hospital costs among providers, payers, and patients

Should this be an Aim or just a method as part of Aim?

Order?

Include?

Aims Continued

- Develop hospital, regional, and national estimates of the cost of resistance
- CIRAR – to assess incentives for implementation of effective interventions (Saiman/Lowi?)
- CIRAR – to assess relationship between payment and implementation of interventions (Stone)

Potential Implications for Decreasing Antimicrobial Resistance/Significance

- Without incentives to put strategies in place, won't be able to implement these strategies and reduce resistance

Introduction & Background

- AMR – substantial costs
- Interventions exist, but often not implemented
- One reason is mismatch between costs and benefits

External Benefits

- Subsequent admissions of same patient
- Other patients
- Reduced spread of resistance to future susceptibles
- Payers

Payer/Provider

- “Despite the evidence that poor quality costs money, however, health care organizations and professionals have not adopted quality-based process management to compete in today’s marketplace. Indeed, a variety of barriers embodied in current payment methods prevent health care organizations from pursuing quality improvement.” (IOM, Chasm Report, p. 191)

Aims

- For a range of organisms across two distinct hospital campus sites:
 - [Estimate the hospital costs of resistant infections for the index patient]
 - Estimate the hospital costs of resistant cases external to the index patient
 - Estimate the distribution of hospital costs among providers, payers, and patients

Should this be an Aim or just a method as part of Aim?

Order?

Include?

Aims Continued

- Develop hospital, regional, and national estimates of the cost of resistance
- CIRAR – to assess incentives for implementation of effective interventions (Saiman/Lowi?)
- CIRAR – to assess relationship between payment and implementation of interventions (Stone)

Performance Sites

- New York Presbyterian Hospital
 - Columbia University Medical Center campus
 - Weill Cornell Medical Center campus

Campus sites share an organizational and financial structure but serve very different populations and have distinct payer mixes

Methods

- Data linkage:
 - Electronic medical record clinical information including some orders
 - Clinical data warehouse including infection control information
 - Hospital Utilization, Cost, and Payment data from Financial Cost Accounting System (TSI)
 - Patient location data

Methods II

- Match
 - Identify all cases of selected resistant nosocomial and community acquired infections 2002-2009
 - Match resistant infections to susceptible infections (control) by organisms (and date, patient clinical characteristics)

Methods – Aim 1

Compute:

- Average LOS
 - Hospital costs
 - Hospital cost breakdown for resistant vs. susceptible infections by organism; nosocomial vs. community acquired
- Note: Improvement over existing literature by use of 2 campus sites and multiple organisms

Methods – Aim 2

- Estimate “at risk” patients exposed to index resistant/susceptible infections, by room location
- Compute LOS and hospital costs for these patients (by type of infection)

Methods – Aim 3

Compute:

- Primary payer expenditures
 - Payment – costs (provider incidence)
 - Patient costs for index and “at risk” patients, by source and method of payment
- Note that there were substantial changes in payment levels and methods during this period

Methods – Aim 4

- Compute algorithm for identifying resistant cases in discharge data
 - TSI and discharge information
- Assess total hospital costs and distribution
 - Publicly available discharge data

Potential Implications for Decreasing Antimicrobial Resistance/Significance

- Without incentives to put strategies in place, won't be able to implement these strategies and reduce resistance