Return on Investment & Costs: Terms & MCH Applications

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How Do We Show Value to Stakeholders of Investing in Early Detection/Prevention?

- Terms often used interchangeably (but shouldn’t be)
  - Cost-effective
  - Cost-saving
  - Favorable return on investment
  - Cost-beneficial

- Need to use the right methods and terms for a given policy question and audience
Stakeholder Perspectives

- **Stakeholder types**
  - Health care payers
    - Public – taxpayers
    - Private
  - Health care providers
  - Public health programs
  - Patients and families

- **Analytic perspectives**
  - Societal – all costs
  - Health care sector – just medical costs
  - Payer – just costs incurred by one payer
What’s a Cost?

- **Economic cost** – resources used up that cannot be used elsewhere (opportunity or resource cost)

- **Financial cost** – outlays by payers

- **Which cost measure is appropriate to use?**
  - From societal perspective, it shouldn’t matter who pays – we want an estimate of total cost to society
  - For payers and providers, financial cost is very relevant
    - A cost to a payer is revenue to a provider
    - For state agencies, budget impact is crucial
Types of Cost in Economic Evaluations

- **Direct cost** – Cost of providing a service
  - Medical
  - Non-medical
    - Education
    - Justice

- **Indirect cost** – Lost output for person affected
  - Mortality
  - Morbidity and disability

- **Parental time cost** – direct cost by US guidelines

- **Intangible costs**
  - Pain and suffering
  - Loss of well-being
Is an Ounce of Prevention Worth a Pound of Cure?

- Yes, but not necessarily cheaper (Grosse 2005)
- Is prevention less expensive to society (cost-saving)?
  - Sometimes yes
    - Common childhood vaccines
    - Folic acid fortification
    - Long-acting reversible contraception
  - Most preventive services cost more than they save in medical costs
- Is early detection of disease worth the extra cost?
  - Cost-effective – Compares well to other ways to improve health
  - Cost-beneficial – Monetary value of health improvements exceeds the societal cost, i.e., positive net benefit

Triple Aim and Public Health

- **Triple Aim in health care**
  - Better health outcomes
  - More patient satisfaction
  - Lower costs of care

- **Need to think in terms of package of interventions**
  - Some interventions improve health outcomes at higher costs
  - Other interventions reduce costs
  - Not all interventions can or should be cost-saving with financial ROI
Types of Cost Analyses in Public Health

- **Cost of illness or Injury (COI)** – preventable economic burden associated with a disorder or risk factor

- **Intervention cost** – cost of implementing a preventive service or program
  - Costs only
  - Cost-comparison – costs and numbers served

- **Economic evaluation** – costs & health outcomes
  - Cost-effectiveness analysis
  - Cost-benefit analysis
  - Budget impact or return on investment (ROI) analysis
Return on Investment (ROI)

- Standard definition of ROI analysis: calculation of net financial cost to a single stakeholder (e.g., a health plan, a hospital, or a state health department)
  - Cost outlay
  - Avoided financial costs to same institution
  - Time period over which costs are calculated typically varies from 1 to 5 years – CBO uses 10 year budget period for federal programs
  - Outcome measures include
    - ROI ratio – X dollars saved for each 1 dollar spent
    - Net savings
    - Payback period – how long it takes for intervention to break even

- Sometimes ROI is used to refer to an economic evaluation from the societal perspective
Framing an Economic Evaluation of a Public Health Program

- What is the disorder(s) of concern?
  - Calculate the economic costs associated with the condition(s)

- Is there an intervention that is well accepted?
  - If not, can still estimate potentially preventable burden – COI
  - If yes, assess the costs of intervention and numbers of people who are likely to be identified or helped – cost-comparison analysis

- Is there evidence of effectiveness?
  - Quantify the health outcomes or impact of intervention
    - Cases of disease, disability, or unintended births avoided
    - Possibly life-years saved or quality-adjusted life-years (QALYs)
  - Calculate CEA, CBA, and/or ROI
Which Costs Matter to Stakeholders?

- **Costs to whom?**
  - Overall health care costs?
  - Other direct and indirect costs?
  - Costs to specific types of providers?
  - Financial impacts on public sector?

- **Affordability or value?**
  - If an intervention is “affordable” in terms of aggregate costs and no major change in infrastructure is required, decision may be driven by perceived benefits alone.
  - If intervention is perceived as difficult or very expensive, consideration of cost-effectiveness or cost-benefit may play more of a role.
Ways to Model Cost-of-Illness

- **Prevalence-based** – total costs of cases observed during 2014, regardless of age or duration

- **Incidence-based** – projected cost of incident cases occurring during a single year, e.g., 2014
  - Synthetic cohort modeling approach
  - Epidemiologic data used to model incidence and survival
  - Cross-sectional data on per-person incremental use of services and costs by age

- **Use of COI estimates in economic evaluation**
  - To evaluate a prevention strategy, one needs incidence-based COI estimates of cost avoided by prevention or early treatment of one case
Incremental or Attributable Cost

- **Gross cost** – average cost of care for an affected individual

- **Attributable cost** – cost due to the disease itself (including disease complications)
  - Cost associated with treating the disease
  - Difference in total cost for affected and unaffected individuals – incremental cost
    - Adjusted for comorbidity and demographics
    - For congenital conditions adjustment may not be needed

- **Burden estimates are a measure of potential benefit**
Example: Spina Bifida

- **Expected lifetime cost of a live birth with spina bifida**
  - Net present value (NPV) calculated using 3% discount rate
  - In 2012 US dollars (no adjustment for future inflation)

- **Total direct and indirect cost – $1.3 million**
  - Medical cost – $500,212
  - Education and developmental services – $61,430
  - Value of parental lost earnings – $206,459
  - Lost productivity of affected child due to premature mortality and work disability – $507,222
Example: Preterm Birth

- IOM (2007) report estimated aggregate burden of $26.2 billion for each birth cohort born preterm
  - $15.9 billion medical cost from age 0 to 5 years
  - $1.9 billion maternal delivery cost
  - $8.4 billion developmental disabilities
    - Intellectual disability, cerebral palsy, vision impairment, hearing loss
    - $1.0 billion medical, ages 6+ years
    - $0.6 billion Early Intervention (EI)
    - $1.1 billion special education
    - $5.7 billion lost productivity (indirect cost)

- Incremental cost of $51,600 per preterm birth
  - No distinction between late and early preterm birth

Example: Pregestational Diabetes (PGDM)

- Infants born to women with uncontrolled diabetes during pregnancy have worse perinatal outcomes
  - Major birth defects are 3-4 times higher
  - Higher rate of preterm birth
  - Higher rate of perinatal mortality

- Modeling study by Peterson et al. estimates that PGDM in US is associated (NPV, 2012 US dollars) with
  - 88,000 births each year (2.2% of births)
  - Associated discounted lifetime direct and indirect incremental costs of $5.5 billion for the three outcomes listed above
  - Estimate of potential benefit if all women with PGDM were diagnosed and adhered to preconception care guidelines
Severe Combined Immune Deficiency (SCID)

- Expected cost of hospital care for infants with SCID is dominated by three key factors
  - Probability an infant with SCID survives long enough to receive hematopoietic stem cell transplant (HSCT)
  - Average cost of surgical care, which can vary by age at which HTSC is done
  - Probability and cost of intensive care to treat infections

- Average treatment cost for infants with SCID according to Duke University data (Buckley et al. 2012)
  - Infants transplanted <3.5 months – $110,000
  - Infants transplanted > 3.5 months – $450,000

How to Estimate Intervention Costs?

- **Micro-costing or ingredients approach**
  - **Example: staff time cost**
    - Identify which staff provide services
    - Calculate hours used to provide service
      - Direct observation – time-and-motion study
      - Ask staff to keep diary or estimate time
    - Multiply hours by hourly cost of staff time
      - Salary plus required benefits and payroll taxes
      - Cost of providing administrative support – possibly

- **Budget approach**
  - Survey administrators
  - Ask percent of effort for each employee
Economic Evaluation Methods

- **Cost-effectiveness analysis (CEA)**
  - Which approach costs less per unit of health gained?
  - CEA using quality-adjusted life years (QALYs) for outcomes is cost-utility analysis (CUA)

- **Cost-benefit analysis (CBA)**
  - Is the monetary value of benefits to society greater than total cost?

- **Financial Return on Investment (ROI) or Budget Impact Analysis (BIA)**
  - Will financial benefits exceed outlays in a given timeframe for a private payer, public program, or state government overall?
Cost-Effectiveness Analysis

- For each pair of options being assessed (e.g., screening vs. no screening, two different screening algorithms)
  - Assess total outcomes and costs
  - Exclude dominated options that cost more and less effective
  - Calculate incremental cost-effectiveness ratio (ICER) for two strategies that are non-dominated

- How to use ICERs: alternative approaches
  - Single threshold, e.g., if <$50,000 per QALY, cost-effective
  - Range of values, e.g., $50,000-$150,000 per QALY
  - One among multiple criteria
  - Use to inform decisions on implementation
Cost-Effectiveness and Cost-Savings

- If one strategy results in lower total direct costs than another strategy, it is cost-saving
  - If an intervention is both cost saving and has either comparable or better outcomes than the comparator, it is said to be dominant
  - For dominant strategies (better outcomes, lower costs), there is no reason to calculate a cost-effectiveness ratio

- Among the clinical preventive services recommended by US Preventive Services Task Force, about 1/5 are cost-saving
Cost-Benefit Analysis

- All health outcomes are assigned a dollar value

- Two main approaches to valuation
  - Traditional public health CBA approach
    - Uses ‘human capital’ valuation of ill-health or premature death in terms of foregone earnings and household services
    - About $1.3 million present value at birth
    - Same as indirect costs in COI analyses
  - Regulatory benefit-cost analysis (BCA)
    - Willingness-to-pay (WTP) estimates include intangible costs
    - Typically $6-9 million WTP per death avoided or delayed
    - Lack of standard method for valuing non-fatal outcomes
CEA or CBA: Which Method to Use?

- **Cost-effectiveness analysis is generally favored by experts in medical decision making**
  - Medical journals often prefer CUA with cost per QALYs gained
  - Focus is usually on medical costs and impact on health care sector
  - Doesn’t require one to put an explicit dollar value on health or life

- **Policy makers generally prefer cost-benefit analysis**
  - All outcomes are expressed in one metric: dollars, easy to understand
  - Includes both medical and non-medical costs
  - Allows for comparison across multiple sectors
  - Essential for interventions whose primary benefits accrue to other sectors, e.g., home visiting, childhood lead prevention
What about programs with limited outcome data?

- How do you evaluate a program that doesn’t save lives and there is no measure of QALYs?

- Partial CEA with intermediate outcomes
  - Cost per case identified
  - Cost per child with risk factors avoided
  - Cost per child immunized

- Partial CBA with non-health outcomes
  - EHDI – newborn hearing screening and expected impact on costs of special education services (next slide)
  - Lead poisoning prevention and expected impact on IQ scores, special education, and ADHD diagnoses
Avoided education cost from EHDI in US

- Lifetime incremental cost of special education for children $115,600 in 2007 US dollars, 3% discount rate
  - Bilateral sensorineural hearing loss (SNHL) 40 decibels or greater
- Average reduction of 36% in education cost at ages 7-9 for English children with UNHS (Schroeder et al. 2006)
- Reduced cost of $44,200 per child detected at birth (1.2 per 1000) using US special education costs
- Estimated $200 million savings each year to US education system from UNHS/EHDI
  - Exceeds the cost of UNHS and EHDI infrastructure

CEA and CBA: Why not do both?

- Washington state law requires cost-benefit analysis for new regulations, e.g., additions to newborn screening (NBS) panel

- Washington Department of Health develops a spreadsheet model prior to each NBS expansion with two sets of economic calculations
  - Cost-benefit analysis
    - Calculates dollar value of deaths averted using estimate of Value of Statistical Life (currently $7.7 million)
  - Cost-effectiveness analysis
    - Similar but calculates cost per life saved
CEA/CBA example: Folic acid fortification

- Folic acid fortification mandate took effect in US (and Canada) during 1997-1998
- Outcome: 20-30% reduction in cases of spina bifida and/or anencephaly
- Cost: $2-3 million per year for addition to premix
- Avoided costs:
  - Direct costs – reduction in $495 million per year
    - Medical, special ed, and parental productivity cost
  - Direct and indirect costs – reduction of $995 million per year
    - Includes $1.3 million per death averted
- Cost-effectiveness – net savings in direct costs
- Cost-benefit – net economic benefit (~$1 billion p.a.)
**CEA/CBA example: School nursing services**

- “Cost-benefit study” of Massachusetts Essential School Health Services (ESHS) program
  - Program cost: Cost of registered nurse staffing and supplies during 2009-2010 school year in 78 ESHS districts: $79 million
  - Program benefits (reduction in direct costs)
    - Avoided medical care costs -- $20.0 million
    - Avoided loss of teacher productivity -- $129.1 million
    - Avoided loss of parental productivity -- $28.1 million
  - Net benefit -- $98.2 million
  - Could be classified as a CEA rather than CBA
    - Only direct costs were included (if parental cost is treated as direct)
    - No monetary measure of health or other outcomes

CBA: Childhood lead poisoning prevention

- Gould (2009) estimated aggregate economic burden of lead poisoning in children
  - Lost earnings due to reduced IQ: $165-233 billion
    - Includes $25-35 billion in lost tax revenue
  - Direct costs of crime due to lead: $1.7 billion
  - Costs of ADHD attributed to lead: $267 million

- Cost of lead hazard control in 1 million housing units estimated at $1-11 billion

- Assuming this would eliminate entire burden of lead poisoning, net benefit of $181-269 billion
  - A cost-benefit analysis of a hypothetical program

**Budget Impact or Financial Return on Investment (ROI) Analysis**

- Similar to cost-benefit analysis in that outcomes measured in monetary terms, but unlike CBA:
  - **Payer perspective**
    - Only costs incurred by single organization are considered
  - **Short time horizon**
    - Typically costs and outcomes only projected out 1-5 years

- Similar to partial cost-effectiveness analysis – one that reports net cost savings but not health outcomes
  - ROI analyses typically exclude mortality and other long-term health outcomes
  - Only includes intermediate outcomes and use of services
Time horizons in ROI analyses

- **Stakeholder types**
  - Private health plans or employers typically have horizon of 3 to 5 years
  - Medicare calculations usually project costs 10 years in future, consistent with Congressional Budget Office practice

- **Examples**
  - ROI analyses of publicly funded family planning programs have projected cost savings at 1 to 5 years (higher ROI ratios with longer timeframes)
  - Multiple analyses of pediatric asthma management programs show positive ROI for Medicaid within 3 years
How ROI and CEA can differ: Smoking cessation

- Smoking cessation counseling is highly cost-effective but financial ROI estimates vary
  - Warner et al. (1996) modeled ROI of worksite group counseling
    - Averted costs – medical, absenteeism, life insurance payouts
    - Breakeven point just over 3 years
    - ROI 1.7 at 5 years, 5.1 at 10 years
  - Warner et al. (2004) modeled ROI of managed care reimbursement for smoking cessation counseling
    - Cost still higher after 5 or 10 years
    - Reasons for less favorable results than previous analysis
      - Higher turnover, 15% vs. 10% per year
      - Higher discount rate, 11.2% vs. 3.5% per year
      - Higher cost of smoking cessation, $350 vs. $150 per person
Newborn screening overall saves both lives and money (MMWR 2012)

- Screening for some disorders saves lives but not money
  - Sickle cell disease
- Screening for some disorders saves money but doesn’t save lives
  - Congenital hypothyroidism
- Screening for some disorders may both save lives and reduce costs
  - Severe combined immune deficiency

One size of economic evaluation does not fit all

- Financial ROI analysis favors costly conditions that are not lethal
- CEA/CBA analysis captures both lethal and non-lethal outcomes and avoided costs

Diabetes prevention and ROI

- Diabetes Prevention Program group-based weight loss counseling in adults with pre-diabetes reduces incidence of diabetes >50%
  - Community-based program could save $640 in medical costs per participant after 25 years (Zhuo et al., Health Affairs 2012)
    - Costs begin to decrease after 3 years
    - Break even point is 13 years
    - ROI may not be financially attractive to individual insurers
Diabetes prevention and ROI

- Varying estimates of ROI for community-based diabetes prevention lifestyle counseling programs
  - One analysis projected a health plan could recoup costs within a 3-year period (Vojta et al., Am J Prev Med 2013)
  - Another analysis suggested if Medicare paid for counseling of overweight adults ages 60-64 it could break even in <10 years (Thorpe & Yang, Health Affairs 2011)
  - A larger study is underway to produce more robust estimates of costs and cost savings

- Diabetes prevention provides very good value to society, regardless of breakeven period
How to Prepare a Financial ROI Analysis

- **ROI Forecasting Calculator for Quality Improvement**
  - Web-based calculator for health care-based interventions such as an asthma management programs
  - Developed by Center for Health Care Strategies (CHCS) supported by the Robert Wood Johnson Foundation (RWJF)

- **Components**
  - Target Population: (e.g., high-risk diabetics) for proposed quality initiative (e.g., HbA1c testing, group education visits).
  - Program Costs: costs of program design and implementation (e.g., staff training, information technology systems implementation).
  - Utilization Changes: (e.g., decrease in hospital admissions, increase in pharmacy costs)

ROI Case study: Pediatric Asthma Management

- **First step: Identify an effective intervention**
  - Effectiveness first, then cost-effectiveness!

- **Frame a collaboration to assess ROI**
  - Collect program cost data
  - Assess financial outcomes

- **Prepare analysis and disseminate findings**
Case Study: Pediatric Asthma

Easy Breathing asthma program piloted by UCONN & CT Children’s investigators in Hartford, CT 1998-2002

- Citywide disease management program delivered by 6 primary care clinics according to National Asthma Education and Prevention Program asthma guidelines
- Target: urban children with asthma enrolled in Medicaid

Impact evaluation (Cloutier et al. 2005)

- 2.7 fold increase in use of inhaled corticosteroid prescriptions
- Reduced health care utilization
  - Hospital admissions reduced by 35%
  - Emergency department (ED) visits for asthma reduced by 27%
  - Outpatient visits reduced by 19%

CDC approached investigators about conducting a health economic evaluation

Potential ROI analysis (Cloutier et al. 2009)
- Program was funded by grant, no Medicaid reimbursement
- Most Medicaid enrollees covered by capitated plans
- What would financial impact have been for Medicaid managed care plans if the plans had reimbursed the costs of Easy Breathing?

Steps
- Calculate intervention cost
- Calculate reduction in Medicaid expenditures
- Calculate potential ROI for Medicaid managed care plans

Cost Analysis of Easy Breathing Pilot

- **Program elements (as of 1998-2002)**
  - Parent-completed Easy Breathing survey
  - Provider assessment to guide disease severity determination
  - Asthma severity-specific treatment selection guide
  - Individual asthma treatment plan

- **Program costs (Table 1)**
  - Cost components
    - Training and consultation by physician and program coordinator
    - Travel and forms
  - Source of cost estimates – grant funding and time sheets
  - Total cost each year divided by number of children with physician-diagnosed asthma enrolled in program that year
Estimating Impact of Easy Breathing Pilot

- **Healthcare service use and costs (Table 1)**
  - Calculated for 1 year before implementation (July 1997 to June 1998) and 3 years after implementation (July 1998 to June 2001)
  - Utilization of services assessed from Medicaid claims data for children
  - Unit costs for medical services and asthma drugs based on 2006 Connecticut Medicaid reimbursement rates

- **Statistical analysis**
  - Children contributed person-months pre- and post-enrollment
  - Poisson regression models fit using generalized estimating equations controlling for sex, race/ethnicity, site, asthma severity, time, and aging
## ROI Calculation for Easy Breathing Pilot

<table>
<thead>
<tr>
<th>Variable</th>
<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of children with asthma enrolled and with claims</td>
<td>1533</td>
<td>2238</td>
<td>2386</td>
</tr>
<tr>
<td>Savings per child in healthcare expenditures after vs before enrollment in the program, $</td>
<td>(31.94)</td>
<td>36.88</td>
<td>36.56</td>
</tr>
<tr>
<td>Program costs, $</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Personnel$</td>
<td>43,250</td>
<td>22,275</td>
<td>22,943</td>
</tr>
<tr>
<td>Forms and supplies</td>
<td>750</td>
<td>750</td>
<td>750</td>
</tr>
<tr>
<td>Travel</td>
<td>388</td>
<td>388</td>
<td>388</td>
</tr>
<tr>
<td>Total</td>
<td>44,388</td>
<td>23,413</td>
<td>24,081</td>
</tr>
<tr>
<td>Program costs per child with asthma enrolled, $</td>
<td>28.95</td>
<td>10.46</td>
<td>10.09</td>
</tr>
<tr>
<td>Potential return on investment as the difference between reduction in healthcare expenditures and program costs, $</td>
<td>—</td>
<td>26.42</td>
<td>26.47</td>
</tr>
</tbody>
</table>

*a* Adjusted to 2006 US dollars.

*b* Consists of costs for physician champion and program coordinator.


Implementing Easy Breathing would have a positive ROI for Medicaid managed care plans that were at risk. If they paid the mean operating costs of the program in years 2 and 3, the ROI would have been $3.58 to $1.00.
What is the role of ROI or economic evidence in policy making?

- **Easy Breathing is now funded statewide in Connecticut**
  - Thanks to effective championship by Dr. M. Cloutier

- **Economic and financial calculations play a supporting role**
  - Usually, neither necessary nor sufficient conditions for a program to be funded
    - Programs with strong constituencies may be funded year after year despite lack of evidence of effectiveness
    - Programs without champions may lose funding despite good quality evidence of effectiveness and cost-effectiveness
  - Don’t expect an ROI analysis to magically bring support, but if you have strong support already, demonstration of favorable ROI can help
Other MCH Applications

- Family planning
- Preconception health care
  - Folic acid
  - Diabetes management
  - Alcohol screening and counseling
- Prenatal care
- Perinatal care
  - Reduction in early elective deliveries
- Home visiting
- Parenting groups
Preconception health and care

- **Types of preconception interventions**
  - General risk factor screening and counseling
  - Targeted counseling for specific populations or conditions
  - Policy interventions

- **Women who report preconception care visits are more likely** (Williams et al. 2012) to take vitamin supplements, stop drinking and smoking

- **Earned Income Tax Credit appears to reduce LBW via lower stress, reduced smoking, increased use of preventive care** (Hoynes et al. NBER 2012)

Diabetes and preconception care

- Women with poorly controlled diabetes 3-4 times more likely to have infant with major birth defects
- UK evaluation found adverse pregnancy outcomes of 1.3% among women with preconception care vs. 7.8% for no preconception care (Murphy et al. 2010)
- Michigan case study (Herman et al. 1999)
  - Women with type 1 diabetes who received preconception care had
    - 69% fewer birth defects
    - 50% fewer maternal and neonatal ICU admissions
  - Hospital cost savings averaged $34,000 per woman enrolled

Promotion of long-acting reversible contraception (LARC)

- Long-acting reversible contraception (LARC) methods are highly effective, not user-dependent
  - Intrauterine devices and implants
  - High up-front cost but may be less expensive over long run
- Promotion of LARC is associated with reductions in unintended pregnancies (Peipert et al. 2012)
- Potential policy questions for ROI analyses
  - Medicaid reimbursement for postpartum IUD provision
  - Onsite provision of LARC methods at clinics
  - Provider reimbursement rates for LARC
  - Provider and patient education/counseling