Economic Evaluations of Prevention

Louise B. Russell, PhD
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Hawthorne, NY
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The Prevention Agenda

• “Healthy People 2010 is a comprehensive set of disease prevention and health promotion objectives for the Nation to achieve over the first decade of the new century. ... [It] identifies a wide range of public health priorities”.  
  http://www.healthypeople.gov/About/hpfact.htm

• In the health reform debate, prevention has been promoted as a way to control medical costs.
History and Expectations

- Prevention has brought major gains in health and lifespan over the last two centuries.

- Today’s leading causes of death – heart disease, cancer, diabetes – can now be prevented or delayed.

- Prevention’s appeal
  - Better to avoid disease/injury than repair it
  - Prevent the disease, prevent treatment costs
  - Expectation: Better health, lower medical spending

- But does it reduce medical spending?
**Radio advertisement**

- Man scheduled to undergo bypass surgery
- Cost of the surgery: $50,000
- Wouldn’t it be better to avoid surgery through prevention? By losing weight, quitting smoking, exercising, taking medications to reduce blood pressure and cholesterol?
- Better for health
- Cheaper for the medical system
But – prevention is complicated

- Medical science can only identify those at risk of heart disease, a much larger group than those who will someday be candidates for bypass surgery.

- Prevention must be delivered to all people at risk, often repeatedly over many years, to prevent some from developing disease → costs mount up.

- Some develop disease anyway, since prevention is not 100% effective; some do not develop it even without prevention → all receive prevention, but not all experience savings.
Cost-effectiveness Analysis

First applied to health and medicine in the 1970s


- Blood pressure medication extends life and reduces treatment costs for heart disease and stroke
- But the accumulated costs of medication over many years are greater than the savings
- Prevention costs more than treatment
Is Prevention Better than Cure?


- Examined vaccines, blood pressure medication, cancer screening, lifestyle change.
- Prevention usually adds to medical spending.

When is prevention worth the cost?
Outline of the rest of the talk

• How cost-effectiveness analysis (CEA) addresses the cost question

• Review of prevention CEAs

• Features that make prevention more, or less, cost-effective

• Patients’ time, the forgotten cost
Three Types of Prevention

• **Primary** prevention prevents the disease from occurring, e.g., vaccines.

• **Secondary** prevention detects risk factors, or pre-clinical disease, and intervenes to prevent further development, e.g., antihypertensive medication, cancer screening.

• **Tertiary** prevention intervenes to prevent or moderate consequences of established disease, e.g., blindness from diabetes.

• Focus here: primary and secondary prevention
How CEA addresses the cost question

- CEA compares the costs and health outcomes of alternatives (example, next slide)
- Usually counts only medical sector costs
  - Could count other costs and the societal perspective does
  - But medical costs are the point at issue
- **Difference** in costs and health outcomes between 2 alternatives: *net* costs and *net* health effects
- **Cost-effectiveness ratio**: *net* cost divided by *net* health effect, e.g., net cost per year of healthy life saved
### Annual Costs and Healthy Days per patient: Guided self-management vs. traditional asthma care, 1997$


<table>
<thead>
<tr>
<th>Costs/Health effects</th>
<th>Self-management</th>
<th>Traditional</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Counseling</td>
<td>348</td>
<td>179</td>
<td>169</td>
</tr>
<tr>
<td>Peak flow meter</td>
<td>32</td>
<td>0</td>
<td>32</td>
</tr>
<tr>
<td>Drugs</td>
<td>613</td>
<td>623</td>
<td>-10</td>
</tr>
<tr>
<td>Physician visits</td>
<td>47</td>
<td>80</td>
<td>-33</td>
</tr>
<tr>
<td>Hospital stays</td>
<td>33</td>
<td>52</td>
<td>-20</td>
</tr>
<tr>
<td><strong>TOTAL COSTS</strong></td>
<td><strong>1074</strong></td>
<td><strong>935</strong></td>
<td><strong>138</strong></td>
</tr>
<tr>
<td><strong>HEALTHY DAYS</strong></td>
<td><strong>359.2</strong></td>
<td><strong>344.3</strong></td>
<td><strong>14.9</strong></td>
</tr>
</tbody>
</table>

Cost-effectiveness ratio: $3,380 per healthy year
Terminology

- An intervention is **COST-SAVING** if its net costs are negative. No cost-effectiveness ratio is calculated.

- An intervention is **COST-EFFECTIVE** if it costs more than the alternative but improves health and is judged to be good value for money.

- World Health Organization guideline
  - cost-effective: < 3 times per capita GDP ($140,000 in the U.S.), for each year of life saved
  - very cost-effective: < GDP per capita ($47,000)
Models and Data Sources for CEA

Markov simulation models involve

- **Health states** that describe the disease and its treatment
- **Cycle length**, usually a year
- **Transition probabilities**: the probability of moving from one health state to another
- Costs and quality-of-health weights for each health state.
Models and Data Sources for CEA

• Transition probabilities
  – Randomized controlled trials
  – Observational studies, including those based on administrative data

• Costs
  – Claims data
  – Provider accounting systems
  – Time-motion studies

• Quality-of-health weights
  – Surveys
Recent Review of Prevention CEAS


- Tufts-New England Medical Center CEA Registry
- 599 CEA studies published in 2000-2005
- 279 prevention comparisons
- 1221 treatment comparisons
- Less than 20% of preventive interventions, and a similar share of treatment interventions, reduced medical spending.
Cost per healthy year of life saved

Higher cost, less health

- Cost-saving
- $<10K
- $10K to < $50K
- $50K to < $100K
- $100K to < $250K
- $250K to < $1 million
- > $1 million

Percent of interventions

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What makes prevention more cost-effective?

• Component costs

• Risk profile of patients

• Frequency of intervention

• Note the data required to model these possibilities
Blood pressure medication

Weinstein, Stason. *Hypertension: A Policy Perspective*

- Medication is a better value for those whose blood pressure at diagnosis is higher.


- No medication is cost-saving
- Some are more cost-effective than others
- Diuretics, currently the first line of therapy, are among the most cost-effective.
# Blood pressure medication
Updated to 2007$ in LB Russell, Prevention’s Potential

<table>
<thead>
<tr>
<th>Medicine</th>
<th>Cost per life-year</th>
</tr>
</thead>
<tbody>
<tr>
<td>propranolol (beta blocker)</td>
<td>$ 29,282</td>
</tr>
<tr>
<td>hydrochlorothiazide (diuretic)</td>
<td>44,057</td>
</tr>
<tr>
<td>nifedipine (calcium channel blocker)</td>
<td>84,890</td>
</tr>
<tr>
<td>prazosin hydrochloride (alpha blocker)</td>
<td>166,288</td>
</tr>
</tbody>
</table>
Statins to reduce cholesterol


- Cost-effectiveness of statins varies widely with patients’ risk profile
  - LDL
  - Blood pressure
  - Smoking
  - HDL
  - Existing heart disease

- Health gains and treatment savings are greatest for people at greatest risk.
<table>
<thead>
<tr>
<th>No CHD at baseline, high LDL cholesterol</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Men</strong>, LDL 4.2-4.9 mmol/L (160-189 mg/dL)</td>
<td></td>
</tr>
<tr>
<td>DBP&lt;95, nonsmoker, HDL&gt;1.3 (49)</td>
<td>344,000</td>
</tr>
<tr>
<td>DBP≥95, smoker, HDL&lt;0.9 (35)</td>
<td>165,000</td>
</tr>
<tr>
<td><strong>Women</strong>, LDL 4.2-4.9 mmol/L (160-189 mg/dL)</td>
<td></td>
</tr>
<tr>
<td>DBP&lt;95, nonsmoker, HDL&gt;1.3 (49)</td>
<td>539,000</td>
</tr>
<tr>
<td>DBP≥95, smoker, HDL&lt;0.9 (35)</td>
<td>224,000</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>No CHD at baseline, very high LDL cholesterol</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Men</strong>, LDL ≥ 4.9 mmol/L (≥190 mg/dL)</td>
<td></td>
</tr>
<tr>
<td>DBP&lt;95, nonsmoker, HDL&gt;1.3 (49)</td>
<td>210,000</td>
</tr>
<tr>
<td>DBP≥95, smoker, HDL&lt;0.9 (35)</td>
<td>88,000</td>
</tr>
<tr>
<td><strong>Women</strong>, LDL ≥ 4.9 mmol/L (≥190 mg/dL)</td>
<td></td>
</tr>
<tr>
<td>DBP&lt;95, nonsmoker, HDL&gt;1.3 (49)</td>
<td>389,000</td>
</tr>
<tr>
<td>DBP≥95, smoker, HDL&lt;0.9 (35)</td>
<td>180,000</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CHD at baseline</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Men</strong></td>
<td>5,800</td>
</tr>
<tr>
<td><strong>Women</strong></td>
<td>12,600</td>
</tr>
</tbody>
</table>
Cervical cancer screening


- Another classic CEA
- Screening frequency is a major determinant of cost-effectiveness
- Compare interventions by intensity, not only with no intervention (here, no screening)
- Example: screening every 3 years vs. every 2 years

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Cervical cancer screening

<table>
<thead>
<tr>
<th></th>
<th>Cost per life-year, 2007$</th>
</tr>
</thead>
<tbody>
<tr>
<td>at 3 years vs. no screening</td>
<td>$ 40,955</td>
</tr>
<tr>
<td>at 2 years vs. 3</td>
<td>1,292,688</td>
</tr>
<tr>
<td>annually vs. at 2 years</td>
<td>3,277,294</td>
</tr>
</tbody>
</table>
Pneumococcal pneumonia vaccine

- At $16 per person (1995$) -- about $25 today – vaccination against pneumococcal pneumonia reduces medical spending for adults 50-64 with congestive heart failure, chronic lung disease, diabetes, and other chronic conditions
- The 2008 cost/dose, excluding administration costs
  - $16-19 for the US Centers for Disease Control
  - $29-32 for private US purchasers.
- Vaccination would be cost-saving at the CDC price, not at the private price
What about those 5:1 savings claims?

- CEAs of childhood vaccinations typically estimate
  - savings in parents’ time, valued at the wage rate
  - children’s future earnings

- They compare vaccination costs with medical savings, savings in parents’ time, and children’s future earnings.

- The reported ratio: all dollars saved to dollars spent.

- Often a vaccination strategy that saves when time/earnings are considered costs the medical system more than it saves.
Example of 5:1 savings


- Abstract: including parents’ time and children’s future earnings, varicella vaccine “would save more than $5 for every dollar invested”.

- Next line: medical costs of vaccination are greater than medical savings.

- Medical costs: vaccination saved 90 cents for every dollar spent (Table 4, “health care payer’s perspective”).

- Assumed a private-sector price of $35 per dose (1990$). That’s $75 in 2007, the current private-sector price.
Patients’ Time: The Forgotten Cost

- Societal perspective, recommended by the Panel on Cost-Effectiveness in Health and Medicine, includes costs and health effects for all who are significantly affected by the intervention.

- Costs = real resources

- Unpaid time of patients and caregivers is a real resource.
  - Affects patients’ decisions
  - Taken from other uses
Self-monitoring of blood glucose

<table>
<thead>
<tr>
<th></th>
<th>Without patient time</th>
<th>With patient time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Once daily</td>
<td>$7,856</td>
<td>$41,720</td>
</tr>
<tr>
<td>Three times daily</td>
<td>6,601</td>
<td>38,619</td>
</tr>
</tbody>
</table>
## Opportunity Costs

(Russell LB, Prevention’s Potential)

<table>
<thead>
<tr>
<th></th>
<th>2007$</th>
<th>$/yr</th>
<th>Yrs/$1m</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Chickenpox vaccine, pre-school children</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>5,367</td>
<td></td>
<td>186</td>
</tr>
<tr>
<td><strong>Screening for colorectal cancer</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>white men, sigmoidoscopy at 55</td>
<td>1,732</td>
<td></td>
<td>577</td>
</tr>
<tr>
<td>white men, sigmoidoscopy every 10 years vs. at 55</td>
<td>21,366</td>
<td></td>
<td>47</td>
</tr>
<tr>
<td><strong>Mammography</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>women aged 50-79, every 2 years</td>
<td>30,619</td>
<td></td>
<td>33</td>
</tr>
<tr>
<td><strong>MRI for women with BRCA1</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>mammography alone</td>
<td>20,494</td>
<td></td>
<td>49</td>
</tr>
<tr>
<td>mammography plus MRI</td>
<td>514,660</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td><strong>Screening for diabetes</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>adults 55 with high blood pressure vs. no screening</td>
<td>51,211</td>
<td></td>
<td>20</td>
</tr>
<tr>
<td>all adults 55 vs. those with high blood pressure</td>
<td>537,756</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td><strong>Screening once for HIV</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>prevalence 1.0%</td>
<td>34,713</td>
<td></td>
<td>29</td>
</tr>
<tr>
<td>prevalence 0.1%</td>
<td>68,412</td>
<td></td>
<td>15</td>
</tr>
<tr>
<td><strong>Diet/exercise to prevent diabetes, high-risk adults</strong></td>
<td>191,635</td>
<td></td>
<td>5</td>
</tr>
<tr>
<td><strong>Smoking cessation, average of 15 programs</strong></td>
<td>5,221</td>
<td></td>
<td>192</td>
</tr>
</tbody>
</table>
References


References, continued


