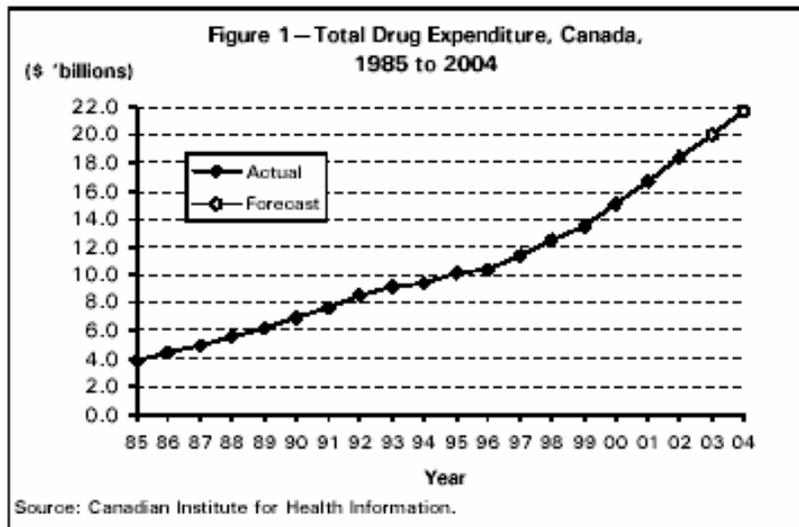


Cost effectiveness Analysis in the Evaluation of Vaccine Programs

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University of Toronto



Average growth 1985-1992: 9.7%

Cette présentation a été effectuée le 27 octobre 2006, au cours du Symposium "Mettre la science au service des programmes d'immunisation, le rôle des comités d'experts" dans le cadre des Journées annuelles de santé publique (JASP) 2006. L'ensemble des présentations est disponible sur le site Web des JASP, à l'adresse <http://www.inspq.qc.ca/jasp>.



“Enter the health economists, holding aloft tables of various interventions and their comparative cost-effectiveness ratios...”

Cost-effectiveness analysis: are the outputs worth the inputs?[Editorial]
Naylor, David MD, ACP Journal Club, May-June 1996

Cost effectiveness analysis

- ◆ “an area of research that identifies, measures, and compares the costs and consequences of health products and services”
- ◆ Synonyms/ related disciplines:
 - Pharmacoeconomics
 - Economic evaluation
 - Health technology assessment
- ◆ Bootman et. Al. [Principles of Pharmacoeconomics](#)

Growing number of ...

- ◆ Academic societies:
 - ISPOR, iHEA, HTAI, SMDM
- ◆ Journals
 - Pharmacoconomics, Value in Health, Int J Tech Ass, Medical Care, Cost Eff Res All, Health Econ
 -
- ◆ Publications
 - ~500/year 1980-1985
 - ~3,500/year 1996-2000

Growing number of ...

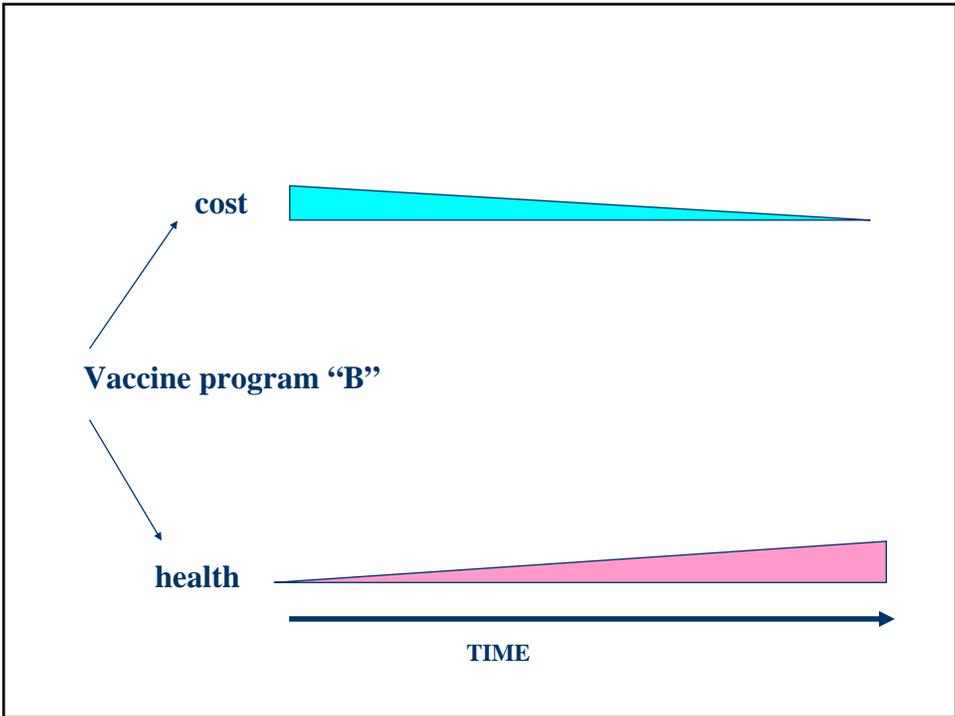
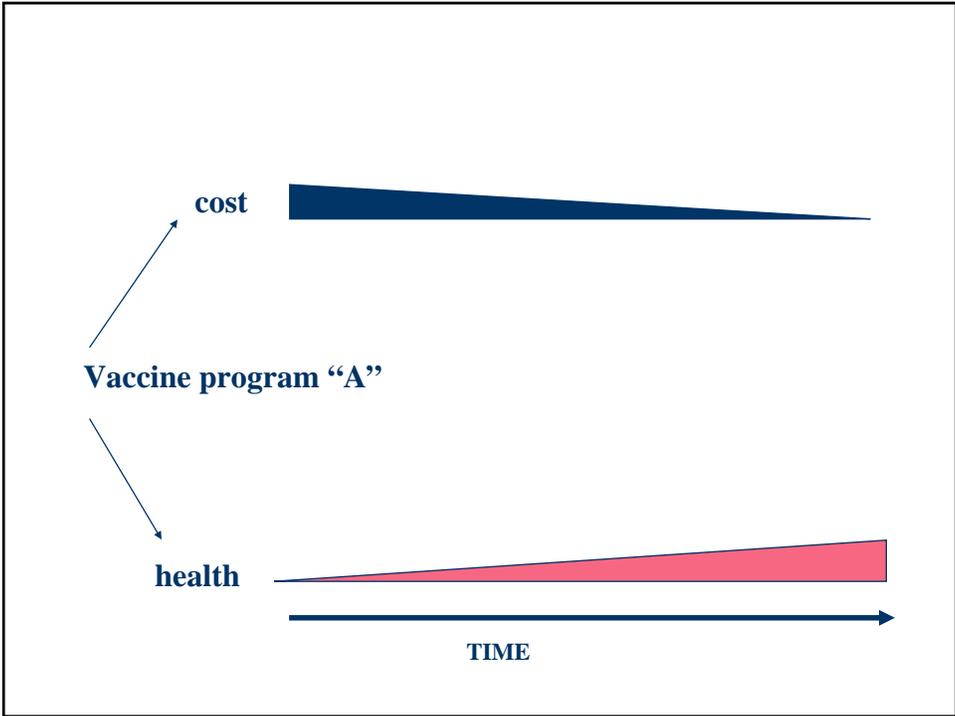
- ◆ Health technology assessment agencies
 - Canada
 - CADTH (Canadian Association for Drugs and Technology in Health)
 - Ontario-DQTC, Medical Advisory Secretariat
 - IHE, AHFMR, AETMIS, TAU,
 - BC, Sask, MB
 - INAHTA – 19 member countries

Growing number of....

- ◆ jurisdictions in which pharmacoeconomic analyses are required for formulary decisions...
 - Australia- (1993)
 - Ontario (1996), NS, NB, PEI, NF (recommended BC, AB, SK)
 - Europe
 - Norway, Sweden, Austria, Belgium, Latvia, Lithuania, Estonia
 - Etc
 - Asia-... developing

Outline

- i)... abc of cost effectiveness analysis
- ii) How can it help in evaluating vaccine programs?
- iii) What are it's limitations?



Cost Effectiveness

(Cost A – Cost B)

(Health A – Health B)

Costs

- Drugs (e.g. Vaccines)
- Lab tests
- Physician Services
- Hospitalization
- Home care
- Long term care

- TIME- waiting, traveling, loss of work

Health

- ◆ “Natural units”

- Prevented:
 - HAV infection
 - Liver death
 - Transplant

← CEA

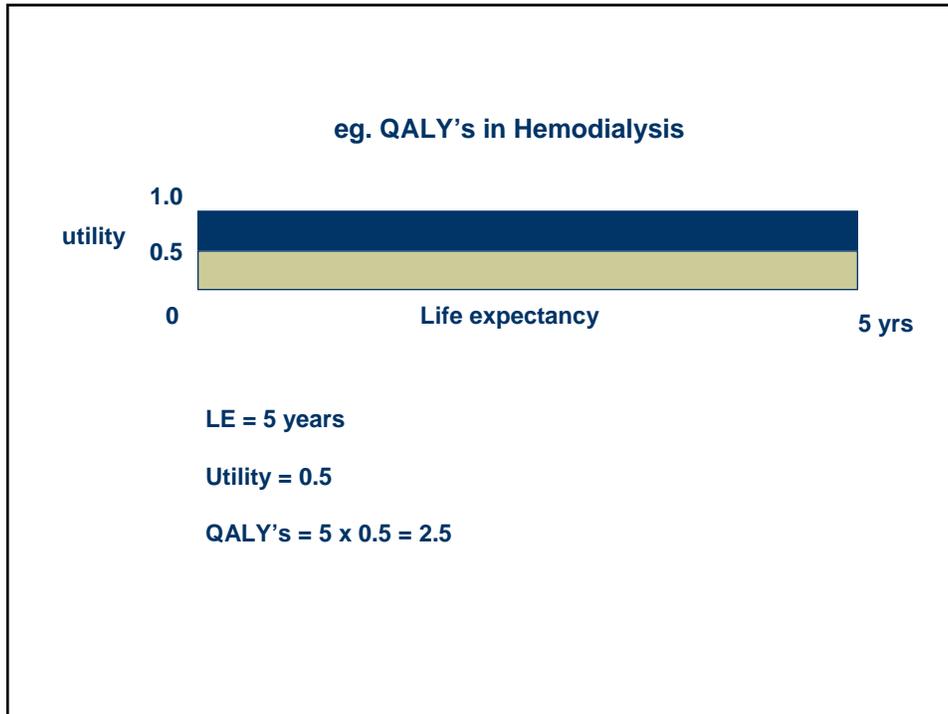
- ◆ Index

- Life years gained
- Quality-adjusted life years gained

← CUA

QALY

- ◆ Health has two dimensions, quality and quantity
- ◆ Utility used to weight length of life
- ◆ Utility - measure of patient preference for standardized health states
- ◆ Expressed on 0-1 scale



- ## Study design
- ◆ Cost-consequence
 - ◆ Cost effectiveness (cost per life year gained)
 - ◆ Cost utility (cost per quality adjusted life year gained)

Interpreting the results

Laupacis et. al. (CMAJ 1993)

- ◆ $< \$20,000 / \text{QALY}$ strong evidence for adoption
- ◆ $\$20,000 - \$100,000 / \text{QALY}$ moderate evidence
- ◆ $> \$100,000 / \text{QALY}$ weak evidence for
adoption

Benefits of CEA

Universal Hepatitis A Vaccination in Canada: A Cost Effectiveness Analysis

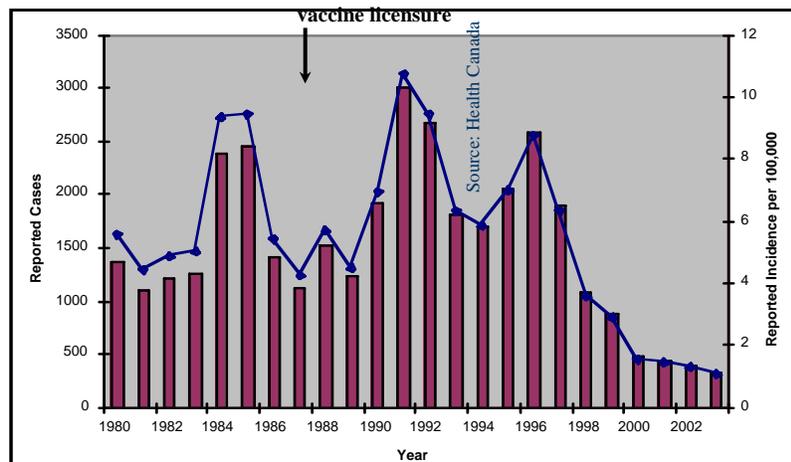
-  ♦ Andrea Anonychuk, MSc
-  ♦ Chris Bauch, PhD
-  ♦ Maggie Hong Chen, MSc
-  ♦ Bernard Duval, MD, MPH
-  ♦ Vladimir Gilca, MD
-  ♦ Murray Krahn, MD, MSc
-  ♦ Ba' Pham, MSc
-  ♦ Arni S.R. Srinivasa Rao, PhD
-  ♦ Andrea C. Tricco, MSc

Funded by:





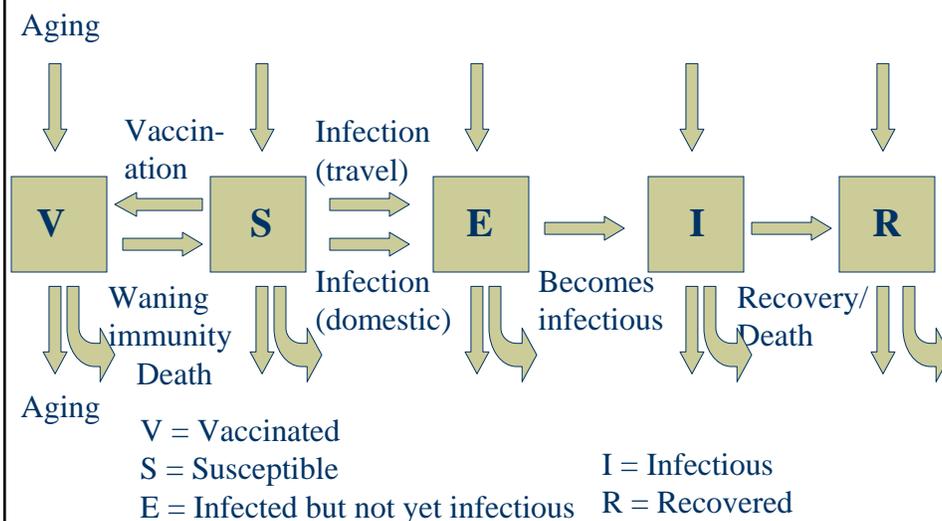
Hepatitis A Epidemiology in Canada



Research rationale

- ◆ Yet, vaccine is safe and effective
- ◆ Fairly cheap
- ◆ Neighbors (US) are vaccinating

Dynamic model description



Results: Costs, cases, deaths

red=ministry, black=society

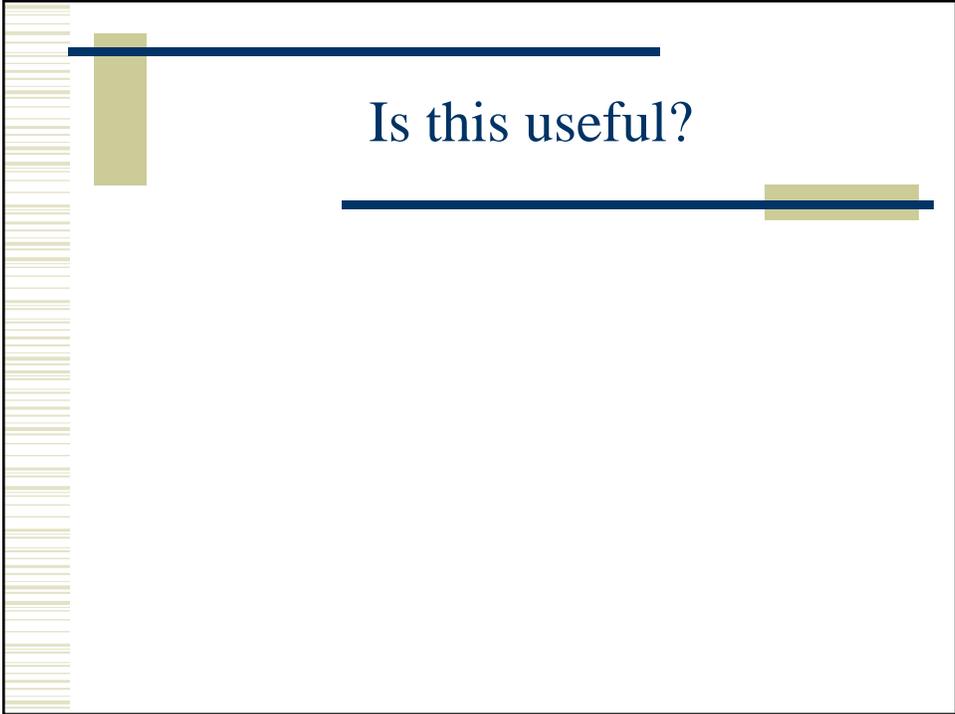
<u>Strategy</u>	<u>Targeted Vaccine Costs, millions \$</u>	<u>Universal Vaccine Costs, millions \$</u>	<u>Infection Costs, millions \$</u>	<u>Total Costs, millions \$</u>	<u>Marginal Costs, millions \$</u>	<u>Marginal QALYS</u>
Current		0 0	0.4 0.9	7.9 20.3	0	0
4+9	6.0 15.6	3.4 3.4	0.3 0.6	9.6 19.6	1.7 -0.7	7.9
9+9	6.0 15.6	1.6 1.6	0.4 0.8	7.9 18.0	-0.02 -2.2	2.7

<u>Strategy</u>	<u>Reported Cases</u>	<u>Deaths</u>
Current	790	3.6
4+9	440	2.8
9+9	610	3.7

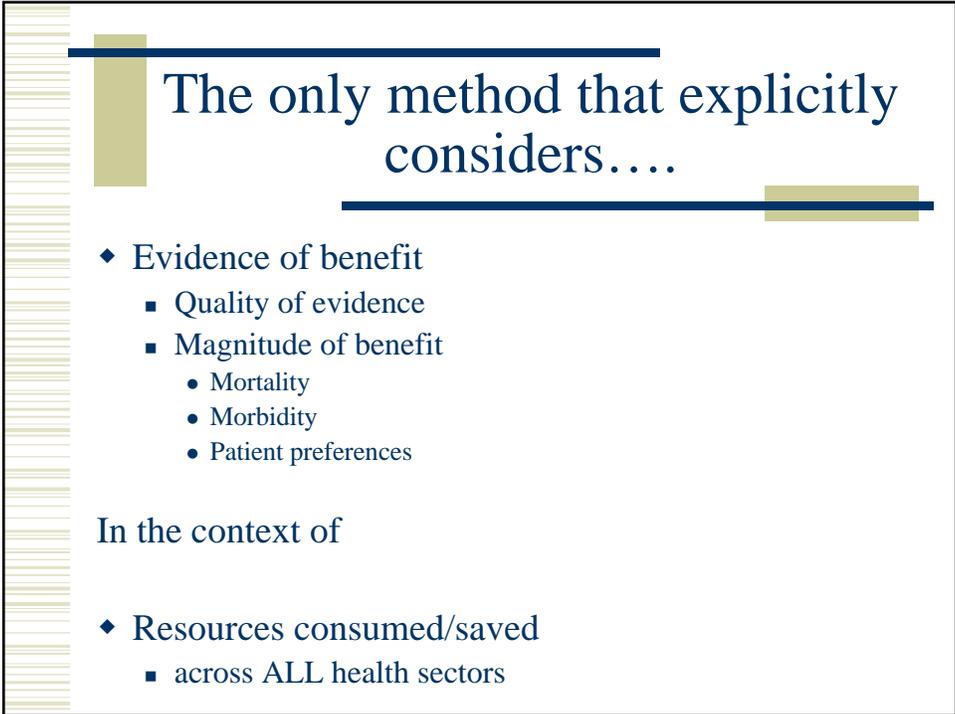
For 1980-1994 population values

Conclusions

- ◆ In absolute terms, QALY gains of implementing universal HA vaccination in Canada are small
 - 10-30 QALYs gained per year (undiscounted)
 - However, a strategy which replaces two doses of HB vaccine at age 9 with two doses of combined HA/HB vaccine is cost-saving.
- ◆ However uncertainty intervals are large due to marginal effects.



Is this useful?



The only method that explicitly considers....

- ◆ Evidence of benefit
 - Quality of evidence
 - Magnitude of benefit
 - Mortality
 - Morbidity
 - Patient preferences

In the context of

- ◆ Resources consumed/saved
 - across ALL health sectors

BUT.....
some caveats...

1. What are your goals...?
Efficiency ?

- ◆ 1) what are goals....?
 - Maximize public health
 - Base decisions on “evidence”

 - OR
 - Consider health gain in context of resources used

2. CEA is a measure of value....

- ◆ Is it a “good deal”
- ◆ Not-
 - Can I afford it...

The screenshot shows the homepage of ConsumerReports.org. The browser address bar displays <http://www.consumerreports.org/main/home.jsp>. The website header includes the logo "ConsumerReports.org" and navigation links for Home, Customer service, My account, SUBSCRIBE, and LOGIN. A horizontal menu lists various product categories: Cars, Appliances, Electronics & computers, Home & garden, Health & fitness, Personal finance, Babies & kids, Travel, and Food. Below the menu is a search bar and a list of site features: A to Z Index, Search, Consumer protection, Donate, Recalls, Web site e-Ratings, Discussions, and Bookstore.

The main content area is divided into several sections:

- FOR SUBSCRIBERS**: A sidebar with "RATINGS" (Expert testing of thousands of products) and links to various product categories: Cars (New cars, Used cars, Pricing, Compare cars, Tires, SUVs), Appliances (Refrigerators, Washers, Dishwashers, Vacuums, Air conditioners), Electronics & computers (Digital cameras, Laptops & desktops, TVs, Camcorders), Home & garden (Lawn mowers, Gas grills, Mattresses), Health & fitness (Exercise & diet, Treadmills, ellipticals), Personal finance (Credit card fees, Mutual funds & expenses), Babies & kids (Car seats, Strollers, Cribs, Monitors), Food (Coffee, Chocolates, Probiotics, Wine), and Travel (Hotel fees, Airline woes, Bikes & bike helmets, Tents).
- New & notable**: A featured article titled "CARS TO WATCH IN 2006 & 2007 Here's our take on more than 20 new and redesigned vehicles." with a "GO" button and links for "Current issue", "Canada extra", and "WSJ.com selections".
- FREE HIGHLIGHTS - 9/25/2005**: A list of featured articles including "Hurricane recovery" (Our guide offers consumer guidance and practical advice in the aftermath of recent hurricanes), "Fuel economy & mpg" (We tell you why you might not be getting the gas mileage you expect), "New iPods" (Get our take on the Nano iPod and the Motorola ROKR), "What breaks, what doesn't?" (Learn the repair rate for a variety of products, and which are the more reliable brands), "Clean air" (Which smoke alarm? Best new, and used-car deals Greener Choices), and "New from Consumer Reports".
- Instant Online Access Now!**: A promotional banner for "Instant Online Access Now!" with a "Subscribe Today >" button.
- Right Car Best Price**: A banner for "Right Car Best Price" with a "NEW USED >" button.
- MedicalGuide.org**: A banner for "MedicalGuide.org Take the FREE tour."

The footer contains a navigation bar with links for Privacy, Security, About us, Our mission, Press room, Site map, and E-mail newsletters. Below the navigation bar is the copyright notice: "Copyright © 2001-2005 Consumers Union of U.S., Inc. No reproduction, in whole or in part, without written permission. This site best viewed with IE 6.0 and above, or Netscape 6.0." and the word "Done" at the bottom left.

3. CEA models don't include everything

- ◆ They DO include mortality, morbidity, quality of life, cost
- ◆ They DON'T include
 - Attitude toward risk, ALL preferences about vaccines, issues of equity, distributional issues,

4. CEA's for vaccine programs are hard to do (well)

- ◆ Require dynamic models
- ◆ Team that includes epidemiologists, mathematical modelers, content experts, health economists

5. Bias is a problem

- ◆ Bias you can see
- ◆ Bias you can't

Bell et. al. BMJ 2006

Table 2 Characteristics of studies associated with favourable incremental cost effectiveness ratios according to three threshold values. Values are odds ratios (95% confidence intervals)

Study characteristic	Crude OR (95% CI)			Adjusted OR (95% CI)*		
	<\$20 000/QALY	<\$50 000/QALY	<\$100 000/QALY	<\$20 000/QALY	<\$50 000/QALY	<\$100 000/QALY
Publication year						
1976-91	1.6 (0.98 to 2.7)	1.4 (0.80 to 2.4)	1.2 (0.67 to 2.3)	1.6 (0.96 to 2.7)	1.3 (0.76 to 2.3)	1.2 (0.61 to 2.2)
1992-6	1.3 (0.94 to 1.9)	1.4 (0.93 to 2.3)	1.1 (0.68 to 1.6)	1.3 (0.87 to 1.8)	1.3 (0.87 to 1.9)	1.0 (0.64 to 1.6)
1997-2001	1.0	1.0	1.0	1.0	1.0	1.0
Journal impact factor†						
<2	1.0	1.0	1.0	1.0	1.0	1.0
2-4	0.62 (0.42 to 0.91)	0.62 (0.41 to 0.94)	0.59 (0.38 to 0.94)	0.75 (0.50 to 1.1)	0.82 (0.53 to 1.3)	0.77 (0.47 to 1.2)
>4	0.60 (0.42 to 0.86)	0.56 (0.38 to 0.82)	0.83 (0.53 to 1.3)	0.95 (0.63 to 1.4)	0.81 (0.52 to 1.3)	1.1 (0.66 to 1.9)
Disease category						
Cardiovascular	1.0	1.0	1.0	1.0	1.0	1.0
Endocrine	1.3 (0.68 to 2.6)	1.2 (0.58 to 2.5)	1.3 (0.58 to 3.0)	1.2 (0.56 to 2.4)	1.1 (0.52 to 2.3)	1.2 (0.53 to 2.7)
Infectious	1.1 (0.66 to 1.7)	0.79 (0.48 to 1.3)	0.74 (0.43 to 1.3)	1.0 (0.64 to 1.7)	0.75 (0.44 to 1.3)	0.71 (0.39 to 1.3)
Musculoskeletal	1.4 (0.60 to 3.3)	1.3 (0.51 to 3.1)	1.4 (0.50 to 3.7)	1.1 (0.43 to 2.7)	0.89 (0.34 to 2.3)	1.1 (0.37 to 3.1)
Neoplastic	0.91 (0.56 to 1.5)	0.79 (0.46 to 1.3)	0.77 (0.42 to 1.4)	0.78 (0.47 to 1.3)	0.64 (0.37 to 1.1)	0.69 (0.36 to 1.3)
Neurological/psychiatric	0.76 (0.40 to 1.5)	0.78 (0.40 to 1.5)	0.66 (0.31 to 1.4)	0.75 (0.39 to 1.4)	0.70 (0.34 to 1.4)	0.61 (0.27 to 1.4)
Other	1.2 (0.75 to 1.8)	0.67 (0.42 to 1.1)	0.52 (0.31 to 0.88)	1.0 (0.63 to 1.6)	0.53 (0.31 to 0.88)	0.49 (0.27 to 0.86)
Study funding source‡						
Non-industry	1.0	1.0	1.0	1.0	1.0	1.0
Industry	2.2 (1.4 to 3.4)	3.5 (2.0 to 6.1)	3.4 (1.6 to 7.0)	2.1 (1.3 to 3.3)	3.2 (1.8 to 5.7)	3.3 (1.6 to 6.8)
Not specified	1.3 (0.95 to 1.9)	1.5 (1.1 to 2.2)	1.4 (0.93 to 2.1)	1.3 (0.89 to 1.8)	1.5 (1.0 to 2.1)	1.5 (0.97 to 2.2)
Region of study						
Europe	0.50 (0.28 to 0.89)	0.43 (0.21 to 0.87)	0.46 (0.21 to 1.0)	0.59 (0.33 to 1.1)	0.42 (0.21 to 0.86)	0.43 (0.19 to 0.96)
United States	0.35 (0.21 to 0.57)	0.29 (0.16 to 0.55)	0.33 (0.16 to 0.66)	0.44 (0.26 to 0.76)	0.35 (0.18 to 0.67)	0.33 (0.16 to 0.68)
Other§	1.0	1.0	1.0	1.0	1.0	1.0
Methodological quality¶						
1.0-4.0	1.0	1.0	1.0	1.0	1.0	1.0
4.5-5.0	0.92 (0.64 to 1.3)	0.95 (0.64 to 1.4)	0.96 (0.62 to 1.5)	1.0 (0.70 to 1.5)	1.1 (0.70 to 1.6)	1.0 (0.63 to 1.6)
5.5-7.0	0.48 (0.33 to 0.70)	0.57 (0.39 to 0.83)	0.82 (0.52 to 1.3)	0.58 (0.37 to 0.91)	0.72 (0.45 to 1.2)	0.90 (0.51 to 1.6)

6. CEA is not the (only) answer to rising costs

- ◆ Funding everything that's cost-effective is a recipe for continued expenditure growth

Inclusion of drugs in provincial drug benefit programs: should "reasonable decisions" lead to uncontrolled growth in expenditures? Gafni, Birch CMAJ 2003

- ◆ "funding new technologies that have "acceptable" ICERs ... leads to continuous increases in program expenditures because the new, more costly technologies are added without other programs being cut to generate sufficient resources for the new program"



Summary



- ◆ CEA is a useful way of putting benefits in the context of costs
- ◆ Will likely have an increasing role in evaluation of vaccine programs
- ◆ Can be extremely powerful, but use with caution