Pharmacoeconomics

Basic principles of pharmacoeconomics, types of pharmacoeconomic analyses and their relevant use in clinical practice
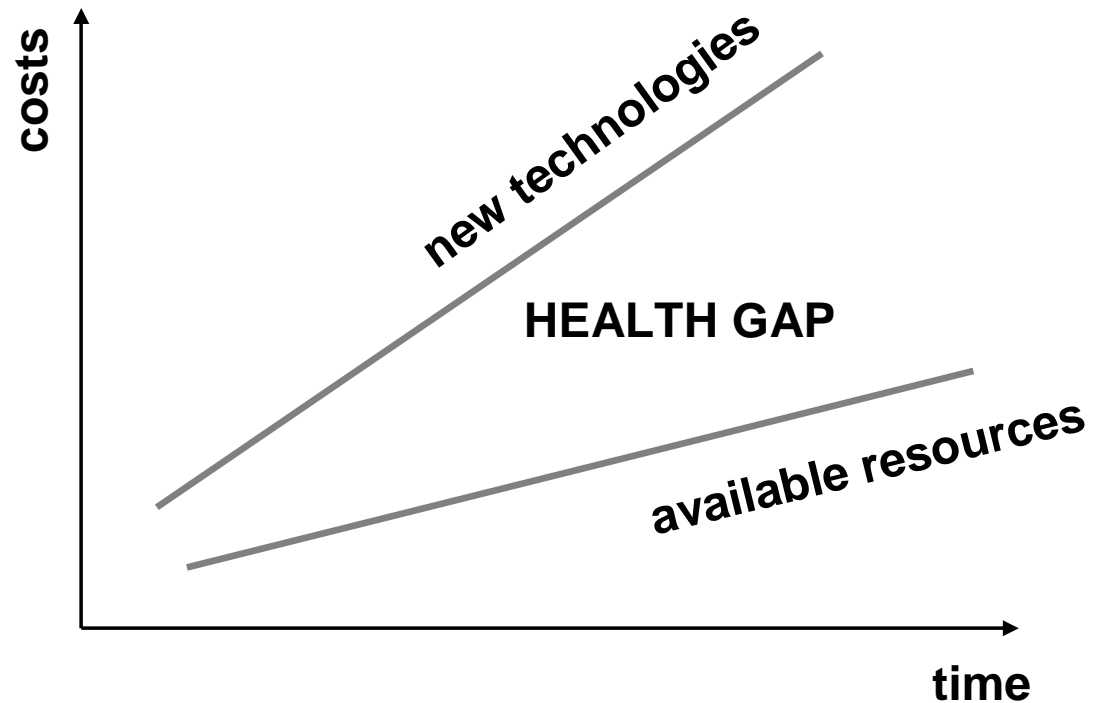
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Pharmacoeconomics

- applies the economic principles and methods to the field of pharmaceuticals and pharmaceutical policy

- assess the overall value of health technologies
  - pharmaceutical products, services and programs
  - identifies, measures and compares **costs and consequences**

- provides valuable information to health care decision makers for allocation of scarce resources

- **pharmacon + economics**

  (= remedy)   *(= the science of scarcity and choice)*

- **Which drug / technology has the highest therapeutic benefit by using accessible resources?**
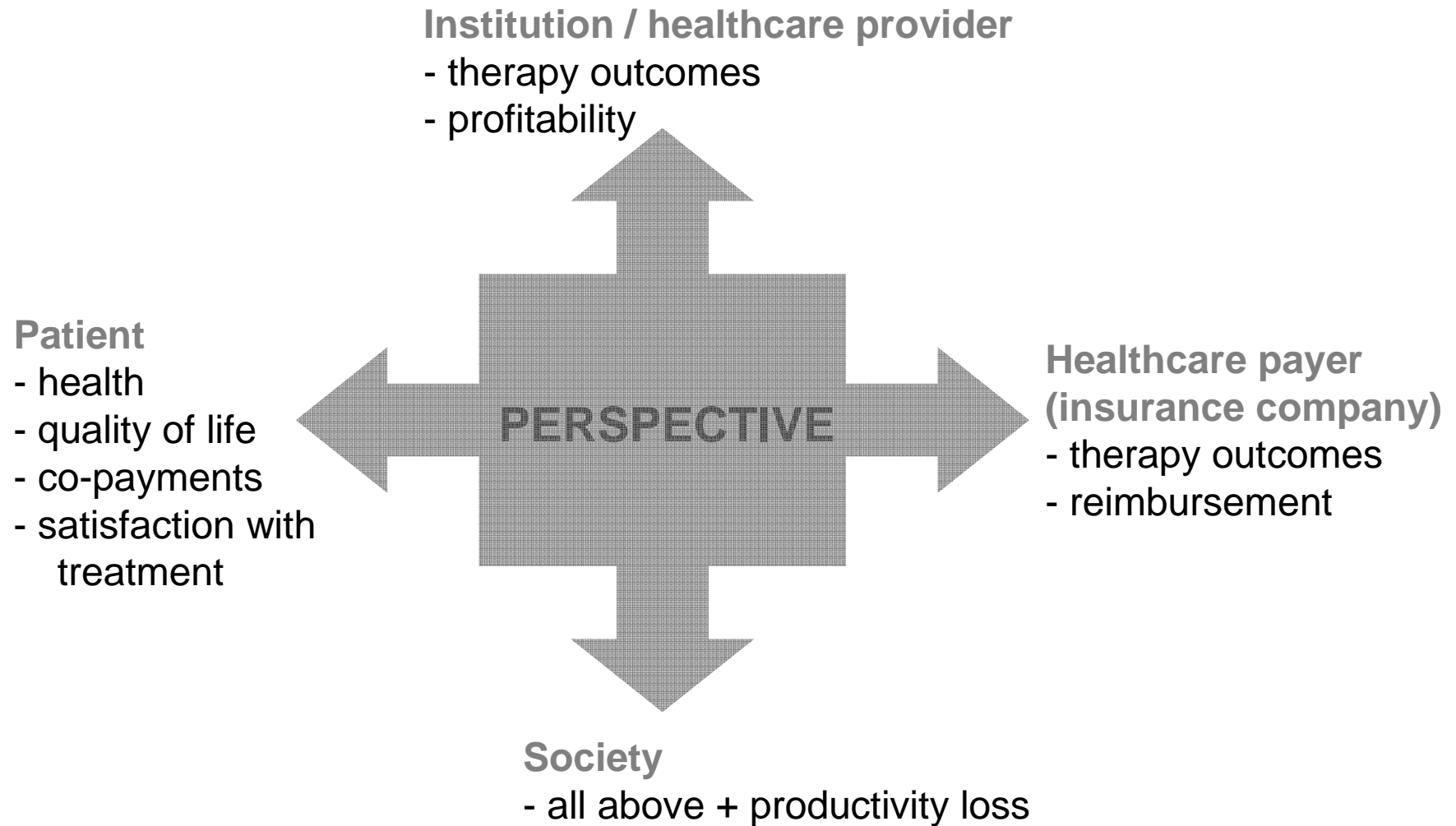
Basic principles I

- limited resources x growing value of modern medicine

- cooperation of:
  - physicians
  - economists
  - statisticians
  - pharmacists

allocation of resources

= satisfaction of needs of all patients on acceptable quality level

Basic principles II

Institution / healthcare provider
- therapy outcomes
- profitability

Patient
- health
- quality of life
- co-payments
- satisfaction with
   treatment

PERSPECTIVE

**Healthcare payer
(insurance company)**
- therapy outcomes
- reimbursement

Society
- all above + productivity loss

Main parameters in PE

Parameter		Example	Synonym
costs / resources		the reimbursement of drug, service, manpower, loss of earnings	
outcomes			
	clinical	uricaemia, BP, bout of depression, mortality	**Effect, efficacy, effectiveness**
	economic	reduction in GDP, loss of wages	**Benefit**
	social	social function, quality of life, utility	**Utility**

Cost categorization

- **Direct medical costs**
  - drugs, lab tests, hospitalizations
- **Direct non-medical costs**
  - transport
- **Indirect costs**
  - lost or reduced productivity
- **Intangible costs**
  - pain and suffering
  - impact on family home life, work, etc.

Direct medical costs

- related to treatment
- *reimbursed* by insurance company

category	specification	example
pharmaceutical costs	cost of drugs, treatment	reimbursement of drug
	tests of safety and effectiveness	kinetic – TDM
		biochemistry, physical, haematology
	treatment of adverse events	ordinary
		only if occurred
other costs	hospitalization	bed-days
	diagnostics	biochemistry, physical, microbiological
	transport	ambulance
	manpower (staff)	wages of health workers

Indirect costs

- experienced by the patient or society
- inconvenience of the patient in society
- loss of earnings and productivity because of illness or death

- difficult to measure
- paid by:
  - patient (lost earnings)
  - employer or society (lost productivity)

Measurement of productivity loss

- **Human-capital approach**
  - value of human capital as individual's future contribution to production (or earnings) in full health

- **Friction-cost approach**
  - value of human capital until replaced by another worker

Intangible costs

- pain, worry or other distress that patients or their family suffer

- impossible to measure in monetary terms

- not considered in economic evaluations (usually)

- might be reported alongside the cost results

Outcomes

➢ **identification and quantification of effectiveness**

Identification and measurement of outcomes

- the crucial moment of assessment
- outcomes / benefits might be measured in:
  - *natural units*
    - life-years saved, strokes prevented, ulcers healed, …
  - *utility units*
    - the quality-adjusted life year (QALY)
  - *economic benefit (money)*
    - the economic benefits of an employee returning to work after illness; money saved due to preventive program
- depends on perspective of analysis, availability and product indication

Outcomes quantification

Outcomes in economic evaluations

- efficacy
- effectiveness
- utility
- efficiency
- willingness to pay

Outcomes quantification

- **efficacy**
  - clinical effect under defined conditions (in clinical trials, RCT)
- **effectiveness**
  - clinical effect under real conditions (in real world clinical practice)
- **utility**
  - health state preferred by individuals = quality of life
- **willingness to pay**
  - life is valued according to what individuals are willing to pay for change that reduces the probability of death or illness = social preferences

  How individuals value life and health?
  - influenced by ability to pay (high-paid x low-paid workers, favours the rich over the poor)
- **efficiency**

  = cost-effectiveness
  - measures how well resources are used in order to achieve a desired output

Pharmacoeconomic analyses

Stages of PE analysis

1) **epidemiology**
2) new treatment advantages
3) hypothesis assignment, definition of research issue
4) study design and realization
5) utilization in practice

ad 1) epidemiology

- incidence and prevalence

- population of patients: age, therapy reaction, symptoms relevance, illness stages

- treatment methods

- cost of illness - medical and social

- impact of current therapy on the cost of illness

ad 2) new treatment advantages

- better short-term efficacy

- better long-term efficacy

- lowering patient monitoring need

- better safety profile of the new medicine, less adverse effects, less drug interactions

- better compliance (e.g. application once daily)

- more convenient application

ad 3) decision analysis

1. Perspective:
- patient
- insurance company
- societal

2. Sort of costs and outcomes:
- direct medical
- indirect
- intangible

- natural units
- utility units
- monetary values

3. Time horizon

ad 4) study design and realization

Types of PE analyses:

- Cost-minimization analysis (CMA)

- Cost-benefit analysis (CBA)

- Cost-effectiveness analysis (CEA)

- Cost-utility analysis (CUA)

Cost-minimization analysis (CMA)

- the simplest form of economic evaluation
- outcomes of 2 healthcare technologies are assumed to be equivalent
- basis of comparison are **costs** alone
- classic example:
  - comparison of 2 generic drugs

morbidity	technology 1	technology 2
G- infection	III.gen. CEF i.m., i.v.	III.gen. CEF p.o.
hypertension	sartans	ACEI
Borrelia meningitis	cefotaxim 3times daily	ceftriaxon once daily

Cost-benefit analysis (CBA)

- costs and benefits are measured in monetary units
- used for
  - evaluation of therapies with outcomes difficult to measure with conventional tool
  - decision making in health policy
- therapeutic outcomes must be complex (e.g. vaccination)
  - benefit for patient or society

- **How much can be saved by rapid recovery?**
- **Is the alternative cost-beneficial?**

Cost-benefit analysis (CBA)

- Study results:
  - **BENEFIT / COST RATIO:**

$$R \ = \ \frac{benefits}{costs}$$

  - **NET BENEFIT CALCULATION:**
    - **positive x negative**

$$N \ = \ benefits - costs$$

■ the comparison of different healthcare interventions, irrespective of the disease

■ discounting is essential if perspective is longer than 1 year!

Cost-benefit analysis (CBA)
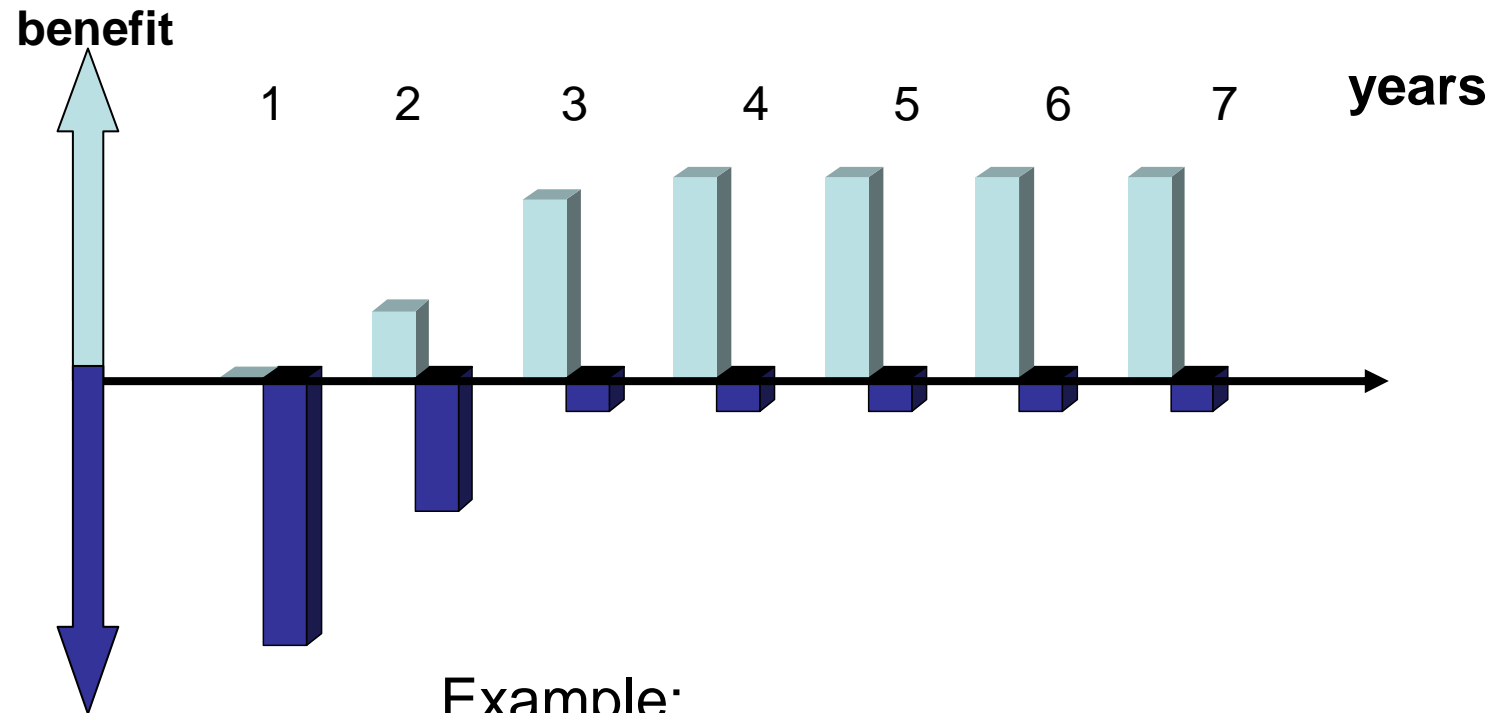
Example:
Does it worth to vaccinate?
Is treatment of disease cheaper?

Cost-benefit analysis (CBA)

Σ benefit

benefits - costs

Σ cost

- costs per 10 years: 80 mil. CZK
- outcomes per 10 y.: 480 mil. CZK

$$480 - 80 = \textbf{400 mil. CZK}$$

- discounting 5%:

$$(480 - 80) / 1{,}05^{10} = \textbf{246 mil CZK}$$

=) net benefit is positive

=) intervention is **COST-BENEFICIAL**
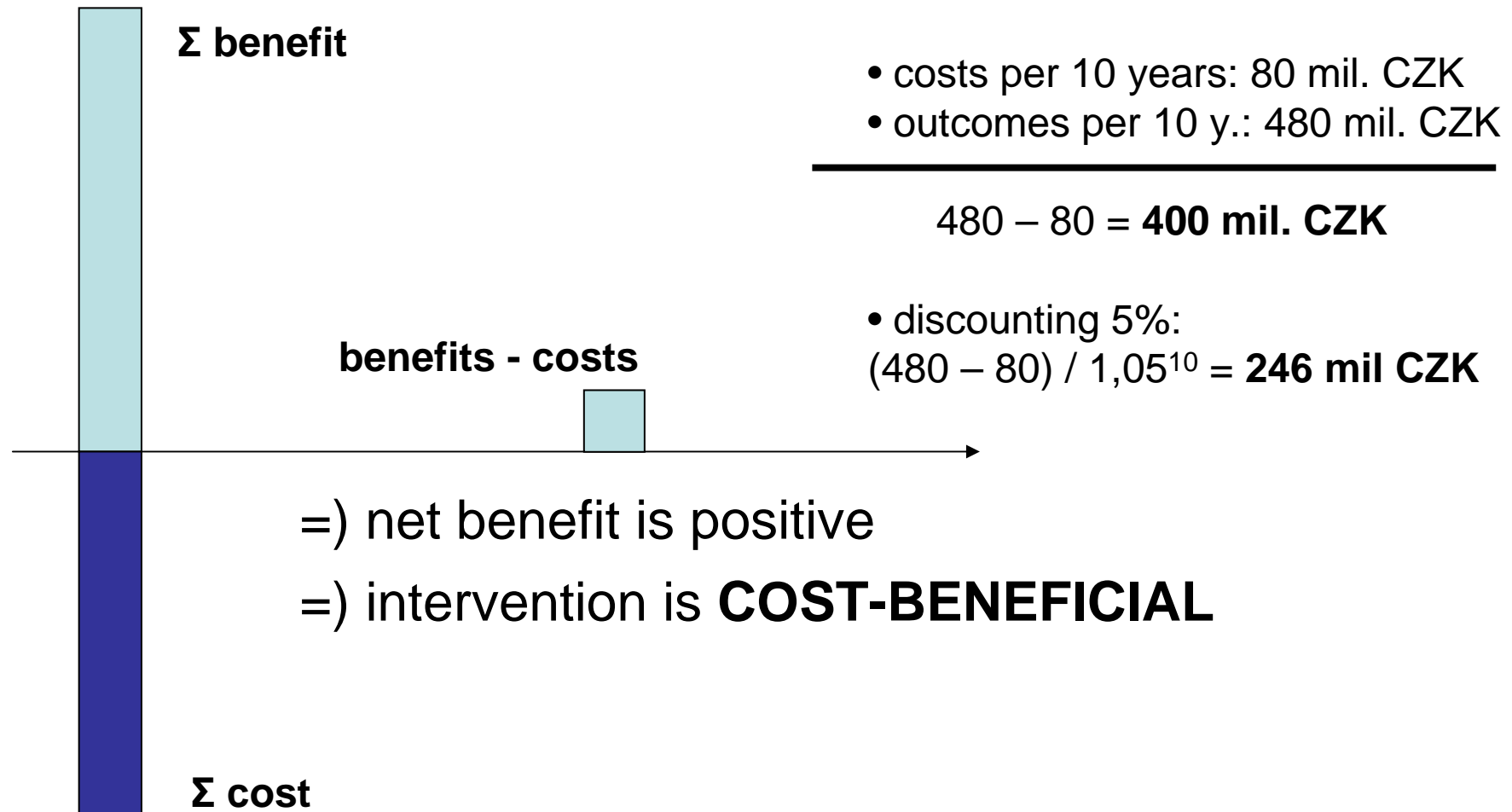
Cost-effectiveness analysis (CEA)

- outcomes measured in **natural units**
    - e.g. complex units: life years gained
    - partial units: re-infections, blood pressure, cholesterol levels

=) **searching a drug which has the best impact on disease history at a reasonable price**

=) **cost per clinical unit**

=) **cost per events avoided**

=) **cost per symptom-free days**

Cost-effectiveness plane

Difference in costs

IV
The new treatment
is **less** effective
and **more** expensive

REJECT

I
The new treatment
is **more** effective
and **more** expensive

**Cost-effective?
ANALYSE!**

Difference in effects

III
The new treatment
is **less** effective
and **less** expensive

**Questionable…
ANALYSE?**

II
The new treatment
is **more** effective
and **less** expensive

ACCEPT
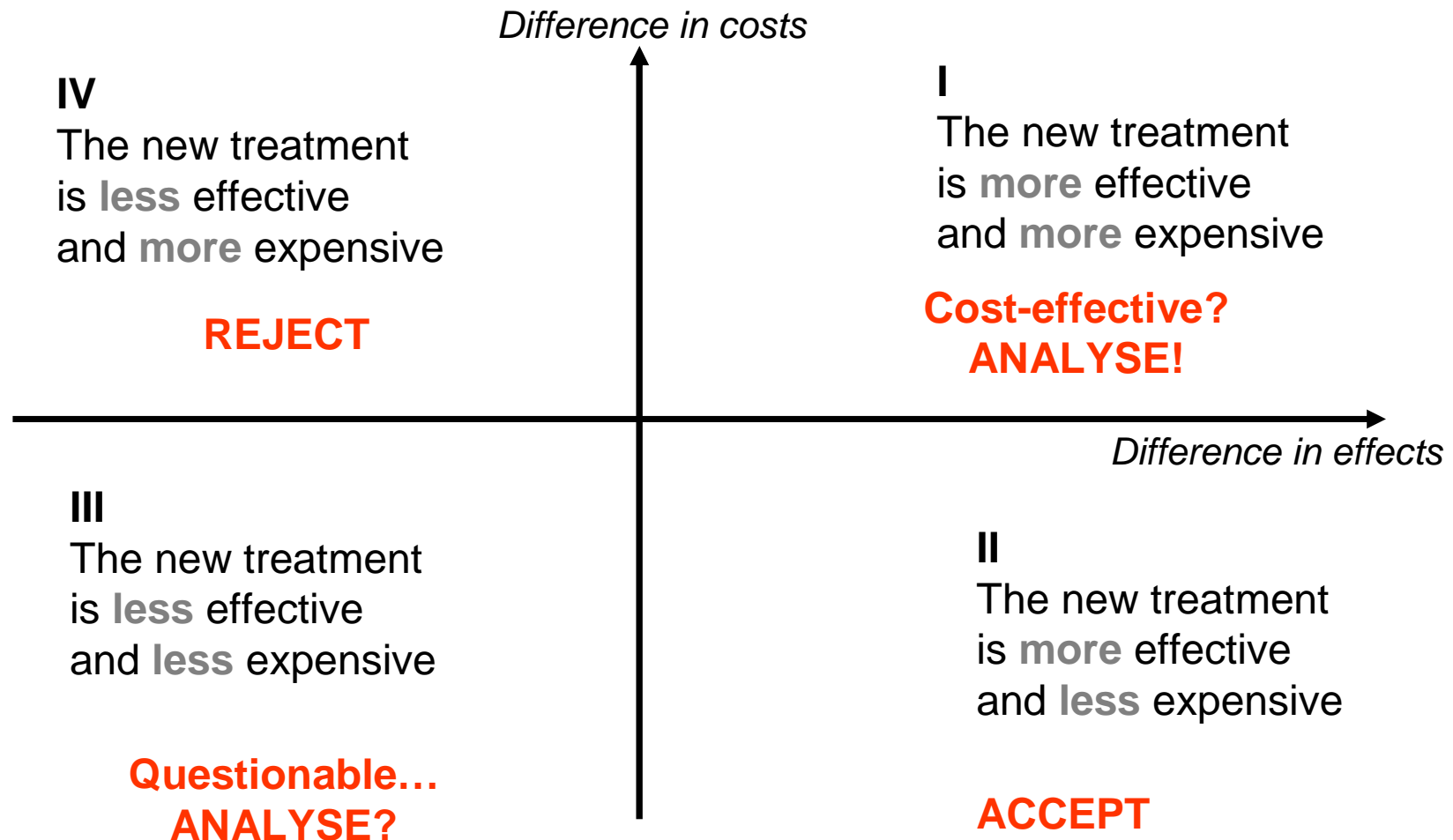
4 possible quantitative results in a cost effectiveness analysis

Cost-effectiveness ratio (CER)

- Complex changes of effectiveness:
  - life years gained

$$CER = \frac{\text{Cost of intervention}}{\text{Therapeutic effect}}$$
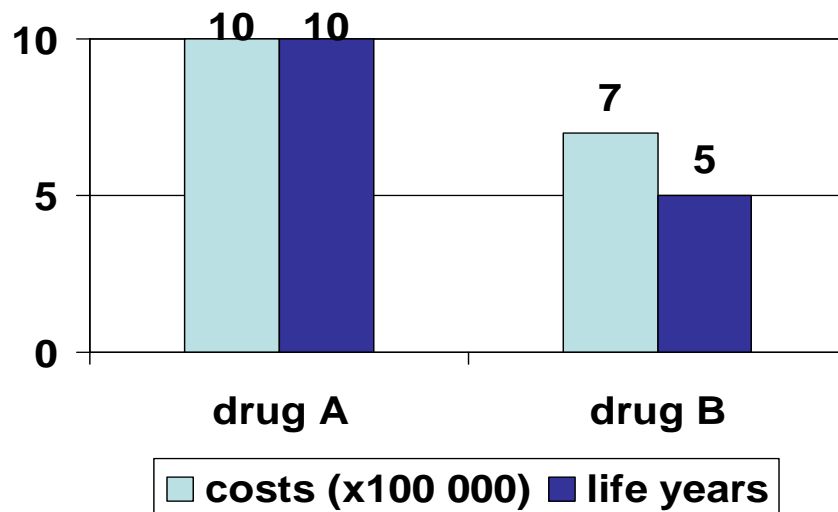
Cost-effectiveness ratio (CER):

C_A / E_A ? C_B / E_B

1 000 000 / 10 ? 700 000 / 5

100 000 CZK / year $<$ 140 000 CZK / year

No difference in CER?
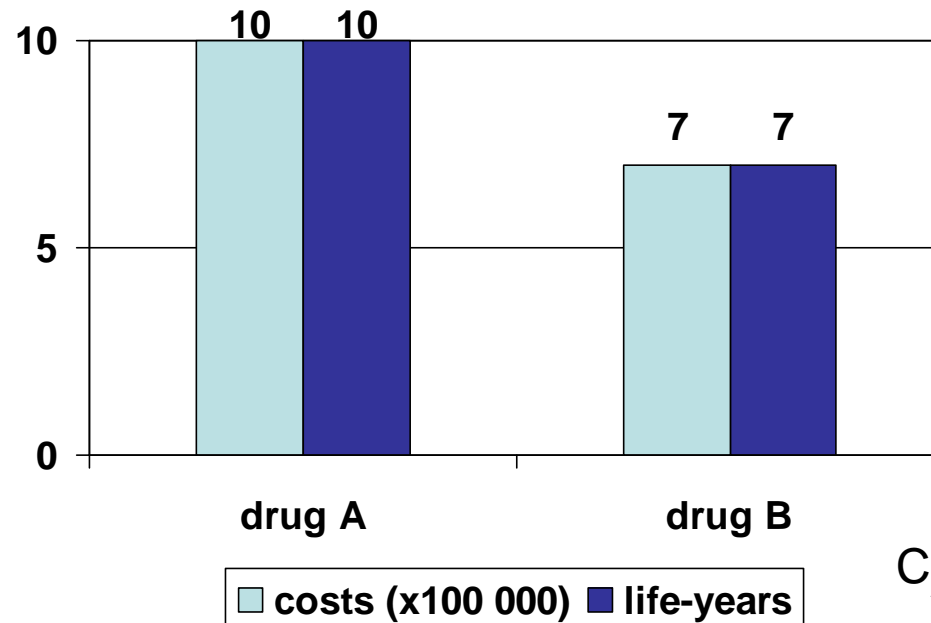
C_A / E_A ? C_B / E_B

1 000 000 / 10 ? 700 000 / 7

100 000 CZK / year = 100 000 CZK / year

➢ *CER reflects cost per unit independently of other treatment options*

Incremental cost-effectiveness analysis

- incremental cost per unit of effectiveness

  = cost per unit by switching from one treatment option to an alternative treatment option

  – *the extra cost per unit gained*

Incremental Cost-Effectiveness Ratio:

$$ICER = \frac{Incremental \quad Cost}{Incremental \quad Effectiveness}$$

ICER
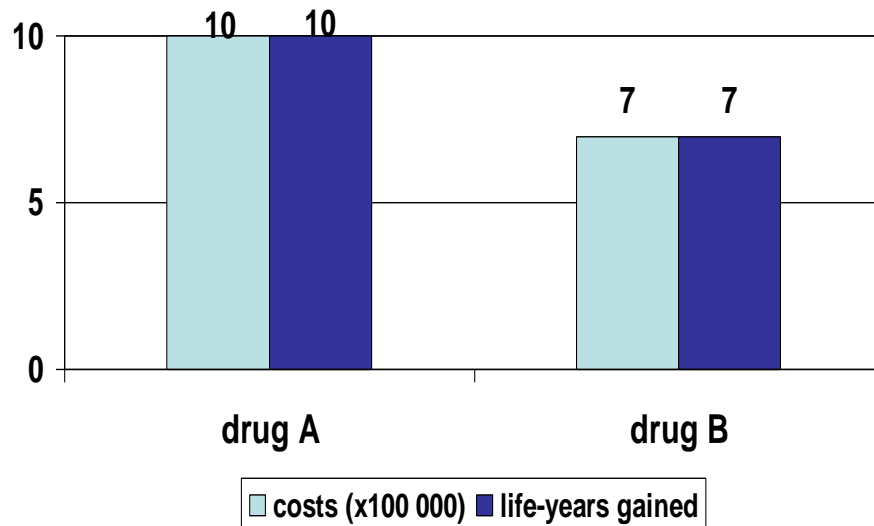
$$ICER = \frac{1\ 000\ 000 - 700\ 000}{10 - 7}$$

ICER = 100 000 CZK / LYG
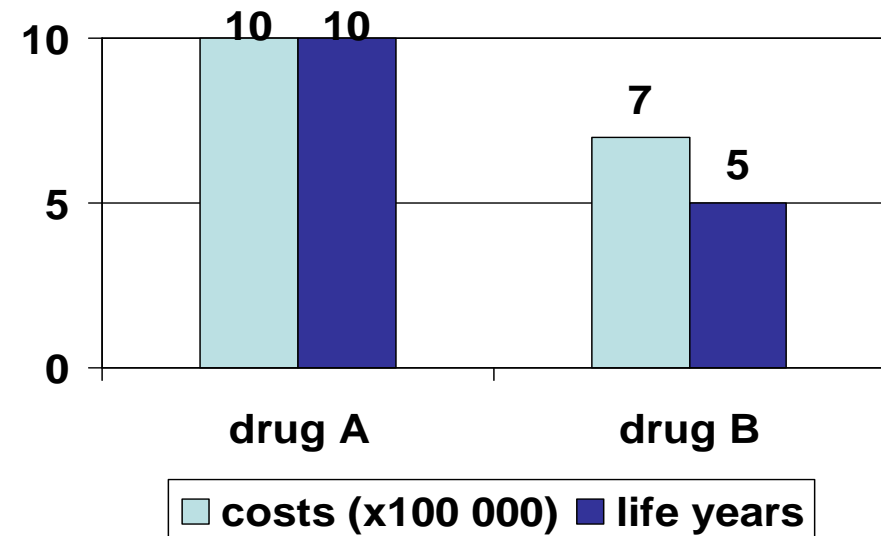
$$ICER = \frac{1\ 000\ 000 - 700\ 000}{10 - 5}$$

ICER = 60 000 CZK / LYG

Cost-utility analysis (CUA)

- **utility** = preference of health state determined by patient or general public

CUA

- the impact of treatment on factors of greatest importance to the patient
  - pain, mobility, social performance,…
  - **PRO**s – *patient-reported outcomes*
- measures effects on morbidity (quality of life) and mortality (quantity of life)
  - = **QALY** *(Quality Adjusted Life Year)*

- enables the comparison of different healthcare interventions, irrespective of the disease

QALY calculation

- **QALY**
  - length of life x quality of life

- **utility = 1** -) perfect health
- **utility = 0** -) death
- **utility < 0** -) worse than death

1 year of perfect health (100%)	**1 QALY**
2 years 50% perfect health	**1 QALY**
2 years 100 % perfect health	**2 QALY**
2 years 25% perfect health	**0,5 QALY**
treatment of patient with 50% perfect health becoming to 75%	**0,25 QALY gained**
treatment of 4 patients with 50% perfect health becoming to 75%	**1 QALY gained**

Cost-utility analysis (CUA)

Example:

	costs (CZK)	estimated survival	utility	QALY
drug A	20 000	4,5 years	0,60	**2,7**
drug B	10 000	3,5 years	0,72	**2,5**

$$ICER = \frac{Incremental \quad Cost}{Incremental \quad Effectiveness}$$

Cost-effectiveness incremental ratio:

$P_e = (20000-10000) / (4,5-3,5) =$ *10 000 CZK / 1 LYG*

Cost-utility incremental ratio :

$P_u = (20000-10000) / (2,7-2,5) =$ 50 000 CZK / 1 QALY

QALY x LYG

QALY

- **chronic diseases**
  - slow progression (RA)
  - uncomfortable symptomatology (GERD)
  - impact on work and mental potential (schizophrenia)
  - with exacerbations (asthma)

- elimination of adverse effects
  - vomiting after chemotherapy

LYG

- **progressive diseases**
  - high mortality
  - poor prognosis
  - serious complications

- asymptomatic disease with serious consequences
  - dyslipidaemia

Use of CUA:

- simple method for reimbursement of different technologies
- no reflection of individual preferences
  - *length of life   x   quality of life?*

ad 5) utilization in practice

- decision making in national health policy

  – drug registration, price settings and reimbursement

- decision making in health services (hospitals)

  – inclusion to positive lists

- clinical guidelines

- patient satisfaction

Impact of new drug on the market:

- **Budget impact analysis (BIA)**

Quality of life measurement

WHO 5 QoL
EQ-5D
FACT-C

Quality of life questionnaires

- **specific** - disease specific questionnaires
  - Functional Assessment of Cancer Therapy *(FACT),* Asthma TyPE questionnaire, Arthritis Impact Measurement Scale (AIMS), Multiple Sclerosis Quality of Life Inventory (MSQLI), Beck Depression Inventory (BDI)
- **generic** (general) – quality of life questions, questions on social emotional and physical functioning, pain, self-care
  - EuroQoL (EQ-5D), Nottingham Health Profile, Short Form 36 (SF36), Sickness Impact Profile

Methods to asses quality and quantity of life

  - **QALY** (Quality Adjusted Life Year)

  - **DALY** (Disability Adjusted Life Year – WHO)

  - **HYE** (Health Year Equivalent)

The EQ-5D descriptive system

- comprises 5 dimensions of health:
  - mobility
  - self-care
  - usual activities
  - pain/discomfort
  - anxiety/depression

- each dimension comprises 3 levels:
  - no problems
  - some/moderate problems
  - extreme problems

- a unique EQ-5D health state is defined by combining 1 level from each of the 5 dimensions

By placing a tick in one box in each group below, please indicate which statements best describe your own health today:

Mobility

I have no problems in walking about ☐
I have some problems in walking about ☐
I am confined to bed ☐

Self-Care

I have no problems with self-care ☐
I have some problems washing or dressing myself ☐
I am unable to wash or dress myself ☐

Usual Activities (e.g. work, housework, family or leisure activities)

I have no problems with performing my usual activities ☐
I have some problems with performing my usual activities ☐
I am unable to perform my usual activities ☐

Pain / Discomfort

I have no pain or discomfort ☐
I have moderate pain or discomfort ☐
I have extreme pain or discomfort ☐

Anxiety / Depression

I am not anxious or depressed ☐
I am moderately anxious or depressed ☐
I am extremely anxious or depressed ☐

EQ-5D

- a total of 243 possible health states is defined in this way

- each state is referred to in terms of a 5 digit code.

  - 11111 indicates no problems on any of the 5 dimensions

  - 11223 indicates no problems with mobility and selfcare, some problems with performing usual activities, moderate pain or discomfort and extreme anxiety or depression.

The EQ VAS

- records the respondents self-rated health status on a vertical graduated (0-100) visual analogue scale

„To help people say how good or bad a health state is, we have drawn a scale (rather like a thermometer) on which the best state you can imagine is marked 100 and the worst state you can imagine is marked 0.

We would like you to indicate on this scale how good or bad your health state is today, in your opinion. Please do this by drawing a line from the box below to whatever point on the scale indicates how good or bad your health state is today.“
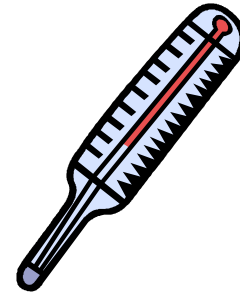
You own health state today

100
90
80
70
60
50
40
30
20
10
0

FACIT

- **FACIT** = Functional Assessment of Chronic Illness Therapy

- **FACT-G:** Functional Assessment of Cancer Therapy – General
  - constitutes the core of all subscales; the FACT-G can be used with patients of any tumor type

- **FACT-C:** For patients with Colorectal cancer

Pharmacoeconomics in the Czech Republic and in the world

Pharmacoeconomic evaluation in the world

Australia, New Zealand	Required for new drugs since 1993
Canada (BC, Ont.)	Required for new drugs since 1995/6
Denmark	Might be required or optional since 1997
France	Might be required since 1997
Finland	Required for new drugs since 1998
Italy	Might be required since 1998
UK	Authority of NICE since 1999
Sweden, Norway	Required for new drugs since 2002
Netherlands	Required for new drugs since 2003
Germany	Cost-benefit analysis since 2007
Czech Republic	**CEA, BIA since 2008**

Cost-effectiveness thresholds

- USA………………… 67.000 EUR / QALY
  - (93.500 USD/QALY)
- UK (NICE).….……… 38.000 EUR / QALY
  - (30.000 GBP /QALY)
- Canada……….…… 56.000 EUR / QALY
  - (83.900 USD/QALY)
- Australia……….….. 35.000 EUR / QALY
  - (51.000 USD/QALY)
- Netherlands..….…… 80.000 EUR/QALY
- Sweden……….….. 70.000 EUR/QALY

- **Czech Republic????**

Cost-Effectiveness Thresholds

Table 2 Theoretical values (in US$/DALY) for cost-effectiveness thresholds in several high-income countries, if thresholds were exclusively based on the "three times Gross Domestic Product (×3 GDP) per capita" approach proposed in the World Health Organization Report 2002 (WHO 2002). Values are based on Purchasing Power Parity-GDP per capita figures for 2000. (Source: The World Factbook 2001, accessed at http://www.bartleby.com/151/a64.html)

Country	"×3 GDP threshold" (US$/DALY)
USA	108,600
Japan	74,700
Canada	74,400
France	73,200
Germany	70,200
Australia	69,600
UK	68,400
Italy	66,300
Spain	54,000
New Zealand	53,100

DALY, Disability-Adjusted Life-Year.

Eichler...ViH 2004

CR: GDP per capita in 2006

= 12 106 EUR

.... 944 295 Kč/DALY

.....59 018 USD/DALY

.....36 319 EUR/DALY

PE society: 346 000 - 1 037 000 Kč / QALY

5/26/2013

Pharmacoeconomics in the Czech Republic
www.farmakoekonomika.cz

Pharmacoeconomics in the Czech Republic

Pharmacoeconomics in the world
www.ispor.org

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