Comparison of breast cancer treatment and targeted prevention; a CzechHTA comparative cost-effectiveness research

Vladimír Rogalewicz, Kateřina Kotajná, Veronika Šinkorová, Hana Dománková

CzechHTA
Czech Technical University in Prague
Faculty of Biomedical Engineering

Background

During last 50 years, technology in medicine has developed unprecedently, as concerns both knowledge and investments.

This process happened more or less smoothly.

Nevertheless, some problems appeared concerning procuring, dissemination and utilization of medical devices.

Doubts were also expressed concerning efficiency, effectiveness, and appropriateness of already standardized procedures in health care.

Source: INAHTA (International Network of Agencies for Health Technology Assessment)

Progress in medicine

- Christian Bernard transplanted heart –1967
  - First transplantation in Czechoslovakia – 1968
- Published first image obtained using magnetics resonance (MRI) – 1973
  - First commertial MRI device in Czechoslovakia – 1988
- Robotic surgery – late 1980´s
  - First operation robot (da Vinci) in CZE – 2005

Healthcare dilemma

Unprecedented technological progress in past decades

- New drugs
- New devices
- New surgical and terapeutic techniques
- Rapid dissemination & easy accessibility of information

Patients require access to the newest discoveries

Physicians want the best for their patients

Healthcare dilemma

Reasons for health care cost increase:

- New technologies/innovations
- Better access to information for patients
- Unhealthy way of life $\Rightarrow$ diseases of civilization
- Growing requirements for quality of life
- Higher accessibility of health care (supply encourages demand)

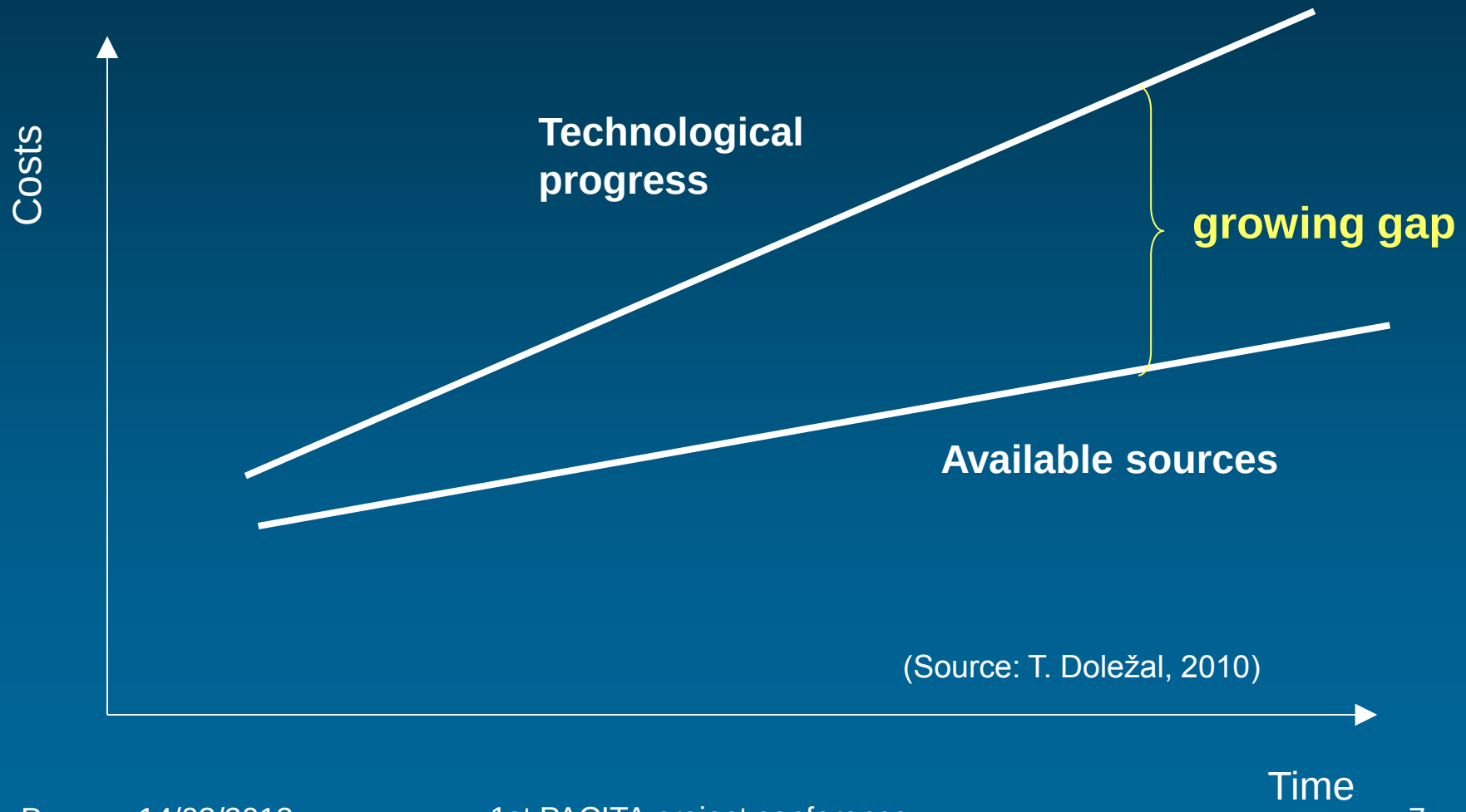
(Source: G. Kobelt 2002)

Healthcare dilemma

Patients require access to the newest discoveries

Physicians want the best for their patients

Possibilities and limits of health care funding



Health Technology Assessment

Health technology assessment (HTA) = systematic assessment of properties, effects and/or impacts of health technologies.

pharmaceuticals, devices, diagnostics and treatments, and other clinical, public health, and organizational interventions

Health Technology Assessment

Health technology assessment (HTA) =

the systematic evaluation of properties, effects, and/or impacts of health care technology. It may address the direct, intended consequences of technologies as well as their indirect, unintended consequences. Its main purpose is to inform technology-related policymaking in health care.

Source: http://htaglossary.net (a common project of INAHTA and HTAi)

Health Technology Assessment

- Identifies evidence, or lack of evidence, on the benefits and costs of health interventions
- Synthesises health research findings about the effectiveness of different health interventions
- Evaluates the economic implications and analyses cost and cost-effectiveness
- Appraises social and ethical implications of the diffusion and use of health technologies as well as their organisational implications
- Helps identify best practices in health care, thereby enhances safety, improves quality and saves costs

Source: INAHTA (International Network of Agencies for Health Technology Assessment)

Four fundamental questions

1. Does the technology work?
2. For whom?
3. At what cost?
4. How does it compare with alternatives?

(Source: C.S.Goodman: HTA101, 2004)

Examples of HTA utilitation

- When is a consultation with a physician better than antidepressants for people with acute depression?

Examples of HTA utilitation

- When is a consultation with a physician better than antidepressants for people with acute depression?
- What is the best surgery of aortic aneurysm?

Examples of HTA utilitation

- When is a consultation with a physician better than antidepressants for people with acute depression?
- What is the best surgery of aortic aneurysm?
- Should human papilomavirus be tested with every throat swab?

Examples of HTA utilitation

- When is a consultation with a physician better than antidepressants for people with acute depression?
- What is the best surgery of aortic aneurysm?
- Should human papilomavirus be tested with every throat swab?
- Should aspirin be administered as a primary prevention of cardiovascular disorders?

Examples of HTA utilitation

- When is a consultation with a physician better than antidepressants for people with acute depression?
- What is the best surgery of aortic aneurysm?
- Should human papilomavirus be tested with every throat swab?
- Should aspirin be administered as a primary prevention of cardiovascular disorders?
- Is a 64-slice computed tomography angiography a better alternative to invasive coronary angiography in the investigation of coronary artery disease?

Examples of Healthcare Interventions Found to be Ineffective or Harmful by HTA

- Autologous bone marrow transplant with high-dose chemotherapy for advanced breast cancer
- Colectomy to treat epilepsy
- Diethylstilbestrol (DES) to improve pregnancy outcomes
- Electronic fetal monitoring during labor without access to fetal scalp sampling
- Episiotomy (routine or liberal) for birth
- Extracranial-intracranial bypass to reduce risk of ischemic stroke
- Gastric bubble for morbid obesity
- Gastric freezing for peptic ulcer disease
- Hydralazine for chronic heart failure
- Intermittent positive pressure breathing
- Mammary artery ligation for coronary artery disease
- Optic nerve decompression surgery for nonarteritic anterior ischemic optic neuropathy
- Quinidine for suppressing recurrences of atrial fibrillation
- Radiation therapy for acne
- Sleeping face down for healthy babies
- Supplemental oxygen for healthy premature babies
- Thalidomide for sedation in pregnant women
- Thymic irradiation in healthy children
- Triparanol (MER-29) for cholesterol reduction

(Source: C. S. Goodman: HTA101, 2004)

Example

Example

Is targeted (ie. genetic based) preventive of breast cancer clinically and economically effective?

Example – background

- Almost ¼ of all tumors in women in CZE are breast cancer
- Hereditary syndrome (BRCA1/2) causes 5–7 % of them
- Patients suspected of this gene alteration undergo DNA testing, and the whole family joins the screening program
- These patients will eventually become ill (predicted risk being 78 % to 83 % by the age of 70), but the cancer is detected in earlier stages

Example – background

- Almost ¼ of all tumors in women in CZE are breast cancer
- Hereditary syndrome (BRCA1/2) causes 5–7 % of them
- Patients suspected of this gene alteration undergo DNA testing, and the whole family joins the screening program
- These patients will eventually become ill (predicted risk being 78 % to 83 % by the age of 70), but the cancer is detected in earlier stages
- **The question again:** Is the screening program clinically and economically effective?

Example (cont.)

- Data (targeted program) collected in 5 Prague hospitals
- Period 2002-2010
- Number of women included: 105
- Number of captured cancer cases: 10

- (All costs as of 2010)

Example (cont.)

- Data (targeted program) collected in 5 Prague hospitals
- Period 2002-2010
- Number of women included: 105
- Number of captured cancer cases: 10

Distribution of captured cases

Disease stage	0	1	2	3	4
Screening YES (real data)	2	6	2	0	0
Normal population (manifested disease without screening)	350	2 573	2 229	877	512
- in percent	5,35	39,34	34,08	13,41	7,83
- distribution of 10 patients (theoretical data)	0,54	3,94	3,41	1,34	0,78

PRICES IN CZK	Insur. points	Per year	Since (age)	Remark	BRCA1 +other	BRCA2
Examination by oncologist	243	2			646.9	495.7
MRI breast	5008	1	20	Until meno-pause	5 660	5 508.8
US breast	159	2	20		425.4	349.8
MMG	521	1	30		648.7	573.1
US belly	277	1	20		355.1	304.7
Dermatology consultation	131	1	20	only BRCA2	0	209.2
Markers 4x	489	1	20		503.8	498.8
Haemocult	55	1	45		61.1	56.1
20-29 years old					7 594	7 803
30-44 years old					8 240	8 023
45-50 years old					8 301	8 084
51+ years old					2 641	2 924

PRICES IN CZK	Insur. points	Per year	Since (age)	Remark	BRCA1 +other	BRCA2
Examination by oncologist	243	2			646.9	495.7
MRI breast	5008	1	20	Until meno-pause	5 660	5 508.8
US breast	159	2	20		425.4	349.8
MMG	521	1	30		648.7	573.1
US belly	277	1	20		355.1	304.7
Dermatology consultation	131	1	20	only BRCA2	0	209.2
Markers 4x	489	1	20		503.8	498.8
Haemocult	55	1	45		61.1	56.1
20-29 years old					7 594	7 803
30-44 years old					8 240	8 023
45-50 years old					8 301	8 084
51+ years old					2 641	2 924

1 EUR = 25 CZK

Price of the Therapy – real data of 91 patients (in CZK)

Stage	N	Mean	Median	Min	Max
0	2	62 516	62 516	52 005	73 028
I	32	125 820	92 294	28 257	298 721
II	38	246 156	214 200	50 140	1 081 956
III	14	211 601	194 827	128 623	362 258
IV	5	216 186	211 961	91 805	324 866

Quality of Life

Stage	Costs (CZK)	Utility [19]	Chances of survival (%)	QALY	Cost per QALY (CZK)
0	62 516	0,87	99,99	0,8699	71 866
I	125 820	0,79	98,6	0,7789	161 535
II	246 156	0,72	87	0,6264	392 969
III	211 601	0,64	64,6	0,4134	511 855
IV	216 186	0,395	27,7	0,1094	780 455

Model of costs for 10 captured cancer cases with and without prevention

Incl. preventive							w/o preventive		
Woman No.	Time of preventive (months)	Price of preventive	stage	Price of therapy until now (CZK)	Price of therapy planned (CZK)	Price of therapy total (CZK)	stage	Price of therapy (CZK)	Difference (CZK)
1	5	3 646	0	52 004	finished	55 690	I	125 820	70 130
2	54	36 738	I	95 263	5 168	137 169	I	125 820	-11 349
3	1	617	0	73 028	finished	73 645	I	125 820	52 175
4	19	11 155	I	77 176	finished	88 331	II	246 156	157 825
5	29	17 807	I	49 177	27 985	94 969	II	246 156	151 187
6	35	18 521	I	160 520	finished	179 041	II	246 156	67 115
7	42	27 086	I	142 291	finished	169 337	I	125 820	-43 517
8	14	10 420	II	367 120	5 168	382 708	III	211 601	-171 107
9	69	41 023	I	108 497	finished	149 520	II	246 156	96 636
10	13	8 986	II	148 475	33 153	190 614	IV	216 186	25 572

Cost-Utility Analysis - CUA

	With preventive* (CZK)	W/o preventive (CZK)
Targeted program cost (105 women)	2 739 952	0
Cost of capturing 1 breast carcinoma	273 995	0
Mean cost of treatment per woman	137 226	191 569
Total cost per woman	411 221	191 569
QALY	0.77	0.61
Cost per QALY	534 053	351 033

Example – cont.

- *The result might have been affected by the small sample and short time of observation*

Example – cont.

- *The result might have been affected by the small sample and short time of observation*
- *Solution: let´s model a larger cohort of patients, and také them lifelong*

Example – Monte Carlo

A fictional cohort generated by Monte Carlo method (on the grounds of data from clinics and literature):

- 164 women with BRCA1
- 167 women with BRCA 2

Generated data:

- Patient´s age when entering the preventive program
- Patient´s age when the tumor detected

All costs as of 2012

Example – results (model)

Cohort	Cost per QALY
W/o preventive	523 065
With preventive (all women in program)	788 561
With preventive (originally healthy women)	388 962

Studies done by CzechHTA (examples)

- Comparison of CT and MR equipment in Prague clinics
- Comparative effectiveness research: hemodialysis vs. peritoneal dialysis
- Cost effectivenes for bare metal stents and drug eluting stents
- Cost effectiveness of morbid obesity treatment
- Clinical and economic analysis of diabetic polyneuropathy pharmacotherapy
- Cost-effectiveness and clinical effectiveness of woman thyroid disease screening after early spontaneous miscarriage
- Quality of working life in patients with multiple sclerosis

Thanks to colleagues, who participate in the HTA program at FBME CTU, and who contributed to this paper:

- Prof. Ing. Peter Kneppo, DrSc.
- Prof. MUDr. Jozef Rosina, Ph.D.
- Doc. Ing. Juraj Borovský, Ph.D.
- Ing. Zuzana Darmopilová, Ph.D.

Postgraduate students:

- Ing. Gleb Donin
- Ing. Zuzana Gabrhelíková Sečanská
- Mgr. Ilya Ivlev
- Ing. Ivana Juřičková
- Ing. Roman Komkov
- Ing. Karolina Kreuterová
- Ing. Veronika Mezerová
- Ing. Pavel Rosenlacher
- Ing. Jakub Vacek

+ Master´s program students (incl. co-authors)

http://www.czechhta.cz

Thank you for attention

rogalewicz@fbmi.cvut.cz