HEALTH-ECONOMICS ANALYSIS OF PUBLIC HEALTH SCREENING PROGRAMMES

Doctoral (Ph.D.) thesis

Imre BONCZ M.D., M.Sc.

Head of the Doctoral School of Health Sciences:
Prof. Dr. József BÓDIS Ph.D., D.Sc.

Programme leader and supervisor of the Doctoral School of Health Sciences:
Prof. Dr. István EMBER Ph.D., D.Sc.

National Health Insurance Fund Administration (OEP)
Institute of Diagnostics and Management, University of Pécs
Pécs-Szombathely-Budapest
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1. INTRODUCTION

Epidemiological indicators of the health status of the Hungarian population are week compared to international standards. During the decades following the Word war II the gap in health expectancy – after some results in the beginning – between the socialist countries of Central and Eastern Europe and the Western-European counties had been widening further. In the one and half decade after the social changes in 1990 several attempts were made towards the improvement of the health indicators of Hungary. The different public health programmes covered several field of interventions (oncology, cardiovascular field, mental problems, file style, etc.).

During the early 1990s new guidelines were issued both at national and international level (Hungarian National Cancer Control Programme and the Cancer Control Programme of the European Union). In the middle of 1990s public health pilot cancer screening programmes were introduced in Hungary, while in the early 2000s, nationwide, organized breast and cervical cancer screening programme were fully implemented. Scientific papers around 2000 even emphasized the importance of the burden of oncological diseases. The question at that time arose whether the well-established programmes of the oncologists will be included into the health policy action programmes with a practical implementation.

Regarding the organized cancer screening programmes one could have experienced a breakthrough around the millennium. In 2001 the public health programme „For a healthy nation" was announced and the organized, nationwide breast cancer screening programme started in January 2002, which can be considered as an important milestone among the Hungarian public health programmes. After the governmental election in 2002 the new „National Public Health Programme" was announced considering public health cancer screening programme as a priority, and within this programme the organized, nationwide cancer screening programme was introduced in the autumn of 2003. Colorectal cancer pilot screening programmes are currently under investigation.

During the early 2000s, nationwide breast and cervical cancer screening programmes financed from public resources were introduced in Hungary.

With the increasing health expenditures there was a clear demand or necessity towards the inclusion of economic considerations for the allocation of health care resources in addition to medical demands.

The classis framework included 3 main criteria (hurdles) for medical technologies (e.g. pharmaceuticals): quality (first hurdle), safety (second hurdle) and efficacy (third hurdle). In many of the most developed countries there is a system for the evaluation of these 3 hurdles. But during the decision making process on finance and reimbursement, when one should make decision on scare resources, a fourth criteria, a fourth hurdle was introduced: effectiveness & cost-effectiveness.

During the analysis of the fourth hurdle (effectiveness & cost-effectiveness) financing agencies are interested – in addition to information derived from randomised clinical trials – in the effectiveness of the certain technology in the everyday medical practice and at what cost they reach this effectiveness. The primary role of "fourth hurdle" is to provide scientific support for decision making on resource allocation, the main tool is health-economics analysis.

Health-economics analysis was originally introduced on decision making on drug reimbursement, but later it was applied decision making on financing several other medical technologies, interventions and programmes. In the past decade several medical journal introduced a guideline for conducting health-economics analysis. The most frequently used methods of health-economics analysis are the following: cost analysis (CA), cost-consequences analysis (CCA), cost-minimization analysis (CMA), cost-effectiveness analysis (CEA), cost-utility analysis (CUA), cost-benefit analysis (CBA).

2. AIMS OF THE STUDY

The central topic of our investigation is the special type of public health programmes, the organized nationwide breast, cervical and colorectal cancer screening programmes.

It is generally considered, that prevention and screening is cheaper that the treatment of advanced diseases, but only a few scientific evidence can support this approach. During our analysis we tried to answer the question what is the burden/cost of organized nationwide breast, cervical and colorectal cancer screening programmes for the only health care financing agency in Hungary (National Health Insurance Fund Administration, Országos Egészségbiztosítási Pénztár, OEP).

Our investigation was focused on the health-economics analysis of organized nationwide breast, cervical and colorectal cancer screening programmes, including:

- To calculate the annual health insurance (OEP) treatment cost of breast, cervical and colorectal cancer.
- To assess the expected epidemiological outcome of the organized nationwide breast, cervical and colorectal cancer screening programmes by calculating the number of lives and life years gained.
- To calculate the annual cost of organized nationwide cancer screening programmes.
- To compare the annual treatment cost of breast, cervical and colorectal cancer to the annual cost of screening programmes.
- Finally to calculate the cost-effectiveness of organized nationwide breast, cervical and colorectal cancer screening programmes (cost/life years gained) from the point of view of a financing agency.

Detailed methodology and results are given in the next chapters based on our previous publications.

3. DETAILED ANALYSIS

3.1. Health economics analysis of breast cancer screening

Aim: The organized breast cancer screening programme has started in Hungary at the end of 2001. To assess the screening rate, the cost of screening and treatment and to calculate the expected epidemiological and economic gain and cost-effectiveness of mass-screening programme.

Data and methods: The data derive from the financial database of the National Health Insurance Fund of Hungary from 2001. To assess the screening rate the authors used the code „No. 42400 mammography screening" of out-patient care. The cost of treatment includes the cost of out-patient care, the acute and chronic inpatient care, the subsidies of medicines' prices and the expenditure on disability to work (including sickness-pay). Breast neoplasms were identified with the following codes of the International Classification of Diseases (ICD, tenth revision): C50: Malignant neoplasm of breast, D05: Carcinoma in situ of breast, D24: Benign neoplasm of breast. The expected benefits of the screening programme were modelled with changing mortality decrease for a 10 years interval.

Results: The screening rates of women aged 45-65 for 2001 and 2002 were 7 % and 21,7 % respectively. The cost of treatment of breast cancer was around 8,6 billion Hungarian forints (29.939.868 USD, 33.426.321 EURO) in 2001. In the age-group 45-65 with 10 % mortality decline 509 lives (net present value, NPV: 365), with 20 % mortality decline 1.074 (NPV: 772) lives and with 30 % mortality decline 1.582 (NPV: 1.139) lives can be saved during a 10 years screening programme. The cost of one life saved varies between 5,7 million forints (19.876 USD, 22.190 EUR)/life saved and 17,8 million forints (62.047 USD, 69.273 EUR)/life saved according to the mortality decline. The cost of one life year saved varies between 271,000 forints (946 USD, 1.057 EUR)/life year saved and 847,000 forints (2.955 USD, 3.299 EUR)/life years saved.

	breast cancer (malignant)	breast cancer (in situ)	breast cancer (benign)	total
outpatient care	766.932.852 Ft	8.246.930 Ft	82.401.072 Ft	**857.580.854 Ft**
acute inpatient care	4.488.292.811 Ft	8.480.550 Ft	121.771.959 Ft	**4.618.545.320 Ft**
chronic inpatient care	26.890.250 Ft	118.110 Ft	115.560 Ft	**27.123.920 Ft**
sickness-pay	594.997.500 Ft	6.901.500 Ft	49.141.500 Ft	**651.040.500 Ft**
drugs (outpatient care)	1.570.788.855 Ft	261.419 Ft	4.534.983 Ft	**1.575.585.257 Ft**
drugs (special permit)	849.992.134 Ft			**849.992.134 Ft**
total	**8.297.894.402 Ft**	**24.008.509 Ft**	**257.965.074 Ft**	**8.579.867.985 Ft**

Table 1
Health insurance treatment cost of breast cancer (2001)

Conclusion: The implementation of organized breast cancer screening can lead to cost savings in Hungary. The cost-effectiveness of breast cancer screening seems to be acceptable for purchaser.

3.2. Health-economic analysis of cervical cancer screening

Aim: To reduce the high mortality rate of cervical cancer there are organized, nation-wide mass-screening programmes. To assess the screening rate, the cost of screening and treatment and to calculate the expected epidemiological and economic gain and cost-effectiveness of mass-screening programme.

Data and methods: The data derive from the financial database of the National Health Insurance Fund of Hungary from 2001. To assess the screening rate the authors used the code „No. 29601 cytological examination for screening" of out-patient care. The cost of treatment includes the cost of out-patient care, the acute and chronic inpatient care, the subsidies of medicines' prices and the expenditure on disability to work (including sickness-pay). Cervical neoplasms were identified with the following codes of the International Classification of Diseases (ICD, tenth revision): C53: Malignant neoplasm of cervix uteri , D06: Carcinoma in situ of cervix uteri, D26.0: Other benign neoplasms of uterus, Cervix uteri. The expected benefits of the screening programme were modelled with changing the screening interval.

Results: The screening rates for 1999, 2000 and 2001 were 14,5 %, 16,2 % and 15,6 % respectively, while the 3 year screening rate for 1999-2001 were 35,7 %. The cost of treatment of cervical cancer was around 1 billion Hungarian forint (3.637.843 USD, 4.061.039 EURO) in 2001. The cost of one life saved according to the current screening strategy was 16,6 million Hungarian forints (57.792 USD) with a successful screening programme, while with a less successful program it was 33,8 million Hungarian forint (118.093 USD). The cost of one life year gained according to the current screening strategy was 0,7 million Hungarian forints (2.513 USD) with a successful screening programme, while with a less successful program it was 1,5 million Hungarian forint (5.134 USD).

	cervical cancer (malignant)	**cervical cancer (in situ)**	**cervical cancer (benign)**	**total**
outpatient care	69.034.605 Ft	6.344.450 Ft	33.891.245 Ft	**109.270.300 Ft**
acute inpatient care	564.944.486 Ft	34.664.503 Ft	2.260.085 Ft	**601.869.074 Ft**
chronic inpatient care	5.653.010 Ft	47.520 Ft	0 Ft	**5.700.530 Ft**
sickness-pay	118.405.500 Ft	15.801.000 Ft	31.095.000 Ft	**165.301.500 Ft**
drugs (outpatient care)	147.163.152 Ft	12.144.403 Ft	938.523 Ft	**160.246.078 Ft**
total	**905.200.753 Ft**	**69.001.876 Ft**	**68.184.853 Ft**	**1.042.387.482 Ft**

Table 2
Health insurance treatment cost of cervical cancer (2001)

Conclusion: It is important to increase the screening rate. With increasing the screening interval for women aged between 25-65 from 1 year to 2 or 3 years, it improves the cost-effectiveness of screening programme.

3.3. Health economics analysis of colorectal screening

Aim: To assess the screening rate, the cost of screening and treatment and to calculate the expected epidemiological and economic gain and cost-effectiveness of mass-screening programme.

Data and methods: The data derive from the financial database of the National Health Insurance Fund of Hungary from 2001. The cost of treatment includes the cost of out-patient care, the acute and chronic inpatient care, the subsidies of medicines' prices and the expenditure on disability to work (including sickness-pay). Colorectal neoplasms were identified with the following codes of the International Classification of Diseases (ICD, tenth revision): C18, C19, C20, C21: Malignant neoplasm of colon, rectosigmoid junction, rectum and anus and anal canal, D01.0, D01.1, D01.2, D01.3, D01.4: carcinoma in situ, D12:Benign neoplasm of colon, rectum, anus and anal canal. The expected benefits of the screening programme were modelled with different screening strategy and mortality decrease for a 10 years interval.

Results: The cost of treatment of colorectal cancer was around 9,98 billion Hungarian forints (34.817.250 USD, 38.871.666 EURO) in 2001. In the age-group 45-65 with 10 % mortality decline 718 lives (net present value, NPV: 515), with 20 % mortality decline 1.462 (NPV: 1.050) lives can be saved during a 10 years screening programme. The cost of one life saved varies between 4,0 million Hungarian forints (13.968 USD, 15.595 EURO)/life saved and 16,3 million Hungarian forints (56.952 USD, 63.584 EURO)/life saved according to the mortality decline and screening strategy. The cost of one life year saved varies between 307.909 Hungarian forints (1.074 USD, 1.200 EURO)/life year saved and 1,25 million Hungarian forints (4.381 USD, 4.891 EURO)/life years saved.

	colorectal cancer (malignant)	**colorectal cancer (in situ)**	**colorectal cancer (benign, polip)**	**total**
outpatient care	170.695.416 Ft	1.312.259 Ft	369.356.535 Ft	**541.364.210 Ft**
acute inpatient care	6.272.803.772 Ft	15.476.012 Ft	1.160.086.896 Ft	**7.448.366.681 Ft**
chronic inpatient care	362.617.938 Ft	820.365 Ft	7.244.040 Ft	**370.682.343 Ft**
sickness-pay	324.217.487 Ft	1.250.810 Ft	45.044.230 Ft	**370.512.527 Ft**
drugs (outpatient care)	531.462.825 Ft	2.113.313 Ft	113.077.357 Ft	**646.653.495 Ft**
drugs (special permit)	600.000.000 Ft			**600.000.000 Ft**
total	**8.261.797.439 Ft**	**20.972.759 Ft**	**1.694.809.058 Ft**	**9.977.579.256 Ft**

Table 3
Health insurance treatment cost of colorectal cancer (2001)

Conclusion: The implementation of organized colorectal screening can lead to cost saving in Hungary. The cost-effectiveness of colorectal screening seems to be acceptable for purchaser, but many methodological and organizational issues should be discussed in details.

3.4. Comparison of the treatment cost of breast, cervical and colorectal cancer

Aim: The aim of our study is to compare the annual treatment cost of breast, cervical and colorectal cancer.

Data and methods: Data derive from the financial database of the National Health Insurance Fund Administration (OEP) and the analysis is carried out from the perspective of the health care financing agency. The treatment cost of breast, cervical and colorectal cancer includes the cost of out-patient care, the acute and chronic inpatient care, the subsidies of medicines' prices and the expenditure on disability to work (including sickness-pay).

Results: The cost of treatment of breast cancer was around 8,6 billion Hungarian forints (29.939.868 USD, 33.426.321 EURO) in 2001. The cost of treatment of cervical cancer was around 1 billion Hungarian forint (3.637.843 USD, 4.061.039 EURO) in 2001. The cost of treatment of colorectal cancer was around 9,98 billion Hungarian forint (34.817.250 USD, 38.871.666 EURO) in 2001. We found significant differences according to the type of malignancies. Drug costs accounted for 12 %, 15 % and 28 % of total treatment cost of colorectal, cervical and breast cancer respectively. The cost of acute hospital care was 54 %, 58 % and 75 % of total treatment cost of breast, cervical and colorectal cancer respectively. The expenditure on disability to work (including sickness-pay) was 3,7 %, 7,6 % and 16 % of total treatment cost of colorectal, breast and cervical cancer respectively.

Conclusion: The distribution of treatment cost showed significant differences according to the clinical characteristics of neoplasm under investigation.

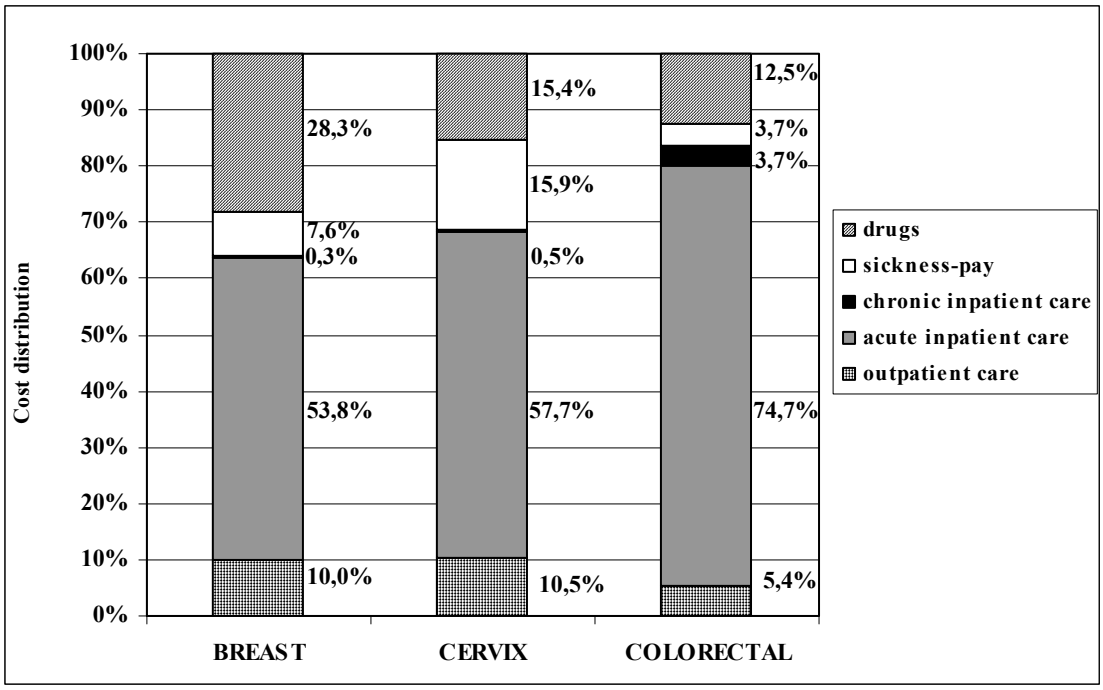


Figure 1
Cost distribution of treatment of breast, cervical and colorectal cancer according to type of care (2001)

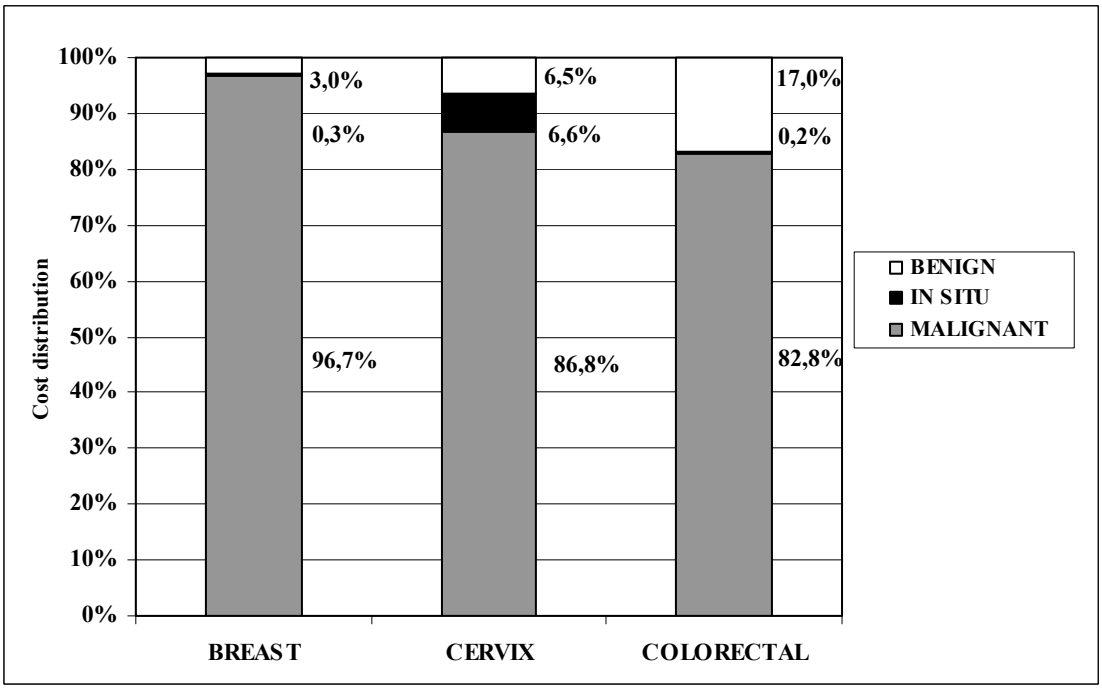


Figure 2
Cost distribution of treatment of breast, cervical and colorectal cancer according to benign, in situ and malignant cases (2001)

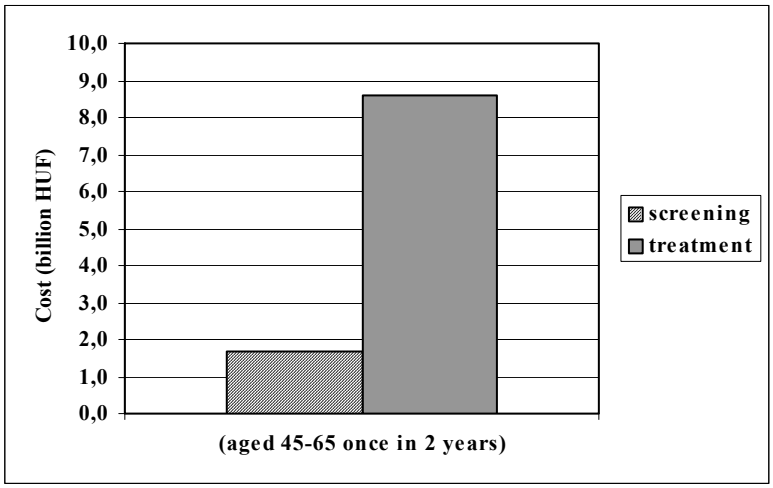
3.5. Comparison of annual treatment cost and cost of screening in Hungary

Analysing any health care technology, important question arises regarding the comparison of the burden of disease and the cost of intervention against this disease. Here we summarize the annual treatment cost of breast, cervical and colorectal neoplasm for 2001 and the expected cost of screening programme at 75 % participation rate.

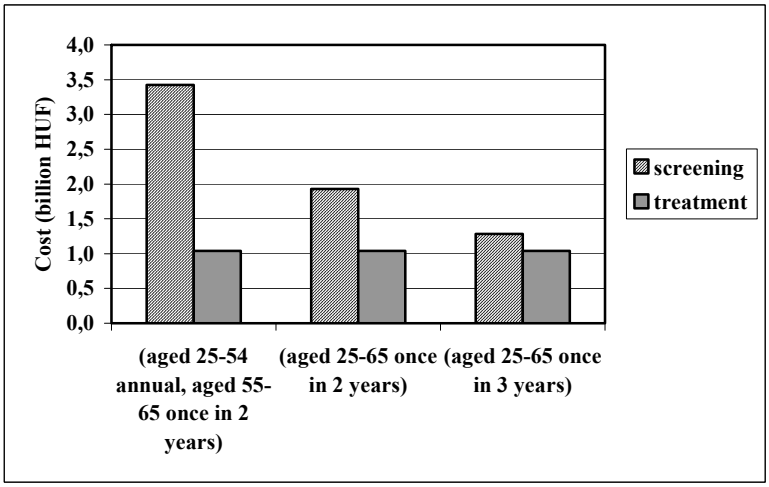
Figure 3 shows the comparison of annual (2001) treatment cost of breast, cervical and colorectal cancer, and the expected cost of screening programme at 75 % screening rate. After this comparison we can conclude that annual treatment cost of breast and colorectal neoplasm are by far higher in Hungary than the cost of screening. However, the cost of cervical screening may be higher than the annual treatment cost of cervical neoplasm depending on the screening strategy. Similar finding were reported from the United Kingdom. We should emphasize here again that health insurance treatment cost are important but not the only cost items.

There was a heated debate in Hungary on the screening strategy before the implementation of cervical cancer screening. Finally, in line with the widely accepted scientific evidences, the following screening strategy was implemented: women aged 25-65 years are invited on every 3 years following a negative smear.

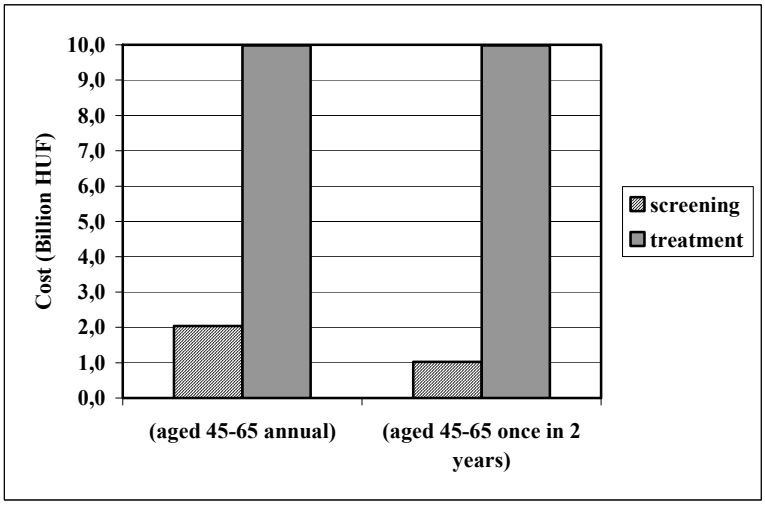
When analysing different screening strategies, one should bear in mind that the screening versus no-screening option does not refer to the screening versus no-intervention option. Before the implementation of the organized nationwide screening programmes, there was a possibility for opportunistic screening on the one hand, and during the usual medical activities (e.g. regular medical check-up, gynaecological examination, etc.) some diseases can be diagnosed.



A) Breast neoplasm



B) Cervical neoplasm



C) Colorectal neoplasm

Figure 3
Comparison of annual health insurance (OEP) treatment cost of breast, cervical and colorectal cancer and annual cost of screening (at 75 % participation rate)

3.6. Cost-effectiveness: screening cost and epidemiological outcome

The results of the cost-effectiveness analysis can be interpreted so called league table (Table 4). Although the application of league tables in the every day decision-making is still very limited, they can provide valuable help for decision making. A limitation of our analysis is that we were able to calculate only gains in lives and life years saved, because no Hungarian data are available on quality of life regarding diseases under investigation, therefore cost of quality adjusted life years (QALY) are not presented here.

The Hungarian cost-effectiveness ratios are lower than those of the well-developed countries. Lindfors et al found in their detailed review that the cost-effectiveness of mammography screening for women aged 50-79 with a 2 years screening interval is around 17.500 USD/life year saved. After analysing several screening strategies Koopmanschap et al concluded that the cost-effectiveness of cervical cancer screening for women aged 26-74 a 2 years screening interval is around 27.700 USD/life year saved. The cost-effectiveness of colorectal cancer screening (no screening versus screening) varies between 10.000-25.000 USD/life year saved.

SCREENING	METHOD	TARGET GROUP AND INTERVAL	HUF / Life year gained	USD / Life year gained	EUR / Life year gained
Breast	Mammography	Women aged 45-65 once in 2 years	400.307 HUF	1.397 USD	1.560 EUR
Cervix	Cytology	Women aged 25-65 once in 3 years	551.712 HUF	1.925 USD	2.149 EUR
Colorectal	FOBT and immunochemical	People aged 45-65 once in 2 years	627.720 HUF	2.190 USD	2.446 EUR

Table 4
Cost of life years gained of the organised breast, cervical and colorectal cancer screening programme

4. NOVEL FINDINGS AND PRACTICAL APPLICATIONS

Our investigations presented in this thesis resulted in novel research findings and practical applications.

Here we summarise the novel findings of our study:

8. We calculated the annual health insurance treatment cost of breast, cervical and colorectal cancer.
9. We compared the annual health insurance treatment cost of breast, cervical and colorectal cancer to each other.
10. We assessed the expected health insurance cost of organized breast, cervical and colorectal cancer screening programmes with different screening strategies.
11. We compared the annual health insurance treatment cost of breast, cervical and colorectal cancer to the expected cost of organized screening programmes. We found among others that the cost of cervical cancer screening with an appropriate participation rate might exceed the annual treatment cost of cervical cancer.
12. We calculated the expected epidemiological outcome (number of lives and life years gained) of the organized nationwide breast, cervical and colorectal cancer screening programme.
13. We can conclude that the results of the cost-effectiveness analysis (cost/life years gained) of nationwide, organised breast, cervical and colorectal cancer screening programmes are acceptable for the Hungarian health care financing agency.
14. The health-economics analysis of colorectal screening with simultaneous application of FOBT and immunochemical method is a novel international finding.

Among the practical applications of our investigation we emphasize that it contributed to the development of organized mammography screening programme, it had a determining effect of the introduction of cervical cancer screening programme, and it facilitated the continuation of colorectal pilot screening programmes.

During the short history (1993-2006) of the Hungarian National Health Insurance Fund Administration (Országos Egészségbiztosítási Pénztár, OEP) the health-economics analysis presented in this thesis can be considered as the first health-economics analysis carried out at the OEP from the point of view of a financing agency and published in the scientific literature.

We hope that our thesis can provide an inspiration for including scientific evidences and health-economics into decision making process and it can facilitate that the 1000 billion HUF medical provisions, prevention and drug budget of the OEP will be allocated in a transparent way with respect to scientific evidences of medicine and health-economics.

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