

# Economics of cancer related medical care: worldwide estimates and available domestic evidence

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## SUMMARY

**Background:** The aims of this article were to report findings of domestic research related to assessment of hospital treatment costs of Serbian patients suffering from cancer and show similar study results among foreign trials. The authors also intended to suggest likely strategies to improve local cost containment in future. Cost-of-illness studies of most high-income economies have proven that malignant disorders belong to top five disorders according to their overall financial burden.

**Methods:** Our trial was conducted as an in depth, retrospective, bottom-up, trend analysis of services consumption patterns and expenses relative to diagnosis at discharge, from perspective of the third party payer. Discounting rates were calculated according to the average official exchange rates of the National Bank of Serbia in respective years. Financial value of medical goods and services consumed was taken out of current price lists of the National Republic Institute on Health Insurance on a day when particular service was provided.

**Results:** There were 434 patients and 4850 admissions processed in 2007, consuming 48,483,740.49 RSD (€613,562.90) while in 2010 there were 539 patients and 9509 admissions, consuming 68,880,953.27 RSD (€658,832.65). In total, drugs value accounts for only 5%, radiotherapy 54% and the rest of expenditure 41% (consultations, surgery, consumables, nursing care, other). Average overall cost per patient treated was 125,922.34 RSD and per hospital admission, it was 8,297.99 RSD. Cancer-related medical care costs, in domestic currency, increased by almost one third in only four-year time span.

**Conclusion:** Higher awareness of clinicians on cost limitations and necessity of prioritization in funding health care, would provide wiser resource allocation and more care with money available.

**Key words:** Health Care Costs; Neoplasms; Cost of Illness; Serbia; Health Expenditures; Radiation Oncology

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## GLOBAL BURDEN OF CANCER DISEASE AND NATIONAL ESTIMATES

Cancer is an important public health and economic concern around the world (1). According to the World Health Organization, over 22 million people in the world live with cancer. Global cancer incidence in 2004 was 11.4 million and that number increased every year (2). There are more than 1 million new cases of cancer per year in the United States (3). It is estimated that in 2015, the number of cancer cases will increase for 40% in most of the European countries (4), and the global increase in the number of new cancer cases is predicted from 10 to 15 million for only one decade, by 2020 (5). Due to high prevalence and incidence, cancer represents a significant cause of mortality in the world. It is a second leading cause of death in the United States. 1.7 million cancer deaths are estimated in Europe in only one year (6). Global cancer deaths are predicted to increase from 7.4 million in 2004 to 11.8 million in 2030 (2). The registry of Serbian cancer population was established in 1970 on the basis of statistical research of interest for the Republic of Serbia (7). According to the last edition of the Health Statistical Yearbook of the Republic of Serbia, morbidity rate of malignant tumors in our country is 120,038 cases. There are small differences in number of cancer cases among the regions in Serbia, with the higher recorded number for the Central Serbia than for the Province of Vojvodina. The most important tumor localization by the number of new cases among men in Serbia are lung and bronchial cancer (5,226), colorectal (3,576) and prostate cancer

(2,948), and among women, breast cancer (5,670), cervix uteri cancer (2,618) and colorectal cancer (1,778) (8). The number of new cancer cases in the Central Serbia increased from 9,898 to 25,235 in the period from 1990 to 2008 (9). 21,415 people per year die from cancer in Serbia. The objective of this paper was to emphasize significant direct medical costs of cancer diagnosis and treatment (diagnostic procedures, hospital admission, physician consultations, prescription and non-prescription drugs) and indirect costs related to reduced work capacity, disability and premature mortality.

## ESTIMATED COSTS OF THE MOST COMMON MALIGNANT DISORDERS WORLDWIDE

Cancer treatment costs represent quite a burden for the National Health Systems' budget. For example, the United States spends 16% of its gross domestic product on health care costs and 5% of that goes to cancer treatment costs (10, 11). In the United Kingdom, the costs of cancer treatment have increased from 7% in 1990's to 10% in 2000's of the total health care costs (12). If the current trend of increasing incidence of disease continues, the cancer care costs will grow further (4).

According to the phase of the disease, cancer care costs can be divided to: initial, continuing and terminal phase costs (13). It seems that the costs would be less if cancer is detected at an early stage, but it is not always true. For example, colorectal cancer treatment costs are the highest in the initial stage of the disease and the lung cancer treatment costs

increase with disease progression (12, 14). Also, there are differences in costs of different types of cancer in the same stage of the disease, so that, the medical costs of breast cancer in the first year of the disease progression (\$ 9,230) are significantly lower than the costs of colorectal cancer treatment (\$ 21,608) (12).

Globally, leading types of cancer by incidence and mortality are lung cancer, breast cancer, colorectal cancer, brain cancer and hematological malignancy (2). Further, the economic consequences of the above-mentioned types of cancer will be discussed. Table 1 shows the summarized results of several cost-of-illness trials of high methodological quality and reliability on most common cancer types.

The same source reported an increase of mean monthly direct costs of lung cancer care from initial to terminal phase of the disease. The amounts were expressed in US\$ (15). In the United States, 12.1% of total cancer care costs go for lung cancer (12).

Breast cancer accounts for 32% of all malignant neoplasms in the US women. In Australia 6.2% of new cases of breast cancer are metastatic. Systematic literature review by Talia S. Foster et al. provided data about breast cancer costs among several high-income economies. Most of the studies that have analyzed the breast cancer care costs included only direct medical costs. Some of those results are given in Table 1 (16). Moreover, Kruse et al. estimated the total monthly costs per patient in the US, which were \$4,966, where 56.4 % of the total costs went to cancer

**Table 1. Short summary of foreign cost-of-illness trials on malignant disorders**

| Type of cancer         | Country     | Study type              | Results                                       | Costs                         | Authors /year                 |
|------------------------|-------------|-------------------------|-----------------------------------------------|-------------------------------|-------------------------------|
| Breast cancer          | Sweden      | Systematic review       | Total annual direct/indirect medical costs    | 142,763 / 171,976 (SEK)       | Talia S. Foster et al. /2011  |
|                        | France      | Systematic review       | Total annual direct medical costs             | 47,832 € (2004)               | Talia S. Foster et al. /2011  |
|                        | UK          | Systematic review       | Total remaining lifetime direct medical costs | 12,502 £ (2002)               | Talia S. Foster et al. /2011  |
| Brain cancer           | Sweden      | Cost -of -illness study | Total annual direct/ indirect medical costs   | 51.7 million/ 11.6 million \$ | Blomqvist P. et al. /2000     |
| Lung cancer            | US          | Case-control study      | Total monthly medical costs                   | 6,181 (US \$)                 | Lucie Kutikova et al. /2005   |
| Acute myeloid leukemia | Sweden      | Systematic review       | Total annual direct medical costs             | 225,293 / 235,506 (SEK)       | Alberto Redaelli et al. /2004 |
|                        | Netherlands | Systematic review       | Total lifetime costs per patient              | 104,000 (US\$)                | Alberto Redaelli et al. /2004 |
|                        | US          | Systematic review       | Total lifetime costs per patient              | 42,000 (US\$)                 | Alberto Redaelli et al. /2004 |
| Colorectal cancer      | US          | Systematic review       | Total treatment costs                         | 36,500(US\$)                  | Nick Bosanquet et al. /2004   |

Study results in Table 1 are shown in different ways so it is not possible to compare the cost of certain types of cancer among the countries. But, for instance, there is a big difference between the total annual direct costs of treatment of breast cancer in France and Sweden. Annual direct costs per patient in France are 47,832 €, while it takes three times less money in Sweden (15,570 €). The situation is the same between the total lifetime costs per patient of acute myeloid leukemia in the Netherlands and the USA. Of course, we should take into account the differences in the exchange rate of the years when the studies were conducted.

There are a few studies on lung cancer economics. One of the most recent studies was conducted in the US, in 2005. The results showed that the lung cancer treatment required US\$ 6,181 per month, per patient. According to that, it is estimated that the lung cancer is the second highest most expensive disease to treat among other malignant disorders. Most of the total costs account for hospitalization costs (49%), while 35% goes to indirect costs such as absenteeism or transportation to health

drugs, 11.4 % to drug administration and the rest to other visit-related services (17). Only one Swedish study by Lidgren et al. reported the total annual indirect costs for breast cancer treatment. There was the difference in costs by age. So, the value of total annual indirect costs for patients less than the age of 50 was 54,987 SEK, and 121,919 SEK for the patients aged 50–64 (18). In Sweden, 30% of total breast cancer treatment costs account for direct medical costs for hospitalization and outpatient consultations. The remaining 70% of total breast cancer treatment costs account for indirect costs that are most related to productivity losses, for example, because the sick leave, early retirement caused by illness or mortality. This particular trial reported the matrix of direct and indirect costs of breast cancer in Sweden, in 2002 (19). Even 37% of total direct medical costs were the screening costs, 32% went to inpatient care, 22% to outpatient care and 9% went to necessary drugs. As for indirect costs, more than half of the costs were related to premature death (53%), 29% were the costs associated with the sick leave and

18% of costs were due to early retirement. The costs were expressed in Swedish crowns (SEK).

According to the study conducted in Sweden as cost-of-illness analysis, the total cost of brain cancer was 201.8 million US\$. Indirect costs related to mortality, sick leave and early retirement accounted for 75 % of the total costs. Most of the direct costs were spent on surgery procedures (79.9%), 19.2% on radiological therapy, and 0.9% on cytostatics. The authors also provided an insight into the structure of direct and indirect costs of brain cancer treatment in Sweden (20). If we compare the indirect costs of brain cancer and breast cancer treatment of the above-mentioned studies, we can observe that the largest part of the costs are the mortality costs. Indirect costs associated with sickness leave are more than three times higher in breast cancer. It can be concluded that breast cancer patients have higher costs due to absence from job than brain cancer patients.

Colorectal cancer is among the most common malignant diseases in developed countries. Mortality rate of colorectal cancer is higher in Europe than in the US. Our country is comparable to countries with medium incidence of colorectal cancer (21). 13% of national expenditure in the US of all cancer treatment goes to colorectal cancer care. Lifetime costs of colorectal cancer for patients covered by the US Medicare are estimated at \$18,000 for the initial treatment and an average of \$36,500 for the overall treatment (12). Colorectal cancer belongs to a very expensive disease when compared to other cancer types. For example, there is a big difference in the direct costs of colorectal cancer and ovarian cancer. Direct costs of colorectal cancer are calculated at more than \$3.5 billion, while the direct costs of ovarian cancer treatment require about \$0.5 billion (22).

Majority of published studies on the cost of treatment of acute myeloid leukemia showed only the direct costs, but there was one study conducted in Sweden that reported both direct and indirect costs. The values of direct and indirect costs of acute myeloid leukemia treatment were very similar, as opposite to the previously presented results, where indirect costs dominated. More than 50% of the direct costs were aimed to initial chemotherapy, and most of the indirect costs were related to productivity loss (23).

Health economic analysis very rarely includes the so-called intangible costs associated with pain, emotional suffering and concerns of the patient. Pain is an integral part of cancer patient life. However, there was one study of direct and indirect costs of pain reported by cancer patients, by Fortner et al. According to its results, cancer outpatients spend approximately \$10,000 per year on pain-related costs. Direct costs associated with pain included analgesic medication costs, medical visit caused by pain, hospitalization and medical procedures related to pain. Estimated average monthly direct costs per patient were \$825. More than half of estimated direct pain-related costs were the costs of analgesic medications. Reported average monthly indirect costs were \$61 per patient. Indirect pain-related costs included transportation costs, over-the-counter medication costs and household help. Most of the indirect pain-related costs, as shown in the study, were associated with household help, and it resulted in a cost of \$25/month/patient (24).

## AN INSIGHT INTO COSTS OF CANCER RELATED MEDICAL CARE AMONG DOMESTIC POPULATION

Being a part of a large scale budget financed health economic research project in Serbia, a retrospective analysis of the expenditure trends 2007-2010, at the Oncology and Radiation Therapy Center, Clinical Center Kragujevac, Serbia was conducted. The authors used administrative registry created by regular invoicing of the services provided for hospitalized patients, according to their ICD-10 codes of diseases, confirmed at discharge. The authors analyzed patterns of medical care goods and services consumption and determined top 10 most expensive diagnoses among oncological patients in Sumadija region, where at least 600,000 inhabitants gravitate towards observed tertiary care facility (see Table 2).

**Table 2. Top 10 most expensive diagnoses among oncological patients in Sumadija region 2007-2010, direct medical costs of hospital inpatient treatment**

| ICD-10 Code | Malignant disorder observed                                                                                  | Costs (RSD)   |
|-------------|--------------------------------------------------------------------------------------------------------------|---------------|
| C50         | Malignant neoplasm of breast<br>– malignant neoplasm of breast                                               | 86,291,259.59 |
| C01         | Malignant neoplasms of lip, oral cavity and pharynx<br>– malignant neoplasm of base of tongue                | 36,520,711.83 |
| C34         | Malignant neoplasm of respiratory and intrathoracic organs<br>– malignant neoplasm of bronchus and lung      | 31,939,365.06 |
| C54         | Malignant neoplasms of female genital organs<br>– malignant neoplasm of corpus uteri                         | 26,644,739.67 |
| C71         | Malignant neoplasms of eye, brain and other parts of central nervous system<br>– malignant neoplasm of brain | 13,153,003.88 |
| C32         | Malignant neoplasm of respiratory and intrathoracic organs<br>– malignant neoplasm of larynx                 | 14,244,175.85 |
| C20         | Malignant neoplasms of digestive organs<br>– malignant neoplasm of rectum                                    | 11,533,349.32 |
| C62         | Malignant neoplasms of male genital organs<br>– malignant neoplasm of testis                                 | 8,098,570.28  |
| C53         | Malignant neoplasms of female genital organs<br>– malignant neoplasm of cervix uteri                         | 5,899,324.9   |
| C52         | Malignant neoplasms of female genital organs<br>– malignant neoplasm of vagina                               | 48,287.05     |

This trial was conducted as an in depth, retrospective, bottom-up, trend analysis of services consumption patterns and expenses relative to diagnosis at discharge, from perspective of the third party payer. Discounting rates were calculated according to average official exchange rates of the National Bank of Serbia in respective years. Financial value of medical goods and services consumed was taken out of current pricelists of the National Health Insurance Institute on a day when particular service was provided.

The number of patients admitted, the financial value of services provided and the number of hospital admissions, were constantly increasing during the observed period, from 434 patients and 4,850 admissions processed in 2007, consuming 48,483,740.49 RSD (€ 613,562.90) for 539 patients and 9,509 admissions in 2010 consuming 68,880,953.27 RSD (€ 658,832.65). In total, drugs value accounts for only 5%, while radiotherapeutic approach consumed some 54% and the rest of 41% expenditure was spent on physician consultations, surgical procedures,

consumables, nursing care and other. This trial provided no precise data on costs of surgical care of cancer patients. An average overall cost per patient treated was 125,922.34 RSD and per hospital admission, it was 8,297.99 RSD. Based on acquired data, we can notice continuing rise in cancer morbidity. Consumed value of cancer-related medical care, increased by almost one third, in only four-year time span. On the other side, the National Republic Institute on Health Insurance as the only core fund in charge of health care financing imposed strict limitations on prescribed cytostatic drugs reimbursement. Consequences of such policy aimed at providing accessible care for most of the target population, can be observed in decreasing overall value of used chemotherapeutical drugs (Figure 1).

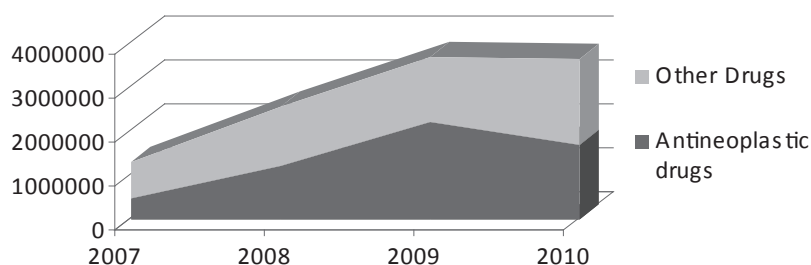


Figure 1. Financial value of drugs consumed at the observed oncology clinic in the period 2007-2010

## APPROACHES TO CONTAIN CANCER HEALTH CARE EXPENDITURES IN FUTURE

Considering clinical complexity of cancer treatment and unpredictability of its outcomes, the observed health care expenditure is crossing the line of affordability in many health systems today. Implementation of efficient costs containment strategies in order to decrease its budget impact but sustain the level of care is certainly a growing need. One of options for reducing cancer treatment costs is screening programs promotion. Screening programs lead to better control of the costs of cancer treatment. Earlier diagnosis of disease will reduce future costs, based on the fact that usually, costs increase with disease progression (25). One of the private payers, The Florida Society of Clinical Oncology (FLASCO) developed a program to reduce cancer care costs. The goal of this program was achieved through standardization of treatment, management of disease, providing appropriate end-of-life care and patient guidance to preferred providers. Standardization of treatment through clinical pathway involved an individualized approach to each patient, adjusted to the specific diagnosis of individual patient, which reduced the use of unnecessary drugs. Disease managers were trained to assist the patients to improve their quality of life, and to help patients to enforce adequate compliance of prescribed drugs. According to this program, it was possible to achieve much better quality of life in terminal phase of the disease with palliative care and symptom control than with medications. Net savings were also realized through directing the patients to providers who offered most cost-effective care (10).

Contemporary cost containment strategies should also be based on evidence based decision-making regarding implementation of oncology treatment protocols. Current knowledge on cost-effectiveness coefficient of particular drugs, surgical or radiation therapy procedures should be a

part of clinical guidelines. Higher awareness of clinicians on expenditure limitations and necessity of prioritization in funding health care, would provide wiser resources allocation and more care with money available.

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## Conflict of interest

We declare no conflicts of interest.

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