Economic Burden of Cardiovascular Diseases in the Russian Federation

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Abstract

Objectives: In the Russian Federation, cardiovascular disease (CVD) is the primary cause of death and premature death; however, to date, there have been no systematic cost-of-illness studies to assess the economic impact of CVD. Methods: The economic burden of CVD was estimated from statistic data on morbidity, mortality, and health care resource use. Health care costs were estimated on the basis of expenditure on primary, outpatient, emergency, and inpatient care, as well as medications. Non–health care costs included economic losses due to morbidity and premature death in the working age. Results: CVD was estimated to cost Russia RUR 836.1 billion (€24,517.8 million) in 2006 and RUR 1076 billion (€29,400.4 million) in 2009. Of the total costs of CVD, 14.5% in 2006 and 21.3% in 2009 were due to health care, with 85.5% and 78.7%, respectively, due to non–health care costs. Conclusions: CVD is a leading public health problem. We first assessed the economic burden of CVD in Russia. Our results can be used for planning investments in prevention programs and measures for improving care for patients with CVD. Regular monitoring of the economic burden of CVD in the future at the federal, regional, and municipal levels will allow assessment of the dynamics of economic burden, as well as the effectiveness of investments in the economy in primary and secondary prevention. Because data are relatively unavailable, there are important limitations to this study, which highlight the need for more accurate CVD-specific information. Keywords: cardiovascular disease, coronary heart disease, cerebrovascular diseases, cost-of-illness study, economic burden, Russia.

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Health Care Expenditure

The following categories of CVD health care services were included in the calculations: primary and outpatient care, accident and emergency (A&E) care, hospital inpatient care, cardiosurgery and percutaneous coronary interventions (PCIs), and medications. Cardiosurgery and PCI expenditures were calculated separately from hospital inpatient care because they are financed through different sources in Russia. Hospital inpatient care is paid by the health insurance system, while cardiosurgery and PCIs are paid by direct payment from the federal budget in the framework of the federal program on high technology and costly medical care or by the patient. Other types of activities related to the CVD were not included because of the difficulties in locating information. Data for A&E care and hospital inpatient care were received from the Ministry of Health of the Russian Federation; data on primary and outpatient care were obtained from several information sources; and data on medications were received from annual pharmacoepidemiology surveys through the COMCON company and other literature data.

Health Service Utilization

Primary and outpatient care

Primary care activities consisted of CVD-related visits to general practitioners (GPs), as well as GP visits to patients’ homes. There is a specific statistical form for all medical organizations that includes data on the number of patients who visited this organization for outpatient care during the year according to the ICD-10 categories. This statistical form is centrally received in the Ministry of Health and processed as a single form for the entire country. We received a single form for the entire country for 2006 to 2009. The number of visits for each outpatient was calculated on the basis of these statistical forms and data from previous studies examining the mean number of visits of patients with CVD during the year.

Inpatient care

Inpatient care was estimated on the basis of the number of CVD-related days in the hospital. There is also a specific statistical form for all inpatient medical organizations that includes data on the number of hospitalizations and number of hospital days in this organization during the year according to the ICD-10 categories. This statistical form is also centrally received in the Ministry of Health and processed as a single form for the entire country. We received the statistical single form for inpatient care in Russia for 2006 to 2009 and selected data on ICD-10 categories of interest.

A&E care

A&E care consisted of all CVD-related hospital emergency visits. A 2009 special statistical form for all inpatient medical organizations included information regarding the number of hospital emergency visits according to the ICD-10 categories. We selected data on ICD-10 categories in 2009 and extrapolated these values for 2006 to 2008.

Cardiosurgery and PCI

The main cardiosurgery institution in Russia, the Bakoulev Center for Cardiovascular Surgery, centrally collects information from all medical organizations involved in such interventions in Russia and annually publishes a statistical yearbook. We selected data regarding the number of PCI, coronary artery bypass grafting, and some other cardiosurgeries performed in Russia in 2006 to 2009.

Health care unit costs

Unit costs of an inpatient day, outpatient visit, and emergency visit were obtained from the Ministry of Health. The official Web site annually publishes information on the mean costs of inpatient days, outpatient visits, and emergency visits in different specialties and total expenditures in the framework of the program of the governmental guarantees of the medical care. The costs of cardiosurgery and PCI paid directly by the federal budget are published annually on the Web site of the Ministry of Health in the description of the Federal Program on High Technology and Costly Medical Care.

Expenditure on medication

There are no national sources of information regarding national expenditures on medications in Russia. We used data from several pharmacoepidemiology surveys made in Russia in 2006 to 2009 and extrapolated these data for the entire country. The main source was the databases of annual surveys conducted by the COMCON company; other studies were used to identify patients with CVD regularly taking medication for long periods as well as some other data. Costs of medications were calculated on the basis of mean prices during the studying years, including value added tax (VAT).

Non–Health Service Costs

Non–health service costs included productivity losses associated with premature death and morbidity and disability pensions. Because little information was found on informal care costs and out-of-pocket expenses across the country, these costs were not included in the calculations.

Estimation of productivity costs due to premature death during working age

Productivity costs due to premature death during working age included the gross domestic product (GDP) per employed person related to CVD attributable to mortality. The productivity loss from CVD-mortality was estimated by calculating the following:

1. number of CVD-related deaths during working age (retirement age is 60 years for men and 55 years for women);
2. number of remaining work years at the time of death (to estimate the likely GDP that an individual who died would have otherwise produced);
3. annual GDP per employed person; and
4. economic activity and unemployment rates.

Future GDP was not indexed in the main analysis, as the usual discount rate of 3% to 3.5% is not reasonable for Russia. The inflation rate was 9% in 2006, 11.9% in 2007, 13.3% in 2008, and 8.8% in 2009. The effects of indexation on productivity costs using rates of 10% and 15% were studied through sensitivity analysis.

Estimation of productivity costs due to cardiovascular morbidity

Morbidity costs were defined as those associated with CVD-attributable absence from work, estimated by multiplying the number of certified days off work due to CVD by GDP produced in one working day.

The number of CVD-related working days lost was obtained from a special statistical form for all medical organizations that included data on the number of disability days during the year according to the ICD-10 categories. This statistical form is also centrally received at the Ministry of Health and processed as a single form for the entire country. We received a single form for working days lost in Russia for 2006 to 2009 and selected data on ICD-10 categories related to CVD.
Sensitivity analysis
We examined the effects of 20% changes in health care costs. Because medication costs were estimated by using subjective assumptions, the effect of 50% changes in these categories was tested. We also assessed the effects of indexation on productivity costs by using rates of 10% and 15%.

Results
Table 1 shows the average unit costs used for calculations and those aggregated from different sources.

Health Care Costs
CVD accounted for more than 69.6 million hospital bed days in Russia in 2006 and 68.0 million in 2009. The number of hospitalizations did not change, but the mean duration of hospital stay decreased each year (from 15.0 to 14.1 days). The number of hospital bed days for CHD was 27.1 million in 2006 and 26.3 million in 2009, and for cerebrovascular diseases it was 17.6 and 17.2 million, respectively. CVD represented 479.2 hospital bed days per 1000 persons in 2009 (Table 2), 185.2 days for CHD, and 121.2 days for cerebrovascular diseases. This parameter is higher than the total for the EU [4] but comparable to some European countries.

The number of GP and outpatient visits was 1603.2 per 1000 persons in 2009, with CHD representing 300.9 visits for 1000 persons in 2009, with CHD representing 300.9 visits for 1000 persons in 2009, and 185.2 days for CHD, and 121.2 days for cerebrovascular diseases. This parameter is higher than the total for the EU [4] but comparable to some European countries.

The major component of CVD-related health care expenditure was inpatient care, which accounted for RUR 52.7 billion (€1545.1 million) in 2006 and RUR 109.9 billion (€2470.8 million) in 2009, representing 43.4% and 47.5% of total health care costs, respectively. CVD-related medication expenditure was also a large cost, representing 27% in 2006 (RUR 32.6 billion) of total costs and 21% in 2007 (RUR 47.6 billion) of health care costs. The third largest component of CVD-related health care expenditure was outpatient care, which represented 20.2% of the total health care costs in 2006 and 21.7% of the total health care costs in 2009. The other two cost components (emergency care and cardiosurgery) accounted for 9.5% in 2006 and 10.0% in 2009 of costs, with A&E representing the smallest component. The structure of the CVD costs in Russia was similar to that of the EU [4], where inpatient care and pharmaceutical expenditure were major components of CVD-related health care expenditure.

Non–Health Care Costs
Mortality losses were relatively high in Russia because of high CVD death rates in the general population and in the working age population. The number of CVD deaths per 1000 persons was several times higher than in Europe [4]. There is a prominent difference in the number of deaths in working-age men and women. The death rate of working-age men (younger than 60 years) was 3.2 in Russia in 2009, while for working-age women it was 0.7. This explains the significant difference in working year losses between men and women (22.1 and 3.4 for 1000 persons in 2009). In the EU, working year losses in men were also higher than in women [4], but to a lesser degree than in Russia. CHD accounted for approximately half of CVD mortality losses, while values for cerebrovascular diseases were much lower, particularly regarding working-year losses.

CVD accounted for 2.1 million working years lost in 2006 and 1.7 million in 2009 owing to deaths during working ages. GDP losses due to mortality in working ages were estimated to cost approximately RUR 630 billion (€18,483.3 million) in 2006 and RUR 117.1 billion (€16,509.6) in 2009, respectively, after adjusting for working status (Table 3).

There were 70.1 million working days lost in 2006 and 67.3 million in 2009 because of CVD morbidity. This represented a cost of RUR 83.8 billion (€2458.4 billion) in 2006 and RUR 117.4 billion (€2662.5 billion) in 2009 after adjusting for working status (Table 3). The costs of disability pensions were rather small, €17.7 million in 2006 and €23.9 million in 2009.

Total Costs of CVD
Overall, CVD was estimated to cost the Russian economy RUR 836.1 billion (€24,517.8 million) in 2006 and RUR 1076 billion (€24,400.4 billion) in 2009 (Table 3). Of the total costs of CVD, 14.5% in 2006 and 21.3% in 2009 were due to health care, whereas non-health care costs were 85.5% and 78.7%, respectively. The structure of costs is completely different from the EU data, where the health care cost was the most significant [4].

Share of GDP (CVD)
The total costs of CVD were equal to 3.1% of the GDP of the Russian Federation in 2006 and 2.8% in 2009, respectively (Table 4).

Costs of CHD and Cerebrovascular Diseases
The total costs of CHD were RUR 339.7 billion (€9962.2 billion) in 2006 (Table 4) and RUR 406.6 billion (€12,204.4 million) in 2009. Health care costs were RUR 58.6 billion (€1719.0 million) and RUR 103.9 billion (€2355.2 million) in 2009. The share of health care costs relative to total costs increased from 17.3% in 2006 to 25.5% in 2009.

The total costs of cerebrovascular diseases were much lower than those of CHD. Total care costs were RUR 139.2 billion (€4083.3 million) in 2006 and RUR 184.5 billion (€5183.9 million) in 2009. Health care cerebrovascular costs were RUR 18.8 billion (€551.9 million) in 2006 (Table 4) and RUR 38.6 billion (€874.1 million) in 2009. The share of health care costs compared with total costs increased from 13.5% in 2006 to 20.9% in 2009.
Sensitivity Analysis

Varying total health care costs upwards and downwards by 20% produced a variation of 1% in the baseline of total CVD-related costs in the period 2006 to 2009. Our results did not vary significantly when the assumptions used to derive medication cost estimates were varied by 50%, resulting in changes of 1% in total costs.

Future earning losses at a 10% discount rate were associated with a reduction of 8% in costs, while a 15% discount rate was associated with a reduction of 11% in costs.

Discussion

This is the first study to estimate the full burden of CVD, including health care and non–health care costs in Russia. We estimated that the total burden of CVD varied between €24.4 and €32.3 billion in the period 2006 to 2009. In a recent European study, the estimated cost of CVD was €169 billion [4]. Because the population of EU is several times higher than that of Russia, the amounts were comparable. We found, however, that the structures of the total costs were completely different in Russia and the EU. A European study found that health care expenditure accounted for 61% of costs, but in our study the share of health care expenditures was only 14.5% of total costs in 2006 and 21.3% in 2009. If our study included the cost of informal care, health care costs would be even lower. Non–health care costs (mainly due to premature death during working age) account for 80% of total CVD costs in Russia.

Direct costs associated with CVD in the EU included costs for hospital admissions (57%), costs for drug therapy (27%), and costs for ambulatory care and A&E (16%) [4]. In general, the structure of direct costs in our study was similar.

In our study, the share of health care costs for CVD relative to total costs was 13.5% to 20.9%. In the study of 27 EU countries, it was shown that total costs from stroke were 68.5% due to direct costs and 31.5% due to indirect costs [5]. In the United States, the economic burden of stroke includes 67% of direct health care costs and 33% of losses in the economy due to premature mortality and disability days [6]. Thus, in Russia, the structure of the economic burden of CVD is different from that due to the predominance of indirect costs.

Table 2 – Resource units per 1000 population in the Russian Federation in 2009.

<table>
<thead>
<tr>
<th>Mortality losses</th>
<th>CVD</th>
<th>CHD</th>
<th>Cerebrovascular diseases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deaths</td>
<td>8.0</td>
<td>4.1</td>
<td>2.6</td>
</tr>
<tr>
<td>All</td>
<td>7.8</td>
<td>4.2</td>
<td>2.2</td>
</tr>
<tr>
<td>Men</td>
<td>8.2</td>
<td>4.0</td>
<td>3.0</td>
</tr>
<tr>
<td>Women</td>
<td>thankful</td>
<td>1.1</td>
<td>4.5</td>
</tr>
<tr>
<td>All</td>
<td>22.1</td>
<td>9.1</td>
<td>3.5</td>
</tr>
<tr>
<td>Men</td>
<td>3.4</td>
<td>0.9</td>
<td>0.8</td>
</tr>
<tr>
<td>Working years lost</td>
<td>Working days lost</td>
<td>474.2</td>
<td>80.1</td>
</tr>
<tr>
<td>Health care unit</td>
<td>GP and outpatient visits</td>
<td>1603.2</td>
<td>300.9</td>
</tr>
<tr>
<td>Hospital emergency visits</td>
<td>47.9</td>
<td>5.1</td>
<td>10.6</td>
</tr>
<tr>
<td>Inpatient days</td>
<td>479.2</td>
<td>185.2</td>
<td>121.2</td>
</tr>
</tbody>
</table>

CHD, coronary heart disease; CVD, cardiovascular disease; GP, general practitioner.

Table 3 – Cost of CVD in Russia in 2006–2009.

<table>
<thead>
<tr>
<th></th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>RUR million</td>
<td>€ million</td>
<td>RUR million</td>
<td>€ million</td>
</tr>
<tr>
<td>Inpatient care</td>
<td>52,687.9</td>
<td>1,545.1</td>
<td>65,791.5</td>
<td>1,923.7</td>
</tr>
<tr>
<td>Primary and outpatient care</td>
<td>24,469.5</td>
<td>717.6</td>
<td>32,385.6</td>
<td>946.9</td>
</tr>
<tr>
<td>A&amp;E care</td>
<td>4,032.4</td>
<td>118.3</td>
<td>5,614.5</td>
<td>164.2</td>
</tr>
<tr>
<td>Cardiosurgery and PCI</td>
<td>7,517.5</td>
<td>220.5</td>
<td>9,451.6</td>
<td>276.4</td>
</tr>
<tr>
<td>Medications</td>
<td>32,637.0</td>
<td>957.1</td>
<td>35,249.0</td>
<td>1,030.7</td>
</tr>
<tr>
<td>Total health care costs</td>
<td>121,344.3</td>
<td>3,558.5</td>
<td>148,492.3</td>
<td>4,341.9</td>
</tr>
<tr>
<td>GDP losses due to mortality in working age</td>
<td>630,280.4</td>
<td>18,483.3</td>
<td>687,087.1</td>
<td>20,090.3</td>
</tr>
<tr>
<td>GDP losses due to morbidity</td>
<td>83,830.7</td>
<td>2,458.4</td>
<td>104,067.2</td>
<td>3,042.9</td>
</tr>
<tr>
<td>Disability pensions</td>
<td>602.2</td>
<td>17.7</td>
<td>666.7</td>
<td>19.5</td>
</tr>
<tr>
<td>Total non–health care costs</td>
<td>714,713.3</td>
<td>20,959.3</td>
<td>791,821.0</td>
<td>23,152.7</td>
</tr>
<tr>
<td>Total costs</td>
<td>836,057.6</td>
<td>24,517.8</td>
<td>940,313.3</td>
<td>27,494.5</td>
</tr>
</tbody>
</table>

A&E, accident and emergency; CVD, cardiovascular disease; GDP, gross domestic product; PCI, percutaneous coronary intervention; RUR, rubles.
Several studies demonstrated that health care costs for various CVDs differ significantly depending on the country, the length of hospitalization, and other factors [7-9]. CHD was the most costly CVD (37.8% of total CVD costs). According to estimates of economic burden in the United States, CHD was also the most expensive disorder [10]. In a European study, CHD accounted for 27% of total costs [4]. A UK study showed that CHD and stroke costs were similar (29% and 27% of total CVD costs, respectively) [11]. In some studies, it was shown that myocardial infarction typically accounts for the largest share of CHD costs owing to long hospitalization and costly interventions [12,13].

Studies examining the economic burden of diseases enable comparisons between the burdens of different diseases, allowing decision makers to prioritize limited research funds to areas with the highest burden [14]. Furthermore, if such studies are performed at regular intervals, the impact of health policy decisions can be measured. In Russia, these studies can be used to monitor governmental programs involved in chronic disease prevention.

The results of calculations performed in this study can be used to plan investments in prevention programs and improve care to patients with CVD. Regular monitoring of the economic burden of CVD in the future at the federal, regional, and municipal levels will allow the assessment of the dynamics of economic burden, as well as the effectiveness of investments in the economy in primary and secondary prevention.

The next step of such studies is to estimate the economic cost of risk factors of chronic disease. This will provide support for prioritizing resources for prevention and public health [15]. To be in a better position to inform policy decisions aimed at reducing the burden of disease, improved information regarding epidemiology and accurate information regarding resource use and unit costs is imperative. In Russia, there is lack of recent reliable epidemiology data as well as gaps in the official statistics on resource use.

Our results are likely underestimated. Some categories of costs, such as costs of informal care, were not included because of data limitations.

Despite these acknowledged and important data limitations, this is the first study to quantify the burden of CVD in Russia.

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References


