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IMPACT OF INVESTMENTS ON THE HEALTH SYSTEM IN BULGARIA

The article presents a concise situational analysis of the nation's health and the health system in the period of reform, and the factors affecting them and the market for health services - demographic, health and socio-economic. A short version of the theoretical model DEA analysis is presented, providing the main results of its application and solutions to optimization problems on the impact of investment on the market for health services. The impact of health technologies on this market is analyzed, measuring the effectiveness of the investments associated with the introduction of new technology in the health system. The estimation of the influence has taken into consideration the real capital investments for innovations, associated with the introduction of new knowledge and skills in the field of medicine. The study focuses on technical efficiency, and the resulting assessment could contribute to the optimal allocation of investments on the market for health services.

JEL: I11; I12

Health and health in Bulgaria - case study

Many health, demographic and socio-economic factors affect the population's health, that can influence both health and stability of the insurance model. Assessment (situation analysis) analysis of these factors allows to identify the causes of certain health phenomena, and finding appropriate approaches to solving problems.

Demographic factors

The demographic situation in Bulgaria is characterized by a *stable tendency of decreasing number of population and its aging,* resulting in *low birth rates, increasing mortality and negative net international migration,* formed mainly by young people. Ongoing changes in recent years in the number and structure of the population, and above trends in demographic processes have a strong influence on the economic, health, social and educational systems of society. Interactive development of these processes is a challenge for any government.

The permanent population of Bulgaria at the end of 2013 is *7,245,677 people.*[1] Women represent 51.35% of the population, and men - 48.65%. In the cities there live 73.03%, and in villages - 26.97%. Population in Bulgaria represents 1.5% of the EU population and ranks the country 16 - by population. Population in recent years is constantly decreasing, the main part is concentrated in the cities mainly - Sofia, Plovdiv, Varna. Its number and structure is determined by the size and intensity of its natural and mechanical (migration) movement. Mechanical growth (difference between settled in the country and expelled from the country) is also negative, especially in 2010,[2] but in recent years a relative decrease is observed. It should be noted that a

[1] http://www.nsi.bg/otrasal.php?otr=19&a1=376&a2=377&a3=378#cont

[2] http://www.nsi.bg/bg/content/3058/%D0%BC%D0%B8%D0%B3%D1%80%D0%B0%D1%86%D0%B8%D1%8F

major share of the negative trend of this indicator are women, being nearly 2 times more than men, mainly from the group aged between 19 and 54.

Population decline as measured by the coefficient of natural growth was minus 5.2 ‰ in 2013 while in 2007 it was minus 5.0‰. This rate still has very high negative value in the villages - about 7 times higer than in the cities, which means that the above trend is due to negative demographic trends in the population living in rural areas as an important demographic problem emerges ongoing process of *population aging*. It consists of an increase of the indicator for the average age of the population and the changes in the age structure. In 2013, the distribution of population by main age groups indicates that persons from 0 to 19 years are 1,325,800 (18.2%), aged 20 to 64 years - 4,563,281 (62.60%), and over 65 years - 1,395,471 (19.1%), which is 0.3% more than in 2011 (18.8%). From the standpoint of future developments it should be noted that another not - less important demographic problem in Bulgaria is the very low proportion of the *population between 0 to 14 years*. In 2013, this indicator for our country is 13.6% and in the European Union is 15.6% on the average. The number of elderly people for the period grew twice as fast in 2013 as compared to 2007, combined with a smaller working population and a higher share of people retired, will further burden the social system.

Although less pronounced, the average life expectancy in the country maintained the trend of growth in the past five years. The overall indicator of average life expectancy at birth for the period 2011 - 2013 was 74.45 years, or 0.62 years - higher than that for the period 2009 - 2011 – (73.83). However, life expectancy in Bulgaria is 6 years lower than in the European Union, for men being lower than that for women. For the period 2011 - 2013, the corresponding figures were 71.02 and 78.01 years, or women live about seven years longer. Bulgaria is one of the last in EU life expectancy. More alarming is that the years in health are about 8 years less for men and 12 years less for women. This will be a problem in the coming years for the health care system due to *the increasing age of the population, but in negative health.* It should be recognized that the Bulgarian health care system and the society are not ready to meet this challenge – there are no programs for long-term care of the elderly, no trained professionals and are no resources available to cope with the problem.

The above data show, that Life Years in Health (HLY) in recent years decreased in both men and women, at the expense of the proportion of years lived in illness, and this trend is particularly apparent for persons over 65 years and for women. Along lifestyle and socio-economic factors this trend results in increase of the total illness rate of population, related with Chronification diseases and with a plurality of diseases.

Mortality, morbidity and illness rate

Unlike most European countries, where the standardized mortality ratio is lower than the EU average, Bulgaria it still has one of the highest values (886,50%$_{ooo}$ for 2013).

The available data and forecasts confirm, that in some groups of diseases (bronchitis/emphysema/asthma, diseases of the digestive system and urogenital system, chronic liver disease and cirrhosis, mental and nervous diseases and illnesses of sensory organs) are also expected to increase the permeation of population[3]. This requires the health system to evaluate properly the rising needs in this area and prepare to tackle the problem through proper resource planning. Bulgaria occupies the first five places among the European countries with standardized mortality ratios of neoplasms; diseases of the circulatory system (having twice as high coeficient); other diseases of the heart; cerebrovascular disease; certain conditions originating in the perinatal period. Data for malignant neoplasms show that the incidence is increasing. The main problem for 2012 and 2014 is the population permeation with cancer of the respiratory organs, followed by breast cancer in women.

One of the key problems facing the health system and its stability is the rising number of hospitalizations of the population and the number of surgical procedures in the hospitals. Statistics data for *hospitalized morbidity* for the period 2002-2013 indicate that the number of hospitalized cases in inpatient medical institutions is constantly increasing. The same trend is observed in private hospitals - 15% in 2010, 17.4% in 2011, 20% in 2012 and almost 23% in 2013 due to several reasons:

- inefficiency in outpatient care and above all the activities of general practitioners;
- market orientation of hospitals - etc. "induced demand" from citizens;
- increasing efficiency in the activities associated with the introduction of new and high technologies, reducing the average length of stay, increased utilization of beds and last, but not least the higher turnover in one bed;
- lack of regulations in the system - medical standards for behavior, resource planning and investment, etc.

Behavioral factors related to lifestyle, namely smoking, alcohol abuse, unhealthy and unbalanced diet, low physical activity are leading factors in the structure of the risk for mortality. In combination with external factors - physical and social, they have an impact on the overall health of the population.

Socio-economic factors

The main socio-economic factors associated with the health and stability of the health insurance model are the education level, income, unemployment, health expenditures.

According to the European Commission report on Bulgaria's Convergence Programme for the period 2012-2015, our country was among the first in Europe in illiteracy, poverty and long-term unemployment. In 2012 we were 53rd in literacy in the world, far behind Kyrgyzstan, Trinidad and Tobago, Turkmenistan, Tonga and others.

[3] NCPHA, 2013. Report to public health-MH.

The percentage of people with difficulties in reading and math in our country is the highest in the EU (Petrova Miltcheva-Gotova, 2013). Low literacy leads to poor health of the population, increased risk of medical and patient errors, an increase in hospitalizations and an increase in public and private health expenditure.

Data from the European survey of health literacy of the population shows that Bulgaria ranks first in low health literacy - 61.4% of the interviewed Bulgarians, which indicates a lack of prevention, understanding and non-compliance with prescribed therapy by the GP or specialist. The reason for the low health literacy study reported poor education and social status of the population (Shipkovenska, 2012).

The analysis of the cost structure of households shows, that every household annually sets aside 5% of the household income for health. Compared with allocations for alcoholic beverages and tobacco (about 4%) it can be concluded that the funds earmarked for damaging health factors are almost identical to those for the health, despite the statements of the Bulgarian citizens that health occupies a leading position in their value system.

Poverty and social exclusion have a particularly important impact on the health and stability of the insurance model, affecting them directly and indirectly (inability of a contribution). The progressively increasing share of people at risk of poverty or social exclusion, demonstrates that the stability of the social security system is threatened both due to the increasing demand for health services, paid by it and due to the required the growth of the funds needed to cover them, but inability to increase the contribution rate or the collection of contributions. Failure to take measures aimed at improving the business environment, employment policy income, the state will have to cover this additional resource.

Financing of the health system is one of the main factors affecting its functioning.Total health expenditures as a percentage of GDP remain at one level, the ratio of public and private is almost equal, but there is a slight tendency to increase the share of private spending to public, i.e. household expenditure on health as percentage of GDP steadily increased in recent years. Although in 2008 for health insurance contribution was raised from 6% to 8%, this does not lead to significant changes in the health system.

One of the main problems facing the health care system in recent years is the increase in the number of persons. Lack of objective and publicly available data on the number of persons who do not pay health insurance contributions does not allow to make predictions in this direction. The main group of persons who do not have health insurance consists of disadvantaged groups, marginalized groups, especially those who are permanently unemployed. However, in the last two years NHIF reports higher than planned funds from health insurance contributions.

Key challenges facing the health system

Demographic processes in Bulgaria are characterized by a steady downward trend in the population, due to low birth rates, increasing mortality, negative population growth, negative international balance and steady aging population.

As mentioned above, Bulgaria has one of the highest *standardized mortality coefficients for all causes*. There is a trend of increasing prevalence in the adult population and reducing years of life in health, both globally and in the group of the population 65+ years. Data show chronification prevalence of diseases in the population and the advent of this phenomenon in the younger ages, and multiplicity of diseases which requires additional resources - human and financial to provide adequate health services. Factors lifestyle - smoking, alcohol use, sedentary lifestyle, improper diet permanently settled among the Bulgarian population and will continue to have a negative impact in the long term. Socio-economic factors have worsened in recent years and this will entail a shortage of funds in the system (more difficult collection of health insurance contributions), increasing the proportion of persons without health insurance, further deterioration of health, additional system costs.

The slow recovery of the Bulgarian economy from the effect of the global financial and economic crisis will exacerbate the *main problems* facing the health system and the stability of the insurance model, which can be summarized as:

- *inadequacy and/or lack of resources* - human, financial, material and technical, information and organization and management;
- *discrepancy between the structure (health establishments) and demand for health services* - hierarchical (pyramid) structure does not match the demand - because of inefficient primary care increased demand for specialized and highly specialized care of the population;
- *lack of horizontal integration and interaction;*
- *overcentralisation or full decentralization* - two extreme phenomena that affect the structure and interaction;
- *inadequate decisions* related to regional (territorial) location - National Health Card is only wishful management tool with no real leverage;
- *lack of partnership attitude of professional and patient organizations* - strengthening the lobbying interests and professional egoism
- *overaggregation or fragmentation* of structural elements and connections - eg. creating multiple structures of invasive cardiology.

In Bulgaria most funds are allocated as a share to pay for hospital services, as there is a continuous increase in the number of hospitalizations. This is due to both the real rate in the population and the lack of management efficiency associated with the violation of relationships between outpatient and inpatient care, opportunities to impose standards for hospitalization or creating mechanisms to keep costs.However, there is neither sufficient in volume and quality research in the economics of hospital care, nor research into effective use of resources in inpatient medical establishments.

Healthcare reform - what happened in the period 1999 - 2014

Even at the start of reform in the health system in Bulgaria issues were raised related to funding models and control. Many laws have been adopted, namely 13 directly operating in the healthcare system and 9 indirectly related to health. There

have been numerous legislative changes - 293 changes in the first set of laws and 373 amendments in the second group law. 59 medical standards were accepted and over 400 regulations in the field of health. Numerous changes in the legislation do not follow the socio-economic relations and do not consider the impact on the system, and are aimed primarily at resolving certain operational issues or in the recent years have become a form of lobbying interests of certain key players in the system - professional organizations, patient organizations or at different levels of the industry.

In Bulgaria complicated model of solidarity health insurance with supplementary health insurance was imposed, including various components of the collection of contributions and ways of payment by healthcare providers. The organization of the National Healthcare System in Bulgaria is as follows: equity; accessibility; quality of health care; priority emphasis on health promotion and integrated disease prevention; prevention of risks to public health; special health protection of children, pregnant women and mothers of children up to one year and persons with physical disabilities and mental disorders and state participation in the funding of activities aimed at protecting the health of citizens.

Payment of health services based on the model of mandatory health insurance and contractual basis between health providers (medical institutions) and relevant institutions which pay them on behalf of citizens - Insurance Fund, Ministry of Health and others. Compulsory health insurance is based on the National Health Insurance Fund (NHIF), established in 2000, which pay packages activities determined by regulations of the Ministry of Health under the Health Insurance Act (1999). NHIF as an independent autonomous public institution has 28 regional bodies (regional health insurance funds) through which contracts with the medical care providers.

Inpatient hospitals are organizationally independent and financially autonomous structures. Hospital services are provided by general and specialized hospitals, which are for active treatment to post treatment and rehabilitation, as well as by state psychiatric hospitals. Therapeutic activity is provided by the centers for emergency medical care, mental health centers, centers for skin and venereal diseases, comprehensive cancer centers, dialysis centers, homes for medical and social care, hospices and blood establishments. Medical institutions working under a contract with the NHIF to provide health and medical services to the population at prices and volumes defined by NHIF4 and based upon a National Framework Agreement with the professional organizations of physicians and dentists. Medical institutions that do not have a contract with NHIF can provide services against payment.

The number of medical establishments for hospital care is above average for the European Union - 2009 of 100 000 population accounts for 4.64 hospitals against average of 2.67 EU.[5] The territorial distribution of medical institutions and

[4] According to legislative changes, the prices and scopes are determined according to methods, adopted by the Council of Ministers and a decision of CM.

[5] European health for all database (HFA-DB).

in particular hospital is uneven and there is a clear tendency to concentrate spending in certain areas of the country.

In the structure of beds in the hospital sector by type largest share - 75.7% have acute beds and intensive care, which formed provision 45.6 of the population of 10,000 people on the basis of 33 420 beds. Total beds in public hospitals is distributed as follows - 71.2% of the beds are in the structure of the general hospitals, 22% in specialized hospitals and 6.8% in inpatient psychiatric care. The number of beds in specialized hospitals for post treatment and rehabilitation decreased in comparison with 2010 and formed a share of 11.2% of the total public accommodation fund. Long-term care beds are 2.3% in low coverage of the population - 1.4 per 10 000 people. Bed for physiotherapy and rehabilitation are 11.4% in provision 6.9 10 000 people. In the structure of public hospitals for inpatient care in 2012 dominate general hospitals - 114 (121 in 2010) or 57.7%, followed by specialized hospitals - 73 (77 in 2010) or 36.5%. Specific share in the hospitals hold 12 state psychiatric hospitals - 5.7%. The data shows that we reduce the number of hospitals in recent years due to the closure or liquidation. The number of beds in private hospitals in 2012 was 6,916 beds in 38 multidisciplinary, 50 specialized hospitals for active treatment and 4 hospitals for long-term treatment and rehabilitation, which accounted for 13% of hospital beds.The data reveal, that the number of hospitals has been decreasing in the recent years, mainly due to closure or liquidation.

Economic analysis of health insurance model

Development of the healthcare system and financial stability of the insurance model largely depend on the financial resources allocated by the state and citizens. The data for the consolidated state budget in health care show that the funds for health as a percentage of GDP stagnated, as there is a nominal increase each year by 2011 compared to 2010 the increase was within 8% next two years - 2012 and 2013 the increase was 1.7%, and 1.5% and the largest is 2014 to 2013 - 4.23%. Upon closer analysis of the data the following conclusions could be drawn:

- Minimum increase of the resources by the function "Healthcare" in the long run;
- Gradual withdrawal of the state and municipalities from financing the activities in healthcare
- Concentration of resources and expenditures for health in one single payer – NHIF

The cost analysis of NHIF should be connected with the analysis of the data[6] for implementation of the policies of the State (Ministry of Health) in the provision of health and medical services to the citizens of R. Bulgaria.

[6] Annual Report 2013…

From the data on costs incurred under the Policy "Promotion, Prevention and Control of Public Health" the following conclusions can be drawn:

- Reducing total cost of this policy, which is a risk factor for the health of the nation for the future, resulting in inefficiency of the health system that does not invest in promotion and prevention
- Continuous reduction of the funds spent by the Ministry under this policy, from 64% in 2010, reaching 49% in 2014.
- Increasing the costs carried out by the NHIF in terms of disease prevention by expanding the volume of activities and programs that are paid by the NHIF according to the requirements of Ordinance № 39 of the Ministry of Health. Payment activities in disease prevention in the requirements of the Health Insurance Act only apply to insured persons. A large number of persons without health insurance (which is the situation with respect to time) prevention programs are not effective, which will be reflected in future on the costs of other structural elements of the system - emergency and medical establishments for hospital care (increased hospitalization, late detection of diseases, and so on etc.)

Under the policy "Accessible and quality health care" the following trends are identified:

- Increasing the costs of the policy in 2012 and 2013 compared to total health expenditure and their sharp reduction in 2014 which reached 65.95%;
- Continuous increase in the percentage of the costs incurred by the NHIF, which reach 90% of the total cost of the policy, at the expense of reducing the costs of MH, from 20% in 2010, reaching 10% in 2014;

Movement of costs between the two institutions is associated primarily with continuous transfer of activities and services that have been funded by the Ministry of Health to the NHIF - dispensary activity, intensive care, hemodialysis and assisted reproduction, or adding new activities and services to the basic package activities funded by the NHIF - new technologies in imaging and robotic surgery. This creates continuous difficulties in the management of the system, and failure to plan and control the expected effects on the funds spent.

The same trends are observed in the field of *medication policy*, namely the transfer of payments to the NHIF, the share of funds of the Ministry of Health on this policy ranges from 25% in 2010 up to 2% in 2014. The main trends are:

- Maintaining a level of payments for medicines by NHIF in pharmacies.
- A sharp increase in the payment of medicines in hospital care and for a malignancy. This is related to the transfer of responsibility for paying for diseases by the MH to NHIF in 2012 and the creation of several new procedures and pathways to meet these needs of the population. A major problem here is that NHIF pays for insured persons under the requirements of the Health Insurance Act, but some people with malignant and rare diseases are not insured and that the future will be a problem to them. When switching funding from the Ministry of Health to the NHIF the number of contractual partners increases, because the payments include private hospitals.

• As a result of legislative changes related to public procurement under the Public Procurement Act (PPA) from each hospital different prices were observed for the same medication product for the treatment of cancer, which are paid by the NHIF.

• Expanding the scope and volume of payment for medical implants in several years, reaching approximately 100 million for 2014

In view of the above major trends the following issues should be resolved through legislation, namely:

1. The policy related to the determination of medicinal products, medical devices and dietary foods for special medical purposes, paid by NHIF, is determined by the Ministry of Health, and the ability the NHIF to influence it is limited.

2. Transfer of activities of the Ministry of Health to the NHIF without preliminary socio-economic calculations and analysis of the budget capabilities and the NHIF to cover these additional services. It is observed, that the average value of all medical activities, paid by NHIF is uncreasing. However this is not due to inflation or other economic factors, but changes in the regulatory framework (Regulations № 38,39,40 MoH), and the introduction of new technologies (investments), that the least changes in some of their parameters push up the values of the medical service.

3. Transfer payments from year to year. From 2013 to 2014 BGN 91,482 were transferred, which in 2014 will be reported an expected deficit in the budget of the NHIF.

4. Expected deficit in the budget of the NHIF due to growth of health insurance payments, and the budget of the Ministry of Health because of improper planning of activities, which are covered by public funds within BGN 490 million

Measurement/analysis of the impact of investments on health systems

In recent years, the growth rate of health expenditures accelerated, efficient allocation of health resources has become a problem and is at the heart of hot debates among health policy makers in Bulgaria. Increasingly, hinting that the inefficiency of health care facilities is an important factor for growth of healthcare costs. The reason many authors indicate is that a major share of the inefficiency of health services in the hospital sector is mainly due to the method of payment through clinical pathways. Another major problem, indicated by different authors, is that the material-technical base of medical institutions is outdated and requires additional investments. Another reason, indicated by some authors is the continuous development of new technologies that require additional pressure to invest in the system.

For the purpose of measuring the impact of investments (health technology) on the market of health services several theoretical models were analyzed – Grossman's model of the demand for health, the Model of macroeconomic production function and its variety - Cobb-Douglas production function. Both models allow to analyze and forecast the impact of investments (technologies) on the market for health services, but because of the above restrictions (Tonkova, Goranova, 2008) are poorly justified useful

for evaluating the impact of innovation (investments) on the "quasi" market of health services or these models do not allow for the valuation of the hypothesis whether an investment leads to an increase in the volume of services offered. An additional complication is the presence of so-called induction of health services (Fabbri, 2001), which is related to the uneven level of awareness among patients and health care providers (information asymmetry), due to such a "dependence" of the patient from the expertise of the doctor or not least the provision of so-called "extreme care". Significant information asymmetry can give healthcare providers the opportunity to stimulate demand. The more complex the product or service, the greater is the potential for such behavior. Accident victims can be persuaded to buy the services of lawyers and chiropractors, car mechanics can make unnecessary repairs, personal financial advisors can advise investments in their interest.

The role of the provider of health services, causing additional demand is especially controversial in medical economics (see Newhouse, 1970; Evans, 1974; Fuchs, 1978; De Jaegher, and Jegers, 2000). In this context, it is accepted that there are physicians inducing demand, when they affect the pattern of demand of patient, interpreted to be in the best interest of the patient (McGuire, 2000). And in the legal profession or trade in services, the availability of induced demand is related to the fact that: "Everyone knows that doctors strongly influence the amount and pattern of medical care in a developed economy" (Evans, 1974).

Based on the views of Farrel (1993) for the economic efficiency of the company the composition of the variables in the model has been determined. Using a Cobb-Douglas production function two sub-models are constructed, including hospital and outpatient medical care. For the calculation of these two models it is assumed that the most appropriate method is that of the stochastic cost frontier analysis (Data Envelopment Analysis - DEA-analysis), which allows for the specification of the model of the stochastic frontier and consideration of the factors of inefficiency.

Limiting the growth of healthcare costs and improving the health of the population are among the most important and difficult challenges facing policymakers. The role of innovation for progress on these social goals is controversial because some experts consider innovation as a major source of cost growth, while others consider innovation as a means to improve the quality of care and bearing health benefits.

The social value of healthcare can be defined as the difference between the expected value of health, measured for each period as aggregate years of life in good quality and total expenditure on health. Similarly the social value of innovative activity related to health care is defined as the difference between the social benefits of improvements in health and social costs associated with this activity.

Theoretical model of data envelopment analysis (DEA)

The main analysis is the measurement of the technical efficiency of invested funds as investments in efficiency results - in this case a change in the volume of health services and hence their prices, input-related investment funds, by application of DEA method. In other studies the effectiveness of hospital care is proved that there are limitations because they rely on a single input-single output analysis, despite the fact

that production (activity) of hospitals is associated with multiple inputs and multiple outputs (Atanasova; Vekov, Grigorov, Dzhambazov, 2009; MF, 2010). Furthermore, analytical methods are often directed more towards the central trends in hospital activities than the delimitation (frontier) best results observed in practice (Seiford, and Thrall, 1990). In this regard, DEA has a relatively simple method for processing a plurality of inputs and outputs.

Although there are a number of alternative econometric techniques to measure efficiency, DEA is gaining popularity. DEA has recently been identified by several researchers as a key model for the measurement and separation of X-inefficiency (Leibenstein, and Maital, 1992), and to measure the effectiveness of the performance of hospitals (Valdmanis, 1992; Melnick, Zwanziger, Bamezai, and Pattison, 1992), and to measure both the technical performance and the efficiency of scale in doctors (Chilingerian, 1995) and that of the nursing homes in Netherlands (Kooreman, 1994). DEA model could be appled in banks, hospitals, tax offices, schools, universities, countries, regions, different sectors of the economy and others. (Chang, 1998; Chattopadhy, 1996; Ersoy, Kavuncubasi, Ozcan, Harris, 1997; Puig-Junoy, 1998; Kirigia, 2007).

DEA Model to measure the total technical efficiency originally was developed by (Charnes, Cooper, Rhodes, 1978). This model, which assumes constant returns to scale (CRS), is a sensitive model to measure technical efficiency. As a result of the work of Banke et al. (Banker, Charnes, Cooper, 1984), the second version of the model DEA, suggesting variable returns to scale (VRS) is designed to separate the purely technical efficiency from the efficiency of scale.

The efficiency in DEA model can be classified into four categories: general technical efficiency,[7] pure technical efficiency, scale efficiency and effectiveness of the return. In the real world, many hospitals work more or less than the optimum amount of efficiency. Technically inefficient hospitals use a relatively large amount of material, compared with other groups, hospitals, working with the same dimensions of the input and output. For example, some hospitals do not work with the most productive quantity (number of) patients.[8]

DEA is a model used to measure the results and allows for assessment of the relative efficiency of decision unit (Decision Making Units - DMU) (units involved as input and output data) from one set (Banker, Charnes, Coope, 1984), (Banker, 1996; Lovell, Rouse, 2003). The model is applied by comparing all units in this collection as the best working are determined, which make up (define) the limit of efficiency as well.

$$\textit{Technical efficiency} = \frac{\sum \textit{weighted outputs}}{\sum \textit{weigted inputs}}.$$

[7] Overall technical efficiency is divided into pure technical efficiency and scale efficiency (Chilingerian, 1995).

[8] A number of empirical studies measuring this performance is controversial because of many input and output data (cases). DEA model provides an easy way to deal with this problem.

The relative efficiency is the ratio of weighted sum of outputs to weighted sum of inputs. In practice, the calculation procedures are limited to solving problems of linear programming in which unknowns are the weights of these input-output data. The resulting value of the efficiency range from 0 to 1. That is, evaluation of the effectiveness of each studied parameter is expressed by a value that ranges from a maximum score for inefficiency - 0 to maximum result for efficiency – 1.

The main assumption that is made in the application of DEA models to assess the effectiveness is that individual units of the surveyed aggregation work homogeneous, i.e. have the same mix of input and output. For the purposes of our study we assume that the investment can be described as technically inefficient. if the result is below the limit of efficiency.

The main options for DEA models based on:

- Optimization of input *(input oriented DEA model)* or output *(output oriented DEA model);*[9]
- Return to scale - constant (constant return-to-scale - CRS) or variable (variable return-to-scale - VRS).[10]

Here the focus is on the assessment of the technical efficiency (TE) of the investments in two directions - hospital care and outpatient care and especially services volume and price of the service, i.e. compared units will be all the investments for five years (2010-2014).

CRS DEA models enable to evaluate the overall technical efficiency - overall technical efficiency (OTE) or (TECRS), while VRS model assesses the pure technical efficiency - pure technical efficiency (PTE) or (TEVRS). If there is a difference between the two types of performance, it means that there is inefficiency resulting from the scale (size) of the units, i.e. it is the efficiency of scale - scale efficiency (SE), which can be defined as the ratio between the overall and pure technical efficiency.

OTE enables us to identify inefficiencies associated with the input/output configuration and the amount of operations. In DEA OTE is split into two mutually exclusive components: pure technical efficiency (PTE) and scale efficiency (SE). This separation allows us to analyze the source of inefficiency. Pure technical efficiency (PTE) is obtained by evaluating the effectiveness of activities and assessment of efficiency without taking into account the efficiency of scale. It reflects the pure productivity and the possibility to organize resources in the production process. So, the PTE may be used to estimate or indicate the analysis of performance (activity).

Efficiency of scale (SE) allows us to evaluate and choose the optimal amount of resources, i.e. to decide the amount of input in other words, to choose

[9] We talk about models that are oriented to the output when optimization problem is aimed at maximizing the output while in input oriented models the optimization task is to minimize the input (Kundurzhiev, Salchev, 2011).

[10] The return of scale is related to how to change output data in case of change of input data. If the change in the output is proportional to the change in the input we speak of constant returns to scale (CRS). Accordingly, if the change of the input does not lead to proportional change of output, the returns to scale is variable (VRS).

the scale of production, which will reach the expected level of production. Inappropriate size (volume) of the input (too big or too small) can sometimes be the cause of technical inefficiency. This is called scale inefficiencies and has two forms: diminishing returns to scale (decreasing return-to-scale - DRS) and increasing returns to scale (increasing return-to-scale - IRS).

To determine whether a unit has been active in increasing or decreasing return to scale it is necessary to calculate the technical efficiency in non-growth returns to scale (TE_{NIRS}).

In case of failure of scale, i.e. SE <1 and, if: $TE_{VRS} > TE_{NIRS}$, than inefficiency related to scale is due to increasing return to scale; $TE_{VRS} = TE_{NIRS,}$ then the appropriate inefficiency is due to decreasing returns to scale.

Figure 1

Graphical representation of DEA concept

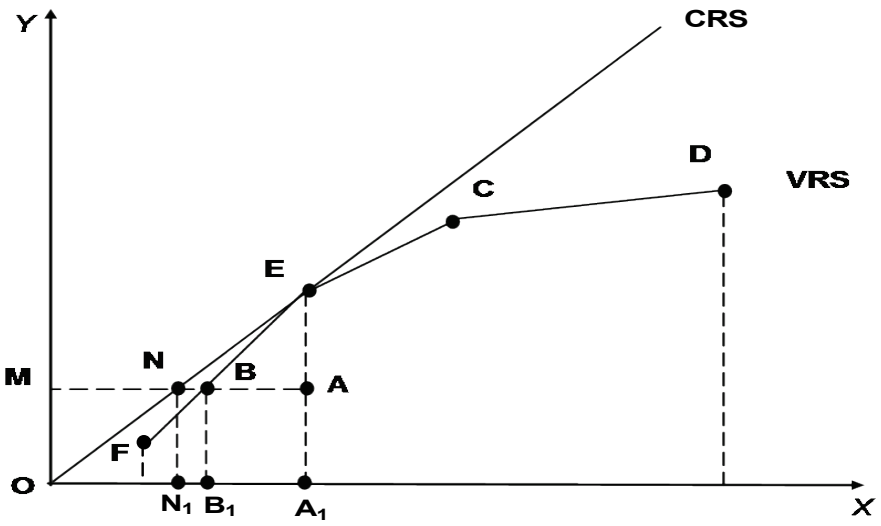


Figure 1 graphically illustrates the concept of DEA. Points F, B, E, C and D represent the units that form the efficiency frontier in variable returns to scale (VRS). The efficiency of the unit in Section A, based on input data is determined by the relationship:

$TE_{CRS} = MN/MA; MN = TE_{CRS} *MA$

$TE_{VRS} = MB/MA; MB = TE_{VRS} *MA$

$SE = MN/MB$

$SE = (TE_{CRS} *MA)/(TE_{VRS} *MA) = TE_{CRS} / TE_{VRS}$

In its core essence DEA is a non-parametric method and therefore eliminate certain conditions and requirements that are placed in front of parametric methods. As strengths of DEA can be identified:

- It can work with many inputs and many outputs;
- It does not require a connection between input and output;
- Comparisons between objects are direct;
- Inputs and outputs can have very different values

Some of the weaknesses of DEA are:

- Measurement error can cause significant problems;
- DEA is not a measure of "absolute" performance;
- It does not report random error;
- A problem can be the large intensiveness of calculations (complex computational procedures)

Results[11]

Analysis of the impact of investments on prices, volume in hospital care, and life expectancy

The nature of the study and the selected input-output specification is oriented towards optimizing outputs, i.e. to determine the technical efficiency of investment is attached output-oriented DEA model, evaluating constant returns to scale and cross efficiency.

Table 1

Description of the data included in the model

	2010	2011	2012	2013	2014
Number of DMUs	5	5	5	5	5
Number of Inputs	3	3	3	3	3
Number of Outputs	1	1	1	1	1
Distance	Radial	Radial	Radial	Radial	Radial
Orientation	Output-oriented	Output-oriented	Output-oriented	Output-oriented	Output-oriented
Scale efficiency	(CRS & VRS)	(CRS & VRS)	(CRS & VRS)	(CRS & VRS)	(CRS & VRS)
Effectiveness	Cross Efficiency	Cross Efficiency	Cross Efficiency	Cross Efficiency	Cross Efficiency

Table 2 presents summary statistics for input-output data for the analysis on the impact of investment in hospital on:

- the volume of services in hospital care - number of hospitalizations;
- the price of the service - the average price of the clinical pathway (CP);
- an average length of life expectancy at birth (LE).

[11] All tables include calculations made by the author based on data from NHIF, MH and NCPHA.

Table 2

Summary of statistics for input-output data

DMU type in analysis	DMU	Minimum	Maximum	Mean	Standard Derivation
Input	Investment – all	87 691 448	280 560 852	153 072 237,2	67 685 359,5592
Input	Hospital beds – number	44 811	45932	45386,4	399,3458
Input	Physicians per 1000	371,14	377,75	374,048	2,463
Output (1)	Number of hospitalization per year	1 697 979	2 087 700	1 856 723,2	150 048,1239
Output (2)	Price (average) of CCPs per year	631,68	671,47	648,272	14,8928
Output (3)	LE in birth	73,43	74,45	73,862	0,3572

Input variables are the same in all three models (1, 2, 3) of the DEA and include total investment in hospital care, the number of hospital beds per year and number of physicians per 100 inhabitants for the year. First entry variable indicates the volume of investment, second and third input - reflect the capabilities of the system to perform certain activities, as well as the opportunities for efficient use of the resources. The expectation is that the higher investment will result in higher efficiency - i.e. change in the number of services and corresponding prices. Output in three models - number of hospitalizations price of CP and life expectancy at birth reflect the effects of the activities and resources invested in it (investments). The analysis of the third output variable has been applied to evaluate the impact of investments not only on quantitative criteria, but also in a quality indicator.

The results of the model DEA (CRS model) are shown in Table 3.

Table 3

Results of the CRS pattern

	Technical Efficiency Score (CRS)		
	Number of hospitalization per year	Price (average) of CCPs per year	LE in birth
Median	0,908	0,978	0,999
Max	1,00	1,00	1,00
Min	0,828	0,956	0,999
SD	0,085	0,021	0,0004
Mean	0,878	0,977	0,999
Max efficiency=1	*2*	*2*	*4*
Efficiency 100%	40%	40%	80%
Efficiency < 100%	60%	60%	20%

Years in which the investment has a maximum efficiency are two of five (2013 and 2014)- in the number of hospitalizations and the cost of the CP, while the average life expectancy they are 4 - is only effective in the 2012 lowest coefficient of efficiency in the number of hospitalizations - 0.828, followed by the price factor in the CP - 0.956 and highest in average life expectancy at birth.

Figure 2

Graphical presentation of the Model of Investment (All-Inv) vs. Number of hospitalization (Volume)

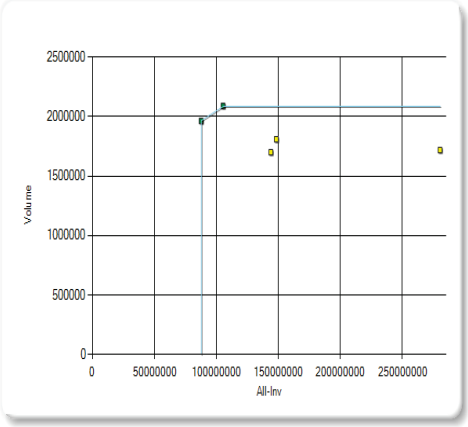
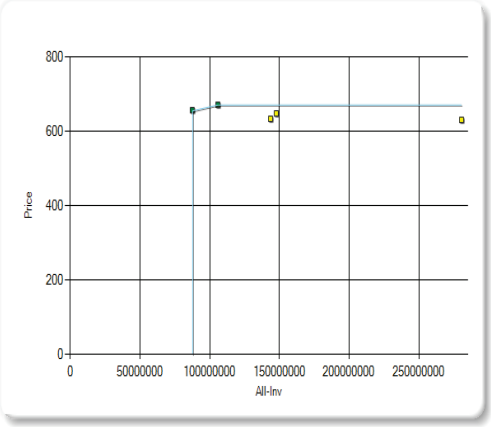


Figure 3

Graphical presentation of the Model of Investment (All-Inv) vs. Price of CCPs (Price)



The results of solving an optimization problem to study the impact of the investment on the three studied indicators - volume, price and life expectancy are presented in Table 4.: From the data in order to achieve full effectiveness in in the years 2010, 2011 and 2012 it is necessary for the same level of investments to increase either the number of hospitalizations or cost of clinical pathway, while in life expectancy it refers only for 2012, i.e. the investment made in this year is insufficient.

Table 4

Solving the optimization problem

Optimization	Number of hospitalization per year	Price (average) of CCPs per year	LE in birth
Y2010	From 1 697979 to 2 051 168	From 632,96 to 659,66	From 73,43 to 73,43
Y2011	От 1 715 971 to 2 054 761	От 631,68 to 660,82	From 73,58 to 73,58
Y2012	From 1 813 965 to 2 065 759	From 649,22 to 664,36	From 73,83 to 73,87
Y2013	From 1 968 001 to 1 968 001	From 656,03 to 656,03	From 74,02 to 74,02
Y2014	From 2 087 700 to 2 087 700	From 671,47 to 671,47	From 74,45 to 74,45

In terms of overall efficiency, CRS model showed that the analysis of the number of hospitalizations and the cost of clinical pathways efficiency is 40%, i.e.

impact on investment is within this value, while the impact (effectiveness) on life expectancy - up to 80%.

The cross efficiency data in Tables 5, 6 and 7, demonstrate that investments influence the number of hospitalizations and the price of clinical pathways and each subsequent year there is an accrual of efficiency

Table 5

Cross-efficiency number of hospitalizations

Number of hospitalization per year	Efficiency	Y2010	Y2011	Y2012	Y2013	Y2014
Y2010	82,781	82,781	83,512	87,811	94,761	100
Y2011	83,512	82,781	83,512	87,811	94,761	100
Y2012	87,811	82,781	83,512	87,811	94,761	100
Y2013	100	73,73	54,149	77,493	100	100
Y2014	100	80,001	82,871	85,851	94,052	100

Table 6

Cross-efficiency at a price of CP

Price (average) of CCPs per year	Efficiency	Y2010	Y2011	Y2012	Y2013	Y2014
Y2010	95,951	95,951	95,59	97,721	98,221	100
Y2011	95,59	95,951	95,59	97,721	98,221	100
Y2012	97,721	95,951	95,59	97,721	98,221	100
Y2013	100	92,108	80,716	93,49	100	100
Y2014	100	92,722	94,849	95,532	97,478	100

Table 7

Cross-effectiveness in life expectancy at birth

LE in birth	Efficiency	Y2010	Y2011	Y2012	Y2013	Y2014
Y2010	100	100	100,029	99,835	99,559	99,615
Y2011	100	99,971	100	99,806	99,53	99,587
Y2012	99,933	99,991	100,261	99,933	99,793	99,918
Y2013	100	100,438	100,468	100,275	100	100,06
Y2014	100	97,015	99,645	97,983	99,196	100

To assess the sensitivity the correlation between indicators was investigated, too (Table 8). The highest correlation coefficient between investment and studied indicators is at the cost of clinical pathway 0.7114, while the lowest is in the average life expectancy at birth - 0.5791. Inverse correlation between addiction is the number of hospital beds and survey indicators, suggesting that the increase in hospital beds is not efficient for the healthcare system in its current state.

Table 8

Correlation between survey indicators

Correlation coefficient	Number of hospitalization per year	Price (average) of CCPs per year	LE in birth
Investment – total	0,6791	0,7114	0,5791
Hospital beds – number	-0,2648	-0,1371	-0,3113
Physiacians per 1000 of population	0,9951	0,9874	0,9894

Analysis of the impact of investments on prices, volume in outpatient care and immunizations

In this kind of analysis the same model is administered to assess the impact through efficiency similarly to the study of hospital care.

Table 9

Description of the data included in the model

	2010	2011	2012	2013	2014
Number of DMUs	5	5	5	5	5
Number of Inputs	3	3	3	3	3
Number of Outputs	1	1	1	1	1
Distance	Radial	Radial	Radial	Radial	Radial
Orientation	Output-oriented	Output-oriented	Output-oriented	Output-oriented	Output-oriented
Scale efficiency	Constant (CSE)	Constant (CSE)	Constant (CSE)	Constant (CSE)	Constant (CSE)
Effectiveness	Cross Efficiency	Cross Efficiency	Cross Efficiency	Cross Efficiency	Cross Efficiency

Table 10 presents the impact of statistics for outpatient care on: Volume of health services; number of services under the „Child Health“; number of immunizations; Cost of services in primary health care

Table 10

Summary statistics for input-output data

Type of DMU in analysis	Name	Minimum	Maximum	Mean	Standard Derivation
Input (1)	Investment (programmes)	30 940 000	77 945 000	55 978 200	19 126 843,6121
Input (2)	Expences “Child Health”	31 084	6 3854	52 582	11 818,6542
Input (3)	Number of GP’s per 1000 of population	60,7	63,19	62,01	0,8973
Output (1)	Number of services – programme “Child Health”	8646	14129	10677,4	2010,4485
Output (2)	Price of services in Primary Health Care	9,90	12,35	10,938	0,8668
Input (4)	Expences of Immunization	2 245 078	4894178	4 063 596,4	944 578,8839
Output (3)	Number of Immunization	911 451	1 181 620	1 089 993	94 858,4422

It is evident, that input-output variables are different in the analyzed models:

●In assessing the number of services under the "Child Health" and the cost of services in outpatient primary care input investments by MH of the IB policy "Promotion and Prevention" program expenditures "Child Health" and the number of GPs in 1000 inhabitants – i.e. Input (1), (2), (3) and Output (1) Output (2)

●In assessing the number of immunizations again input investments and the number of general practitioners, as an additional entry, replacing spending on "Child Health" is "cost immunizations" - Input (1), (3), (4) and Output (3);

●Output variables are a number of services under the "Child Health" Output (1), the price of the service Output (2) and the number of immunizations Output (3) and for the effects of activities and inputs (investments)

The results of the model DEA (CRS model) are shown in Table 11**.** Data show that the lowest coefficient of performance (i.e. lowest impact on investment) is in the number of services under the "Child Health" - 0.707 and the highest number in immunizations - 0.851. With a maximum efficiency are two years (2010 and 2013) in the performance range of services under the "Children's health and the number imunitsations, while the price of the service they are three (2010, 2013 and 2014). The ratio of efficiency to inefficiency 40:60% in the number of services and the number of immunizations, while the price of the service is the opposite 60: 40%.

Table 11

Results of the CRS model

	Technical Efficiency Score (CRS)		
	Number of services – programme "Child Health"	Price of services in Primary Health Care	Number of Immunization
Median	0,8802	0,9548	0,9592
Max	1,00	1,00	1,00
Min	0,707	0,827	0,851
SD	0,124	0,075	0,063
Mean	0,86	0,99	0,98
Max efficiency=1	2	3	2
Efficiency - 100%	40%	60%	40%
Efficiency < 100%	60%	40%	60%

The results of solving the optimization problem on studying the impact of investments on the three observed indicators – volume of services under the "Child Health" program, prices and number of immunizations are presemted in table 12. The data demonstrate that in order to achieve full effectiveness under the first and the third indicator in 2011, 2012 and 2014 it is required at this level of investment to increase their values while for outpatient primary medical care it refers only for 2011 and 2012.

Table 12

Solving the optimization problem

Optimization	Number of services – programme "Child Health"	Price of services in Primary Health Care	Number of Immunization
Y2010	From 14 129 to 14 129	From 9,9 to 9,9	From 1 181 620 to 1 181 620
Y2011	From 11 678 to 14 026	From 10,24 to 12,37	From 1 153 672 to 1 173 018
Y2012	From 9812 to 13 874	From 10,83 to 11,43	From 1 115 627 to 1 160 302
Y2013	From 9122 to 9122	From 11,37 to 11,37	From 1 087 595 to 1087595
Y2014	From 8646 to 10 042	From 12,35 to 12,35	From 911 451 to 1071392

In terms of overall efficiency, CRS model showed that the analysis of the number of services in the "Child Health" and the number of immunizations it is 40%, i.e. impact on investment is within this value, while the efficiency of the price of the service in outpatient care it reaches 60%.

The data in Tables 13, 14 and 15 presenting the cross efficiency show, that the investments affect so,ehow the number and price of services.

Table 13

Cross-efficiency range of number services under the "Child Health" Program

Number of services – programme "Child Health"	Efficiency	Y2010	Y2011	Y2012	Y2013	Y2014
Y2010	100	100	44	44	31,429	31,429
Y2011	83,259	100	83,259	70,722	66,466	63,704
Y2012	70,722	100	83,259	70,722	66,466	63,704
Y2013	100	100	61,431	55,016	100	84,519
Y2014	86,098	100	68,379	59,827	100	86,098

Table 14

Cross-efficiency service price

Price of services in Primary Health Care	Efficiency	Y2010	Y2011	Y2012	Y2013	Y2014
Y2010	100	100	55,063	69,311	55,908	64,07
Y2011	82,727	100	82,727	94,682	89,287	100
Y2012	94,682	100	82,727	94,682	89,287	100
Y2013	100	65,304	48,771	55,564	100	100
Y2014	100	100	82,727	94,682	89,287	100

Table 15

Cross-efficiency number of immunizations

Number of Immunization	Efficiency	Y2010	Y2011	Y2012	Y2013	Y2014
Y2010	100	100	47,5	47,5	42,222	42,222
Y2011	98,351	100	98,351	96,15	94,757	80,3
Y2012	96,15	100	98,351	96,15	94,757	80,3
Y2013	100	100	65,925	66,636	100	85,072
Y2014	85,072	100	65,925	66,636	100	85,072

The correlation between indicators has been also investigated for impact assessment. The highest correlation coefficient to the investment is in the service price - 0.7198 and the lowest in number of services under the "Child Health" - 0.5137 (Table 16).

Table 16

Correlation coefficients in studied indicators

Correlation coefficient	Number of services – programme “Child Health”	Price of services in Primary Health Care	Number of Immunization
Investment – (programme)	0,5137	0,7198	0,6338
Expences “Child Health”	-0,8333	0,6779	
Number of GP’s per 1000 of population	0,9313	-0,991	0,9174
Expences of Immunization			-0,2903

Conclusions and recommendations

The analysis of the impact of investments in "quasi" market of the healthcare is possible and necessary. In the attached model analysis (DEA) through efficiency it was proven that investments directly affect the volume and cost of health services, especially because of the rapid development of technology and innovation. Despite the proven relationship between investments and the number and cost of services, it is not strong enough. Applying the DEA model to establish such a connection on the market of health services data were used on the funds for investment for a short period (due to the available public data on it), which in turn leads to the incompleteness of the model. No data were found on equipment provision in years (availability of new technological devices such as MRI or computerized axial tomography), which did not allow to assess their direct impact on the price and volume of services.

The following conclusions could be made from the obtained results:

1. *The impact of health technologies (investments) on the market for hospital services and the indicator life expectancy at birth:*

• in the number of hospitalizations and the cost of the clinical pathways (CP) from the studied period in which the investment has a maximum efficiency there are two (2013 and 2014), while at the average life expectancy they are 4 - only ineffective is 2012. The lowest ratio efficiency is in the number of hospitalizations -

0.828, followed by the price factor in the CP - 0.956 and highest in average life expectancy at birth.

- Investments influence the number of hospitalizations and the cost of clinical pathways, such as accumulation of efficiency in each subsequent year.
- The highest correlation coefficient between investment and performance is examined in the price of the clinical pathway 0.7114, while the lowest is in the average life expectancy at birth - 0.5791. Inverse correlation exists between the number of hospital beds and survey indicators, suggesting that the increase in hospital beds is not efficient for the healthcare system in its current state.

2. The impact of health technologies (investments) on the market of outpatient medical care and the number of immunizations:

- The lowest coefficient of performance (i.e. lowest impact on investments) is in the number of services under the programme "Child Health" - 0.707 and the highest number in immunizations - 0.851. Under these indicators are two years (2010 and 2013) from the studied period with ratio of efficiency to inefficiency 40:60%, while at the price of the service in outpatient primary medical care they are three years (2010, 2013 and 2014). At the opposite ratio: 60: 40%
- In terms of overall efficiency, CRS model shows that the analysis of the number of services in the "Child Health" and the number of immunizations it is 40%, while the efficiency of the price of the service in outpatient medical care reaches 60%.
- The highest correlation coefficient in the price of the service in outpatient medical care - 0.7198, while the lowest is in the range of services under the "Child Health" - 0.5137.

In conclusion it could be noted, that from the economic perspective, both the available financing and the provision of health care are considerable obstacles to improve competitiveness due to their negative effect on the transition to economics, based on knowledge /services by means of launching local campaigns, attracting investments and transfer of technologies. There are a few political leaders, who are aware, that supplementary investments in a better healthcare system for the population of all ages are necessary not only due to social and ethnical considerations, but in the long run they may contribute also to improve the nation's competitiness in economic aspect.

The pressure on the healthcare system is increasing due to the growing number of ageing people and the increasing additional years of life, accompanied by various types of disabilities. This causes an escalation of public expenditure, which must somehow be covered by national insurance schemes or tax. Not accidentally, the report of the Economic Policy Committee and European Commission (DG ECFIN) "The impact of aging on public expenditure", explicitly states that "if the increase in years of healthy life (decrease morbidity rates) occurs simultaneously with changes, leading to greater life expectancy ... then the foreseen increase in healthcare spending due to aging would be halved. "

Main place in the agenda of the current health care reform must find the implementation of targeted investment in healthcare, including: educational programs

in the field of public health; health financing and modernization and restructuring of hospitals. The provision of a specific quality health statistics is of great importance for more effective and efficient management of limited funds and resources and setting priorities when taking further steps. Right decisions on health-related issues are very important for the government, because this sector consumes large and growing share of national income

All this shows how imperative it is to adopt a consistent and measurable national plan to maintain long-term financial and political commitment and to implement a balanced approach, including compatible programs for evolutionary change based on sound principles. In many cases, the stepp-by-step change in the funding needed to launch major reforms may be a difficult task for many of the new Member States and the provision of funds from external sources may be critical.

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