The development of the optimal management decisions within the framework of realization of the government programs of public health development in the Omsk region

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Abstract: The article describes the algorithm of the development of the optimal managerial decisions within the framework of the realization of the government programs in the field of the development of the health system at the regional level. While applying this algorithm, the optimal management decision was developed to increase the absolute number of healthy newborn babies of women with the diseases and in need of supplementary nutrition on medical indications. The author's algorithm was used to develop the management solution. Data Mining methods, in particular naive Bayes classifier was used to identify important factors influencing the health of infants in the first year of life born from mothers with pathology. Forecasting the number of infants born from mothers covered by those measures was carried out with the application of the agent-based model implemented in C++. The analysis was conducted according to the statistical data for the period of 2009 – 2012 years. In the course of the experiment it was revealed that the health of the babies is affected by health and lifestyle of mothers. The management solution implemented in the form of measures to provide the pregnant women with supplementary nutrition in the period of 2014 – 2020 years was developed to reduce the absolute number of the newborns with disabilities from mothers with pathologies. Realization of the developed measures will allow increasing the absolute weight of healthy newborns from mothers covered by the measures in 6.4 %, 89.4 % of which will preserve health during the first year of life. Implementation of the management decision will reduce the cost of children treatment from the regional budget up to 648 million rubles. The costs of measures implementation is 14 million rubles.

1. Introduction

Currently, there is an intensive growth in number of new developments and innovations, the increase of the number of scientific researches. This has led to the active development of the health care system in the world, and, in particular, to the technology of the medical aid to the population.

The main tendencies of the health care system development are:

• the revealing of the patterns of various diseases development, the development of new methods of their diagnostics, treatment and prevention (Migunova et al., 2013, Zhang, 2014, Laila Shehata Dorgham et al., 2014);

• the development of the new technologies of building-up a healthy lifestyle of the population (Miroshnikov and Kudryasheva, 2009, Vershinin et al., 2010);

• the development of methods and technologies of the health care system management (Pelletier and Kenneth, 2005, Pelletier et al., 2009, Malinkina, 2010, Kulikova et al., 2014, Badenbroek et al., 2014);

• the development of methods of decision making support in public health care management (Aliyev, and Manatilova, 2013, Kulikova et al., 2014);

• the development of methods of marketing promotion of medical services (Kuznetsov and Krivenko, 2008);

• the development of information systems management decision making and support of health care employees (Khulhachiev, 2011, Minaev et al., 2013, Kulikova et al., 2014).

The efficiency of medical institutions management is largely determined by the leaders' quality and speed of decision making. The acceleration of scientific-technical progress, the increase of requirements to the quality and technological effectiveness of rendered medical aid to the population (Badaev, 2013, Khamidullina, 2013) increase the requirements to the administrative decisions developed in health care that should be taken in constantly changing conditions – the conditions of risk and uncertainty, when the human factor is of great importance and every mistake, even

not significant, could lead to considerable negative consequences, including death (Kazakovtsev et al., 2014). Management decisions in health care should be flexible, taking into account different variants of development, to be of low risk, to be developed in the shortest possible time and, most important, to be oriented to the solution of socio – economic problems, to improve health, comfort and welfare of the people. At the same time optimal management decisions in health care should be based on the principle of minimizing the use of resources, but not at the expense of reducing the quality and availability of medical aid to the people. In the field of health care, the development and improvement of medical aid to the population and management decisions are

realized through the government program. We will examine the peculiarities of the development and adoption of optimal decisions in the process of realization of the government programs of healthcare development on the example of one of the regions of the Russian Federation – the Omsk region.

2. Material and Methods

For the development of the optimal management decisions within the framework of realization of the government programs in the field of health care, the author's algorithm was developed (Kulikova et al., 2014). The main stages of this algorithm are shown in figure 1.
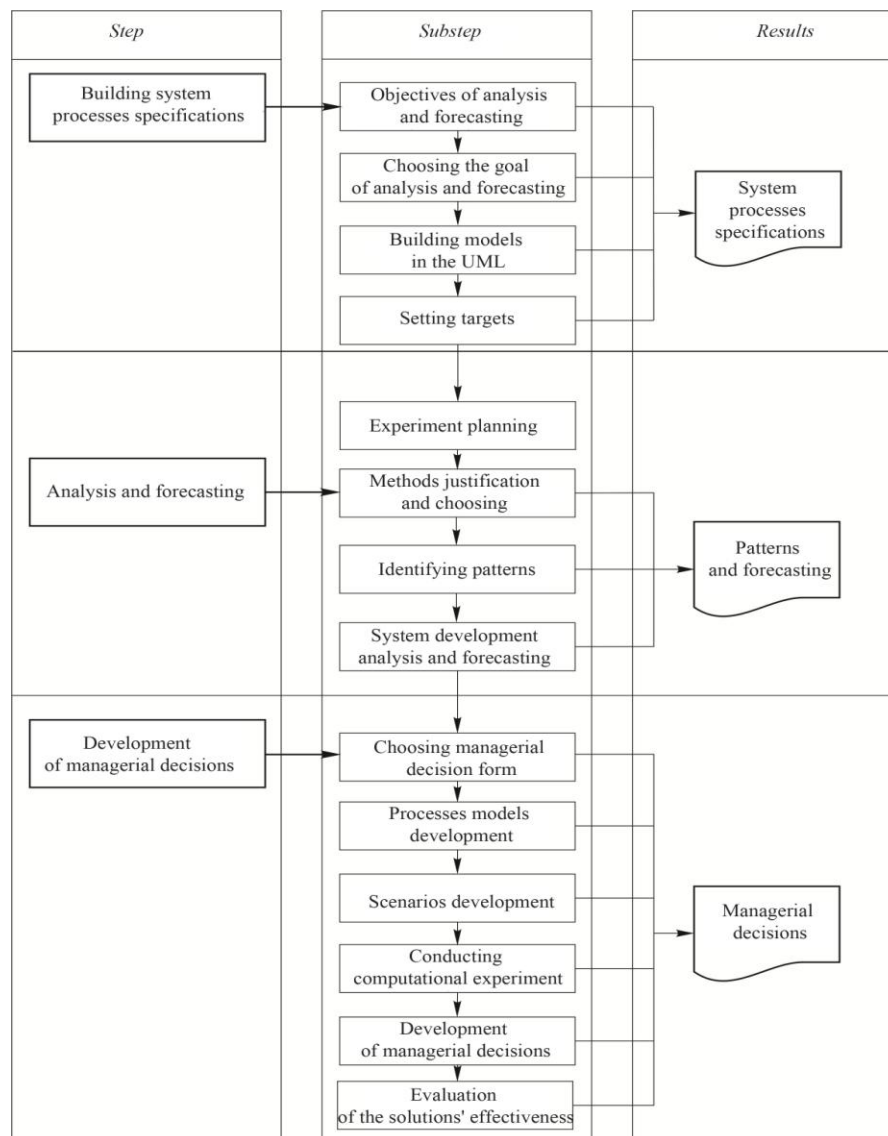

Figure 1. Stages of development of optimal managerial decisions within the framework of realization of the government programs in the development of the healthcare system

The UML notations, one of the conceptual modeling languages, are used to highlight the processes in healthcare, their description and cognitive studies. Data Mining and mathematical modeling methods are used to identify the regularities and forecast the tendencies of the disease incidence. The scenarios showing the dynamics of scenario factor changes are used to describe the possible variations of the situation. The simulation modeling and computing experiment conducted on the computer are used to develop management decisions and evaluate their effectiveness. To assess the efficiency of the developed optimal management decisions are usually used such socio-economic indicators as percentage of reducing morbidity, mortality examined pathology (group of pathologies), increasing the birth rate, the income (for example, saving financial means in the state budget for reducing morbidity), etc.

Using the above algorithm, the estimation of efficiency of the developed management decision on preservation of health of the newborns from the women who have some diseases, in the Omsk region, was made.

The naive Bayes classifier implemented in SQL Server 2012 was used to identify the significant factors that affect the health of the infants born from mothers with pathology. The statistical data, obtained in the survey of 975 women from 25 townships of the region for the period of 2009 – 2012 years, was used in the analysis. The influence of 59 socio-economic factors describing women's way of life, their material welfare and medical care of the pregnant women were studied. The management decisions efficiency evaluation was also made according to these statistics. The results of the research by O.V. Migunova (Migunova et al., 2013) on the effectiveness of using supplementary nutrition for pregnant women were used as the developed measures efficiency evaluation.

The method of agent-based modeling was used to calculate the predictable number of children born from pregnant women with pathologies, who needed the supplementary nutrition on medical indications. The model code is implemented in C++.

3. Results

Based on the analysis of statistical data, the significant factors influencing the health of infants were revealed. Table 1 shows the range of factors and their level of significance for the cases when a child has problems with health or has no deviations.

Table 1. The influence of the factors on the health of infants

Factor	Presence / absence of deviations in health	Value / range of values of the factor	The significance, %
Does a woman has a healthy lifestyle?	false	true	78
The frequency of consuming vegetables, except potatoes	false	Several times a day	59
Does a pregnant woman use too much salt in food?	false	true	54
The number of grams of vegetables consumed by a pregnant woman per meal, g	false	150-200	45
Does a woman overeat?	false	false	44
The frequency of fruit consumption by a woman a day	false	everyday	38
The income level of a pregnant woman's family	false	above-average	38
The child's weight at birth, g	true	less than 2050	78
On what week of pregnancy a woman was registered in the medical institution	true	more 3	72
The number of cups of coffee or tea consumed by a pregnant woman a day	true	more 6	59
Is a pregnant woman on a diet?	true	true	48
Does the woman eat fatty or fried food?	true	true	47
The presence of medical indications for prescribing supplementary nutrition for a pregnant woman	true	true	45
The number of pregnancies	true	more 5	38
The presence of urinary system diseases of a pregnant woman	true	true	37

Based on the results of the study, we can conclude that the factors related to mother's health during her pregnancy, lifestyle and income influence the health of children in the first year of life. If a pregnant woman is healthy, leads a healthy lifestyle and does not overeat fatty, fried food and coffee, and follows all doctor's recommendations, her child will be born healthy and will maintain health for many years.

One of the factors that affect child's health is his mother's diseases that require supplementary nutrition on medical indications. These diseases include the deficit of body weight, anemia, celiac disease, fetus development delay syndrome during chronic placental insufficiency, etc. (Migunova et al., 2013).

Under the government program of development of public health of the Omsk region, the activities for providing supplementary nutrition to women with medical indications were developed as measures of social support. Supplementary nutrition includes protein mixtures presented in table 2.

Table 2. Protein mixtures included in the supplementary nutrition of pregnant women

Products	Manufacturer	Characteristic
Balanced products for the supplementary nutrition of pregnant women		
Femilak	Russia	Dry, enriched with vitamins
MDmil Mama	France	Dry mixtures
Dumil Mama plus	Denmark	
EnfaMama	USA	Dry enriched with vitamins milk formula
Products enriched with some essential micronutrients		
Annamaria	France	Dry enriched milk formula
Madonna	Russia	Dry enriched with vitamins mix
Products enriched with lactogenic additives		
Milky way	Russia	Dry milk-soy formula with Galega extract
Products for mothers with breastfed babies from the risk group of sensitization		
Amaltea	Holland	Dry enriched with vitamins goat milk

These protein formulas compensate for the deficiency of essential nutrients+vitamins and minerals depending on the composition, which are not enough in food consumed. They contribute to the favorable course of pregnancy, reduce the risk of complications during pregnancy and childbirth, help to cope with toxemia, and help establish lactation and improve the quality of breast milk.

Let us calculate the socio-economic efficiency of the developed activities. For evaluation we will use a generalized scenario that describes projected developments. The period of activities implementation is from 2014 to 2020 years.

The number of women in the Omsk region receiving supplementary nutrition on medical indications is 1,400 people per year (table 3). The cost of activities implementation is 2 million rubles per year. Using the simulation model that is implemented in C++, we can project that during the study period 5657 babies will be born from pregnant women covered by the activities. The analysis of the results obtained during the experiment and women's survey showed that prescribing to the pregnant women supplementary nutrition with medical indications allows to increase the proportion of healthy newborns without birth defects up to 6.4% (Migunova et al., 2013), 89.4 % of which preserves health in the first year of life. Table 3 shows the indicators of socio-economic efficiency of the developed activities in the framework of realization of the government program of healthcare development in the Omsk region. The cost of treatment of a sick child is 2 million rubles a year.

Table 3. The indicators of socio-economic efficiency of the developed activities for the period of 2014-2020 years

Indicator	Unit	Value
The percentage reduction in the number of newborns with pathologies from the women who need supplementary nutrition on medical indications	%	6,4
The percentage of children preserving health in the first year of life	%	89,4
Projected number of babies born from women receiving supplementary nutrition	number of children for the period of the program implementation	5657
The projected number of children who will keep their health at birth as a result of activities implementation	number of people for the period of the program implementation	324
The costs of the implementation of the activities to provide supplementary nutrition for pregnant women with medical indications	million rubles for the period of the program implementation	14
The income from the realization of activities to provide supplementary nutrition to pregnant women with medical indications	million rubles for the period of the program implementation	648
The period of the subprogram realization	years	7

4. Discussions

On the basis of the carried out calculations we can conclude that the developed activities allow to keep health in the first year of life of 324 children born from the women with pathologies and in need of supplementary nutrition on medical indications. This will reduce the costs of treating children from the regional budget to 648 million rubles. The costs of implementation will be 14 million rubles.

The analysis of the efficiency of the investment projects and programs implemented in the healthcare system with the government support leads to the conclusion that investment in health saving technologies and preservation of nation's health provides not only a significant income but the opportunity to strengthen economic and social potential.

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