On the Modernization of Healthcare Necessary for Successful Counteraction to New Dangerous Infectious Diseases

Anatoly V. Siga [1], Maria A. Bakumenko [2], and Elena S. Remesnik [3]
VI Vernadsky Crimean Federal University, 295007, Simferopol, Russia
ksavo3@cfuv.ru, bakumenko_ma@mail.ru, remesnikes@cfuv.ru

Keywords : model, dangerous infection, antagonistic game, optimal solution, healthcare modernization, socially significant sector of the economy .

Abstract: The article constructs a simple game-theoretic model that characterizes the success of counteracting new, that is, previously unseen, dangerous infectious diseases. The constructed game-theoretic model is called the simplest model of "success in countering new dangerous infections" and is a neoclassical antagonistic game, namely a paired zero-sum game defined by a partially known payoff matrix of dimension 2 ×2. An analysis of the optimal solution to the constructed simplest model of "success in countering new dangerous infections" is performed. Based on the analysis of the optimal solution to the simplest model of "success in countering new dangerous infections", the need to implement such a modernization of healthcare is substantiated, which will allow achieving the true goals of the functioning of this socially significant sector of the economy and, in particular, will allow the best possible counteraction to new dangerous infectious diseases .

1 INTRODUCTION

The methodology of the research carried out in the article is based on the application of mathematical modeling, game theory and statistical solutions, as well as a systems approach. In particular, global healthcare is perceived as a complex system consisting of many elements interacting with each other and with the external environment.

The aim of the study is to construct a game-theoretic model characterizing the success of counteracting new, that is, previously unseen, dangerous infections, to analyze the optimal solution to the corresponding antagonistic game, and to develop such a modernization of healthcare, the implementation of which will allow achieving the true goals of the functioning of healthcare and, in particular, will allow the best possible counteraction to new dangerous infections .

To understand the research carried out in the article, it is necessary to know the basics of game theory, given in the fundamental publications on game theory, for example, in such articles (Neumann , 1928), (Borel , 1921), (Borel , 1924), (Borel , 1927), monographs (Neumann , Morgenstern , 1944), (Blackwell , Girshick , 1954), textbooks (Vorobyov, 1984), (Vorobyov, 1985), as well as information about neoclassical antagonistic games, given, for example, in the works (Segal, Blyshchik, 2005), (Segal, 2019).

Healthcare is the most important and most resource-intensive socially significant sector of the economy of any country. As the pandemic of the new coronavirus infection, the various socio-economic consequences of the spread of COVID -19 and new strains of this coronavirus throughout the world have shown, healthcare is characterized by the presence of serious problems and insufficient quality of its functioning. Important questions arise that require full answers from both the professional community and government authorities.

1. What is the reason for these problems and the insufficient level of quality of healthcare?
2. What should be done to improve the quality of healthcare?

[1] https://orcid.org/0000-0003-2090-4464
[2] https://orcid.org/0000-0001-7299-1753
[3] https://orcid.org/0000-0001-5360-3778

3. What should be done to ensure that the actual quality of medical care provided reaches the desired high level?
4. What measures should be taken first of all in order to improve the actual quality of medical care provided?

Let us emphasize, first of all, that it is necessary to understand what exactly are the true goals of the functioning of healthcare, which will allow us to develop such a modernization of healthcare, the implementation of which will allow us to achieve the true goals of the functioning of healthcare, in fact, to improve the real quality of the medical care provided, and, in particular, will allow us to best counteract new dangerous infectious diseases.

When a patient is admitted to a healthcare facility, the process involves two parties that interact in a certain way. The first party to this interaction is the healthcare representatives, i.e. the medical workers who must provide medical care to the patient. The second party is the patient who needs medical care, for example, due to infection with a new dangerous infection (a new strain of the COVID -19 coronavirus or an equally severe new, i.e. previously unseen, infection).

2 THE SIMPLEST MODEL OF "SUCCESS IN COMBATING NEW DANGEROUS INFECTIONS"

The success of counteracting a new dangerous infection, in fact, the success of the interaction between health care representatives, on the one hand, and the totality of all patients infected with a new dangerous infection during a pandemic, on the other hand, can be analyzed by considering various models of this interaction. Let us consider *the simplest model of " success in counteracting new dangerous infections "*, which is a neoclassical antagonistic game, namely a zero-sum game, defined by a partially known payoff matrix of dimension 2×2.

An antagonistic game is a finite game $\Gamma_{\mathbf{R}} = \langle \boldsymbol{I}, \boldsymbol{J}, \mathbf{R} \rangle$ two-person (player) zero-sum game, where $\boldsymbol{I} = \{1; 2; \ldots; i; \ldots; k\}$ – the set of all pure strategies of the first player (player 1), $\boldsymbol{J} = \{1; 2; \ldots; j; \ldots; n\}$ – the set of all pure strategies of the second player (player 2), $\mathbf{R} = \mathbf{R}_{k \times n} = (r_{ij})$ – fully or partially known *payoff matrix* of the game $\Gamma_{\mathbf{R}}$, r_{ij} – the payoff of the first player (player 1) in the situation $(i; j)$, i.e. in the case when in a game he applied his pure strategy i, and the second player (player 2) applied his pure strategy j.

Thus, the simplest model of " success in counteracting new dangerous infections " is defined by the following components:

1. $\boldsymbol{L} = \{1; 2\}$ – a set of players, where player 1 (the first player) is the healthcare system that organizes the provision of medical care to the entire population of patients infected with a new dangerous infection, player 2 (the second player) is the infectious agent that causes a new dangerous infectious disease;
2. $\boldsymbol{I} = \{1; 2\}$ – the set of pure strategies of the first player, where his first strategy ($i = 1$) means that the modernization of healthcare has not been completed and it is characterized by the same state in which healthcare was in 2019–2022 , and its second strategy ($i = 2$) means that the modernization of healthcare has been completed and it is characterized by a new state, different from the state in which it was in 2019–2022;
3. $\boldsymbol{J} = \{1; 2\}$ – the set of pure strategies of the second player, while his first strategy ($j = 1$) means that the infectious agent is characterized by approximately the same degree of danger compared to the degree of danger that COVID -19 was characterized by in 2020, and its second strategy ($j = 2$) means that the infectious agent is characterized by a significantly higher degree of danger compared to the degree of danger that COVID -19 was characterized by in 2020;
4. both players seek to maximize the probability of achieving their success;
5. we will consider the success of the first player to be that the pandemic of a new dangerous infection will last no more than 2 years, and during this period the healthcare system will develop an effective method of treating the infectious disease, which will allow in the vast majority of cases to achieve a fairly rapid complete (in particular, without undesirable consequences) recovery of patients infected with a new dangerous infection;
6. r_{ij} – probability of success of the first player in situation $(i; j)$.

Let us note once again that the simplest model of " success in counteracting new dangerous infections " refers to the case when the patient's disease is a sufficiently serious new disease caused by an infectious agent characterized by a danger level no less than that of COVID -19 in 2020, for example, a new strain of the COVID -19 coronavirus or a no less severe new, that is, previously unheard of, infection. At the same time, establishing an appropriate diagnosis requires mandatory several medical diagnostic tests, and proper treatment requires careful monitoring of the course of the disease. Finally, a new infectious disease is characterized by such a high degree of danger and prevalence that the World Health Organization (WHO) is forced to declare a pandemic, and the success of counteracting new dangerous infections is characterized by the probability of achieving first-player success. Obviously, only such healthcare modernization should be implemented that maximizes the probability of achieving first-player success.

In general, the payoff matrix of this antagonistic game is as follows:

$$\mathbf{R} = \mathbf{R}_{2\times 2} = (r_{ij}) = \begin{pmatrix} 0{,}5 & a \\ b & c \end{pmatrix}. \quad (1)$$

We will adhere to the following natural assumptions, which we will call *the basic prerequisites of the simplest model of* " *success in counteracting new dangerous infections* ":

1. $r_{11} = 0.5$, since according to the Bernoulli-Laplace principle of insufficient reasons, in the absence of information about the conditions for the occurrence of possible outcomes, these outcomes should be considered equally probable, and in the situation under consideration, only 2 different outcomes can occur: the success of the first player or his failure;

2. for the values of the elements of each row of the matrix (1), the following relations must be satisfied

$$r_{11} = 0.5 > a = r_{12},\ r_{21} = b > c = r_{22}, \quad (2)$$

since in the case where the infectious agent is characterized by a significantly higher degree of danger compared to the degree of danger that COVID -19 was characterized by in 2020, the probability of the first player succeeding should be less than the probability of the first player succeeding in the case where the infectious agent is characterized by approximately the same degree of danger compared to the degree of danger that was characterized by COVID -19 in 2020;

3a. If the completed modernization of healthcare does not allow achieving the true goals of healthcare functioning, then for the values of the elements of each column of the matrix (1), the following relations must be satisfied:

$$r_{11} = 0.5 > b = r_{21},\ \ r_{12} = a > c = r_{22}, \quad (3)$$

since such modernization means a deterioration in the state of health care and reduces the values of the probabilities of the first player achieving success;

3b. Otherwise, if the implemented modernization of healthcare allows achieving the true goals of healthcare functioning, then for the values of the elements of each column of the matrix (1), the following relations are necessarily fulfilled:

$$r_{11} = 0.5 < b = r_{21},\ \ r_{12} = a < c = r_{22}, \quad (4)$$

since such an upgrade means an improvement in the state of health care and increases the probabilities of the first player achieving success.

According to the classification (Seagal, 2019, pp. 90-91) of information situations regarding unknown values of the elements of the payoff matrix, the simplest model of " success in countering new dangerous infections " is a neoclassical antagonistic game (Seagal, 2019, pp. 55-56), defined in the field of the second information situation, when the unknown values of the elements of the payoff matrix are given functions of one or more variables, in this case, the parameters a , b , c .

Let us find the optimal solution to the antagonistic game given by the payoff matrix (1), for which it is necessary to complete the following stages of solving this game.

Step 1: Calculate the lower net price of the game$\alpha = \max\limits_i \alpha_i = \max\limits_i \min\limits_j r_{ij}$.

Taking into account the validity of relations (2), the estimates of the pure strategies of the first player and the lower pure price of the game given by matrix (1) are equal to

$$\alpha_1 = \min_j r_{1j} = \min\{0{,}5;\ a\} = a,\ \alpha_2 = \min_j r_{2j}$$
$$= \min\{b\ ;\ c\} = c,\ \alpha = \max_i \alpha_i = \max\{a\ ;\ c\}.$$

Step 2: Calculate the Upper Net Price of the Game$\beta = \min\limits_j \beta_j = \min\limits_j \max\limits_i r_{ij}$.

The estimates of the pure strategies of the second player and the upper pure price of the game given by matrix (1) are equal to

$$\beta_1 = \max_j r_{i1} = \max\ \{\ 0{,}5\ ;\ b\ \},\ \beta_2 = \max_j r_{i2}$$
$$= \max\ \{\ a\ ;\ c\ \},\ \beta = \min_i \beta_i\ .$$

Step 3. Checking for the presence of a saddle point.

If the equality is fulfilled$\alpha = \beta$, then such an antagonistic game is a saddle point game and has a solution in pure strategies. If the strict inequality holds$\alpha < \beta$, then such an antagonistic game has no solution in pure strategies, and it is necessary to continue its solution, that is, it is necessary to find a solution to the game without a saddle point in mixed strategies of the players.

Let us first consider situation 3a, when the implemented modernization of health care does not allow achieving the true goals of health care functioning. Taking into account the validity of relations (3), the lower net price of the game defined by matrix (1), the estimates of the net strategies of the second player and the upper net price of the game defined by matrix (1) are equal to

$$\alpha = \max\{ a ; c \} = a ,\ \beta_1 = \max_j r_{i1} = \max\{0{,}5; b \} = 0.5,\ \beta_2 = \max_j r_{i2} = \max\{ a ; c \} = a ,\ \beta = \min\{0{,}5; a \} = a .$$

Let us now consider situation 3b, when the implemented modernization of health care allows achieving the true goals of health care functioning. Taking into account the validity of relations (4), the lower net price of the game defined by matrix (1), the estimates of the net strategies of the second player and the upper net price of the game defined by matrix (1) are equal to

$$\alpha = \max \{ a ; c \} = c ,\ \beta_1 = \max_j r_{i1} = \max \{0.5; b \} = b ,\ \beta_2 = \max_j r_{i2} = \max \{ a ; c \} = c ,\ \beta = \min \{ b ; c \} = c .$$

Therefore, in situation 3a the following equalities are true:

$$\alpha = \beta = a ,$$

and in situation 3b the equalities are true

$$\alpha = \beta = c .$$

Thus, **the simplest model of “success in counteracting new dangerous infections” is always a game with a saddle point** , and for the net price of the antagonistic game, given by matrix (1), the following relations are satisfied: in situation 3a

$$\boldsymbol{V}^* = \alpha = \beta = a = r_{12} , \qquad (5)$$

and in situation 3b

$$\boldsymbol{V}^* = \alpha = \beta = c = r_{22} . \qquad (6)$$

Before moving on to the analysis of the found optimal solution of the simplest model of “success in counteracting new dangerous infections”, let us consider what the optimal solution of an antagonistic game defined by matrix (1) might look like in mixed strategies of players for the case when matrix (1) does not have a saddle element.

If , for example, relations (1)–(3) are not satisfied, then the antagonistic game defined by matrix (1) may turn out to be a game without a saddle point. For example, if relations *a are satisfied* $< b < c < 0.5$, that is $r_{12} < r_{21} < r_{22} < r_{11} = 0.5$, then in this case we have $\alpha = \max \{ r_{12} ; r_{21} \} = r_{21} = b$, $\beta = \min \{0.5; r_{22} \} = r_{22} = c$, that is $\alpha = b < c = \beta$, which means the absence of a saddle point. In this case, it is necessary to continue solving such an antagonistic game, that is, it is necessary to proceed to the next stage of solving a game without a saddle point, which consists in finding an optimal solution to a game without a saddle point in mixed strategies of players, see, for example, (Seagal, 2019, p. 80).

3 ANALYSIS OF THE OPTIMAL SOLUTION OF THE SIMPLEST MODEL OF "SUCCESS IN COUNTERACTING NEW DANGEROUS INFECTIONS"

As shown above, the simplest model of "success in countering new dangerous infections" is always a saddle point game, and the corresponding antagonistic game has an optimal solution in pure strategies of the players.

In the case where the completed modernization of healthcare does not allow achieving the true goals of healthcare functioning, that is, when relations (1)–(3) are fulfilled, equalities (5) take place, and the optimal solution of the simplest model of “success in counteracting new dangerous infections” has the following form: $i^* = 1$ – maximin pure strategy of the first player, $j^* = 2$ – minimax pure strategy of the second player, $(i^* ; j^*) = (1; 2)$ – equilibrium situation in pure strategies of players, $\boldsymbol{V}^* = a$ – net price of the game.

In the case when the implemented modernization of healthcare allows achieving the true goals of healthcare functioning, that is, when relations (1)–(2) and (4) are fulfilled, equalities (6) take place, and the optimal solution of the simplest model of “success in counteracting new dangerous infections” has the following form: $i^* = 2$ – maximin pure strategy of the first player, $j^* = 2$ – minimax pure strategy of the second player, $(i^* ; j^*) = (2; 2)$ – equilibrium situation in pure strategies of players, $\boldsymbol{V}^* = c$ – net price of the game.

Let us note in advance that the conclusions that can be obtained as a result of the analysis of the optimal solution of the simplest model of "success in counteracting new dangerous infections" are largely consequences of the basic premises of the simplest model of " success in counteracting new dangerous infections "; the essence of their statements does not contradict either common sense or the actual state of affairs. The external obviousness of the statements of these conclusions does not mean that the use of the simplest model of " success in counteracting new dangerous infections " is unnecessary. Externally obvious statements, as a rule, require scientific justification, and in mathematics, strict proof. Moreover, there are many known examples when an externally obvious statement turned out to be fundamentally erroneous.

Taking into account the definitions of the main components of the simplest model of “success in counteracting new dangerous infections” and the obtained optimal solution of the corresponding antagonistic game, we can come, in particular, to the following conclusions.

1. Success in counteracting new dangerous infectious diseases caused by infectious agents such as new strains of the COVID -19 coronavirus or no less severe new, i.e. previously unheard of, infections, with a short duration of the pandemic (no more than 2 years) , while during the pandemic period, healthcare must develop an effective method for treating this infectious disease, allowing in the vast majority of cases to achieve a fairly rapid, complete (in particular, without undesirable consequences) recovery of patients infected with a new dangerous infection.
2. It is necessary to develop such a modernization of healthcare, the implementation of which will allow achieving the true goals of healthcare functioning and, in particular, will allow the best possible counteraction to new dangerous infections. When developing such a modernization of healthcare, it is necessary to focus on the most unfavorable behavior of the infectious agent, which will be characterized by a significantly higher degree of danger compared to the degree of danger that COVID -19 was characterized by in 2020.
3. It is absolutely impossible to implement healthcare modernization, the implementation of which will not allow achieving the true goals of healthcare functioning and, in particular, will not allow the best possible response to new dangerous infections.
4. The content of healthcare modernization, the implementation of which will allow achieving the true goals of healthcare functioning and, in particular, will allow the best possible counteraction to new dangerous infections, as well as the principles of organizing the functioning of healthcare, is determined by the essence of the true goals of healthcare functioning.

4 THE TRUE GOALS OF HEALTH CARE AND THE PRINCIPLES OF ITS FUNCTIONING

The true goal of any socially significant industry should be recognized as achieving the highest possible quality of its functioning. Accordingly, the true goal of healthcare should be recognized as achieving the highest possible quality of medical care provided by the healthcare system.

Achieving the true goals of the functioning of socially significant sectors of the economy is impossible without the introduction of an optimal system of principles for organizing the activities of socially significant sectors of the economy and their institutions. An optimal system of principles for organizing the activities of socially significant sectors of the economy and their institutions is a system of principles for organizing their activities that fully corresponds to social justice and social utility. **The organization of the functioning of any socially significant sector should be based on the assumption of the dominance of the social, rather than the economic, component** .

An optimal (from the point of view of the best achievement of the true goals of functioning) system of principles for organizing the activities of healthcare and its institutions must necessarily include the following principles, most of which, we note right away, were characteristic of the functioning of the Soviet healthcare system.

1. *Universal access to health care* .
2. *Mixed financing* , that is, financing of health care and its institutions should be carried out from a wide variety of sources.
3. *The right of citizens to receive medical care* of a certain level, which must be financed by the state and free for citizens of the country.
4. *Health care should be managed by the Ministry of Health* , which, in particular, implements the practical implementation of the right of citizens to medical care.
5. *Multi-level healthcare institutions* . Health care implies organization based on at

least two main principles: district and hierarchical. At the level of the therapeutic district and the district hospital, the most common diseases should be treated and preventive measures should be taken, while more complex cases should be transferred to higher level institutes and hospitals, for example, regional ones, using a referral system.

6. *Scientific character of technologies* applied by healthcare and its institutions. Here a special role belongs to research institutes, federal and national medical research centers.

7. *Participation in the provision of medical care* (*but not in its organization*) *of the patients themselves* , starting with responsible self-medication. Prevention and social hygiene should be the cornerstone of health policy.

5 THE FIRST STAGE OF HEALTHCARE MODERNIZATION

Let us consider the most important measures with which to begin the modernization of healthcare, the implementation of which will allow us to achieve the true goals of healthcare functioning and, in particular, will allow us to best counteract new dangerous infections.

The quality of functioning of socially significant branches of the economy should be assessed by the level of achievement of the true goals of functioning of socially significant branches of the economy. The purpose of socially significant branches of the economy, the true goals of their functioning determine all the characteristic features of socially significant branches of the economy, all their specifics and, of course, the entire range of attributes of their activity. All aspects, including basic aspects, and the efficiency of functioning of socially significant branches of the economy should be assessed from the standpoint of their compliance with public (social) justice and public (social) utility. In the case of socially significant branches of the economy, it seems appropriate to talk not about " *socially significant services* ", but about " *benefits provided by socially significant branches of the economy and their institutions* ".

Optimization of the functioning of socially significant sectors of the economy, including healthcare, requires modernization of the organization of activities of these sectors. Modernization of socially significant sectors of the economy must begin with a priority and most important event: with a change in legislation. The change in legislation should be carried out from the position of introducing an optimal system of principles for organizing the activities of socially significant sectors of the economy and their institutions, that is, such a system of principles for organizing the activities of socially significant sectors of the economy and their institutions that best corresponds to the true goals of the functioning of these sectors of the economy, satisfies the interests of the entire society, and fully complies with public justice and public utility .

In almost all countries, according to their legislation, healthcare is a kind of service sector, since it provides medical services, while the rights of patients are protected by consumer rights laws. First of all, the terms "medical service" and "educational service" should be excluded from the current legislation of all countries. The term "medical service" can be replaced by the term "medical care", understood, for example, as "a set of measures aimed at maintaining and (or) restoring health and including medical intervention or a set of medical interventions aimed at preventing, diagnosing and treating patients, their medical rehabilitation." At the same time, it seems appropriate to prescribe at the legislative level the rights (but not as the rights of the consumer of services), duties, responsibilities and standards of patient behavior. The specified legislative activity can be coordinated by WHO.

The use of artificial intelligence (AI) in healthcare and medicine requires separate research. The introduction of artificial intelligence technologies is a global process that extends to all countries and simultaneously affects the private life of each person, requires its study in time and space, since this process, in particular, can lead to fundamental changes in the labor market. If humanity is not ready for artificial intelligence technologies to displace a significant share of the workforce, this can lead to catastrophic consequences in almost all countries.

In matters of implementing artificial intelligence technologies, legal issues are extremely important: the use of artificial intelligence must be strictly regulated by laws and other legal acts. In particular, artificial intelligence should not replace the decision maker: only a person should have the legal right to make management decisions , and in the process of making management decisions by a person, artificial intelligence technologies should be used as a powerful tool that allows making the right, optimal (best) decision and avoiding errors in this process. Finally, when using artificial intelligence, one should adhere to measures that will not allow it to get out of human control.

The first step towards creating a tool for interaction between the state, developers, scientific organizations and society on AI ethics issues was the adoption of the Russian Code of Ethics in the Sphere of Artificial Intelligence (see https://ethics.a-ai.ru/), developed on October 26, 2021, taking into account all global trends with the support of the state, by the largest leading Russian companies from the Alliance in the Sphere of AI together with the scientific community and public institutions. The Code is advisory in nature, and accession to it is carried out on a voluntary basis. Currently, the Code has more than 330 signatories, including the Ministry of Health of the Republic of Karelia, Tomsk National Research Medical Center of the Russian Academy of Sciences, A.I. Burnazyan Federal Medical Biophysical Center , Federal Research and Clinical Center of FMBA of Russia, N.N. Blokhin National Medical Research Center of Oncology. In 2021, 193 countries of the world that are members of UNESCO adopted the first global Recommendation on AI Ethics. Research on AI governance is of interest to both politicians and scientists, and many scientific papers are devoted to the topic of ethical issues in the use of AI (Corr ê a et al ., 2023).

The issues of healthcare financing require a separate study. In particular, the following conclusion, obtained on the basis of an analysis of the impact of coronavirus, should be recognized as fair COVID -19: “Along with financial support for healthcare, it is also necessary to improve the financial mechanisms of the industry itself, which sometimes involves the use of non-standard approaches that were not typical for a normal epidemiological situation” (Starodubov et al ., 2020).

6 CONCLUSION

As the pandemic of the new coronavirus infection, the various socio-economic consequences of the spread of COVID -19 and new strains of this coronavirus throughout the world have shown, healthcare is characterized by the presence of serious problems and insufficient quality of its functioning.

The purpose of socially significant sectors of the economy, including healthcare, the true goals of their functioning determine all the characteristic features of socially significant sectors of the economy, all their specifics and, of course, the entire spectrum of attributes of their activities. In the case of socially significant sectors of the economy, it seems appropriate to talk not about " *socially significant services* ", but about " *benefits provided by socially significant sectors of the economy and their institutions* ".

The true goal of any socially significant industry should be recognized as achieving the highest possible quality of its functioning. Accordingly, the true goal of healthcare should be recognized as achieving the highest possible quality of medical care provided by the healthcare system.

Achieving the true goals of the functioning of socially significant sectors of the economy is impossible without the introduction of an optimal system of principles for organizing the activities of socially significant sectors of the economy and their institutions. An optimal system of principles for organizing the activities of socially significant sectors of the economy and their institutions is a system of principles for organizing their activities that fully corresponds to social justice and social utility. **The organization of the functioning of any socially significant sector should be based on the assumption of the dominance of the social, rather than the economic, component** . Thus, in any socially significant sector of the economy, the social prevails over the economic. In particular, no requirement of any economic efficiency can be imposed on socially significant sectors of the economy, their institutions, and the employees of these institutions.

It is necessary to recognize as mandatory and urgent such modernization of healthcare , the implementation of which will allow achieving the true goals of healthcare functioning and, in particular, will allow the best possible counteraction to new dangerous infections. The content of healthcare modernization, the implementation of which will allow achieving the true goals of healthcare functioning and, in particular, will allow the best possible counteraction to new dangerous infections, as well as the principles of organizing the functioning of healthcare, is determined by the essence of the true goals of healthcare functioning. When developing healthcare modernization, it is extremely important to focus on the most unfavorable behavior of the infectious agent, which will be characterized by a significantly higher degree of danger compared to the degree of danger that COVID -19 was characterized by in 2020.

ACKNOWLEDGEMENTS

The research was supported by a grant from the Russian Science Foundation No. 23-28-00127, https://rscf.ru/en/project/23-28-00127/.

REFERENCES

Blackwell, D., Girshick, M. A., 1954. *Theories of Game and Statistical Decisions* . N. Y. 368 RUR

Borel, E. , 1921. La Theorie du Jeu et les Equations Integrales a Noyau Symetrique . *Comptes Rendus de L'Academie des Sciences* . (173) . P. 1304-1308.

Borel, E., 1927. Sur le Systeme de Formes Lineaires et la Théorie des Jeux. *Compte Rendue de L'Academie des Sciences* . (184). P. 52-54.

Borel, E., 1924. Sur les Jeux ou le Hasard se Combine avec L'Habilite Joueurs. *Compte Rendue de L'Academie des Sciences* . (178). P. 24-25.

Corrêa , N. K. et al., 2023. Worldwide AI ethics: A review of 200 guidelines and recommendations for AI governance. *Patterns* (4 (10)). P. 100857.

Neumann, J. von., 1928. Zur Theorie der Gesellschaftsspiele. *Mathematische Annalen* . (100). P. 295-320.

Neumann, J. von., Morgenstern, O., 1944. *Theory of Games and Economic Behavior* . Princeton. 625 p.

Sigal, A. V., 2019. *Game Theory and Its Economic Applications* . Moscow. 418 p.

Sigal , A. V., Blyschik V. F., 2005. Antagonistic game under conditions of partial uncertainty. *Economic cybernetics: International scientific journal* . (5-6 (35-36)). P. 47-53.

Starodubov , V. I. et al., 2020. The effect of coronavirus COVID-19 on the situation in Russian healthcare. *Manager of Healthcare* . (4). P. 58-70.

Vorobyov , N. N., 1984. *Fundamentals of Game Theory. Non-Cooperative Games* . Moscow. 496 p. (In Russian).

Vorobyov, N. N. (1985) *Game Theory for Cybernetics Economists* . Moscow. 272 p.