

The Concept of Decisions Support System to Mitigate the COVID-19 Pandemic Consequences based on Social and Epidemic Processes Intelligent Analysis

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Abstract

The study is aimed at interdisciplinary analysis of social barriers and barriers to overcoming the consequences of epidemics and the development of programs for sociological support of anti-epidemic measures in the context of the COVID-19 pandemic. The goal is to solve the problem of increasing the biosafety of the population as a component of national security through the formation of directions and tools for preparatory work with the public conscience with use of social attitude investigation to ensure the effectiveness of vaccination and minimize the negative non-medical consequences of various measures to combat the COVID-19 pandemic. The concept of comprehensive methodology for analyzing the crisis behavior of the masses with a combination of sociological and mathematical methods has been developed. It is planned to obtain scientifically substantiated information on the social factors of the spread of the virus, the social effects of a sense of hopelessness, social barriers to vaccination and the role of social networks in these processes; a practical task for the project is the development of models of crisis mass behavior and a system of targeted measures for managing the social atmosphere during a prolonged pandemic with uncertain prospects for an exit. It is expected to receive a concept of sociological support for pandemic measures to determine the optimal strategies of media, information and educational and socio-political influence on the state of mass consciousness in the context of the COVID-19 pandemic.

Keywords 1

Public Health, Epidemic Process, Epidemics Control, Intelligent Information Technologies, Social Factors of Pandemic, Epidemic Model.

1. Introduction

The modern era of globalization creates specific socio-ecological conditions for the existence of the world human community, which, in turn, determine the originality of the course of the epidemic process of many infectious diseases, for which there are no borders between countries and continents [1]. The specificity of socio-ecological factors determines the modern epidemiological evolution of infectious diseases, taking part in the formation of the characteristics of the epidemiology of diseases, such as the pandemic nature of the spread of pathogens, the emergence of new infections, the spread of pathogens of known infections to previously free territories, etc. [2].

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Global relationships are fraught with global epidemiological problems. The world is turning into a single global socio-ecological epidemiological system, in which all the ongoing processes are interconnected and interdependent.

The experience of the global eradication of smallpox shows the effectiveness of common approaches in the fight against infections at the global level [3]. At the same time, humanity continues to face the problems of the emergence and spread of new pandemic strains of pathogens, and this process will continue [4]. The evolution of pathogens of infectious diseases occurs much faster than changes in human society, therefore it is necessary to develop universal mechanisms of influence both on the epidemic process and on the social conditions in which the epidemic process takes place. The leading role of social factors as drivers of the development or extinction of the epidemic process should be emphasized.

The extent of the spread of any pathogen is determined not so much by the biological properties of the pathogen, but by the activity of the mechanism and ways of its transmission, as well as the possibility of their effective implementation in specific conditions of place and time [5].

The intelligent model which uses social factors determines the structure of contacts between people [6]. In infections with an aerosol transmission mechanism, the speed of spread of the virus depends on the intensity of social contacts. People interact with each other, each individual has his own social contacts, the nature and structure of which will determine the rate of spread of the virus, time, place and contingents of risk of infection. The nature of the formed intelligent model can determine the strategy and tactics of fighting the infection.

It is necessary, on the one hand, to implement the most effective, cost-effective anti-epidemic measures, and, on the other hand, to prepare the population to adhere to any measures that may be proposed by national governments [7]. At the same time, the attitude to measures even with proven effectiveness (for example, vaccine prophylaxis, the introduction of which helped eradicate smallpox, eliminate polio and measles in many areas, reduce the incidence of diphtheria, pertussis, tetanus, etc.) in society is ambiguous. Today, less than half of the world's population is ready to be vaccinated against COVID-19 [8].

The above mechanism of increasing social tensions is a consequence of the departmentalization of public administration, when the health care system makes decisions solely on the basis of knowledge and practices accumulated in this area. Instead, epidemic impact is insufficiently or incorrectly taken into account to assess social status.

During the COVID-19 pandemic, restrictive measures strengthened the role of media and social media in people's lives and perceptions of the pandemic [9]. Social media has become a powerful tool for communication, dissemination and consumption of information [10]. On the one hand, the population is increasingly involved in social networks and can receive reliable scientific information about the development of the pandemic, and about the effectiveness of measures to contain it. On the other hand, social networks are becoming a source of fake news, misinformation, disinformation, conspiracy theories. "We're not just fighting a pandemic; we're fighting an infodemic", said Tedros Adhanom Ghebreyesus, WHO's director-general, at the 2020 Munich Security Conference. Infodemia undermines trust in health institutions and programs [11]. This leads to the ineffectiveness of measures to combat the pandemic. We believe that the way out of the impasse is possible only through a comprehensive analysis of epidemic and social conditions, given the need to take into account both the impact of social dynamics on the epidemic and epidemic dynamics on social. Such analysis should also take into account the impact of certain anti-epidemic measures, including vaccination. An important task of this analysis is also to determine the nature of long-term "post-epidemic" social processes.

It is clear that from the short-term perspective it is important to analyze the situation against the background of the COVID-19 pandemic, but from the long-term perspective we can consider this situation as a trigger for developing scientific tools for comprehensive analysis of socio-epidemic status of society in the epidemic of serious diseases. From the latter point of view, the course of the COVID-19 pandemic and related social processes is a source of empirical knowledge that can test theoretical hypotheses and verify the tools created.

We consider research as a combination of epidemiological and sociological approach to the analysis of the situation on the basis of mathematical models and methods of analysis with experimental verification of the results with the help of created simulation models.

In the anti-epidemic sphere, communication can be defined as advocacy and argumentation of the proposed solutions for managing the epidemic process in order to prevent, reduce or eliminate the risk of complications of the epidemic situation under the influence of certain risk factors [12]. The main purpose of the exchange of information in the field of epidemiological risk is to achieve informed consent of decision-makers in this area and the public on the implementation of measures to prevent, reduce the significance or eliminate the risk.

The COVID-19 pandemic has revealed the unpreparedness of the global health system for effective action to overcome or mitigate the effects of major disease epidemics.

An analysis of the pandemic also shows that anti-epidemic measures were implemented by national governments without proper scientific analysis of possible scenarios, and their introduction was not least due to considerations that the government should do something [13].

Thus, the situation has developed according to the following scenario:

- introduced quarantine restrictions, which were perceived by society as unreasonably restricting civil rights, which contributed to the growth of social tensions;
- as a result of quarantine restrictions, small and medium-sized businesses were negatively affected, which also contributed to the growth of social tensions;
- the growth of social tensions was channeled into distrust to authorities actions, and therefore became a factor in the deterioration of public perception of anti-epidemic measures.

This circle is a mechanism for promoting social instability, which can be used by both populist political forces and terrorist organizations. That is, inadequate anti-epidemic actions not only contribute to the growth of epidemic threats, but also worsen the state of social security.

Thus, preventing the development of the situation in the above scenario requires the availability of scientifically based, effective methods of analysis of scenarios for the development of epidemic and social conditions of a particular country or region.

Limited resources required to implement adequate emergency response activities; the presence of various options for managerial decisions and the need to choose the most optimal of them; the presence of conflicting opinions in this area at various levels of government or in various interest groups (social, political, religious, etc.); the lack of awareness and understanding among non-specialists (military personnel, the population) of any new epidemiological dangers (for example, newly emerging infections, such as COVID-19, the problem of bioterrorism, etc.) and the nature of protective measures required in connection with them dictate the need to develop new methodological approaches to solving problems based on the analysis of the socio-epidemiological situation, the results of virtual experiments with mathematical models for the development and adoption of an optimal effective management decision [14].

We are emerging from a situation of relatively poorly managed social reactions to both the COVID-19 pandemic itself and the measures being taken to combat it. Sharp rejection of quarantine measures by a significant part of the population of various countries of the world, the persistence of a high percentage of COVID dissidence, mass protests against lockdowns and mask regimes, combined with panic and negative socio-psychological and socio-economic effects of lockdowns in the EU [15], the USA [16], and post-Soviet countries [17] provide strong evidence that vaccination, as the only sure way to get out of the pandemic trap, will face a set of social barriers. The success of vaccination directly depends on the preparation of the social atmosphere and requires an integrated approach in which medical measures are complemented by socio-political, socio-psychological, socio-economic procedures. We hypothesize that the potential vaccination rejection rate, combined with the negative effects of quarantines and lockdowns, creates an obstacle to effective pandemic control that cannot be overcome by purely medical or administrative means.

The **aim** of research is to form directions and tools for preparatory work with the public conscience to ensure the effectiveness of vaccination and minimize the negative consequences of various measures to combat the COVID-19 pandemic based on a comprehensive analysis of the social factors in the fight against the COVID-19 pandemic.

Research (using methods of sociological surveys, in-depth interviews, expert interviews) should include:

- *social factors of the spread of the virus*: social mobility and contact of various social groups during the quarantine period, socio-demographic and stratification factors of perception of anti-pandemic events;
- *social effects of a feeling of hopelessness (loss of the future)*: social fear of infection (plus social neuroses, psychoses developing as a result of information pressure), fear of isolation, communicative breakdown, fear of losing contacts (imposed loneliness, forced individualism, especially for those who are not attracted to Internet communication), fear of loss of sources of livelihood (socio-economic fear); the impact of the perception of a pandemic on attitudes towards the socio-economic and socio-political structure, to assess the effectiveness of social systems, on protest moods and extremist orientations; attitude to quarantine, to other measures to combat the pandemic (mask mode, social distance), its relationship with the attitude towards future vaccination;
- *social barriers to vaccination*: attitudes towards vaccination, stereotypes, (dis) information myths about vaccination; the role of information agents (media, opinion leaders) in shaping attitudes towards vaccination, the potential for using opinion leaders to create the necessary prerequisites for vaccination; negative (barrier) information potential of COVID-dissident communities; attitude to medicine in general, to the national medical industry, to the management structure of the medical industry, factors of these relations; the difference in attitudes towards vaccination of social groups depending on mobility, the number of contacts during the quarantine period;
- *management of the social atmosphere*: prospects for adjustment / formation of an attitude towards vaccination, reduction of social tension and conflict potential, stimulation of readiness to participate in support campaigns; prospects for disseminating evidence-based information to overcome barriers to attitudes towards vaccination.

2. Analysis of current state of researches

Research on the social factors, effects and consequences of the COVID-19 pandemic is now taking place both internationally and in individual countries. Among the interesting and relevant interdisciplinary research is the analysis of the prospects for vaccination against COVID-19 of the Royal Society of the British Academy [18], the Vaccine Confidence Project [19], an international research project to analyze public attitudes and emotions in response to the COVID-19 pandemic, High School's Monitoring of New Yorkers' responses to the pandemic Public Health and Health Policy and Emerson College [20]. All of these studies are in progress and cannot yet provide validity and comprehensive results. In Ukraine, such studies are not systematically conducted today. At the same time, it is obvious that regardless of the effectiveness of international projects, it is necessary to thoroughly analyze the social factors of success in combating the pandemic, acting within the country: national cultural, political, social specifics are not sufficiently represented by international projects. Vaccination and possible reactions to it is carried out by WHO [21], social consequences of the pandemic are being analyzed by the international working group on suspended sciences [22]. This provides an opportunity for fruitful international cooperation within the framework of our project. Studying the problems of the prospects for vaccination against COVID-19, it is advisable to take into account the results of previous studies on the attitude of the Ukrainian population to vaccination in general [23]. During the failed measles and rubella immunization campaign in Ukraine in 2008, vaccination concerns turned into a public health problem. Health-care workers became the agents of official immunization policies that were perceived with fear by the public and negatively reported in the media, causing parental concerns about vaccinations and the insistence of health officials to vaccinate. The study showed that in the post-Soviet context, public health control is being rethought as one of the conditions for admission to the European Community, as a so-called “sanitary democracy”, and as a basis for disputes between citizens and the state, relations between which form the structure of medical and social risk.

Paper [24] analyzes research findings related to COVID-19 and social media during the first outbreak of COVID-19 from November 2019 to November 2020. The authors identified five such

topics covered on social media: surveying public opinion, identifying infodemias, assessing mental health, identifying or predicting COVID-19 cases, analyzing government responses to the pandemic, and assessing the quality of health information in prevention education videos. It highlights the lack of research on the application of machine learning on social media data related to COVID-19 and the lack of research documenting real-time surveillance that has been developed from social media data on COVID-19.

Given the unprecedented scale of the impact of the COVID-19 pandemic on the social, economic and political state of the country in the world, solving this problem requires not only a sanitary-epidemiological and pharmacological, but also a sociological approach. There is a clear need to understand both the social factors of the spread of the disease and social barriers and obstacles, it is actualized in the systemic fight against this disease. Today's socio-scientific research on the causes and consequences of the Covid-19 pandemic focuses on the following main areas:

1. Macro and microeconomic consequences of the pandemic, its impact on international trade relations, global and local risks associated with it: potential crises that can lead to a policy of combating the spread of Covid-19, for various sectors of the economy: production, trade, services, transport, tourism, etc. [25-28]. This includes a number of studies of the impact of quarantine measures on certain areas of human activity – IT technologies, logistics, education, sports, volunteering, etc. [29].

2. Geopolitical influence of the COVID-19 pandemic: disclosing possible transformations of (over) state structures, possible impact on the global order [30]. Separately, attention is paid to the European integration processes and their possible crisis, as well as the crisis of international organizations (primarily WHO).

3. Analysis of state policy to combat the course and consequences of pandemic. In the paradigm of comparative political science, scientists study the experience of different countries (especially China, South Korea and Sweden) in the fight against COVID-19 in order to determine the effectiveness and riskiness of certain X events [31].

4. Information policy and media effects associated with pandemic are considered by communicators (patterns in the spread of news and “fakes” around COVID-19, requirements for public relationship activities, etc. [32].

5. Psychological and mental consequences of pandemic and self-isolation are investigated on the verge of socio-humanitarian and medical condition of medical workers [33].

6. Demographic shifts caused by COVID-19 migration processes [34]. Comparison of the Ukrainian and foreign social conditions of the pandemic will make it possible to reasonably and reasonably use foreign experience in combating its consequences. the possibility of various options for dealing with the consequences of the pandemic, to develop recommendations for the systemic overcoming of potential barriers.

3. Proposed methodology

The novelty of the proposed approach lies in its interdisciplinarity, combining the large-scale use of sociological research tools with mathematical models and epidemiological assessments and forecasts to obtain a comprehensive picture. The following sociological methods will be used:

- mass polls;
- in-depth and expert interviews;
- analysis of media materials to monitor the social atmosphere and its dynamics.

This will make it possible to form a reasonable set of measures for managing and correcting social effects and post-effects of a pandemic and combating it (in particular, vaccination, the success of which directly depends on sociological support).

For the first time, the following will be simultaneously investigated:

- public sentiment and responses to the pandemic;

- social assessment of the effectiveness of the medical sphere and attitude towards health authorities and medical workers;
- the state and prospects of correcting the level of trust in the authorities and the motivation of the "medical" behavior of citizens;
- political factors and effects of the fight against the pandemic;
- the state of the information field around the pandemic and the fight against it, directions of outreach work on the formation of support for vaccination.

The proposed approach provides for the development of a comprehensive methodology for interdisciplinary research of social factors in the development of a pandemic and the fight against it. The need to solve less than two consecutive tasks – a detailed study of the social background and environment for the deployment of anti-pandemic measures and effective socio-engineering influence on certain parameters to minimize the significance of social resistance and increase the effectiveness of the fight against pandemic – determines the need to update sociological methods of mass polling, focused group and expert interviews, analysis of media materials by, firstly, their combination with mathematical models of behavior of large social masses, and secondly, the use of methods for identifying key parameters and verification of modeled connections and predicted effects (in particular, panic reactions are extrapolated) and the development of appropriate criteria for optimal management, decision-making and resource allocation for the implementation of socio-engineering tasks determines the inclusion in integrated methodology methods of organized, controlled media impact on the mass consciousness, rely on a combination of sociological, marketing, media techniques. As part of the project, new methods for simulating epidemic processes and models for predicting the incidence of COVID-19 will be developed, which, unlike the existing ones, will take into account social factors affecting the dynamics of the process. Thanks to experimental studies of the constructed models, it will become possible to determine the degree of influence of one factor or another on the development of the epidemic process.

The proposed methodology includes three stages:

1. Situation study: analysis of public moods, emotions, expectations related to the pandemic and future vaccination, socio-economic, socio-political and socio-psychological factors of the effectiveness of anti-pandemic measures (sociological monitoring: mass polls, analysis of materials Mass media, focus groups);
2. Research of reactions to ongoing vaccination, sociological support and adjustment of the current information policy of state and international health authorities (sociological monitoring: mass polls, analysis of media materials, expert and in-depth interviews)
3. Research of the post-effects of vaccination, social assessments of its effectiveness and the activities of state and international health authorities, as well as key areas of communication of the latter with various social groups (sociological monitoring: mass polls, analysis of media materials, focus groups, in-depth interviews, development and implementation of media and socio-political marketing campaigns).

4. Expected results

On the basis of the patterns determined in the course of the study, models of the stratified behavior of the social masses will be developed during a protracted – "long" – crisis situation in conditions of non-obviousness of the prospects for its development or exit from it. The models will be based on taking into account the informational and cognitive habitualization practices of specific social groups (by age, professional, territorial, and other characteristics); group peculiarities of perception of the existing and expected situation in combination with actualized "panic" filters of group and mass consciousness; systems of stereotypes and the level of trust in the actors of the medical sphere and political institutions, structures and mechanisms; specific economically and media-conditioned "fears" and their impact on self-assessment of health status and assessment of publicly declared threats.

Based on the results of the analytical stages of the proposed approach, a concept will be developed for information and educational, media and advertising and socio-political marketing support for

quarantine measures, vaccinations and pandemic monitoring observations with a high degree of interference in confidentiality. The concept will serve as a universal foundation for the development of localized sociological support programs designed to aim targeted population groups, taking into account the group specifics of “pre-crisis” behavior.

The scientific novelty of the results includes:

- a detailed description of the state of mass consciousness and public moods, emotions, expectations, thoughts on measures to combat the COVID-19 pandemic;
- statistically significant and sociologically substantiated representative information about group consciousness and behavioral patterns on measures to combat the COVID-19 pandemic (in particular, about social group differences in the acceptance / rejection of quarantine practices, about the prospects for supporting / counteracting vaccination);
- a model of factor conditioning of group and massive responses to vaccination, microgroup strategies and behavioral tactics in a quarantine situation, the dynamics of attitudes towards vaccination and a wide range of medical and non-medical measures to combat the COVID-19 pandemic;
- a scheme of the desired channels for obtaining information about the pandemic and measures to combat it, including identifying the most effective channels for potential impact and correction of group and mass perceptions about the pandemic and measures to combat it, as well as increasing access to information for specific social groups;
- a set of recommendations and practical measures to increase the level of trust in national and international health authorities, the formation of a favorable social mood for vaccination;
- plan for sociological support of vaccination;
- projects of media and socio-political marketing campaigns in support of vaccination, identification of social factors influencing the epidemic process of COVID-19 based on an impelled intellectual simulation model.

The expected results are planned to be used for sociological support of programs to combat pandemic to minimize deviations and aberrations. The means of influencing the state of mass consciousness developed at the end of the project, embodied in specific media, information and educational and socio-political marketing projects and programs, will reduce the level of rejection of vaccinations and quarantine measures. The target-group models of vaccination and post-vaccination follow-up observations created during the project can be used by the Ministry of Health and other health authorities and government authorities to increase the efficiency of the deployment of medical anti-pandemic measures.

The created model will allow state and local authorities, civil society, health services, media, educational institutions and other interested agents to more carefully and consistently promote mass vaccination of the population, minimizing the negative impact of possible social barriers and obstacles, contributes to the national security of Ukraine. Having a quantitative and qualitative measurement of the risks and threats that the bodies that will implement mass vaccination in Ukraine may face, the conductors of this procedure will be able to reasonably develop an action strategy based on research data. The result of a systematic analysis of the social context of the COVID-19 pandemic will improve the tools for countering similar threats in the future and effectively mitigate for their negative impact on the course of social processes, thereby strengthening the national security of the country.

5. Conclusions

The value of the proposed approach lies in the complexity of the analysis of the social factors of the pandemic on the scale of the Ukrainian society. This approach makes it possible to analyze the patterns of perception catalyzed by the pandemic (fears, stereotypes, trust, etc.) and actions (everyday consumer, labor, medical, quasi-medical practices, etc.) that can negatively affect the implementation of mass vaccination of the population of Ukraine. Unlike similar studies in recent years, the proposed

approach is not focused on describing the social perception of (non) security of a certain type (informational, criminal) or fixing the impact of COVID-19 on a particular area (politics, economics). A fundamentally new approach is proposed with a focus on analyzing the social factors of the pandemic for the Ukrainian society as such. This will make it possible to create a unique "snapshot" of the reaction of the Ukrainian society to a large-scale danger and to reveal the means and methods of ensuring integration and new threats of disintegration.

As a result, a generalized theoretical model of the response of different-level social entities to crises of natural origin, in particular, epidemic, is proposed. In the future, it can be applied more broadly – to explain the peculiarities of the flow of customary micro-level social interactions in a situation of “curvature” of natural danger, including outside the Ukrainian society. This approach will allow reaching the level of international comparative studies, comparing the significance of various social factors of the COVID-19 pandemic in various global and local social communities.

Implementation of proposed approach will allow:

- to assess the scale and significance of social barriers to vaccination;
- to develop effective tools to influence public adherence;
- to provide targeted information and sociological promotion of vaccination (different for different target groups of the population);
- to increase the expected effectiveness of vaccination;
- to reduce the negative socio-psychological and socio-political effects of anti-pandemic measures;
- to reduce the level of social tension caused by social fears of “losing the future”;
- to develop models of emergency general social response to future epidemics.

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