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Cluster Model of Emergency Medical Care Organization: Improvement of Public Administration Tools

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ABSTRACT

The article considers the features of the cluster model of the organization of emergency medical care and ways to improve the tools of public administration to ensure the efficiency, coordination and availability of medical services. It is determined that the analysis of budget financing of primary health care and emergency care services is important for assessing the ability of the state to ensure the timeliness and quality of medical interventions. Medical care, centralized dispatch services and training departments contribute to the standardization of procedures, prompt redistribution of resources, and increase the efficiency of interregional coordination. It has been established that the application of the cluster approach involves the optimization of patient transportation routes, centralization of funding, standardization of processes and integration of digital solutions, including telemedicine facilities and call monitoring systems. It is noted that the legal regulation of the functioning of emergency medical care teams and departments forms the basis for the continuity of care, coordination between structures and adaptation to social, demographic and territorial characteristics. It is noted that strategic planning of the activities of institutions within hospital clusters ensures the concentration of management decisions on long-term structural changes and increases the resilience of the health care system. It has been revealed that the introduction of a cluster model of emergency medical care organization provides a synergistic effect of interaction between institutions, increases the efficiency, accessibility and quality of medical services, and also contributes to bringing the health care system of Ukraine to international standards of quality of medical care.

KEYWORDS

emergency medical care, cluster model, public administration, budget financing, standardization, patient routing.

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Кластерна модель організації екстреної медичної допомоги: удосконалення інструментів державного управління

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СТАТТЯ

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АНОТАЦІЯ

У статті розглянуто особливості кластерної моделі організації екстреної медичної допомоги та шляхів удосконалення інструментів державного управління для забезпечення ефективності, координації та доступності медичних послуг. Визначено, що аналіз бюджетного фінансування первинної медичної допомоги та служб екстреної і невідкладної допомоги є важливим для оцінювання здатності держави забезпечувати своєчасність і якість медичних втручань. Підкреслено, що інтеграція регіональних центрів екстреної медичної допомоги, централізованих диспетчерських служб і навчально-тренувальних відділів сприяє стандартизації процедур, оперативному перерозподілу ресурсів та підвищенню ефективності міжрегіональної координації. Встановлено, що застосування кластерного підходу передбачає оптимізацію маршрутів транспортування пацієнтів, централізацію фінансування, стандартизацію процесів та інтеграцію цифрових рішень, включно з телемедичними засобами та системами моніторингу викликів. Зауважено, що нормативно-правове регулювання функціонування бригад і відділень екстреної медичної допомоги формує основу для безперервності надання допомоги, координації між структурами та адаптації до соціальних, демографічних і територіальних особливостей. Зауважено, що стратегічне планування діяльності закладів у межах госпітальних кластерів забезпечує концентрацію управлінських рішень на довготривалих структурних змінах та підвищує стійкість системи охорони здоров'я. Виявлено, що впровадження кластерної моделі організації екстреної медичної допомоги забезпечує синергетичний ефект взаємодії установ, підвищує ефективність, доступність та оперативність медичних послуг, а також сприяє приведенню системи охорони здоров'я України до міжнародних стандартів якості медичної допомоги.

КЛЮЧОВІ СЛОВА

екстрена медична допомога, кластерна модель, державне управління, бюджетне фінансування, стандартизація, маршрутизація пацієнтів.

1. Introduction

The health care system of Ukraine is in the conditions of deep structural and functional transformations, which determines the urgent need to improve public administration tools and mechanisms for resource provision of important subsectors of medical care. A significant role is played by the efficiency of the distribution of financial, human and technological resources in the subsectors of primary, emergency and emergency medical care, because the promptness of response and the quality of medical services to the population depend on this. In addition, ensuring optimal coordination and integration of these resources is a prerequisite for increasing the overall capacity of the health system. In this context, the relevance of the study is determined by the need for scientifically grounded improvement of state management mechanisms to ensure the effective organization of emergency medical care (EMD).

2. Literature Review

The analysis of recent studies and publications shows that the problems of improving the organization of EMD cover managerial and technological aspects. Thus, O. Ignatenko and I. Uruzbayeva investigate the development of digitalization of EMD [1]. O. Lyubinets and V. Milashovska consider the strategic planning of the activities of health care institutions of the hospital cluster [9]. V. Knyazkova, D. Guz, O. Rudynska and V. Krylenko emphasize the formation of clusters of medical institutions as an administrative tool for management in the conditions of decentralization [2]. In addition, S. Sakhanenko considers territorial medical clusters as elements of the formation of agglomerations and the development of their structure [13].

3. Problem Statement

The article is aimed at analyzing the cluster model of EMD organization and ways to improve public administration tools to ensure the efficiency, coordination and availability of medical services.

4. Methods and Materials

The methodological basis of the study is based on the use of a comprehensive interdisciplinary approach, which allows combining the theoretical foundations of public administration, modern concepts of the organization of medical services and tools of system analysis. The basis of the study is the provisions of the theory of state regulation, health care management, spatial organization of medical clusters and principles of assessing the effectiveness of public administration.

To form a theoretical model of the cluster organization of emergency medical care, a structural and logical method was used, which provided an opportunity to systematize the key elements of the functioning of clusters, determine their managerial relationships and establish the logic of interaction between regional centers, dispatch services and medical institutions of different levels. This made it possible to form a conceptual scheme for the integration of resources and processes within a single managerial space.

To study the actual state of emergency medical care and assess the effectiveness of its functioning, a comparative analysis was used, which made it possible to compare regional models of EMD organization, determine differences in approaches to financing, patient routing, staffing and dispatching. The comparison was carried out on the basis of data from the Ministry of Health of Ukraine, the Center for Medical Statistics, reports of the National Health Service of Ukraine and regional programs for the development of health care.

To establish the impact of clustering on the effectiveness of management decisions, the method of system analysis was used, which made it possible to assess multi-level relationships between resource provision, organizational structure, process standards and final indicators of the quality of medical care. Particular attention is paid to the analysis of the mechanisms of centralization of dispatch services, the concentration of specialized equipment, the logistics of patient movement and the role of digital tools in increasing the efficiency of response.

In order to assess the compliance of the cluster model with regulatory requirements, a regulatory analysis was carried out, which included a study of legislative acts, by-laws, standards for the provision of emergency medical care, industry protocols and international recommendations (WHO, OECD, EU Health Systems). This made it possible to identify gaps in the current regulation, identify areas for improving management tools and assess the possibility of adapting European clustering models to the Ukrainian context.

To assess the impact of clustering on the availability of medical services, methods of geographic information analysis were used. Based on cartographic data, the territories with the lowest level of transport accessibility were determined, as well as the optimal routes of movement of teams and the location of bases were modeled in accordance with population density and remoteness from hub hospitals.

In order to form generalized conclusions of the study, the SWOT analysis method was used, which made it possible to assess the strengths and weaknesses of the cluster model, identify potential opportunities for development and risks associated with managerial, financial and territorial constraints.

The application of a comprehensive methodology made it possible to comprehensively study the functioning of the cluster model of EMD, identify institutional shortcomings, assess managerial advantages and develop proposals for improving public administration tools in the field of emergency medical care.

5. Results and Discussion

The analysis of budget financing of primary health care and emergency care services is a necessary element of the study of the modern health care system of Ukraine, since it is these links that provide the basic level of availability of medical services. In this regard, the structuring and evaluation of state expenditures on polyclinics, outpatient clinics and ambulance services make it possible to objectively determine the level of the state's ability to ensure the quality and timeliness of medical services. interventions. Firstly, there is a need to find out how the distribution of budget resources affects the functioning of the relevant medical institutions, including updating the material and technical base, improving the skills of personnel and compliance with the standards for the provision of medical care. Secondly, the assessment of the dynamics of expenditures makes it possible to identify trends in the formation of financial priorities of the state and establish their compliance with the real needs of the health care system.

Therefore, in order to clearly reflect the dynamics of financing important links of the health care system, it is advisable to consider the volume of expenditures of the state budget of Ukraine on polyclinics, outpatient clinics and ambulance and emergency services in the context of individual years (Fig. 1). Therefore, the analysis of the dynamics of expenditures of the state budget of Ukraine on the financing of polyclinics, outpatient clinics and emergency medical care services in 2018–2024. testifies to the tendentious strengthening of financial prerequisites for the modernization of public administration instruments in this area. In particular, the increase in actual funding from UAH 33.18 million in 2018 to UAH 424.69 million in 2024 indicates the priority of the development of the continuous medical care system and forms the basis for the introduction of structurally and functionally new models, including cluster ones.

Taking into account the consistently high performance rates of budget assignments (96–98% in most years), it can be stated that the above financial predictability creates favorable conditions for the systematic planning of management decisions in the field of EMD, while the exceptional values of 2018 and 2021 (72.04% and 84.48%, respectively) indicate the influence of external factors, without violating the general trend towards strengthening public administration and optimizing the budget mechanism. At the same time, in January-September 2025, UAH 33183997.46 was fulfilled with the implementation of the revised equal plan at the level of 72.04% [12].

In view of this, it is important to emphasize that in the context of the formation of a cluster model for providing EMD, financial stability becomes an important tool for the development of management mechanisms [3]. In particular, the targeted allocation of funds for fleet renewal, the creation of modern dispatch systems, the development of telemedicine solutions and digital route maps creates the basis for the standardization of management processes [4].

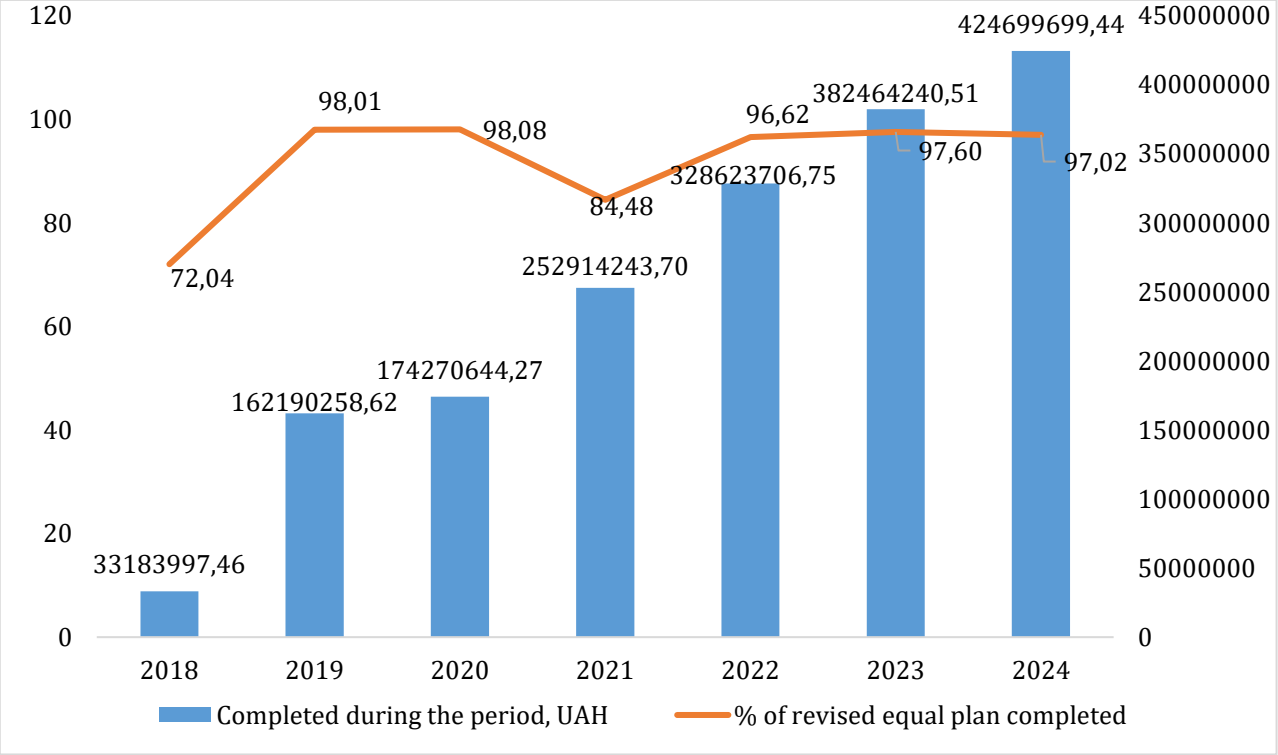

Figure 1. Expenditures from the state budget of Ukraine to finance polyclinics and outpatient clinics, ambulance and emergency care

Source: Compiled based on [11].

Currently, the EMS system in Ukraine functions as a complex network covering the Autonomous Republic of Crimea, all regions, as well as the cities of Kyiv and Sevastopol. Its institutional structure includes EMS and disaster medicine centers, emergency (ambulance) medical aid stations, emergency (ambulance) medical care teams, as well as emergency medical care departments, which are defined in Article 5 of the Law of Ukraine "On Emergency Medical Care" [15]. In this regard, the system assists the population free of charge and focuses on prompt response to emergencies and mass accidents.

In the structure of each EMD station or center, an important role is played by an emergency (ambulance) team, which carries out primary diagnostics, stabilization of patients' condition and their transportation to appropriate health care institutions. The presented functional distribution ensures the continuity of the medical route (from the scene of the incident to the medical institution) and forms the basis for further integration of regional services into the system of the cluster management model [15].

At the same time, current trends in the development of the EMD system indicate the need to move from an isolated territorial organization to a cluster model, which provides for the pooling of regional resources, standardization of management processes and the creation of interregional centers of competence, which in turn makes it possible to improve the quality of response and optimize logistics routes, especially in cases of emergencies, in particular in the current conditions of martial law.

In the system of the cluster model of EMS organization, the determining factor is the institutional capacity of regional EMS centers, since they ensure the interoperability of institutions, standardization of procedures and the possibility of prompt redistribution of resources between territories. In this context, the activities of the Lviv Regional Center for Emergency Medical Care and Disaster Medicine (https://stat.loda.gov.ua/hospital/knp-lvivsko-oblasno-rady-lvivskyj-oblasnyj-tsentr-ekstreno-medychno-dopomogy-ta-medytsyny-katastrof) demonstrate the effectiveness of a centralized dispatch service, an extensive network of substations, a system of personnel training and the implementation of medical transportation tasks in accordance with the current legislation. As a result, the Lviv Center can be considered as an infrastructural basis for interregional coordination, as it has sufficient human, technical and technological potential to integrate into wider clusters of interaction and provide support to adjacent territories in the event of large-scale incidents. The same characteristics can also be traced in the activities of the Odesa Regional Center for Emergency Medical Care and Disaster Medicine (https://emd.od.ua/pro-nas), which provides medical response in the city of Odesa and the region.

The above examples of the functioning of regional EMS centers emphasize that effective infrastructure and centralized coordination are a prerequisite for high-quality EMD delivery. In turn, the implementation of such opportunities is impossible without clearly defined normative principles for the activities of structural units that provide a direct response to urgent situations.

According to the Model Regulations on the Emergency (Ambulance) Medical Care Team, approved by the Resolution of the Cabinet of Ministers of Ukraine dated November 21, 2012 No. 1114 [7], a team is defined as a structural unit of an EMS and disaster medicine center or an emergency (ambulance) medical aid station. Its activities are focused on providing EMD to persons in emergency conditions directly at the scene, as well as during transportation to health care facilities.

In continuation of this, the document [16] details the main tasks of the team, which include: the provision of EMD at the pre-hospital stage, the transportation of patients with medical support by order of the dispatcher of the operational dispatch service of the center, as well as participation in the elimination of the consequences of emergencies. All functions of the team are directly related to ensuring the efficiency, timeliness and continuity of assistance, which makes it possible to further standardize such processes at the level of interregional EMD clusters. In this regard, the above regulation consolidates the functional responsibilities of teams and at the same time creates prerequisites for their integration into network structures focused on the sharing of resources and unified response protocols.

Taking into account the above, the activities of the Municipal Non-Profit Society "Regional Center for Emergency Medical Care and Disaster Medicine" of the Dnipropetrovsk Regional Council (https://emddnipro.itmed.org/about-us) demonstrate the practical implementation of the principles of the cluster approach in the EMS system. Therefore, the center provides territorial coverage and prompt response through a network of stations and substations, and integrates a centralized dispatch service and automated workstations for coordinated management of call flows. The presented functions allow you to create unified routes for transporting patients, which ensures the rapid delivery of people in critical conditions to specialized healthcare institutions, optimizes the use of resources and guarantees standardized medical care. In addition, the training department of the center provides training for medical and non-medical workers to work in emergencies, which strengthens the integration potential of the system and its ability to function within interregional clusters.

In view of the above, the effective functioning of the network of EMD centers demonstrates the need to integrate organizational practices with regulatory mechanisms governing hospital clusters and patient transportation routes. In this context, the amendments made by the Resolution of the Cabinet of Ministers of Ukraine dated November 5, 2025, No. 1456 [19] ensure the unification of standards, coordination of routes with the Ministry of Health of Ukraine and centralized planning of patient flows, which helps to increase the efficiency of response and optimize resources in the EMS system. The presented changes contribute to the formation of efficient transport corridors and the minimization of the time of delivery of patients with critical conditions to specialized institutions, including state-owned medical institutions, approved by the Ministry of Health of Ukraine.

Due to the improvement of transportation routes, the ability of the EMD system to function in a cluster organization is enhanced, so the integration of municipal and state institutions into the common medical space ensures the rational use of specialized resources. This aspect means that patients with strokes, heart attacks, or severe injuries are directed directly to the nearest facility that has appropriate technological capabilities, which increases the effectiveness of clinical outcomes and reduces mortality [19].

Taking into account the increased efficiency of patient routing within the cluster organization of EMD, the centralization of financing and the conclusion of contracts with one regional EMS center becomes an important mechanism for integrating resources and standardizing processes. Therefore, this coordination ensures the interconnection between individual structures and creates conditions for the optimal distribution of material, technical and human resources, which enhances the efficiency of response and the quality of assistance in critical situations.

Thus, according to the current regulation, the National Health Service of Ukraine enters into agreements with one center of EMD and disaster medicine of communal ownership in each region [18]. This aspect ensures the centralization of funding and creates prerequisites for the formation of an effective cluster model, within which regional EMS structures function as interconnected elements of a single response network and coordinate the activities of teams in the mode of interregional interaction. In the context of the established financial mechanisms, the tariff for medical services for the provision

of EMS is defined as a global rate based on the capitation rate for the readiness to provide services during the year and amounts to UAH 306.3 per year (as of 2025). The introduction of such a rate allows taking into account the size of the population, as well as the specific conditions for assisting in different territorial categories, which in turn strengthens the capacity of regional centers to integrate into cluster structures [18].

Adjustment coefficients are applied to the base capitation rate, which reflects the characteristics of the territories and the conditions for the provision of medical care:

1) for settlements in the territories of possible hostilities – 1.48;

2) for settlements in the territories of active hostilities – 6.01;

3) for mountainous settlements – 1.2 [18].

The use of these coefficients allows for a balance between financial resources between territories with different risks and ensures a rational distribution of resources, which is especially important for optimizing the functioning of cluster structures.

In this context, a full-fledged digital transformation of the EMS system at the pre-hospital stage becomes a prerequisite for the implementation of an effective cluster approach [8], because the improvement of the functionality of the Central 103 IAS, the introduction of uniform standards of interaction between regional systems and innovative solutions for the digitalization of informed consent of patients allow optimizing the work of teams and ensuring transparency of processes at all levels [1, p. 37].

On the example of the Kharkiv region, we note that the territorial structure and digital integration of the bases of EMS teams demonstrate the practical implementation of the cluster approach, which includes 26 branches, 49 permanent and 113 temporary bases to serve the population of about 2.73 million people. The information and dispatch system with GPS monitoring and automated call distribution allows you to quickly send "free" teams, optimize routes and abandon the traditional territorial approach, ensuring the effectiveness of pre-hospital care. In addition, the interaction of the 103 and 112 services and the modern material and technical base increases the level of preparedness of teams for emergencies and supports the continuous process of personnel training, which is important for the sustainable functioning of the EMD cluster model.

Based on the above, it should be noted that the implementation of the cluster approach in the EMS system is manifested through the territorial structure of brigade bases, digital integration and route optimization, which increases the efficiency of pre-hospital care and the readiness of personnel for emergencies. In this context, the regulatory framework, in particular the Model Regulations on Emergency Medical Care Departments [17], ensures the establishment of clear functional standards for the activities of departments, defining their role in receiving, transporting and providing comprehensive medical care to patients in various emergency conditions.

The generalization of the above indicates that the regulation of the department's activities is not limited only to the definition of its clinical tasks, but provides for a wider range of organizational and coordination processes. This creates the basis for considering additional functional responsibilities aimed at ensuring the continuity of EMS provision and increasing its effectiveness. Therefore, the functional responsibilities of the department also include supporting the exchange fund of immobilization equipment, analyzing the causes of deaths, conducting training activities to improve the quality of work, as well as ensuring coordination with EMS teams and operational dispatch service. In addition, it is envisaged to use telemedicine tools for providing consultations and introducing new methods of diagnosis and treatment on the basis of evidence-based medicine, which creates the basis for a systematic approach to the organization of an EMS cluster network, where different departments interact as a single structure [17].

In addition, strategic planning of the activities of health care institutions integrated into the hospital cluster is carried out, taking into account the demographic characteristics of the service area and the functional tasks of each institution. This mechanism ensures the concentration of managerial decisions on long-term structural changes that form the basis for improving the efficiency of medical care. Thanks to this, conditions are created for the coordinated development of cluster elements and their ability to adapt to external challenges.

At the same time, the development of hospital clusters depends on the level of participation of the population and medical personnel in decision-making processes to improve the availability and quality of medical services. As evidenced by the study [9], social inclusion contributes to the formation of an understanding of the role of the health care system in regional development and strengthens

responsibility for the state of public health [9, p. 87]. Accordingly, the structured interaction between the cluster institutions and the population determines the fundamental parameters of the system's stability.

In this context, the new models of EMS organization in Ukraine, which are being implemented in the process of modernization of regional EMS services, are demonstrative. In particular, the creation of territorial EMD and disaster medicine centers, which function as single management entities at the regional level, ensures vertical and horizontal coordination between substations, dispatch services and hub hospitals. Information on the structure of these centers and their activities is officially published by the Ministry of Health of Ukraine (https://moz.gov.ua/uk/ekstrena-medichna-dopomoga). At the same time, the health care management system provides for the use of administrative methods that function as instruments of state regulation of the activities of medical institutions [6]. In the structure of the hospital cluster, these methods strengthen coordination between medical care entities and ensure the consistency of management decisions. Therefore, the presented integration is important for building a system focused on effectively responding to challenges related to conditions requiring emergency care.

In addition, it should be noted that the regulatory regulation of the functioning of operational dispatch services in the field of EMD is interrelated with the provisions of the Resolution of the Cabinet of Ministers of Ukraine dated 17.10.2012 No. 1031 "On Approval of the Procedure for the Functioning of the System of Emergency Assistance to the Population at the Single Telephone Number 112" [14]. This act defines the organizational principles for the creation and operation of the 112 system as an integrated network of dispatch services, which ensures the acceptance and initial processing of citizens' appeals. The presence of such provisions forms the regulatory basis for further coordination between rapid response services, including in the EMS segment, since the routing of calls to the relevant EMS center is carried out in the system of the general structure of the 112 system. Accordingly, the development of a unified operational dispatch service at the regional level is based on the principles of integration, standardization of response algorithms and unification of procedures for taking calls, which contributes to reducing response time and rational distribution of workload between ambulance teams.

The transformation of the health care system through medical reform is aimed at ensuring equal access of the population to quality medical services and reorienting management approaches so that the patient is at the center of the system [2]. In the cluster model, this means revising patient routing principles, expanding access to pivotal hospitals, and increasing the role of analytical tools for monitoring response.

In this regard, the example of the implementation of the Electronic Health System (eHealth) in the direction of modules related to EMD patient routing is important. The presented solution strengthens the ability of the state to manage patient flows and ensure their rapid direction in the structure of the cluster network.

It should also be noted that back in 2019, the Government approved the Concept for the Development of the EMS System, which defined the strategic guidelines for the modernization of the system and formed the basis for its structural transformation [10]. In the context of the implementation of the provisions of the Concept, it was envisaged to create prerequisites for a significant increase in the quality and availability of EMD, since in a critical situation, each person must receive timely and technologically provided intervention. At the same time, attention was focused on the need to strengthen the prestige of professions in the field of EMD, which provides for the formation of a fair and competitive system of remuneration for employees [16]. The tool demonstrated above clearly follows the principles of the cluster model, in which human resources are considered as an important element of the capacity of the regional network.

Therefore, the main result of the introduction of the cluster form of organization of health care institutions is the formation of conditions for improving the quality, efficiency and accessibility of medical care due to the synergistic effect of interaction between diversified institutions [5]. This form provides an opportunity to build a comprehensive and continuous chain of service provision, integrated into a single interdisciplinary platform at the intersection of healthcare, education, science and production, which in turn contributes to bringing medical care to the level of international standards [13, p. 367; 20].

Taking into account the above provisions, it is advisable to emphasize that in the EMD system, the cluster model provides optimization of patient routing and increase in response speed due to the concentration of resources, standardization of management procedures and integration of information flows. Therefore, one of the important practical manifestations of this process should be the functioning

of a single operational dispatch service at the regional level, which acts as a center for coordination of calls, operational monitoring and distribution of resources. This mechanism, in turn, will create the basis for strengthening the manageability and accountability of EMDs within the cluster

6. Conclusions

Thus, the analysis of the study allows us to state that the implementation of the cluster model of EMD organization provides an increase in the efficiency, accessibility and efficiency of medical services through the integration of regional centers, standardization of management processes and optimization of patient transportation routes. In this context, financial stability, centralization of resources and regulatory regulation of the functioning of teams and departments create prerequisites for continuity of care and integration of technological and digital solutions. In addition, the use of unified dispatch systems and telemedicine facilities allows to increase coordination between EMD entities and ensure rapid response in critical situations, while strategic planning and taking into account demographic, social and territorial characteristics contributes to the stability of the cluster network and the formation of a single medical space integrated into the system of public health management, which ultimately creates a synergistic effect of interaction between institutions and provides implementation of international standards for the quality of medical care.

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