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СТРАТЕГИЧЕСКОЕ УПРАВЛЕНИЕ РАЗВИТИЕМ СИСТЕМЫ ФЕТАЛЬНОЙ МЕДИЦИНЫ РЕСПУБЛИКИ КАЗАХСТАН: ОРГАНИЗАЦИОННО-ЭКОНОМИЧЕСКАЯ МОДЕЛЬ

Аннотация

Актуальность. *Фетальная медицина является на сегодняшний день одной из стремительно развивающихся высокотехнологичных направлений перинатологии, позволяющее диагностировать и корректировать патологию плода внутриутробно. В Республике Казахстан служба находится на этапе институционального становления: первые внутриутробные вмешательства были выполнены в 2024 году, появились специализированные отделения в Астане и Алматы, однако стоит отметить, что развитие носит проектный характер и не закреплено системными механизмами стратегического управления и устойчивого финансирования.*

Целью данного исследования *является научное обоснование организационно-экономической модели стратегического управления развитием службы фетальной медицины Казахстана.*

Методы. *В исследовании был проведен системный и структурно-функциональный анализ, контент анализ нормативно-правовых актов и статистических данных, SWOT и PEST анализ, метод сбалансированной системы показателей, экономико-организационное моделирование.*

Результаты. *Четырехуровневая сетевая модель hub and spoke была предложена, имеющая интеграцию с действующей трехуровневой регионализацией перинатальной помощи, был обоснован экономический механизм с смешанным финансированием (ГОБМП, ОСМС, ГЧП, экспорт услуг) и тарификация через клинико-затратные группы, а также разработана стратегическая карта с ключевыми показателями эффективности и дорожная карта в три этапа.*

Заключение. *Модель обеспечивает переход от единичных вмешательств к управляемой, финансово устойчивой и территориально доступной системе, снижающей потребность в лечении за рубежом.*

Ключевые слова: *фетальная медицина; стратегия; ОСМС; модель; организация;*

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ҚАЗАҚСТАН РЕСПУБЛИКАСЫНЫҢ ҰРЫҚ МЕДИЦИНАСЫ ЖҮЙЕСІН ДАМЫТУДЫ СТРАТЕГИЯЛЫҚ БАСҚАРУ: ҰЙЫМДЫҚ-ЭКОНОМИКАЛЫҚ МОДЕЛЬ

Аңдатпа

Өзектілігі*. Ұрық медицинасы бүгінгі күні перинатологияның қарқынды дамып келе жатқан жоғары технологиялық бағыттарының бірі болып табылады, бұл ұрықтың патологиясын жатырда диагностикалауға және түзетуге мүмкіндік береді. Қазақстан Республикасында бұл қызмет институционалдық қалыптасу сатысында: алғашқы жатырішілік араласулар 2024 жылы жүргізілді, Астана мен Алматы қалаларында мамандандырылған бөлімшелер ашылды. Алайда қызметтің дамуы жобалық сипатта қалып отыр және стратегиялық басқару мен тұрақты қаржыландырудың жүйелі тетіктерімен қамтамасыз етілмеген.*

Бұл зерттеудің мақсаты *Қазақстанның ұрық медицинасы қызметінің дамуын стратегиялық басқарудың ұйымдық-экономикалық моделін ғылыми негіздеу болып табылады.*

Әдістері*. Зерттеу барысында жүйелік және құрылымдық-функционалдық талдау, нормативтік-құқықтық актілер мен статистикалық деректердің мазмұнын талдау, SWOT және PEST талдау, теңдестірілген көрсеткіштер жүйесінің әдісі, экономикалық және ұйымдастырушылық модельдеу жүргізілді.*

Нәтижелер*. Төрт деңгейлі hub and spoke желілік моделі перинатальды көмектің қолданыстағы үш деңгейлі аймақтандыруымен интеграцияланған ұсынылды, аралас қаржыландырумен экономикалық механизм (ТМККК, МӘМС, МЖӘ, қызметтер экспорты) және клиникалық-шығынды топтар арқылы тарифтеу негізделді, сондай-ақ тиімділіктің негізгі көрсеткіштері бар стратегиялық карта және үш кезеңдегі жол картасы әзірленді.*

Қорытынды*. Модель бірлік араласудан шетелде емделу қажеттілігін төмендететін басқарылатын, қаржылық тұрақты және аумақтық қол жетімді жүйеге көшуді қамтамасыз етеді.*

Түйін сөздер: *ұрық медицинасы; стратегия; МӘМС; модель; ұйым;*

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STRATEGIC MANAGEMENT OF FETAL MEDICINE SYSTEM DEVELOPMENT IN THE REPUBLIC OF KAZAKHSTAN: ORGANIZATIONAL AND ECONOMIC MODEL

Abstract

Background. *Fetal medicine is currently one of the rapidly developing high-technology fields of perinatal medicine, enabling the diagnosis and treatment of fetal conditions in utero. In the Republic of Kazakhstan, fetal medicine services are at an early stage of institutional development. The first intrauterine interventions were performed in 2024, and specialized fetal medicine units have been established in Astana and Almaty. However, the development of these services remains project-based and is not yet supported by systematic mechanisms for strategic management and sustainable financing.*

The aim of this study *is to scientifically substantiate the organizational and economic model of strategic management of the development of fetal medicine in Kazakhstan.*

Methods. *The study included system and structural and functional analysis, content analysis of regulatory legal acts and statistical data, SWOT and PEST analysis, balanced scorecard method, economic and organizational modeling.*

Results. *The four-level hub and spoke network model was proposed, which has integration with the current three-level regionalization of perianatal care, an economic mechanism with mixed financing (GOBMP, MSHI, PPP, export of services) and billing through clinical and cost groups were substantiated, and a strategic map with key performance indicators and a roadmap in three stages were developed.*

Conclusion. *The model provides a transition from single interventions to a managed, financially stable and geographically accessible system that reduces the need for treatment abroad.*

Keywords: *fetal medicine; strategy; CSHI; model; organization;*

Introduction

Fetal medicine is a field of perinatology, the subject of which is the fetus as an independent patient, and the patient is prenatal diagnosis and minimally invasive or open intrauterine interventions aimed at correcting congenital pathology before the birth of the child. According to the results of the study, intrauterine correction reduces the need for bypass surgery and improves motor outcomes. The economic assessment of subsequent years has demonstrated that prenatal correction can be not only clinically effective, but also cost-effective. According to cost-benefit studies, it is able to save over 20 thousand US dollars and provide an increase of about one year of quality life per patient [1-3].

The development of fetal medicine in Kazakhstan is unfolding against the background of steady progress of the maternal and child health service. According to WHO estimates, the country is among the countries with the highest rates of maternal mortality reduction, so in 2024 this figure was about 10.1 cases per 100,000 live births, and maternal mortality has decreased by about a third over the past 3 years, infant mortality by a quarter and reached historical lows during the years of independence. The basis for these results was laid back in the second half of the 2000s with the introduction of the regionalization of perinatal care, the distribution of maternity organizations at three levels, depending on the degree of risk of pregnancy and childbirth [4, 5].

The active formation of fetal medicine in Kazakhstan began in 2023-2024. With the organizational work and support of the charitable foundation and corporate partners, two departments of fetal medicine were opened in Astana and Almaty, specialists began performing intrauterine operations for the first time, including correction of feto-fetal transfusion syndrome in 2024 at the Center for Crinatology and Pediatric Cardiac Surgery in Almaty. The task of providing technical assistance, which was once not available to patients, has been completely solved [6].

Along with this, the achieved level of development solves a systemic problem. The establishment of the service is project-based, point-based, it relies on the enthusiasm of individual teams, while it is not supported by allocated tariffs and sustainable sources of funds. Assistance is focused in two cities, which may create risks of territorial inequality in access in a country with a vast territory and low population density [7].

The purpose of this study is the scientific substantiation of the organizational and economic model of strategic management of the fetal medicine service of the Republic of Kazakhstan. To achieve this, the tasks of diagnosing the current state and institutional environment of the service, designing an organizational architecture integrated with the current system of regionalization, substantiating the economic mechanism and developing a strategic management system were set.

Methods

This study is a conceptual and analytical study with elements of organizational design. Data collection was carried out using regulatory legal acts of the Republic of Kazakhstan (the Code "On the Health of the People and the Healthcare System", the National Development Plan until 2029, state programs for the development of healthcare and orders on the regionalization of perinatal care), official statistics on maternal and infant mortality.

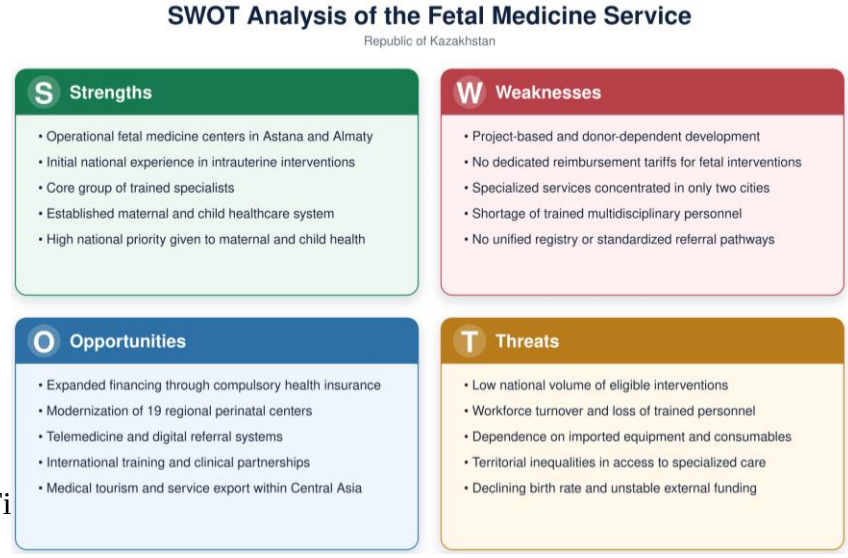
The system structural and functional analysis included a description of the service as a multi-level system, content analysis of regulatory and statistical sources, comparative analysis, SWOT and PEST analysis for assessing the internal and external environment, the balanced scorecard method for building a strategic map and a system of indicators. Methods of economic and organizational modeling were used to design the financial contour.

Results

Diagnostics and the current state of the institutional environment of the service

The institutional environment for the development of fetal medicine in Kazakhstan is generally favorable. According to the national development plan, by 2029, it is planned to increase total expenditures on the healthcare system to 5% of the gross domestic product, as well as reduce the share of pocket expenses of the population to 20%. It is worth noting the prioritization of measures to reduce maternal and infant mortality.

As we all know, since 2020, there has been a system of compulsory social health insurance, where every citizen of the Republic of Kazakhstan is insured, and thanks to this system, the total financing of the industry has increased by more than 2.5 times. And in 2024, over 2.8 trillion tenge was allocated for medical care, including about 1.6 trillion tenge for primary health insurance and more than 1.2 trillion tenge for compulsory health insurance. Along with this, the maternity care infrastructure is being improved. Master plans for the renovation of 19 regional perinatal centers were approved, the network of women's consultations, as well as perinatal centers, was restored, and boarding houses for high-risk pregnant women were deployed. Starting in 2025, a preventive program is being implemented with a package of free studies at the primary health care level. The structure of internal and external factors by SWOT analysis is presented in figure 1.

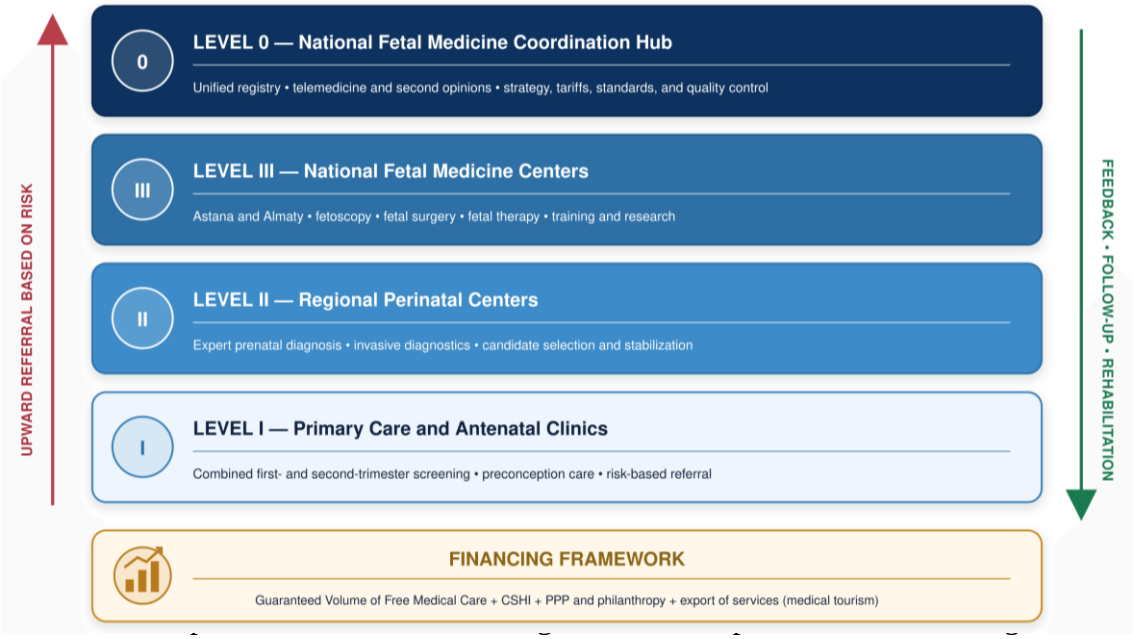


Fi c of Kazakhstan

The main diagnostic finding is that the technological barrier to entry has generally been overcome, while managerial and economic barriers remain today. And they define the subject of the design and the organizational and economic model.

Organizational architecture. A four-tier hub and spoke network.

The proposed four-level network does not create a parallel vertical, but rather is configured above the current three-level regionalization of perinatal care, while complementing it with a specialized fetal intervention circuit. The logic of the architecture of the four-tier Hub and Spoke network implies the concentration of the most complex and rare interventions in a few centers with a wide network, ensuring identification, selection, and patient orientation. This approach meets the specifics of fetal surgery, when small volumes of interventions make centralization one of the conditions for safety and quality. The system levels and their functions, as well as the main organizations, are shown in Figure 2.



hub-

In this case, the routing loop is a bottom-up backbone element with increasing risk, and the top-down feedback loop is a catamnestic observation, rehabilitation, and referral to lower levels. National zero-level centers turn disparate centers into a managed network, thereby ensuring the same selection criteria, remote consultation, as well as comparability of outcomes and reasonable allocation of resources.

The economic mechanism

The economic stability of the service is mainly ensured by the diversification of resources and correct pricing. The proposed mixed financing model combines both government guarantees and an insurance mechanism, as well as private-charitable resources and income from services. Table 1. This design has a significant connection with the combination of state pension insurance and compulsory medical insurance fixed in the legislation and with the course towards an increase in the share of insurance financing.

Table 1 – Financial outline of the model: source and purpose

Source	Funding	Tool

CSHBP	Screening, prenatal and invasive diagnostics, socially significant interventions	Per capita standard of primary health care, diagnostic standards
CSHI	Planned fetal interventions, inpatient care for the insured	Clinical and cost groups for fetal surgery
PPP and charity	Initial investments in equipment, personnel training, pilot programs	Public-private partnership contracts, grants, funds, social investments
Export of services	Development of centers, hubs, reinvestment in quality	Paid services for non-residents

One of the central tasks of the economic mechanism is the formation of dedicated clinical and cost groups for fetal interventions. To date, these interventions do not have independent tariffs and are "dissolved" in related articles, which makes financing opaque and demotivates organizations. The development of QPS that take into account the resource intensity of fetoscopic and open operations, the cost of consumables, and the length of stay is a prerequisite for transferring the service to sustainable cost recovery.

The economic justification for the expediency of investments is based on the logic of value-based healthcare, the desire to maximize clinical outcomes per unit cost. During intrauterine correction, it is possible to reduce the severity of disability, as well as lifelong costs of rehabilitation, repeat operations and social support.

Another macroeconomic effect is related to import substitution, the development of the internal service, which replaces expensive treatment abroad and stabilizes funds within the national economy.

Strategic management of service development is based on a balanced scorecard that includes the end results, namely, patient health and satisfaction with processes, resources, and training. The strategic map, in turn, includes four interrelated perspectives. These are the results for the patient and society, then processes and quality, finances and resources, as well as personnel, training and development. The logic of bottom-up causality is that investments in human resources and digital tools can improve processes, ensure financial sustainability, and ultimately deliver results for patients. The key indicators for the prospects are shown in table 2.

Table 2 – Balanced scorecard for the strategic development of the fetal medicine service in the Republic of Kazakhstan

Perspective	Key indicators	Landmark
Results for the patient and society	Coverage of expert prenatal diagnostics of risk groups.	Improving outcomes
Processes and quality	The proportion of patients routed according to the protocol.	Reduction of deadlines, completeness of the register
Finances and resources	The share of the service covered by the allocated tariffs	Sustainable cost recovery
Personnel and development	Number of trained fetal specialists, participation in international programs	Formation of a critical mass of personnel

In the implementation of the model, it is advisable to build it in stages. In other words, the first stage is formation: it implies institutionalization with the consolidation of the status of the service, as well as the creation of a national coordination center and registry, the development of clinical protocols and clinical cost groups, as well as the postponement of routes between the two centers and regions. The second stage includes scaling, namely the strengthening of the second level on the basis of the modernized regional perinatal centers, as well as the deployment of consultations through telemedicine, building human resources and increasing the volume of interventions to a safe threshold, as well as the transition to sustainable insurance compensation. The third stage involves sustainable development and export, namely reaching the market, self-sufficiency of the profile contour, the development of medical tourism from Central Asian countries, as well as investing income in quality and science, replicating models with ridiculous high-tech trends.

Discussion

The proposed model develops the idea of regionalization, which has proven effective in reducing maternal mortality in Kazakhstan, and this model transfers its principles to a new complex technological order. The difference between our model and the established practice is the transition from individual clinical successes to systemic management. Uniform selection criteria, transparent pricing, a register of outcomes and strategic indicators have been defined that turn a set of centers into a single managed network. The concentration of rare interventions in the centers correlates with international experience, when the safety of fetal surgery is directly related to the volume of the center's practice [8, 9].

The four-tier system of centers is consistent with the international approach to the certification of fetal therapy centers in terms of the complexity of the intervention, as well as the necessary resources. The consensus on the levels of medical care in fetal therapy centers notes that the complexity of the intervention should mainly correspond to the availability of both obstetric, anesthesiological, neonatal, pediatric, and ethical resources, which preserves the priority of safety, as well as the autonomy of pregnant patients. This is fundamentally important for the Republic of Kazakhstan, since the development of fetal medicine cannot only lead to the purchase of endoscopic equipment or the training of specialists. It requires the formation of a stable multidisciplinary team that can prepare around the clock for obstetric and neonatal services and the possibility of intensive care, genetic counseling and psychological support, as well as monitoring the child [10,11].

The concentration of the most complex interventions in the republican centers of Astana and Almaty is justified from the clinical and economic side. International recommendations, in turn, provide for the referral of complex cases to specialized centers that have relevant experience. The new recommendations of the International Society of Ultrasound in Obstetrics and Gynecology on the management of multiple pregnancies indicate the urgent need for expert assessment. Also, treatment of complicated pregnancies in both regional and tertiary centers of perinatal medicine. With a limited national number of potential interventions, greater decentralization can lead to the dispersion of personnel, technological and financial resources, which is insufficient to accumulate clinical experience [12].

Centralization should not imply the concentration of all diagnostic care in just two megacities. Therefore, in our proposed model, the functions are distributed between levels, namely, the identification of risk factors and primary routing is based on the PHC and women's counseling levels. Expert diagnosis and candidate collection in regional perinatal centers is one of the most difficult intrauterine interventions in republican centers. And this distribution of functions allows us to maintain the safety of high-quality care and at the same time makes it possible to ensure its territorial accessibility [13].

It is the combination of technology centralization and decentralization that is one of the significant organizational advantages of the proposed model for Kazakhstan, which is characterized

by a large territory and uneven population density. The availability of medical services is determined not only by the number of operating rooms, the timeliness of pathology detection, but also by the safe transportation of a pregnant woman. The use of consultation in telemedicine can reduce the number of unjustified trips and ensure the participation of national-level specialists, regardless of the place of residence of patients [14].

But it is worth noting that a telemedicine point will be effective if it is compatible with information systems, using a standardized format for transmitting both ultrasound images and other clinical data, thereby ensuring the protection of personal data and clearly consolidating responsibility for the final clinical decision. Thus, digitalization in this model should not be considered as an independent goal, but as a good tool for improving the availability and quality of medical care [15].

The urgent need to create a national registry is determined not only by the tasks of registration, accounting, but also by the peculiarities of fetal surgery itself. The small number of interventions, the versatility of congenital pathologies, and the delayed nature of clinical outcomes make it difficult to assess quality based on inpatient statistics. According to the experience of the North American Fetal Therapy Network, they demonstrate the importance of multicenter registries and collaborative research to standardize practice. And this is a study of the natural course of diseases and a comparison of the results of various interventions [16].

The national registry should include the entire patient's trajectory. These are the results of prenatal diagnosis, these are both indications and contraindications to intervention, the decision of the consultation, the type of procedure, maternal complications, the time and method of delivery, as well as neonatal outcomes, the need for surgery, the subsequent development of the child and the quality of life of the family. Without long-term follow-up, the number of procedures performed may increase. And this may not be considered as an indicator of the effectiveness of the service [17].

The clinical potential of intrauterine treatment has been confirmed strictly for certain pathological conditions. But the results cannot be extended to all congenital anomalies. In randomized cohort studies, myocardial correction of myelomeningocele significantly reduced the frequency of cerebrospinal fluid bypass surgery and improved motor outcomes in children by 30 months of age. At the same time, this intervention was accompanied by an increased risk of premature birth [18].

And this benefit-risk ratio confirms the need to define strict selection criteria, full informed consent from the patient, and independent discussion of each case. Therefore, these performance indicators of the service should not stimulate a mechanical increase in the number of surgical interventions. patient selection, maternal safety, prenatal survival, functional outcomes of the child, and family quality of life should be priority indicators.

Conclusion

Our proposed organizational and economic model provides for the transition from individual intrauterine interventions to the formation of a managed, financially stable and geographically accessible fetal medicine system in the Republic of Kazakhstan. The four-level hub and spoke architecture integrated with the regionalization of perinatal care can make it possible to centralize complex interventions in specialized centers and at the same time provide early detection of pathology, patient routing and expert advice at the regional level.

Author contribution

Conceptualization: Sh.K. **Investigation:** Sh.K. **Supervision:** Sh.K. **Methodology:** Sh.K. **Making interpretations:** Sh.K. **Writing – review & editing:** Sh.K.

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