

## Evolution of surgical treatment for congenital heart defects in Russia: a discussion analysis of the 2024 National Registry data

Alexander A. Morozov

**Corresponding author:** Alexander A. Morozov, [morozov\\_1981@mail.ru](mailto:morozov_1981@mail.ru)

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### ORCID

A.A. Morozov, <https://orcid.org/0000-0001-9350-8804>

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Saint Petersburg State Budgetary Healthcare Institution "Children's City Multidisciplinary Clinical Specialized Center for High Medical Technologies", Saint Petersburg, Russian Federation

### Abstract

This discussion article provides an analysis of the fundamental results from a large-scale study of the 2024 National Registry of surgical treatment for congenital heart diseases in the Russian Federation, which encompasses 14,640 surgical interventions. The published epidemiological and clinical indicators demonstrate the high overall efficacy of the Russian cardiac surgery service, as evidenced by an extremely low hospital mortality rate (1.42 %) and a distinct, clinically justified transition toward minimally invasive strategies. The data presented in the registry highlight the critical demand for further centralization of expertise for the treatment of high-risk neonatal cohorts and establish an evidence base for optimizing patient routing on a national scale.

**Keywords:** congenital heart diseases, cardiac surgery, national registry



## Эволюция хирургического лечения врожденных пороков сердца в России: дискуссионный анализ данных национального регистра 2024 года

А.А. Морозов

**Для корреспонденции:** Александр Александрович Морозов, [morozov\\_1981@mail.ru](mailto:morozov_1981@mail.ru)

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### ORCID

А.А. Морозов, <https://orcid.org/0000-0001-9350-8804>

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Санкт-Петербургское государственное бюджетное учреждение здравоохранения «Детский городской многопрофильный клинический специализированный центр высокотехнологичных медицинских технологий», Санкт-Петербург, Российская Федерация

### Аннотация

Настоящая дискуссионная статья посвящена анализу фундаментальных результатов масштабного исследования данных Национального регистра хирургического лечения врожденных пороков сердца в Российской Федерации за 2024 г., охватившего 14 640 оперативных вмешательств. Опубликованные эпидемиологические и клинические показатели демонстрируют высокую общую эффективность отечественной кардиохирургической службы, что подтверждается предельно низкой госпитальной летальностью (1,42 %) и отчетливым, клинически обоснованным переходом к малоинвазивным стратегиям. Представленные данные подчеркивают критическую потребность в дальнейшей централизации экспертизы для лечения высокорисковых неонатальных когорт и формируют доказательную базу для оптимизации маршрутизации пациентов в масштабах всей страны.

**Ключевые слова:** врожденные пороки сердца, кардиохирургия, национальный регистр



## Introduction

Congenital heart diseases (CHD) traditionally represents one of the most complex and resource-intensive challenges in modern pediatrics and cardiac surgery [1]. As the leading cause of infant mortality among all developmental anomalies, CHD requires the establishment of a highly integrated healthcare delivery system: from prenatal screening to multistage surgical repair and long-term follow-up [2]. Given the rapid evolution of medical technologies, the introduction of new hybrid protocols, and the changing demographic landscape, fragmented assessments of individual clinics' outcomes are losing their relevance. They are giving way to the era of "big data" and national registries. The current study by Soyнов et al., summarizing the 2024 data from all Russian cardiac surgery centers providing care to pediatric patients with cardiovascular anomalies, including neonates, is a monumental effort whose significance for the national healthcare system cannot be overstated [3]. This document does not merely record the current state of affairs; it sets strategic benchmarks for the development of the entire specialty.

## Discussion

From the standpoint of evidence-based medicine and scientific research methodology, this registry possesses several undeniable strengths that make it a reliable foundation for clinical and organizational decision-making.

First is its unprecedented scale and representativeness. The inclusion of 14,640 patients from 31 centers ensures maximum population coverage. This large sample size mitigates the statistical biases typical of single-center studies and provides an objective picture reflecting the performance of all participating institutions.

Second is the use of the validated international risk stratification tool, the RACHS II scale. This sound decision by the authors allows not only for the internal structuring of national data by complexity – from the routine closure of septal defects to complex surgical procedures for critical CHD in neonates – but also for comparing the outcomes of Russian surgeons with the results of international databases (STS Congenital Heart Surgery Database, ECHSA).

Third is the exceptional transparency and objectivity of the data. The authors address complex issues in cardiac surgery, publishing data on the surgical treatment of critical CHD in neonates and extremely low-birth-weight infants, as well as the outcomes of palliative reconstructions for critical CHD, where in-hospital mortality can exceed 30 %. Analyzing the results of multicenter studies allows for the optimization of treatment algorithms for complex heart anomalies, significantly improving the ef-

ficacy of surgical care. The high level of detail regarding the applied surgical paradigms should also be highlighted. The study clearly reflects the evolution of approaches and the stable trend toward implementing minimally invasive technologies in the treatment of CHD: the proportion of endovascular interventions reached 38.4 % with a minimal mortality rate (0.3 %), while the interventional arrhythmology segment (1,342 procedures) demonstrated a 100 % survival rate.

Strict stratification of operations into primary and redo, radical and palliative, as well as a detailed analysis of interventions performed under cardiopulmonary bypass, impart substantial academic and fundamental value to the registry.

The significance of this national registry for the healthcare system of the Russian Federation has several strategic dimensions: clinical, organizational, and economic. The vast territory of the Russian Federation, coupled with uneven population density, creates unique challenges for the referral pathways of patients with critical CHD. The registry data allow for the assessment of the efficacy of regional cardiac surgery services, identifying the need to establish cardiological follow-up services in the postoperative period. The development of prenatal diagnostics becomes a factor in further mitigating risks associated with postnatal transfer, enabling maternal transport for delivery followed by immediate surgical care for the newborn. However, the complexity of prenatal diagnosis for certain critical congenital heart diseases necessitates the development of regional centers capable of providing care of any complexity level. Analyzing surgical volumes alongside outcome evaluations allows for the creation of algorithms to assess the feasibility of developing regional clinics, identifying leading hospitals not only by quantitative indicators but also by the efficiency of referral pathways and healthcare outcomes.

It should be noted that among the 16 leading clinics in the country performing the highest number of interventions for critical CHD in neonates, 7 centers are under regional jurisdiction and 9 are under federal jurisdiction, three of which are National Medical Research Centers. The registry's utility is also reflected in the justification for decentralizing several routine surgical interventions. This allows them to be performed both in regional clinics and, if necessary, by mobile surgical teams, especially when transporting a critically ill patient is impossible.

The implementation of a hybrid or endovascular approach represents another significant trend, the relevance of which for Russian cardiac surgery is confirmed by the registry data. An illustrative example is the analysis of palliative care outcomes in ductus-dependent CHD. While the classic surgical creation of a systemic-to-pulmonary

shunt is associated with a mortality rate of 9.74 %, stenting of the patent ductus arteriosus reduces this figure to 4.95 %. Such a notable difference in outcomes among the most critically ill patient cohort provides grounds to believe that the endovascular approach in this clinical situation serves as a more favorable and safer alternative.

From a health economics perspective, treating a patient with CHD is an investment in a saved life that will yield socio-economic benefits for the state in the future. The reduction in overall mortality to 1.42 % means that the vast majority of children can achieve a normal quality of life. The 2024 registry provides undeniable arguments for preserving and expanding the volume of high-tech medical care, proving its high cost-effectiveness in the context of human capital.

Despite these impressive results, the registry leaves room for discussion. Primarily, this concerns the cohort of low-birth-weight neonates and patients with a functionally univentricular heart. Future research should focus on mortality predictors specifically within these groups. It may be advisable to integrate data on the status of prenatal diagnostics into subsequent registry reports to determine the extent to which the antenatal detection of an anomaly reduces postoperative mortality through the planned admission of the mother to a perinatal center affiliated with a cardiac surgery clinic. The successful development of multidisciplinary pediatric hospitals with an integrated cardiac surgery service has also proven advantageous, offering the capability for the simultaneous treatment of combined congenital anomalies starting from the neonatal period.

Furthermore, in the era of rapidly developing personalized medicine, analyzing long-term outcomes will be a crucial next step. Assessing quality of life, the need for reoperations (especially after the implantation of conduits and heart valves), and the neurological status of children who underwent surgeries under cardiopulmonary bypass will transform the surgical registry into a comprehensive medical and social platform. The analysis of performed surgical interventions conducted within the registry will eventually be supplemented by an in-depth and comprehensive analysis of the quality of surgical care and long-term outcomes. Altogether, this will enable the determination of optimal management strategies for patients with CHD, their referral pathways, rehabilitation, and quality control criteria for the surgical care provided.

## Conclusion

The 2024 national registry data confirm the high level of safety and efficacy of the Russian cardiac surgery service, demonstrating a distinct evolution toward minimally invasive and hybrid technologies that significantly improve outcomes even in the most critically ill patient populations. The identified patterns justify the feasibility of further strategic centralization of high-risk neonatal interventions in expert centers and confirm the registry's status as a fundamental tool for the evidence-based planning and improvement of the high-tech medical care delivery system in the Russian Federation.

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