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# ASSESSMENT OF THE DYNAMICS OF HOSPITALIZED MORBIDITY CHILDREN IN THE FIRST YEAR OF LIFE

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**ABSTRACT.** In order to assess the hospitalized morbidity in children of the first year of life, an assessment of the rates of hospitalization and the average length of stay of a patient in a bed, depending on the type of hospitalization, the profile of beds and the class of diseases according to ICD-10 in dynamics over three years was made. To analyze the data, information obtained from the medical information system "Ariadna" by sampling 3371 children was used. Inclusion criteria: permanent residence in St. Petersburg, hospitalization in the first year of life in 2020–2022. It was found that the highest frequency of emergency hospitalizations was observed in the year of the onset of the COVID-19 pandemic. Patients of the first year of life who were admitted urgently stayed in the hospital for less time than planned patients. Most often, patients were hospitalized in ophthalmic, pediatric and surgical beds, which accounted for 2/3 of all hospitalizations in the children's multidisciplinary hospital during the study period. The children spent the longest time in other beds, among which the largest contribution was made by resuscitation beds for newborns. High rates of average length of stay were observed in neuropsychiatric, pediatric and surgical beds. Children with congenital anomalies (malformations), deformities and chromosomal abnormalities ranked first in the frequency of admission to the hospital, second and third places — with diseases of the skin and subcutaneous tissue and respiratory diseases, which grew during the studied time interval. The lowest rate of hospitalizations and the average length of stay in intensive care was observed in the year of strict quarantine restrictions, which was associated with the predominance of patients from the obstetric hospital of the perinatal center and emergency children with a general decrease in the flow of patients from medical organizations of the metropolis. Thus, the indicators of hospitalized morbidity were significantly affected by the COVID-19 pandemic, the presence of a perinatal center in the structure of a children's multidisciplinary hospital, and the children's hospital performing the functions of a third-level medical organization.

**KEY WORDS:** children of the first year of life; children's multidisciplinary hospital; frequency of hospitalizations; average length of stay of a patient in a bed; metropolis.

# ОЦЕНКА ДИНАМИКИ ГОСПИТАЛИЗИРОВАННОЙ ЗАБОЛЕВАЕМОСТИ ДЕТЕЙ ПЕРВОГО ГОДА ЖИЗНИ

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**РЕЗЮМЕ.** Для анализа данных госпитализированной заболеваемости детей первого года жизни была проведена оценка показателей частоты госпитализации и средней длительности пребывания больного на койке в зависимости от типа госпитализации, профиля коек и класса болезней по МКБ-10 в динамике за три года. Для анализа данных были использованы сведения, полученные из медицинской информационной системы «Ариадна», путем выборки 3371 ребенка. Критерии включения: постоянное проживание в г. Санкт-Петербурге, госпитализация на первом году жизни в 2020–2022 гг. Установлено, что наиболее высокая частота экстренных госпитализаций наблюдалась в год начала пандемии COVID-19. Пациенты первого года жизни, поступившие экстренно, находились в стационаре менее длительно, чем плановые больные. Наиболее часто пациенты госпитализировались на офтальмологические койки, койки педиатрических и хирургических профилей, на долю которых в исследуемый период приходилось 2/3 всех госпитализаций в детский многопрофильный стационар. Наиболее длительно дети находились на прочих койках, среди которых наибольший вклад внесли реанимационные койки для новорожденных. Высокие показатели средней длительности пребывания прослеживались на психоневрологических, педиатрических и хирургических койках. На первом месте по частоте госпитализаций в стационар были дети с врожденными аномалиями (пороками развития), деформациями и хромосомными нарушениями, на втором и третьем местах — с болезнями кожи и подкожной клетчатки и болезнями органов дыхания, которые в течение изучаемого временно́го интервала росли. Самый низкий показатель частоты госпитализаций и средней длительности пребывания в реанимации наблюдался в год строгих карантинных ограничений, что было связано с преобладанием пациентов из акушерского стационара перинатального центра и экстренно поступивших детей при общем снижении потока больных из медицинских организаций мегаполиса. Таким образом, на показатели госпитализированной заболеваемости оказывали существенное влияние пандемия COVID-19, наличие перинатального центра в структуре детского многопрофильного стационара и выполнение детской больницей функций медицинской организации третьего уровня.

**КЛЮЧЕВЫЕ СЛОВА:** дети первого года жизни; детский многопрофильный стационар; частота госпитализаций; средняя длительность пребывания больного на койке; мегаполис.

## INTRODUCTION

The struggle for the life and health of each newborn becomes especially important in the context of demographic problems, when the birth rate is much lower than the mortality rate and further population decline may become a problem of state security [2, 3]. According to the Unified Plan for Achieving National Development Goals of the Russian Federation, reducing infant mortality is a key component of increasing life expectancy [6].

The priority of child health care is one of the fundamental principles of national health care, which guarantees special protection for children [8]. In modern conditions, the protec-

tion of motherhood and childhood is a priority for the health care system of the Russian Federation [7]. To increase the indicator of child health at the state level, a significant number of programs are being developed, among which is the Federal project "Development of children's health care, including the creation of modern infrastructure of medical care for children" [9].

The project envisages the development of infrastructure for the organization of medical care for children in children's polyclinics, children's polyclinic departments and the construction (reconstruction) of regional, district and republican children's hospitals. Thus, in case health deviations occur, our country ensures that children are provided with the necessary medical care of adequate quality and accessibility.

There is no doubt that the first year of life is the most important stage in the formation of a person's future health. During the first 12 months there is a rapid development of all organs and systems. Moreover, the infant adapts to the outside world. That is why early detection of diseases and pathological conditions is especially important for timely provision of medical care to a child [5]. The current system of children's health care is represented by a wide network of medical organizations, it is fully capable to meet the needs of the pediatric population [11]. Hospital institutions, which have been equipped with modern equipment in different Russian regions over the past few years, play a special role in the system of medical care for the pediatric population [1]. Specialized, including high-tech, medical care for children provided in inpatient settings of children's hospitals is the most resource-intensive sector of children's health care [10]. Advanced techniques and scientific developments are actively introduced into practical healthcare in the course of providing this type of medical care [4]. In addition, multidisciplinary children's hospitals are provided with the most highly qualified medical personnel.

Thus, the assessment of the dynamics of hospitalized morbidity in children of the first year of life is a relevant topic for research since the first year of life is extremely important period for the formation of the child's future health and, concurrently, children's hospitals are important in the system of providing specialized medical care to the pediatric population.

## AIM

To evaluate the dynamics of hospitalized morbidity in children of the first year of life in 2020–2022.

## MATERIALS AND METHODS

The base of this study was a multidisciplinary pediatric hospital of the Federal State Budgetary Educational Institution of Higher Professional Education "St. Petersburg State Pediatric Medical University" of the Ministry of Health of Russia (SPbSPMU), which belongs to the third-level hospitals. Information obtained from the Ariadna medical information system was used for data analysis by sampling children hospitalized during the first year of life in 2020–2022. Inclusion criteria: hospitalization in the first year of life in a pediatric multidisciplinary hospital of SPbSMU and permanent residence of the child in St. Petersburg. Thus, 3371 children were selected for the research: 1124 children in 2020, 1119 children in 2021, 1128 children in 2022. The average age of the hospitalized patient was 5.35±0.10 months, sex distribution: boys — 57.3%, girls — 42.7%.

Hospitalized morbidity was assessed by analyzing the frequency of hospitalizations and the average length of stay of a patient in a bed depending on the type of hospitalization, bed profile, classes of diseases in accordance with ICD-10 and intensive care stay. For this purpose, extensive and intensive indicators, arithmetic weighted mean and its error were calculated. The reliability of differences in the indicators was assessed using Student's criterion. Differences were considered significant at $p < 0.05$. Statistical processing of data was performed using MS Office 2016 and STATISTICA 10.0 software.

## RESULTS AND DISCUSSION

The assessment of the frequency of hospitalizations depending on their type showed (Table 1) that 654.80 for every 1,000 of discharged infants were urgently hospitalized in the year of the COVID-19 pandemic onset, whereas from 2021 onwards, health care organizations have fully adapted to the new conditions and the prevalence of planned admissions has increased.

*Table 1*

The frequency of hospitalization and the average length of stay of a patient in a bed, depending on the type of hospitalization in 2020–2022 (in ‰ (abs.) and M±m)

*Таблица 1*

Частота госпитализации и средняя длительность пребывания больного на койке в зависимости от типа госпитализации в 2020–2022 гг. (в ‰ (абс.) и M±m)

| Тип госпитализации / Type of hospitalization | 2020 год / year | | 2021 год / year | | 2022 год / year | | Динамика / Dynamics | |
|---|---|---|---|---|---|---|---|---|
| | Частота / Frequency | Средняя длительность / Average duration | Частота / Frequency | Средняя длительность / Average duration | Частота / Frequency | Средняя длительность / Average duration | Частота / Frequency | Средняя длительность / Average duration |
| Экстренная / Emergency | 654,80 (736) | 5,81±0,57 | 467,38 (523) | 8,16±1,17 | 464,54 (524) | 4,71±0,30 | –29,1 | –18,9 |
| Плановая / Planned | 345,20 (388) | 6,86±0,52 | 532,62 (596) | 8,39±0,48 | 535,46 (505) | 8,08±0,56 | +35,5 | +15,1 |

* Статистически значимая разница между показателями 2020 и 2022 гг. (p <0,05).

In 2021, the level of planned hospitalization increased by 28.6% compared to a previous year, and in 2022 it slightly decreased by 0.6%. In general, over the three years, the decrease in the flow of emergency patients was 29.1%. Assessment of the average length of stay of a patient in a bed depending on the type of hospitalization revealed that patients admitted in a planned manner stayed in the hospital for a longer period of time. The greatest difference between the average length of stay of children of the first year of life in the hospital was observed in 2022, when it was 2 times longer than the period of emergency hospitalization (p <0.05). At the same time, the duration of planned hospitalization increased by 15.1% between 2020 and 2022, while the duration of emergency hospitalization decreased by 18.9%. Despite this difference, in 2021, the average length of stay of patients admitted for emergency hospitalization was almost equal to the planned one.

Patients were most frequently hospitalized in ophthalmology, pediatric and surgical beds (Table 2), which accounted for 2/3 of all hospitalizations in the pediatric multidisciplinary hospital in 2020–2022. Over the three years, the level of hospitalizations of children in these beds decreased, along with psychoneurological and other beds, which was determined by an increase in the frequency of hospitalizations in infectious diseases beds, as well as dermatology and otolaryngology beds. Assessment of the average length of stay of patients in a bed depending on their profile revealed that during the research period, infants had the longest stay in other beds, with neonatal intensive care beds contributing the most. In 2020, the highest average length of stay was in neuropsychiatric (9.75±1.75 days) and pediatric (9.63±2.21 days) beds. Evaluation of the dynamics of indicators revealed that compared to 2020, in 2022, the average length of stay increased most significantly in pediatric beds (+41.2%), otolaryngology (+34.6%) and ophthalmology beds (+15.7%). At the same time, children spent less time in hospital in infectious diseases (–38.1%), surgery (–23.4%) and dermatology beds (–26.9%).

The frequency of hospitalization and the average length of stay of a patient in a bed, depending on the class of diseases according to ICD-10 (Table 3) were studied in the course of the study. It was revealed that during the whole research period children with congenital malformations, deformations and chromosomal abnormalities were in the first place in terms of frequency of hospitalizations, while the second and third places were occupied by diseases of the skin and subcutaneous tissue and diseases of the respiratory organs, which increased during 2020–2022. In addition to them, the rate of hospitalization of patients with certain conditions originating in the perinatal period (+42.3%) and diseases of the skin and subcutaneous tissue (+22.3%) increased significantly during the study period. The frequency of hospitalizations of children with endocrine, nutritional and metabolic diseases and diseases of the eye and adnexa decreased most significantly (by

*Table 2*

The frequency of hospitalization and the average length of stay of a patient in bed depending on the type of bed profile in 2020–2022 (in ‰ (abs.) and M±m)

*Таблица 2*

Частота госпитализации и средняя длительность пребывания больного на койке в зависимости от типа профиля коек в 2020–2022 гг. (в ‰ (абс.) и M±m)

| Профиль коек / Bed profile | 2020 год / year | | 2021 год / year | | 2022 год / year | | Динамика / Dynamics | |
|---|---|---|---|---|---|---|---|---|
| | Частота / Frequency | Средняя длительность / Average duration | Частота / Frequency | Средняя длительность / Average duration | Частота / Frequency | Средняя длительность / Average duration | Частота / Frequency | Средняя длительность / Average duration |
| Педиатрические / Pediatric | 205,52 (231) | 5,66±1,63 | 207,33 (232) | 10,53±2,50 | 198,58 (221) | 9,63±2,21 | –3,4 | +41,2 |
| Хирургические / Surgical | 243,78 (278) | 10,10±4,03 | 197,51 (78) | 15,64±5,97 | 172,87 (213) | 7,74±2,12 | –29,1 | –23,4 |
| Инфекционные / Infectious | 88,97 (100) | 10,40±3,80 | 171,58 (192) | 9,69±0,20 | 153,37 (173) | 6,44±1,62 | +42,0 | –38,1 |
| Психоневрологические / Psychoneurological | 19,58 (22) | 8,82±1,62 | 9,83 (11) | 9,10±1,92 | 6,2 (7) | 9,75±1,75 | –68,3 | +9,5 |
| Дерматологические / Dermatological | 51,60 (58) | 7,13±0,45* | 61,66 (69) | 5,58±0,37 | 85,11 (96) | 5,21±0,39* | +39,4 | –26,9 |
| Отоларингологические / Otolaryngological | 31,14 (35) | 2,80±0,52 | 33,96 (35) | 3,42±0,74 | 46,99 (53) | 4,28±0,67 | +33,7 | +34,6 |
| Офтальмологические / Ophthalmic | 245,55 (276) | 1,72±0,13 | 198,39 (222) | 2,21±0,19 | 198,58 (224) | 2,04±0,19 | –19,1 | +15,7 |
| Прочие / Other | 110,32 (124) | 14,05±6,96 | 119,75 (134) | 19,63±7,13 | 98,4 (111) | 14,20±2,58 | –10,8 | +1,1 |

* Статистически значимая разница между показателями 2020 и 2022 гг. (p <0,05) / Statistically significant difference between the indicators 2020 and 2022 years (p <0,05).

4.2 times). In addition, there was a 1.4-fold decrease in hospitalizations for diseases of the genitourinary system, a 1.3-fold decrease for diseases of the digestive system, and a 1.7-fold decrease for diseases of the blood, hematopoietic organs and certain disorders involving the immune mechanism.

As previously mentioned, the longest period of stay among the children of the first year of life was in the intensive care beds for newborns (Fig. 2), which is determined by the presence of a perinatal center in the structure of the children's multidisciplinary hospital as well as hospitalization and medical evacuation of critically ill patients of the first month of life in the third-level children's hospital. The assessment of the frequency of hospitalizations of children in intensive care in 2020–2022 revealed that the highest value of indicators was observed in 2021, when the hospitalization rate reached 66.13 per 1,000 hospitalized infants under one year of age (Fig. 1). The lowest rate of emergency care hospitalizations was in the year of strict quarantine restrictions. This was attributed to the predominance of patients from obstetric hospitalization as well as to a decrease in the flow of patients from medical organizations of St. Petersburg. Overall, the frequency of intensive care unit hospitalizations decreased by 16.3% over the three years.

Evaluation of the average length of stay of children in intensive care beds showed that during the studied period these indicators were also influenced by the pandemic . In 2020, children admitted mainly from the obstetric hospital

*Table 3*

The frequency of hospitalization and the average length of stay of a patient in a bed, depending on the class of diseases according to ICD-10 in 2020–2022 (in ‰ (abs.) and M±m)

*Таблица 3*

Частота госпитализации и средняя длительность пребывания больного на койке в зависимости от класса болезней по МКБ-10 в 2020–2022 гг. (в ‰ (абс.) и M±m)

| Класс болезней по МКБ-10 / Class of diseases according to ICD-10 | 2020 год / year | | 2021 год / year | | 2022 год / year | | Динамика / Dynamics | |
|---|---|---|---|---|---|---|---|---|
| | Частота / Frequency | Средняя длительность / Average duration | Частота / Frequency | Средняя длительность / Average duration | Частота / Frequency | Средняя длительность / Average duration | Частота / Frequency | Средняя длительность / Average duration |
| I Некоторые инфекционные и паразитарные болезни / Certain infectious and parasitic diseases (A00–B99) | 21,35 (24) | 5,63±1,19* | 17,87 (20) | 8,25±1,77 | 22,16 (25) | 11,40±5,32* | +3,7 | +50,6 |
| III Болезни крови, кроветворных органов и отдельные нарушения, вовлекающие иммунный механизм / Diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism (D50–D89) | 74,73 (84) | 13,33±11,34 | 44,68 (50) | 8,60±1,81 | 44,33 (50) | 16,33±8,31 | –40,7 | +78,1 |
| IV Болезни эндокринной системы / Endocrine, nutritional and metabolic diseases (E00–E90) | 25,80 (29) | 6,31±2,53* | 10,72 (12) | 14,42±2,28 | 6,21 (7) | 11,28±6,65* | –75,9 | –15,4 |
| VII Болезни глаза и его придаточного аппарата / Diseases of the eye and adnexa (H00–H59) | 99,64 (112) | 1,93±0,23* | 17,87 (20) | 4,55±1,03 | 23,94 (27) | 5,89±0,94* | –76,0 | +67,2 |
| X Болезни органов дыхания / Diseases of the respiratory system (J00–J99) | 117,44 (132) | 6,51±0,64 | 147,45 (165) | 9,05±2,70 | 122,34 (138) | 6,49±0,53 | +4,0 | –0,3 |
| XI Болезни органов пищеварения / Diseases of the digestive system (K00–K93) | 105,87 (119) | 4,26±0,83 | 95,62 (107) | 5,07±0,95 | 79,79 (90) | 6,61±1,74 | –24,6 | +35,6 |
| XII Болезни кожи и подкожной клетчатки / Diseases of the skin and subcutaneous tissue (L00–L99) | 97,86 (110) | 4,65±0,40 | 105,45 (118) | 4,37±0,29 | 125,89 (142) | 4,01±0,31 | +22,3 | –13,8 |
| XIV Болезни мочеполовой системы / Diseases of the genitourinary system (N00–N99) | 85,41 (96) | 10,31±0,83 | 80,43 (90) | 12,74±1,54 | 62,06 (70) | 10,80±0,82 | –27,3 | +85,5 |
| XVI Отдельные состояния, возникающие в перинатальном периоде / Certain conditions originating in the perinatal period (P00–P96) | 44,48 (50) | 13,72±3,15* | 64,34 (72) | 10,06±1,18 | 77,13 (87) | 9,69±1,94* | +42,3 | –29,3 |
| XVII Врожденные аномалии (пороки развития), деформации и хромосомные нарушения / Congenital malformations, deformations and chromosomal abnormalities (Q00–Q99) | 238,43 (268) | 6,54±0,78* | 292,23 (327) | 7,43±0,71 | 287,23 (324) | 4,67±0,35* | +17,0 | -28,6 |
| Прочие / Other | 6,23 (7) | 9,13±2,96 | 6,26 (7) | 13,8±15,66 | 3,55 (4) | 10,13±3,00 | –43,0 | +9,9 |

* Статистически значимая разница между показателями 2020 и 2022 гг. (p <0,05).

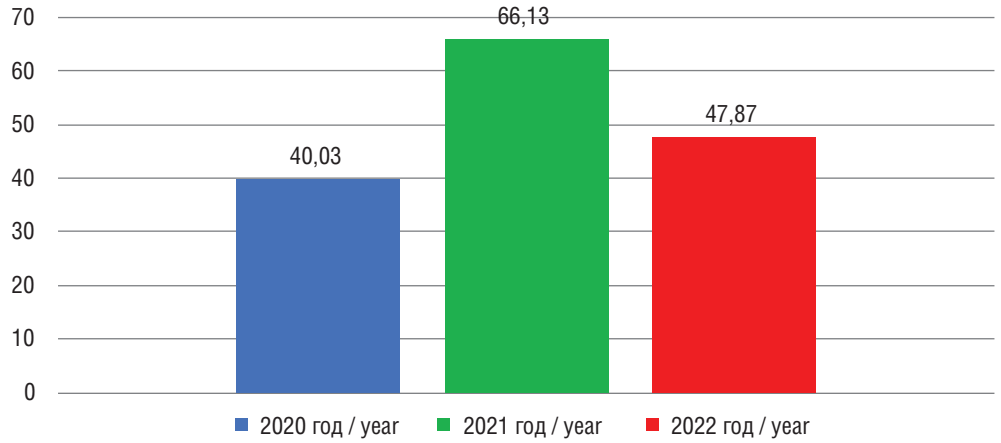


Fig. 1. The frequency of hospitalizations in intensive care in 2020–2022 (in ‰)

Рис. 1. Частота госпитализаций в реанимацию в 2020–2022 гг. (в ‰)

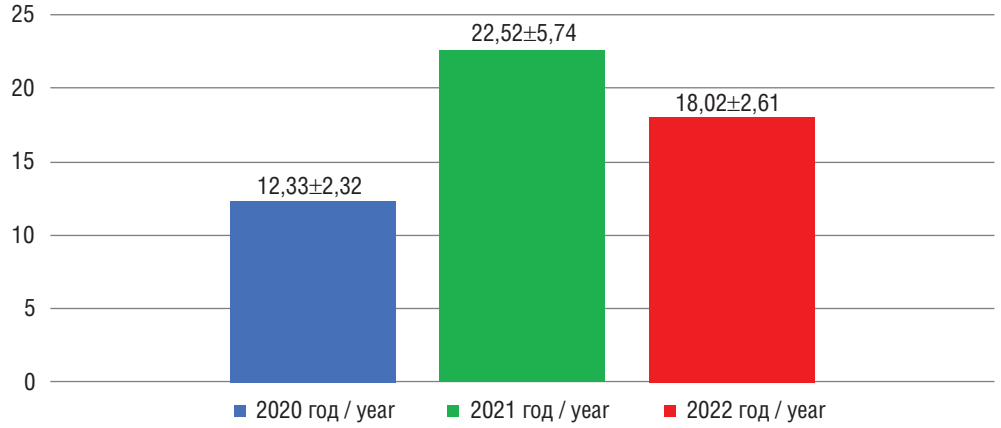


Fig. 2. Average length of stay on a bed in intensive care in 2020–2022 (M±m)

Рис. 2. Средняя длительность пребывания на реанимационных койках в 2020–2022 гг. (в ‰)

of the perinatal center stayed in intensive care beds less than in the subsequent years studied (12.33±2.32 days). In 2021, hospitalizations of critically ill patients from medical organizations and those delivered by ambulance (emergency) increased, the average time of stay in emergency units among children under 1 year old rose by 45.5% to the level of 2020 and by 31.6% in 2022.

Thus, the assessment of hospitalized morbidity indicators revealed that the frequency and duration of hospital bed stays of children in the first year of life were affected by the COVID-19 pandemic, the presence of a perinatal center in the structure of a pediatric multidisciplinary hospital, as well as the level of the hospital and related functional features of the medical organization.

## CONCLUSION

1. The highest rate of emergency hospitalizations was observed in the year of COVID-19 pandemic onset. From 2021 onwards, planned hospitalizations became predominant, and the flow of emergency patients dropped by 29.1% over the three years. Patients admitted on a planned basis had a longer hospital stay than those hospitalized urgently. The average length of planned hospitalization increased by 15.1% between 2020 and 2022, while emergency hospitalization decreased by 18.9%.

2. Patients were most frequently hospitalized in ophthalmology beds, pediatric and surgical beds, which accounted for 2/3 of all hospitalizations in a pediatric multidisciplinary hospital during the research period. Over the three

years, the rate of hospitalizations of children in these beds has been decreasing due to a significant increase in the frequency of hospitalizations in infectious diseases, dermatology and otolaryngology beds. Children spent the longest time in other beds, among which neonatal intensive care beds contributed the most. High average length of stay was also observed in psychoneurological, pediatric and surgical beds. Over three years, the average length of stay in pediatric, otolaryngology and ophthalmology beds increased significantly, while it decreased in infectious diseases, surgery and dermatology beds.

3. Children with congenital anomalies (malformations), deformations and chromosomal disorders were in the first place in terms of frequency of hospitalizations, while the second and third places were taken by diseases of the skin and subcutaneous tissue and diseases of the respiratory system, which were on the rise during the studied period. At the same time, the frequency of hospitalizations of children with diseases of the endocrine system, diseases of the eye and adnexa decreased by 4.2 times.

4. The lowest rate of hospitalizations and average length of stay in intensive care units was observed in the year of strict quarantine restrictions, which was due to the predominance of patients from the obstetric hospital of the perinatal center and emergency children, with a general decrease in the flow of patients from medical organizations of St. Petersburg. Over three years, the frequency of hospitalizations and the average length of stay in intensive care decreased by 16.3 and 31.6%, respectively.

Thus, the conducted research of hospitalized morbidity rates showed the influence of the COVID-19 pandemic, the presence of a perinatal center in the structure of the children's multidisciplinary hospital, and the role of the third-level medical organization.

## ADDITIONAL INFORMATION

**Author contribution.** Thereby, all authors made a substantial contribution to the conception of the study, acquisition, analysis, interpretation of data for the work, drafting and revising the article, final approval of the version to be published and agree to be accountable for all aspects of the study.

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