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ANALYSIS OF THE ACTIVITY OF THE INTENSIVE CARE UNIT OF THE PEDIATRICS CENTER

Resume
Background. This article presents the results of an analysis of the activities of the anesthesiology and resuscitation department at the Scientific Center for Pediatrics and Pediatric Surgery over the period 2020–2022. The study focused on key performance indicators of the resuscitation and intensive care units, including the number of patients treated, mortality rates, and the number of patients transferred to specialized departments.
Purpose of the study. To analyze the activities of the intensive care unit departments to assess the efficiency of the resuscitation and anesthesiology unit and identify key aspects that require optimization to improve the quality of medical care.
Materials and methods. The annual reporting data of the anesthesiology and resuscitation block of the Scientific Center for Pediatrics and Pediatric Surgery for the period 2020–2022 were used for the analysis.
Results. As part of the study, data from four specialized departments of anesthesiology and resuscitation block at the Scientific Center for Pediatrics and Pediatric Surgery were analyzed. Among them, the oncology and hematology department ranked highest in terms of the number of patients treated, the number of children transferred from resuscitation and intensive care units, and the mortality rate. The analysis revealed that the highest number of fatal cases was recorded among newborns, with the primary cause being multiple congenital malformations.
Conclusions. The Pediatric Center needs to focus its efforts on creating conditions for sustainable staffing with anesthesiologists and intensivists, as well as on regular professional development, with a particular emphasis on specialization in the field of oncology and hematology.
Keywords: intensive care unit, anesthesiology, newborns

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ПЕДИАТРИЯ ОРТАЛЫҒЫНЫҢ РЕАНИМАЦИЯЛЫҚ-АНЕСТЕЗИОЛОГИЯЛЫҚ БЛОГЫНЫҢ ҚЫЗМЕТІН ТАЛДАУ

Түйін: Бұл мақалада перинатология орталығының реанимациялық-анестезиологиялық бөлімшесінің 2020-2022 жылдар кезеңіндегі қызметін талдау нәтижелері келтірілген. Авторлар анестезиология, реанимация және қарқынды терапия бөлімшелерінің жұмыс көрсеткіштерін, емделген науқастардың саны, өлім-жітім деңгейі және бейіндік бөлімшелерге ауыстырылған науқастар саны сияқты көрсеткіштерді зерттеді.
Зерттеу мақсаты. Реанимациялық-анестезиологиялық блоктың жұмыс істеу тиімділігін бағалау және медициналық көмектің сапасын арттыру үшін оңтайландыруды талап ететін негізгі аспектілерді анықтау мақсатында перинатология орталығының анестезиология, реанимация және қарқынды терапия бөлімшелерінің қызметіне талдау жүргізу.
Материалдар мен әдістер. Перинатология орталығының реанимациялық-анестезиологиялық блогының 2020-2022 жылдарғы жылдық есептік деректері талданды.
Зерттеу нәтижелері. Зерттеу барысында перинатология орталығының реанимациялық-анестезиологиялық блогының төрт мамандандырылған бөлімшесінің деректері талданды. Олардың ішінде емделушілер саны, балалардың анестезиология, реанимация және реанимация бөлімшелерінен ауыстырылғандар саны және өлім-жітім деңгейі бойынша онкогематология бөлімшесі көш бастады. Талдау сонымен қатар жаңа туған нәрестелер арасында өлім-жітімнің ең көп саны тіркелгенін көрсетті, өлім-жітімнің негізгі себебі бірнеше туа біткен ақаулар болды.
Қорытындылар. Педиатрия орталығы анестезиолог-реаниматологтардың тұрақты кадрлармен қамтамасыз етуіне жағдай жасауға, сондай-ақ олардың біліктілігін жүйелі түрде арттыруға, әсіресе онкогематология саласында назар аударуы қажет.
Түйінді сөздер: қарқынды терапия бөлімшесі, анестезиология, жаңа туған нәрестелер.

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Введение. В данной статье представлены результаты анализа деятельности реанимационно-анестезиологического отделения Научного центра педиатрии и детской хирургии за период 2020–2022 годы. В ходе исследования авторами были изучены ключевые показатели работы отделений реанимации и интенсивной терапии, включая количество пролеченных пациентов, уровень летальности и число больных, переведённых в профильные отделения.
Цель исследования. Провести анализ деятельности отделений реанимации и интенсивной терапии с целью оценки эффективности функционирования реанимационно-анестезиологического блока и выявления ключевых аспектов, требующих оптимизации для повышения качества медицинской помощи.
Материалы и методы. Для анализа были использованы годовые отчетные данные реанимационно-анестезиологического блока Научного центра педиатрии и детской хирургии за период 2020–2022 годы.
Результаты исследования. В рамках исследования были проанализированы данные четырех специализированных отделений реанимационно-анестезиологического блока Научного центра педиатрии и детской хирургии. Среди них отделение онкогематологии лидировало по количеству пролеченных пациентов, числу детей, переведенных из отделений реанимации и интенсивной терапии, а также по уровню летальности. Анализ показал, что наибольшее количество летальных случаев зарегистрировано среди новорождённых, основной причиной которых стали множественные врожденные пороки развития.
Выводы. Центру педиатрии необходимо сосредоточить усилия на создании условий для устойчивого кадрового обеспечения врачами анестезиологами-реаниматологами, а также на регулярном повышении их квалификации, с особым акцентом на специализацию в области онкогематологии.
Ключевые слова: отделение интенсивной терапии, анестезиология, новорожденные.

Background. The Research Center of Pediatrics and Pediatric Surgery is one of the oldest medical institutions in Kazakhstan. It was founded on November 28, 1932 by the decree of the Central Executive Committee and the Council of People's Commissars of the Kazakh ASSR as the Research Institute for the Protection of Motherhood and Infancy.
Currently, the center actively operates departments of neonatology with surgery of newborns, general pediatrics, pulmonology, oncology and hematology, surgery, urology, cardiac surgery, interventional cardiology and vascular surgery. In addition, the center has four departments of anesthesia, resuscitation and intensive care, which provide specialized care to patients of various profiles.
The resuscitation and anesthesiology unit of "RCPPS" JSC provides highly qualified medical care to children from newborns to 18 years old in critical and terminal conditions. The range of pathologies that the specialists of the unit work with includes surgical, complex somatic, oncohematological and cardiac surgical diseases.
Since June 1, 2022, a new department of resuscitation, anesthesiology and intensive care for newborns has started operating at "RCPPS" JSC. Thus, the structure of the resuscitation and anesthesiology unit includes four specialized departments:
1) Department of resuscitation, anesthesiology and intensive care for older children.
2) Department of resuscitation, anesthesiology and intensive care for newborns.
3) Department of resuscitation, anesthesiology and intensive care for cardiac surgery.
4) Department of resuscitation, anesthesiology and intensive care for oncohematological patients.
Below are the departments of the resuscitation and anesthesiology unit of "RCPPS" JSC (Figure 1).

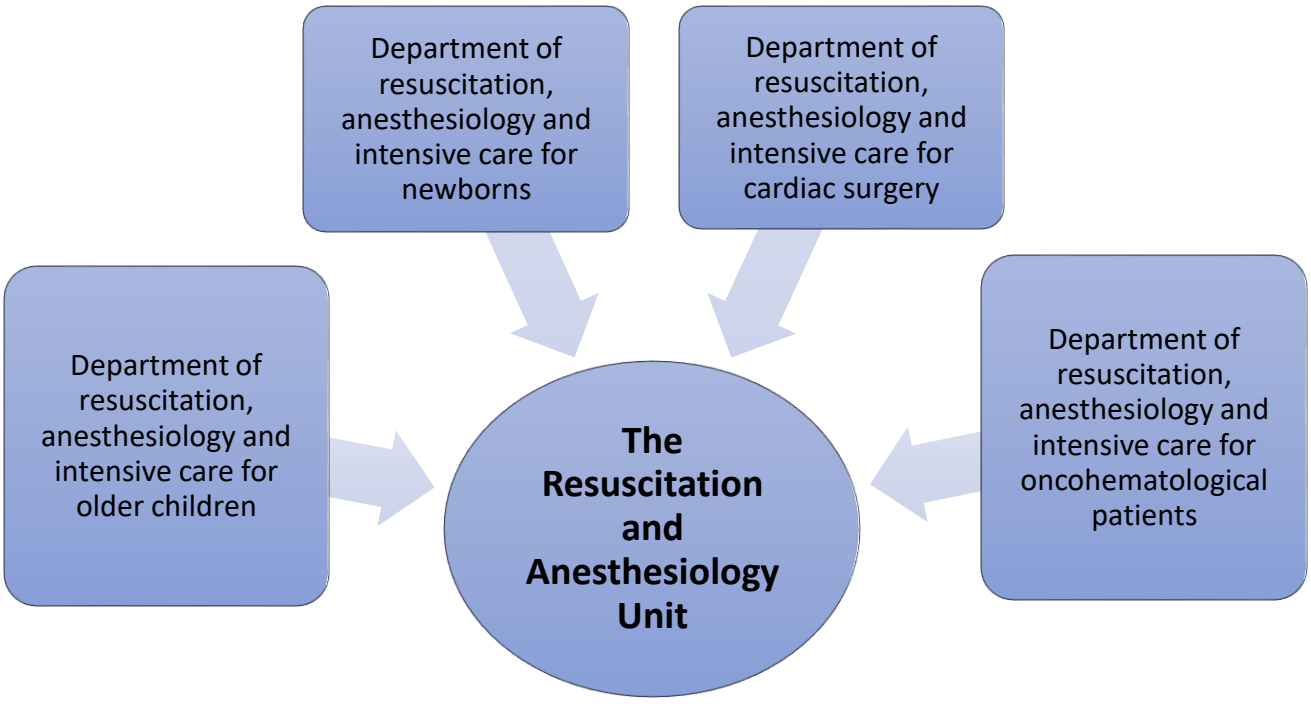

Figure 1 – The structure of the resuscitation and anesthesiology unit of NCPPS

According to many studies, the main performance indicators of the resuscitation and anesthesiology unit are the number of treated patients, the average length of stay in the department, the mortality rate, the number of patients transferred to specialized departments, as well as other key parameters reflecting the quality and effectiveness of medical care [1-7].
Purpose of the study. To analyze the activities of the intensive care unit departments of "RCPPS" JSC in order to assess the efficiency of the resuscitation and anesthesiology unit and identify key aspects that require optimization to improve the quality of medical care.
Materials and methods. The research materials include annual reporting data of the resuscitation and anesthesiology unit of "RCPPS" JSC for the period 2020-2022.
Results. This article analyzes data on the number of children admitted in 2020-2022, the number of patients transferred to specialized departments, as well as deaths for the same period. The results of the study are presented with distribution across four departments of the resuscitation and anesthesiology unit, which made it possible to identify the features of the work of each of them.
Below are the main performance indicators of the resuscitation and anesthesiology unit of the National Center for Pediatrics and Children's Surgery for 2020-2022 (Table 1).

Table 1 – Performance indicators of the resuscitation and anesthesiology unit of the National Center for Pediatrics and Children's Surgery for 2020-2022

Department	Department of resuscitation, anesthesiology and intensive care for newborns			Department of resuscitation, anesthesiology and intensive care for older children			Department of resuscitation, anesthesiology and intensive care for cardiac surgery			Department of resuscitation, anesthesiology and intensive care for oncohematological patients		
	2020	2021	2022	2020	2021	2022	2020	2021	2022	2020	2021	2022
Total number of admitted:	-	-	163	1670	1623	1508	503	491	460	3287	3585	3795
Died	-	-	6	11	20	6	33	28	22	38	60	46
Mortality rate per number of children admitted	-	-	3,6%	0,6 %	1,2%	0,4%	6,6 %	5,7%	4,7%	1,2 %	10,3%	8,7%

The analysis showed a decrease in the dynamics of admission of older children to the intensive care unit in the period from 2020 to 2022. In 2022, the rate of decline in this indicator was 7.1% compared to 2021, while in 2021 a decrease of 2.0% was recorded compared to 2020. A similar trend is observed in the cardiac surgery intensive care unit: in 2022, the number of children admitted decreased by 6.3% compared to 2021, and in 2021 the decrease was 2.4% compared to 2020.
In the period from 2020 to 2022, there was a significant increase in the number of children admitted to the oncohematology intensive care unit. In 2022, the growth rate of this indicator was 5.9% compared to 2021. Similarly, in 2021, there was also an increase in the number of admissions, with the growth rate being 9.1% compared to 2020.
The mortality rate in the intensive care unit is one of the key indicators of the department's performance and the quality of medical care provided to patients in critical condition. This indicator reflects the department's ability to ensure the survival of patients with severe pathologies and complications [8–12]. A decrease in the mortality rate indicates an increase in the qualifications of medical personnel, the introduction of modern technologies and improved treatment conditions, which together contribute to improved treatment outcomes and patient recovery [13–17].
Below are the mortality rates in the intensive care unit and anesthesia departments for the analyzed years (Table 2).

Table 2 – Mortality structure in intensive care and anesthesiology departments in 2020–2022

Departments	2020	2021	2022
	% (95 % CI)	% (95 % CI)	% (95 % CI)
Department of resuscitation, anesthesiology and intensive care for newborns	-	-	7,5 (5,39;9,61)
Department of resuscitation, anesthesiology and intensive care for older children	21,2 (18,79;23,61)	18,5 (16,8;20,2)	7,5 (5,39;9,61)

Department of resuscitation, anesthesiology and intensive care for cardiac surgery	26,9 (24,58;29,22)	25,9 (24,28;27,52)	27,5 (25,63;29,37)
Department of resuscitation, anesthesiology and intensive care for oncohematological patients	51,9 (50,01;53,79)	55,6 (54,34;56,86)	57,5 (56,07;58,93)
Total (abs., %)	52 (100,0)	108 (100,0)	80 (100,0)

During the analyzed period, 240 fatal cases were registered in the intensive care and anesthesiology departments, with the highest number of fatal cases in 2021 - 108 cases. The proportion of fatal cases was distributed as follows: in the oncohematology intensive care unit - 55.6%, in the cardiac surgery intensive care unit - 25.9%, and in the intensive care unit for older children - 18.5%. These data make it possible to identify the departments with the highest mortality rates and focus efforts on improving the quality of medical care in them.
Below are the mortality rates by intensive care unit departments for 2020-2022 (Table 3).

Table 3 – Mortality rates in intensive care units for 2020–2022

Departments	2020	2021	2022	Всего
	% (95 % CI)	% (95 % CI)	% (95 % CI)	abs. (%)
Department of resuscitation, anesthesiology and intensive care for newborns	-	-	6 (100,0)	6 (100,0)
Department of resuscitation, anesthesiology and intensive care for older children	29,7 (27;32,4)	54,1 (51,92;56,28)	16,2 (13,25;19,15)	37 (100,0)
Department of resuscitation, anesthesiology and intensive care for cardiac surgery	21,9 (19,73;24,07)	43,8 (41,96;45,64)	34,4 (32,42;36,38)	64 (100,0)
Department of resuscitation, anesthesiology and intensive care for oncohematological patients	20,3 (18,78;21,82)	45,1 (43,84;46,36)	34,6 (33,23;35,97)	133 (100,0)

The neonatal intensive care unit began functioning only in 2022. Therefore, during the period we analyzed, a low mortality rate was noted in comparison with other departments. In the elderly intensive care unit, there were 37 fatal cases in 2020-2022. The highest proportion was in 2021 - 54.1%. This was followed by 2020 - 29.7% and 2022 - 16.2%.
In the cardiac surgery intensive care unit, an increase in the mortality rate was also noted in 2021 - 43.8% in comparison with other years analyzed. In 2022, this figure was 34.4%, in 2020 - 21.9%. A total of 64 fatal cases were registered in the cardiac surgery intensive care unit from 2020 to 2022.
In the oncohematology intensive care unit, there were 64 fatal cases from 2020 to 2022. There were 133 fatal cases. The highest proportion of fatality rates was noted in 2021 - 45.1%, followed by 2022 - 34.6%. In 2020, the fatality rate was 20.3%. In 2022, 80 children died in the intensive care and anesthesiology departments. The main contribution to mortality was made by patients with oncohematological and cardiac surgical diseases. In patients with oncological pathologies, tumor progression with metastasis was noted. Among those who died with a diagnosis of acute leukemia, there was a resistant course of the disease, relapses and septic complications. Mortality among cardiac surgical patients was due to the complexity and severity of congenital heart defects, accompanied by pathology of other body systems.
All other deceased children with surgical pathology had multiple congenital malformations. The main causes of death were multiple organ failure, late hospitalization in extremely serious conditions, and septic complications aggravated by antibiotic resistance.
Below is the age structure of deceased children in the intensive care and anesthesia departments for 2022 (Figure 2).

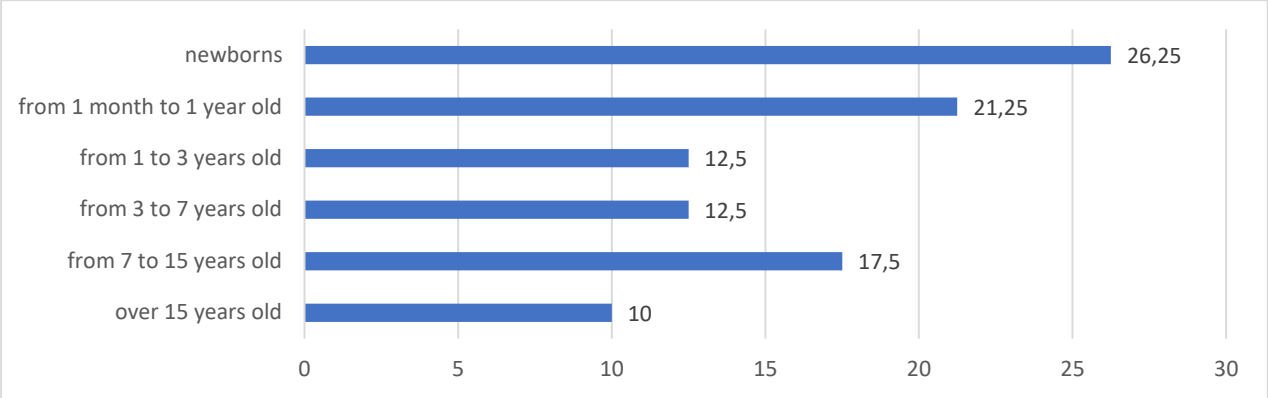

Figure 2 – Age structure of deceased children in the intensive care and anesthesiology departments for 2022, %

According to the analysis, it was found that the greatest number of fatal cases occurred in newborns - 26.25%. Next were children from 1 month to 1 year old - 21.25%. In third place were children from 7 to 15 years old - 17.5%. 12.5% f fatal cases occurred in children from 1 year to 3 years old and from 3 years to 7 years old. 10.0% of fatal cases occurred in children over 15 years old.

Mortality by age: 21 (26%) - are children of the neonatal period: with MVD-8 (38%), with CHD 12 (57%) and 1 (2%) with nephroblastoma. 17 (21%) children under one year: with CHD 10 (59%), with CHD 3 (17.5%), with OH pathology 4 (23.5%). Children aged 3 years and over: with congenital heart disease 1 (2%), with OH pathology 41 (98%). Below are the mortality rates by days (Figure 3).

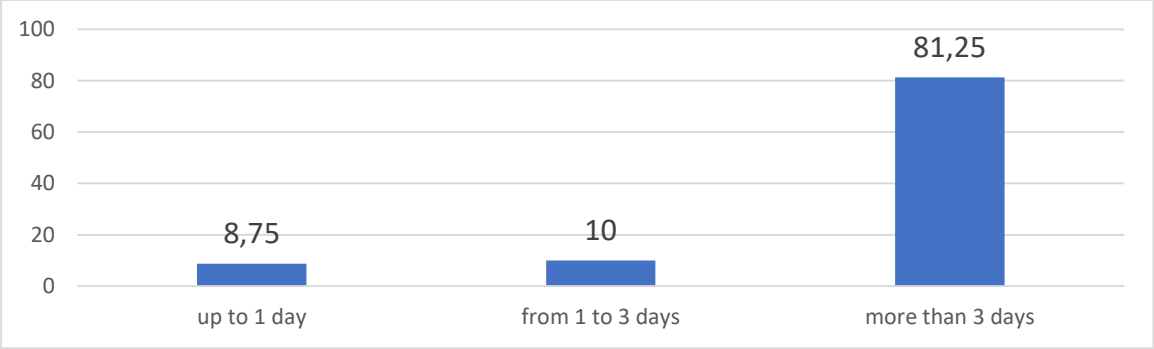

Figure 3 – Fatality rates by days for 2022

As can be seen from the figure, 81.25% of fatal cases occurred after 3 days. 8.75% of fatal cases occurred before 1 day. 10.0% of fatal cases were recorded from 1 to 3 days.

The number of patients transferred from the intensive care departments to specialized departments is an important indicator of the effectiveness of treatment and stabilization of the condition in the intensive care unit. This indicator reflects success in bringing patients out of critical condition, allowing them to continue treatment in less intensive conditions. An increase in the number of transfers may indicate a high level of medical care, timely and effective use of diagnostic and therapeutic measures.

Below are data on the number of children transferred from the intensive care departments to other departments (Table 4).

Table 4 – Number of children transferred from intensive care units to other units from 2020 to 2022

Departments	Year			Total
	2020	2021	2022	
Department of resuscitation, anesthesiology and intensive care for oncohematological patients	2671	3475	3726	9872
Department of resuscitation, anesthesiology and intensive care for newborns	-	0	150	150
Department of resuscitation, anesthesiology and intensive care for older children	1066	1606	1547	4219
Department of resuscitation, anesthesiology and intensive care for cardiac surgery	377	441	439	1257

During the analyzed period, 9872 children were transferred from the oncohematology intensive care unit to other departments of the NCPPS. 4219 children were transferred from the elderly intensive care unit, 1257 from the cardiac intensive care unit, and 150 from the neonatal intensive care unit.

Below is the proportion of children transferred from the intensive care unit to other intensive care units from 2020 to 2022 (Table 5).

Table 5 - Proportion of children transferred from the intensive care unit to other departments of the NCPPS from 2020 to 2022

Departments	Year		
	2020	2021	2022
	%, 95 % CI	%, 95 % CI	%, 95 % CI
Resuscitation for oncohematological patients	64,2 (64,02;64,38)	62,9 (62,74;63,06)	63,6 (63,45;63,75)
Department of resuscitation, anesthesiology and intensive care for newborns			2,6 (2,35;2,85)
Department of resuscitation, anesthesiology and intensive care for older children	25,6 (25,34;25,86)	29,1 (28,88;29,32)	26,4 (26,18;26,62)
Resuscitation for cardiac surgery	9,1 (8,81;9,39)	8,0 (7,75;8,25)	7,5 (7,25;7,75)
Total	4114	5522	5862

In 2020, 4,161 children were transferred from the intensive care unit to other departments. The largest share of transferred patients was from the oncohematology intensive care unit - 64.2%. The second place was taken by the intensive care department for older children with an indicator of 25.6%. The lowest share of transferred children was recorded in the cardiac surgery intensive care unit - 9.1%. In 2021, 5,522 children were transferred from the intensive care unit to other departments of the NCPPS. The largest share of transferred children was from the oncohematology intensive care unit - 62.9%. 29.1% of children were transferred from the intensive care unit for older children, 8.0% of children from the cardiac surgery intensive care unit.

In 2022, 5,862 children were transferred from the intensive care units to other departments. The largest number of children were transferred from the oncohematology intensive care unit - 63.6%. The next place was taken by the senior intensive care unit - 26.4%. The smallest number of children were transferred from the cardiac surgery intensive care unit - 7.5%.

We analyzed the number of children admitted and transferred from various departments, which allows us to assess the load on the intensive care and anesthesia unit and the efficiency of using the bed fund.

Below is a comparative analysis of the number of children admitted to the intensive care unit and transferred from the intensive care unit from 2020 to 2022 (Table 6).

Table 6 – Comparative analysis of the number of children admitted to the intensive care unit and transferred from the intensive care unit, 2020-2022.

Department	Year					
	2020		2021		2022	
	Admitted	Transferred	Admitted	Transferred	Admitted	Transferred
Department of resuscitation, anesthesiology and intensive care for oncohema-tological patients	2711	2671	3534	3475	3770	3726
Department of resuscitation, anesthesiology and intensive care for newborns					161	150
Department of resuscitation, anesthesiology and intensive care for older children	1079	1066	1627	1606	1554	1547
Department of resuscitation, anesthesiology and intensive care for cardiac surgery	391	377	476	441	461	439

As follows from the table presented, in the period from 2020 to 2022, there is a difference in the number of patients admitted to the intensive care unit and those transferred from these departments to other departments of the NCPPS.

In 2020, 2,711 children were admitted to the oncohematology intensive care unit, of which 2,611 were transferred to other departments. 40 children were not transferred for a number of reasons, including death or transfer to another medical organization. 1,079 children were admitted to the intensive care unit for older children, of which 1,066 were transferred to other departments of the NCPPS. The remaining 13 children were not transferred due to death. 391 children were admitted to the cardiac surgery intensive care unit, of which 377 were transferred, and in 14 cases a death was recorded.

In 2021, 3,534 children were admitted to the oncohematology intensive care unit, of which 3,475 were transferred to other departments. 59 children were not transferred for various reasons, including death or transfer to another medical organization. 1,627 children were admitted to the neonatal intensive care unit, of which 1,606 were transferred to other departments of the NCPPS. The remaining 21 children were not transferred due to death. 476 children were admitted to the cardiac surgery intensive care unit, of which 441 children were transferred, and 35 children were not transferred due to death or transfer to another medical organization.

In 2022, 3,770 children were admitted to the oncohematology intensive care unit, of which 3,726 were transferred to other departments. The remaining 44 children were not transferred for several reasons, including death or transfer to another medical facility. A total of 1,554 children were admitted to the pediatric intensive care unit, of which 1,547 were transferred to other departments of the NCPPS. Seven children were not transferred due to death. 461 children were admitted to the cardiac intensive care unit, of which 439 were transferred. In 22 cases, children were not transferred due to death or transfer to another medical facility. 161 children were admitted to the neonatal intensive care unit, of which 150 were transferred to other departments. Nine children were not transferred for several reasons, including serious condition or death.

Over the analyzed period, a gradual increase in the number of patients served, especially in the oncohematological intensive care unit, is noted, which indicates a growing need for specialized medical care in this area.

Discussion. Analysis of the activities of the resuscitation and anesthesiology unit of NCPPS showed that today it includes four specialized departments. The expansion of the unit is associated with the opening of a new intensive care unit for newborns in 2022. The need to create this department is confirmed by the fact that 163 children were hospitalized in the first year of its operation, which indicates a high level of demand for the care provided.

During the analyzed period, there was a significant increase in the number of children admitted to the oncohematological intensive care unit. In 2022, the growth rate was 5.9% compared to 2021. The total number of hospitalized children increased from 3,287 in 2020 to 3,795 in 2022, which indicates an increase in the need for specialized medical care in this area.

In the period from 2020 to 2022, 240 fatal cases were registered in the intensive care and anesthesiology departments. The highest number of fatal cases was recorded in 2021 - 108 cases, in 2022 - 80 cases, and in 2020 - 50 cases. An analysis of the mortality distribution showed that the highest number of cases during the analyzed period was noted in the oncohematology intensive care unit - 133 cases. Moreover, 26.25% of all fatal cases were among newborns. Most fatal cases (81.25%) occurred more than three days after admission, 8.75% of cases were registered within the first day, and 10.0% - in the period from one to three days. These data emphasize the importance of timely diagnosis and intensive care in the early stages of hospitalization.

According to the results of a comparative analysis of data for 2020–2022 on the number of children admitted to and transferred from the intensive care unit, the following dynamics were revealed: in 2020, 4,181 children were admitted to the departments, of which 4,114 were transferred to other departments; in 2021, the number of children admitted was 5,637, and 5,522 were transferred; in 2022, 5,946 children were hospitalized, of which 5,862 were transferred. The main reasons for the discrepancies between the number of children admitted and transferred are fatal outcomes and transfers to other medical organizations, which emphasizes the need to analyze the factors affecting these indicators.

Conclusion. The pediatric center needs to focus on creating conditions for sustainable staffing with anesthesiologist-resuscitators. Particular attention should be paid to the systematic improvement of their qualifications, especially in the field of oncohematology, where a high level of professional knowledge and skills is required for the effective treatment of patients with serious diseases.

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