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# PROFESSIONAL COMPETENCIES OF THE NEONATAL RESUSCITATION TEAM: LOCAL AUDIT IN MATERNITY INSTITUTIONS OF THE KHABAROVSK REGION

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**Abstract.** *Introduction.* Providing adequate birth care remains the most important strategy for reducing neonatal mortality and morbidity. Neonatal resuscitation is crucial, as it affects early and long-term outcomes. The accumulated clinical experience demonstrates the limited possibilities of large-scale analysis of the quality of resuscitation care for newborns. In this regard, the development of effective tools for measuring and improving the quality of neonatal resuscitation is of great interest. *Goal.* To study the results of resuscitation of full-term newborns in the delivery room and the level of professional competencies of medical specialists before and after systematic training (regular simulation trainings of medical specialists) in obstetric institutions of the Khabarovsk Territory. *Materials and methods.* The study was conducted in two groups of full-term newborns born at 37 to 42 weeks of gestation, who underwent asphyxia and neonatal resuscitation in the delivery room (a solid sample), in 2017 and in 2021 — before and after the implementation of regular simulation trainings by medical specialists of maternity hospitals in the Khabarovsk Territory. The article presents an analysis of clinical and laboratory data of full-term newborns who underwent neonatal resuscitation in the delivery room, qualitative and temporal data on the implementation of neonatal resuscitation measures in the delivery room, an assessment of the professional competencies of medical specialists of obstetric institutions who underwent regular simulation retreats using specially designed scales. *Results.* All fragments of neonatal resuscitation were analyzed in a structured manner, typical disadvantages and the most difficult components to implement were identified. There was a decrease in the number of deviations from the algorithm of neonatal resuscitation in dynamics under the conditions of regular simulation re-trainings of medical specialists of obstetric institutions. *Conclusion.* The data obtained give an idea of the quality of neonatal resuscitation in practice and allow us to recommend the inclusion in the individual educational trajectory of all medical staff of obstetric institutions at any level of the educational program under the section "Neonatal resuscitation".

**Keywords:** *neonatal resuscitation, neonatologist, anesthesiologist-resuscitator, obstetrician-gynecologist, simulation training*

# ПРОФЕССИОНАЛЬНЫЕ КОМПЕТЕНЦИИ НЕОНАТАЛЬНОЙ РЕАНИМАЦИОННОЙ БРИГАДЫ: ЛОКАЛЬНЫЙ АУДИТ В РОДОВСПОМОГАТЕЛЬНЫХ УЧРЕЖДЕНИЯХ ХАБАРОВСКОГО КРАЯ

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**Резюме.** *Введение.* Предоставление надлежащей помощи при рождении остается важнейшей стратегией снижения неонатальной смертности и заболеваемости. Неонатальная реанимация имеет решающее значение, так как влияет на ранние и отдаленные исходы. Накопленный клинический опыт демонстрирует ограниченные возможности широкомасштабного анализа качества реанимационной помощи новорожденным. В связи с этим большой интерес представляет разработка эффективных инструментов измерения и улучшения качества неонатальной реанимации. *Цель*. Изучение результатов проведения реанимации доношенных новорожденных в родильном зале и уровня профессиональных компетенций медицинских специалистов до и после систематического обучения (регулярных симуляционных ретренингов медицинских специалистов) в родовспомогательных учреждениях Хабаровского края. *Материалы и методы.* Исследование проведено в двух группах доношенных новорожденных детей, родившихся на сроке от 37 до 42 недель гестации, перенесших асфиксию и неонатальную реанимацию в родильном зале (сплошная выборка), в 2017 и в 2021 году — до и после реализации регулярных симуляционных ретренингов медицинских специалистов родовспомогательных учреждений Хабаровского края. Представлен анализ клинико-лабораторных данных доношенных новорожденных, подвергшихся неонатальной реанимации в родильном зале, качественно-временных данных выполнения мероприятий неонатальной реанимации в родильном зале, оценка профессиональных компетенций медицинских специалистов родовспомогательных учреждений, проходивших регулярные симуляционные ретренинги с использованием специально разработанных шкал. *Результаты.* Структурированно проанализированы все фрагменты неонатальной реанимации, выявлены типичные недостатки и наиболее сложные для реализации компоненты. Отмечено снижение числа отклонений от алгоритма неонатальной реанимации в динамике в условиях регулярных симуляционных ретренингов медицинских специалистов родовспомогательных учреждений. *Заключение.* Полученные данные дают представление о качестве неонатальной реанимации на практике и позволяют рекомендовать включение в индивидуальную образовательную траекторию всех медицинских сотрудников родовспомогательных учреждений любого уровня образовательной программы по разделу «Неонатальная реанимация».

***Ключевые слова:*** *неонатальная реанимация, неонатолог, анестезиолог-реаниматолог, акушер-гинеколог, симуляционное обучение*

## INTRODUCTION

A neonatal period is the most vulnerable stage for child survival: this stage accounts for about half of all child deaths, with the remainder occurring before the age of five years. This trend is observed worldwide.

One in ten newborns requires neonatal resuscitation in a labor room at birth with indirect cardiac massage (ICM), 0.05% of children receive ICM combined with drug therapy (WHO, 2020).

Neonatal resuscitation in a labor room is critical to lives of neonates as it affects early and long-term outcomes [1–4, 9–11]. The complexities of neonatal resuscitation in the delivery room raise a wide range of questions, which actualizes the task of predicting the outcomes of the neonatal period, including the effectiveness of neonatal resuscitation care in a delivery room [5].

The basic principles of neonatal resuscitation care in the delivery room are the readiness of medical personnel to immediately provide resuscitative measures to a newborn and a clear algorithm of actions in the delivery room [13, 15]. In addition, the distribution of medical care at different levels of obstetric facilities (OBUs) differs, medical specialists in level II OBUs are less prepared to provide emergency care than in level III OBUs. Nevertheless, the realities of practice require a uniform level of qualification and readiness for interchangeability among all specialists.

Resuscitation care of newborns in the labor room is an emergency form of medical care, requiring special training and professional competences. The level of professionalism of medical specialists directly affects the quality of medical care.

Much experience has been accumulated, confirming the high efficiency of practice-oriented approach in mastering professional competences using simulation technologies in medicine [6–8, 12, 14, 16–20]. At the same time, the analysis of clinical simulation-training approach to mastering and maintaining competence skills for providing

medical care to newborns in the delivery room is presented non-systematically and fragmentarily.

Educational technologies make it possible to ensure the maintenance of professional competencies of medical specialists involved in the process of obstetrics. Subsequently, the quality and timeliness of resuscitative measures for newborns will positively affect the outcomes of critical conditions in neonatal resuscitation.

## AIM

The aim of the research is to analyze the results of resuscitation of premature newborns in the delivery room and the level of professional competence of medical specialists before and after systematic training (regular simulation retraining of medical specialists) in obstetric institutions of Khabarovsk Territory.

## MATERIALS AND METHODS

The study was performed at the Department of Pediatrics, Neonatology and Perinatology with a course of emergency medicine, on the basis of the Federal Accreditation Centre of the Federal State Budgetary Educational Institution of Higher Education 'Far Eastern State Medical University' of the Ministry of Health of the Russian Federation, as well as on the basis of obstetric institutions of Khabarovsk Territory. The research was conducted in two stages.

At the first stage, a retrospective study was carried out in a group of neonates (n=45) born in 2017 at 37 to 42 weeks of gestation. They underwent asphyxia and neonatal resuscitation in the delivery room (continuous sample), before the implementation of regular simulation retraining of medical specialists of obstetric institutions of Khabarovsk Territory.

At the second stage, a prospective study was performed in a group of neonates (n=44), born in 2021 at 37 to 42 weeks of gestation, who underwent asphyxia and neonatal resuscitation in the delivery room (continuous sample), after the implementation of regular simulation retraining of medical specialists of obstetric institutions of Khabarovsk Territory and introduction of the program on "Neonatal resuscitation and stabilization of newborns in the delivery room" into practice.

At the interim stage (2017–2021), regular simulation retraining of medical specialists of obstetric institutions of Khabarovsk Territory was implemented according to the developed "Educational program to reduce infant mortality in Khabarovsk Territory" (on the basis of the Federal Accreditation Centre of FSBEU VO FESMU of the Ministry of Health of Russia).

At each stage, clinical and laboratory data of premature newborns were examined. All neonates received neonatal resuscitation in the delivery room, qualitative and temporal data of neonatal resuscitation in the delivery room were studied, and the professional competences of medical specialists of obstetric institutions were assessed.

To assess the quality of neonatal resuscitation in the delivery room, a checklist was specially developed (based on primary medical documentation — insert card of neonatal resuscitation and stabilization in the delivery room).

An educational program on "Neonatal resuscitation and stabilization of newborns in the delivery room" (since 2017) was developed and implemented by means of simulation technologies to form and maintain the level of professional competencies of the staff of obstetric institutions; the program was implemented in the mode of regular annual retraining.

In order to assess the professional competences of the staff of obstetric facilities, interviewing was conducted with a specially designed questionnaire.

The clinical effectiveness of simulation training was assessed using specially designed scoring scales and Spearman correlation analysis.

Statistical processing of materials was carried out using application software with the help of descriptive and analytical statistics methods generally accepted in medical practice.

## RESULTS

Analyzing the quality of neonatal resuscitation in the delivery room, critical components of neonatal resuscitation were identified at specific time episodes of resuscitation interventions. It was found that effectiveness and outcome of neonatal resuscitation depends on Apgar scores, lactate concentration in venous blood, and blood saturation measured by pulse oximetry.

It was found that stabilization of vital functions of the newborn increased by 1.85 times ($p < 0.05$) during neonatal resuscitation. The average time of stabilization and observation of the newborn increased 1.4 times in dynamics.

According to the assessment of neonatal status, we can conclude that in 2021, the status of the newborn was monitored more carefully, neo-

natal resuscitation measures were performed in the delivery room. The heat chain (temperature control) was observed and the effectiveness of resuscitation measures in the delivery room was dynamically assessed (Fig. 1).

According to the analysis of the interventions performed, the quality and timeliness of neonatal resuscitation interventions was 67.9% in 2017 and 97% in 2021 (p <0.05).

It was demonstrated that the time of decision-making and initiation of respiratory therapy in the second group decreased by 2 times against the background of faster regression of condition severity (p <0.05).

The most reliable criteria of neonatal severity are pathological changes in oxygen status indicators and an increase in blood lactate concentration.

It was found that in 2017 it was possible to reach the target oxygenation parameters only at the time interval of 5–10 minutes after birth, and in 2021 — by the 4th minute after birth (p <0.05).

There was a difference in the rate of lactate normalization, which was 1.28 times faster in the second group (Table 1).

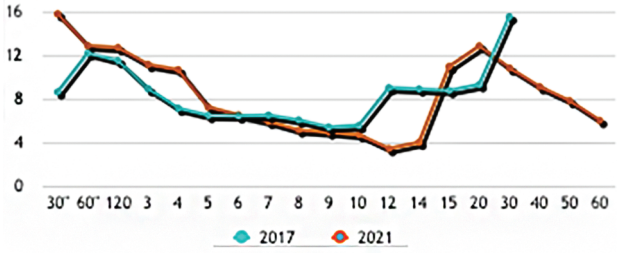


Fig. 1. Dynamics of the severity of the condition of newborns during neonatal resuscitation

Рис. 1. Динамика тяжести состояния новорожденных при проведении неонатальной реанимации

Analysis of professional competencies of medical specialists in different levels providing resuscitation care to newborns who underwent regular simulation retraining during the study period (about 80.0% of all medical specialists of obstetric institutions of Khabarovsk Territory) was conducted in each group.

100.0% of respondents expressed willingness to participate in neonatal resuscitation in the delivery room, if necessary, in 2021, compared to 58.0% of respondents in 2017.

The number of medical specialists applying neonatal resuscitation skills in their practical work increased from 76.0% in 2017 to 81.9% by 2021. 58.1% of specialists fully implement neonatal resuscitation in the delivery room, and 41.9% of specialists do not fully implement neonatal resuscitation according to the needs of a specific clinical situation.

Neonatal resuscitation in the delivery room implies teamwork, which may include all medical specialists involved in the delivery process (neonatologists, anesthesiologists-resuscitators, obstetricians-gynecologists, nurses). Participants of neonatal resuscitation teams are distributed by number: the first number — team leader, provides respiratory therapy; the second number — monitoring, indirect cardiac massage; the third number — assistant, providing vascular access, administration of drugs.

Over the analyzed period, there were performed constant simulation retraining. As a result, interchangeability, which implies team interaction with all medical specialists involved in the process of obstetrics care, increased on average by 3.7 times (p <0.05) during neonatal resuscitation in the delivery room (Fig. 2).

**Table 1. Characteristics of laboratory parameters of newborns who suffered asphyxia at birth**

**Таблица 1. Характеристики лабораторных показателей новорожденных, перенесших асфиксию при рождении**

| Параметры / Options | 1 час после рождения / 1 hour after birth | | | 12 часов после рождения / 12 hours after birth | | | 24 часа после рождения / 24 hours after birth | | |
|---|---|---|---|---|---|---|---|---|---|
| | 2017 | 2021 | p | 2017 | 2021 | p | 2017 | 2021 | p |
| pH | 7,18 (±0,17) | 7,15 (±0,16) | p <0,05 | 7,37 (±0,18) | 7,38 (±0,16) | p <0,05 | 7,37 (±0,14) | 7,45 (±0,13) | p <0,05 |
| cGlu mmol/l | 3,65 (±0,98) | 3,76 (±1,23) | p <0,05 | 3,35 (±0,92) | 4,3 (±1,05) | p <0,05 | 6 (±0,81) | 3,9 (±0,98) | p <0,05 |
| cLac mmol/l | 6,24 (±3,53) | 6,68 (±3,25) | p <0,05 | 3,5 (±3,34) | 2,75 (±3,18) | p <0,05 | 1,8 (±2,98) | 1 (±2,87) | p <0,05 |
| cBase(Ecf) mmol/l | –9,09 (±5,36) | –10,15 (±4,71) | p <0,05 | –0,31 (±5,17) | –1,5 (±4,89) | p <0,05 | –0,5 (±5,02) | 1,9 (±4,78) | p <0,05 |

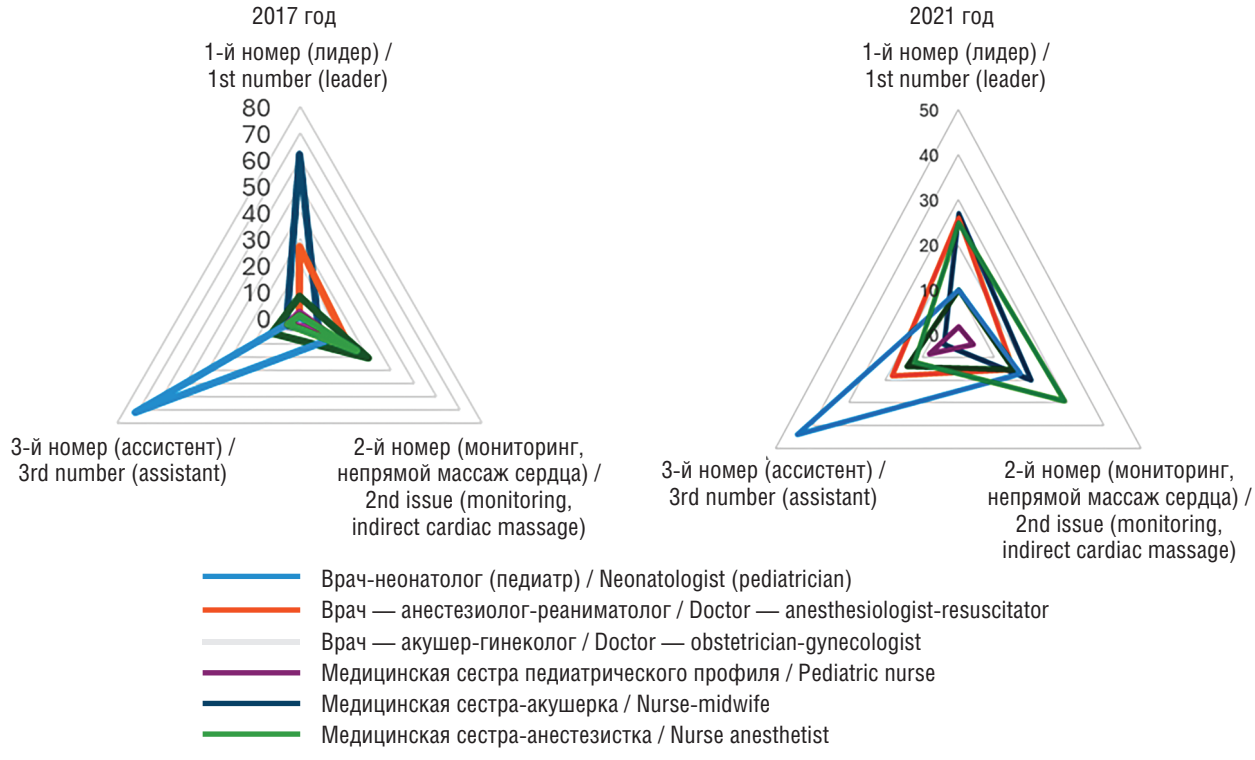


Fig. 2. Distribution in team work in neonatal intensive care in the delivery room of doctors and nursing staff of obstetric institutions in 2017 and 2021

Рис. 2. Распределение в командной работе в неонатальной реанимации в родильном зале врачей и среднего медицинского персонала родовспомогательных учреждений в 2017 и 2021 гг.

A reliable expansion of professional competences among obstetrics specialists was revealed in the course of regular professional simulation retraining.

The clinical effectiveness of simulation training of medical specialists of obstetric institutions was analyzed. Using specially developed scales, evidence of clinical effectiveness of simulation training was obtained. The correlation between the dynamics of clinical changes in the state of newborns during neonatal resuscitation depending on the resuscitation measures performed was revealed. The interventions were performed by medical specialists of obstetric institutions who underwent regular simulation retraining during the study period.

Key time episodes of neonatal resuscitation in the labor room were identified, during which the quality of neonatal resuscitation components in the labor room critically influenced the regression of the severity of the condition.

Correlation analysis using the Spearman correlation criterion in the first group of newborns revealed a relationship between the severity of the condition and the quality of care during the entire period of neonatal resuscitation in the labor room. At the same time, there are reliable features in the significance of the components of resuscitation measures for newborns in the labor room at certain time episodes.

The greatest contribution to the dynamics of clinical changes was made by neonatal resuscitation measures performed in the first minutes of life ($p < 0.05$) and at the 15$^{th}$ and 30$^{th}$ minutes of stabilization ($p < 0.05$).

Thus, assessment of the newborn's condition at the 30th second, 1st and 2nd minutes (r=0.557, 0.755 and 0.598) has priority importance. The clinical scenario that unfolds depends on the assessment as well. The next important quality of neonatal assessment is the 12$^{th}$, 14$^{th}$ and 15$^{th}$ minutes (r=0.095). The most important component is the provision of heat chain during the first 5 minutes of life (r=0.786, 0.315, 0.309).

The severity of the condition resolves with timely measures to ensure airway patency, it depends on the selected parameters of respiratory support within the period of 1$^{st}$ and 2$^{nd}$ minute (r=0,38, 0,442) as well as on the speed of decision making related to tracheal intubation and transfer to artificial lung ventilation.

## CONCLUSION

Introduction of an educational program for specialists of obstetric institutions on the section "Neonatal resuscitation and stabilization of newborns in the delivery room" allowed:

- to reduce the time of decision-making and initiation of respiratory therapy by 2 times against the background of faster regression of the severity of the condition of newborns ($p < 0.05$);
- to increase timely stabilization of vital functions of newborns in the delivery room by 1.85 times ($p < 0.05$);
- to significantly expand the range of professional competences of the staff of obstetric institutions providing medical care to newborns ($p < 0.05$);
- to increase interchangeability in teamwork during resuscitation in the delivery room by 3.7 times ($p < 0.05$);
- to increase the adherence to neonatal resuscitation algorithms on 77.2 to 93% ($p < 0.05$).

The findings demonstrate faster stabilization of neonates who received better neonatal resuscitation in the delivery room.

Thus, the data obtained allow us to recommend the inclusion of the educational program on "Neonatal resuscitation and stabilization of newborns in the delivery room", which has proven its clinical effectiveness, in the individual educational trajectory of all medical staff of obstetric institutions at any level.

## 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.

**Competing interests.** The authors declare that they have no competing interests.

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**Consent for publication.** Written consent was obtained from legal representatives of the patients for publication of relevant medical information within the manuscript.

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