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OPTIMIZATION OF ANESTHESIOLOGY AND RESUSCITATION CARE FOR PATIENTS WITH PNEUMONIA IN THE INTENSIVE CARE UNIT OF A MULTIDISCIPLINARY HOSPITAL

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Introduction. Pneumonia complicated by acute hypoxemic respiratory failure is a common reason for intensive care and frequently requires escalation of respiratory support. The clinical effectiveness of high-flow oxygen therapy (HFOT) depends not only on device availability but also on correct setup, titration, monitoring, and timely recognition of treatment failure.
Objective. To evaluate changes in selected clinical and operational indicators of HFOT after implementation of a standardized training program for medical staff in a multidisciplinary intensive care unit.
Materials and Methods. A single-center before-and-after quality improvement study was conducted over six months. The source manuscript reports 100 patients requiring HFOT. Twenty nurses and 10 physicians completed theoretical and hands-on training. Baseline indicators were recorded during the first three months and reassessed during the subsequent three months. Outcomes included achievement of SpO_2 ≥92%, respiratory rate <25 breaths/min, need for intubation, patient-reported discomfort, and incorrect HFOT parameter settings.
Results. After staff training, the proportion of patients achieving SpO_2 ≥92% increased from 70% to 95%, and the proportion with a respiratory rate <25 breaths/min increased from 65% to 90%. The reported need for intubation decreased from 30% to 10%, patient-reported discomfort from 40% to 15%, and incorrect parameter settings from 50% to 5%.
Discussion. The direction and magnitude of the observed changes are consistent with better standardization of HFOT delivery after training. However, the uncontrolled before-and-after design, absence of detailed case-mix data, and lack of exact pre- and post-training cohort denominators limit causal interpretation.
Conclusion. Structured multidisciplinary training was associated with improvement in both patient-related and process indicators of HFOT. Prospective studies with predefined eligibility criteria, patient-level data, appropriate comparative statistics, and adjustment for clinical severity are needed to confirm the effect.
Keywords. pneumonia; intensive care unit; high-flow oxygen therapy; high-flow nasal cannula; respiratory support; staff training; quality improvement.

ОПТИМИЗАЦИЯ АНЕСТЕЗИОЛОГО-РЕАНИМАЦИОННОЙ ПОМОЩИ ПАЦИЕНТАМ С ПНЕВМОНИЕЙ В ОТДЕЛЕНИИ РЕАНИМАЦИИ МНОГОПРОФИЛЬНОГО СТАЦИОНАРА

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Введение. Пневмония, осложненная острой гипоксемической дыхательной недостаточностью, остается одной из частых причин интенсивной терапии и нередко требует эскалации респираторной поддержки. Эффективность высокопоточной оксигенотерапии (ВПОТ) определяется не только доступностью оборудования, но и правильностью его настройки, титрования параметров, мониторинга и своевременного распознавания неэффективности терапии.
Цель. Оценить изменения отдельных клинических и организационных показателей применения ВПОТ после внедрения стандартизированной программы обучения медицинского персонала в отделении интенсивной терапии многопрофильного стационара.
Материалы и методы. Проведено одноцентровое исследование качества медицинской помощи по схеме «до-после» продолжительностью шесть месяцев. В исходной рукописи указаны 100 пациентов, которым требовалась ВПОТ. Обучение прошли 20 медицинских сестер и 10 врачей; программа включала теоретическую и практическую подготовку. Исходные показатели регистрировали в течение первых трех месяцев и повторно оценивали в последующие три месяца. Анализировали достижение SpO_2 ≥92%, частоту дыхания <25/мин, необходимость интубации, жалобы на дискомфорт и ошибки настройки параметров ВПОТ.

Результаты. После обучения доля пациентов с SpO_2 ≥92% увеличилась с 70% до 95%, а доля пациентов с частотой дыхания <25/мин - с 65% до 90%. Необходимость интубации снизилась с 30% до 10%, жалобы на дискомфорт - с 40% до 15%, доля неправильных настроек параметров - с 50% до 5%.
Обсуждение. Направленность и величина изменений согласуются с более стандартизированным применением ВПОТ после обучения персонала. Вместе с тем неконтролируемый дизайн «до-после», отсутствие подробных данных о структуре сравниваемых когорт и точных численностях групп ограничивают причинную интерпретацию результатов.
Заключение. Стандартизированное межпрофессиональное обучение было связано с улучшением клинических и процессных показателей ВПОТ. Для подтверждения эффекта необходимы проспективные исследования с заранее определенными критериями включения, анализом индивидуальных данных и статистическими методами, соответствующими типу исходов.
Ключевые слова. пневмония; отделение интенсивной терапии; высокопоточная оксигенотерапия; высокопоточная назальная канюля; респираторная поддержка; обучение персонала; улучшение качества.

КӨП БЕЙІНДІ АУРУХАНАНЫҢ ҚАРҚЫНДЫ ТЕРАПИЯ БӨЛІМШЕСІНДЕ ПНЕВМОНИЯМЕН АУЫРАТЫН НАУҚАСТАРҒА АНЕСТЕЗИОЛОГИЯЛЫҚ-РЕАНИМАЦИЯЛЫҚ КӨМЕКТІ ОҢТАЙЛАНДЫРУ

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Өзектілігі. Жедел гипоксемиялық тыныс жеткіліксіздігімен асқынған пневмония қарқынды терапияның жиі себептерінің бірі болып қала береді және респираторлық қолдауды күшейтуді қажет етуі мүмкін. Жоғары ағынды оттегі терапиясының (ЖАОТ) тиімділігі жабдықтың қолжетімділігіне ғана емес, оны дұрыс баптауға, параметрлерді титрлеуге, мониторингке және емнің тиімсіздігін уақтылы тануға да байланысты.
Мақсаты. Көп бейінді стационардың қарқынды терапия бөлімшесінде медицина қызметкерлеріне арналған стандартталған оқыту бағдарламасын енгізгеннен кейін ЖАОТ қолданудың жекелеген клиникалық және ұйымдастырушылық көрсеткіштерінің өзгерісін бағалау.
Материалдар мен әдістер. Алты ай бойы бір орталықта «дейін-кейін» сызбасы бойынша медициналық көмектің сапасын жақсартуға бағытталған зерттеу жүргізілді. Бастапқы қолжазбада ЖАОТ қажет болған 100 пациент көрсетілген. 20 мейіргер мен 10 дәрігер теориялық және практикалық оқытудан өтті. Бастапқы көрсеткіштер алғашқы үш айда тіркеліп, келесі үш айда қайта бағаланды. SpO_2 ≥92%-ға жету, тыныс алу жиілігінің <25/мин болуы, интубация қажеттілігі, пациенттің жайсыздыққа шағымы және ЖАОТ параметрлерін дұрыс орнатпау жиілігі бағаланды.
Нәтижелер. Оқытудан кейін SpO_2 ≥92%-ға жеткен пациенттердің үлесі 70%-дан 95%-ға, ал тыныс алу жиілігі <25/мин болғандардың үлесі 65%-дан 90%-ға дейін өсті. Интубация қажеттілігі 30%-дан 10%-ға, жайсыздық туралы шағымдар 40%-дан 15%-ға, параметрлерді қате орнату 50%-дан 5%-ға дейін төмендеді.
Талқылау. Бақыланған өзгерістердің бағыты мен көлемі қызметкерлерді оқытудан кейін ЖАОТ қолданудың неғұрлым стандартталғанын көрсетеді. Алайда бақылау тобы жоқ «дейін-кейін» дизайны, салыстырылған когорталардың клиникалық құрылымы және олардың нақты саны туралы ақпараттың жеткіліксіздігі себеп-салдарлық қорытынды жасауға мүмкіндік бермейді.
Қорытынды. Стандартталған пәнаралық оқыту ЖАОТ-тың клиникалық және үдерістік көрсеткіштерінің жақсаруымен байланысты болды. Әсерді растау үшін алдын ала анықталған іріктеу критерийлері, пациент деңгейіндегі деректер және нәтижелердің түріне сәйкес статистикалық талдау қолданылатын проспективті зерттеулер қажет.
Түйінді сөздер: пневмония; қарқынды терапия бөлімшесі; жоғары ағынды оттегі терапиясы; жоғары ағынды назальды канюля; респираторлық қолдау; персоналды оқыту; сапаны жақсарту

INTRODUCTION

Pneumonia, including community-acquired and hospital-acquired forms, is a major cause of acute respiratory deterioration in intensive care and may be complicated by respiratory failure and sepsis [1]. For patients who progress to severe hypoxemia, respiratory support must be individualized and escalated according to clinical response.

Key components of intensive respiratory and resuscitation care in severe pneumonia include lung-protective ventilation with low tidal volumes and limitation of plateau pressure [2], the use of high-flow nasal oxygen or non-invasive ventilation in selected patients with hypoxemia [3], and prone positioning in severe acute respiratory distress syndrome (ARDS) [4]. Sedation should preserve comfort without

unnecessarily suppressing spontaneous breathing [5]; agents that allow lighter, more controllable sedation may be useful when clinically appropriate [6]. Hemodynamic stabilization in septic pneumonia requires attention to perfusion targets [7], while fluid balance, early mobilization, and nutritional support are also relevant to recovery [15,18,24], [8], [9].

High-flow therapy (HFT) delivers heated and humidified gas at flow rates that exceed those used in conventional oxygen systems. Terms such as high-flow nasal cannula (HFNC), high-flow nasal oxygen (HFNO), and high-flow oxygen therapy (HFOT) are often used interchangeably, although HFT is a broader technical term [10]. The technology has evolved from early high-flow systems into a widely used form of respiratory support [11], and its current clinical role includes both practical delivery considerations and a range of applications in acute respiratory and critical care [12].

HFNC is generally delivered through a flow generator, an air-oxygen blender, an active heated humidifier, heated tubing, and wide-bore nasal prongs. Its physiological effects are related to washout of upper-airway dead space, reduction of respiratory effort, generation of a modest positive end-expiratory pressure, and changes in tidal and end-expiratory lung volumes. By reducing rebreathing and improving the effective inspired gas mixture, high-flow delivery may improve oxygenation [14]. Positive pressure and high flow can also reduce nasopharyngeal resistance [15], while the degree of end-expiratory pressure varies with flow, interface fit, and whether the mouth is open or closed [16]. Heated humidification improves mucosal tolerance and may facilitate prolonged use of therapy [17]. In acute hypoxemic respiratory failure, these mechanisms can improve oxygen delivery and reduce respiratory workload [18].

Study rationale and objective

The clinical benefit of HFOT depends on consistent bedside implementation: correct device assembly, appropriate flow and FiO_2 titration, monitoring of respiratory status, and timely escalation when treatment is failing. The practical contribution of this study is the simultaneous evaluation of patient-related and process indicators before and after a standardized staff-training program in a real-world multidisciplinary ICU. The objective was to assess whether the training intervention was associated with improved oxygenation and respiratory rate, lower intubation frequency, greater patient comfort, and fewer incorrect HFOT settings.

MATERIALS AND METHODS

Study design and setting

A single-center before-and-after quality improvement study was conducted in the intensive care unit of a multidisciplinary hospital over a six-month period. Baseline performance was recorded during the first three months, followed by a structured educational intervention for staff and reassessment during the subsequent three months.

Participants and clinical context

A total of 100 patients who required HFOT were included during the six-month study period. The training intervention involved 20 nurses and 10 physicians working in the ICU. The available study documentation did not specify the exact numbers of patients in the pre- and post-training periods, detailed inclusion and exclusion criteria, or baseline clinical characteristics; therefore, subgroup and risk-adjusted analyses were not performed.

Training intervention

The intervention combined theoretical instruction with hands-on training. The curriculum covered indications and contraindications for HFOT; device preparation; initial parameter selection; titration of flow and FiO_2; humidification and temperature settings; bedside monitoring; recognition of treatment success or failure; prevention of common complications; and stepwise weaning.

Competency reinforcement

A 10-item nurse questionnaire was used as a structured teaching aid. It addressed indications and contraindications, device preparation, initial settings, target oxygenation, monitoring, criteria of effectiveness, potential complications, and weaning. The questionnaire was used to reinforce a common bedside

algorithm rather than as a validated psychometric instrument.

Outcomes and data collection

Five clinical and operational indicators were compared between the pre- and post-training periods: (1) proportion of patients achieving SpO_2 ≥92%; (2) proportion with respiratory rate <25 breaths/min; (3) need for endotracheal intubation; (4) patient-reported discomfort during HFOT; and (5) incorrect device parameter settings.

Statistical approach

Outcomes were summarized as percentages for the pre- and post-training periods. The original statistical analysis reported p-values from a paired t-test. Because the evaluated outcomes are categorical proportions and patient-level pairing and exact phase-specific denominators were not available for independent reanalysis, the reported p-values were retained as source data but were not used as the sole basis for causal inference. Interpretation therefore emphasizes the direction and magnitude of descriptive changes.

Ethical considerations

This work was conducted as an institutional quality-improvement project aimed at standardizing high-flow oxygen therapy in routine intensive care practice. The analysis used routinely collected, de-identified clinical and operational data. No experimental patient-level interventions or procedures beyond standard clinical care were introduced. Under the institutional framework applicable to this quality-improvement activity, separate ethics committee approval and individual informed consent were not required. Patient confidentiality was maintained throughout the project.

RESULTS

Clinical and process indicators

All five indicators changed in a favorable direction after implementation of the staff-training program. The proportion of patients achieving SpO_2 ≥92% increased from 70% to 95%, while the proportion with a respiratory rate <25 breaths/min increased from 65% to 90%. The reported need for intubation decreased from 30% to 10%, patient-reported discomfort from 40% to 15%, and incorrect HFOT parameter settings from 50% to 5%.

Table 1 - Key clinical and operational indicators before and after staff training

Indicator	Before training (%)	After training (%)
Patients achieving SpO_2 ≥92%	70%	95%
Patients with RR <25 breaths/min	65%	90%
Need for intubation	30%	10%
Patient-reported discomfort	40%	15%
Incorrect parameter settings	50%	5%

The original analysis reported p<0.001 for SpO_2 ≥92% and respiratory rate <25 breaths/min, p=0.002 for need for intubation, p=0.003 for patient-reported discomfort, and p<0.001 for incorrect parameter settings.

Because these outcomes are proportions and patient-level paired data were not available, the p-values should be interpreted cautiously. The main pre- and post-training changes are shown graphically in Figures 1-3.

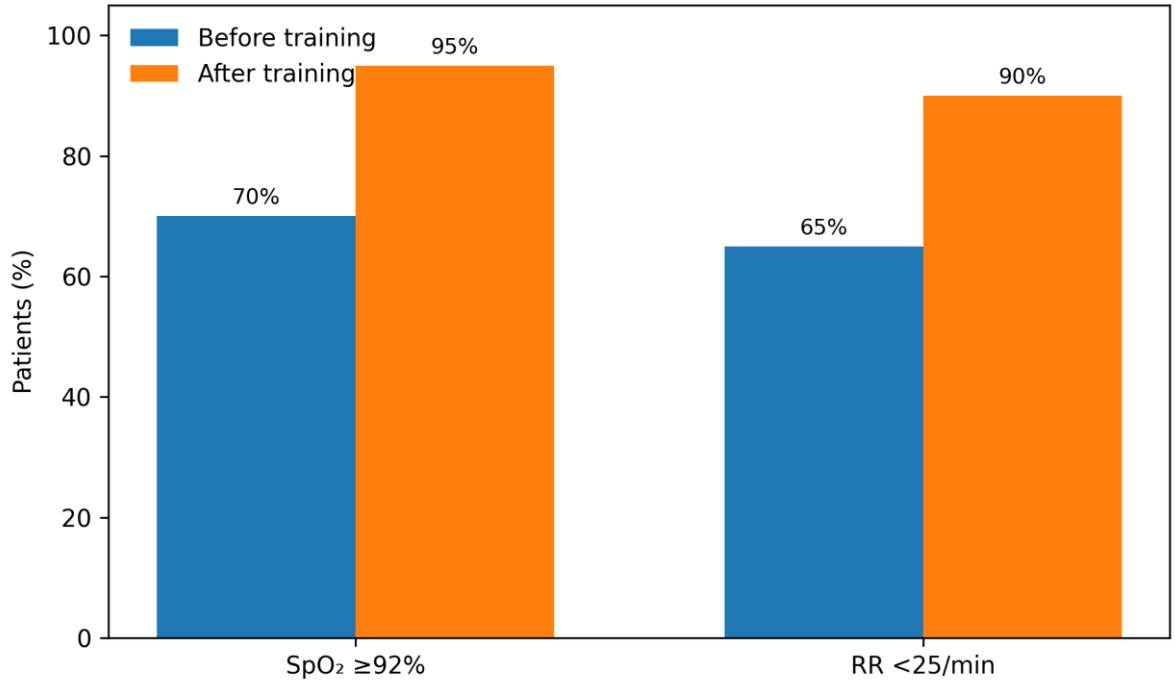

Figure 1 - Proportion of patients achieving the oxygenation target (SpO_2 ≥92%) and respiratory-rate target (<25 breaths/min) before and after staff training

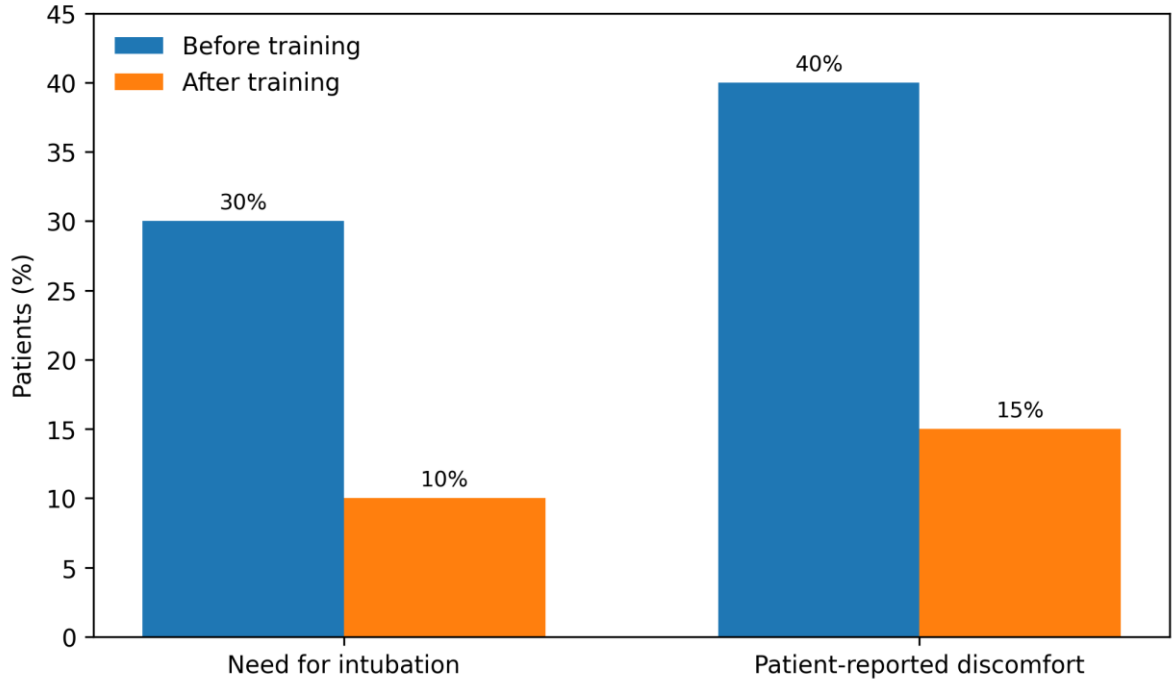

Figure 2 - Need for intubation and patient-reported discomfort before and after staff training

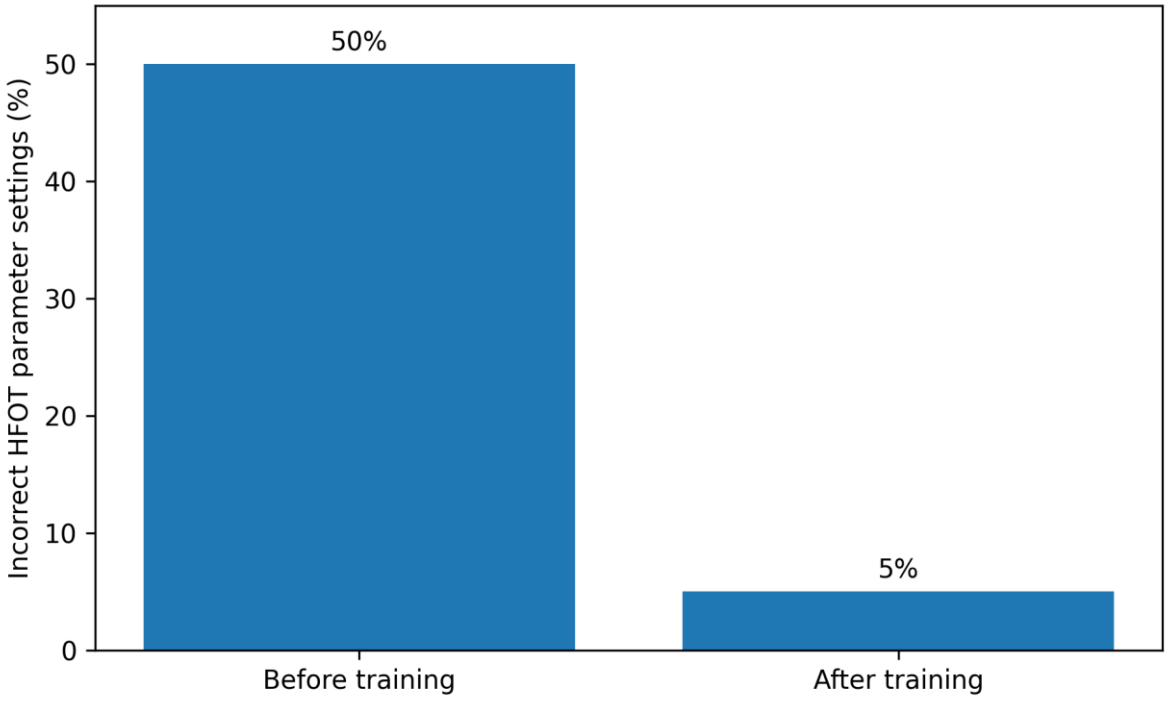

Figure 3 - Frequency of incorrect HFOT parameter settings before and after staff training

DISCUSSION

The observed changes suggest that a standardized training program may improve the consistency with which HFOT is delivered and monitored. This interpretation is clinically plausible because the effectiveness of high-flow support depends on appropriate patient selection, correct settings, and timely recognition of deterioration. Earlier high-flow evidence includes the FLORALI trial and reports of improved comfort and respiratory parameters in acute hypoxemic respiratory failure [19]. Subsequent comparative studies cited in the article likewise emphasize the role of HFNC as an alternative to other non-invasive support strategies in selected patients [20,21].

HFNC is often better tolerated than mask-based non-invasive ventilation, although the choice of modality must remain individualized and should account for respiratory mechanics, gas exchange, airway protection, and the resources required for close monitoring [22]. The manuscript also discusses high-flow support during preoxygenation before intubation [23] and compares it with other preoxygenation strategies [24]. These observations reinforce a central point of the present quality-improvement intervention: training must include not only device operation but also explicit thresholds for escalation.

The evidence cited in the article includes trials and guidelines addressing acute hypoxemic respiratory failure and severe pneumonia [25,26]. Systematic and comparative evidence has also evaluated HFNC against conventional oxygen therapy and non-invasive ventilation [27,28], while physiological reviews describe mechanisms that may explain improved tolerance and oxygenation [29]. During the COVID-19 pandemic, high-flow therapy was widely used for severe viral pneumonia, highlighting the importance of structured monitoring and timely escalation when treatment fails [30]. Failure of non-invasive respiratory support remains clinically important because delayed intubation in a deteriorating patient may worsen risk [31].

Guidance cited in the article supports HFNC/HFOT for selected patients with acute hypoxemic respiratory failure and emphasizes close monitoring [32]. The ERS guideline specifically addresses high-flow nasal cannula use in acute respiratory failure and the need for protocolized escalation [33]. Structured competency assessment and refresher education may also support more consistent bedside implementation of HFOT [34].

The practical strength of this study is that it assesses both patient-centered outcomes (oxygenation, respiratory rate, intubation, and comfort) and a process measure (incorrect parameter settings) within the same implementation project. The marked reduction in incorrect settings is particularly relevant because it is the outcome most directly linked to the training intervention. Improvements in intubation frequency and physiological targets are more clinically important but are also more vulnerable to differences in disease severity, case mix, concurrent treatment, and secular changes between the two observation periods.

Several limitations materially affect interpretation. First, the study used an uncontrolled before-and-after design, so the observed changes cannot be attributed to training alone. Second, exact pre- and post-training patient denominators and detailed baseline characteristics were not available, which prevents assessment of comparability between periods. Third, the reported statistical test could not be independently verified from patient-level data. Fourth, the study did not report predefined inclusion and exclusion criteria, mortality, ICU length of stay, or detailed treatment-failure criteria. Finally, the single-center setting limits generalizability.

These limitations do not negate the quality-improvement signal, but they define the level of inference that is scientifically defensible. The results support implementation feasibility and justify a prospective follow-up study rather than proving a causal reduction in intubation or other hard clinical outcomes.

CONCLUSION

Implementation of a structured HFOT training program for ICU nurses and physicians was associated with better oxygenation and respiratory-rate targets, fewer reported intubations, improved patient comfort, and a substantial reduction in incorrect device settings. The strongest direct signal of the intervention was the improvement in process reliability. Because the study was uncontrolled and the available study documentation does not contain the patient-level data required for risk adjustment or robust inferential analysis, the findings should be interpreted as a quality-improvement signal rather than proof of causality. Future prospective work should predefine eligibility criteria, document baseline severity and cohort denominators, use appropriate statistical methods, and evaluate sustainability and patient-centered outcomes.

PRACTICAL RECOMMENDATIONS

- Use a standardized HFOT initiation and monitoring algorithm in the ICU.
- Provide periodic refresher training and competency reassessment for nurses and physicians.
- Document flow, FiO_2, respiratory rate, SpO_2, work of breathing, and escalation criteria at predefined intervals.
- Use structured feedback on device-setting errors and near-miss events as part of continuous quality improvement.
- Prospectively collect patient-level data to evaluate treatment failure, intubation, ICU length of stay, and mortality.

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DECLARATIONS / ДЕКЛАРАЦИИ / ДЕКЛАРАЦИЯЛАР

Ethics statement. This work was conducted as an institutional quality-improvement project aimed at standardizing HFOT in routine ICU practice. The analysis used routinely collected, de-identified clinical and operational data. No experimental patient-level interventions or procedures beyond standard clinical care were introduced. Under the institutional framework applicable to this quality-improvement activity, separate ethics committee approval and individual informed consent were not required. Patient confidentiality was maintained throughout the project.
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Author contributions. M. Mirsaliyev - Conceptualization; Investigation; Data Curation; Writing - Original Draft. S. Tulekhanova - Conceptualization; Methodology; Supervision; Writing - Review & Editing. D. Jarkenbekova - Investigation; Data Curation; Writing - Review & Editing. A. Alpysbayev - Investigation; Resources; Data Curation; Writing - Review & Editing. A. Satkymbayeva - Investigation; Validation; Data Curation; Writing - Review & Editing.

Этические аспекты. Работа выполнена в рамках внутреннего проекта по улучшению качества медицинской помощи, направленного на стандартизацию применения ВПОТ в повседневной практике отделения интенсивной терапии. Для анализа использовались рутинно собираемые обезличенные клинические и организационные данные. Экспериментальные вмешательства на уровне пациентов и дополнительные процедуры, выходящие за рамки стандартной медицинской помощи, не проводились. В соответствии с институциональным порядком, применимым к данному проекту по улучшению качества, отдельное одобрение этического комитета и индивидуальное информированное согласие не требовались. Конфиденциальность данных пациентов соблюдалась на всех этапах проекта.
Конфликт интересов. Авторы заявляют об отсутствии конфликта интересов.
Финансирование. Исследование не получало внешнего финансирования.
Заявление о публикации. Авторы заявляют, что данный материал ранее не публиковался и не находится на рассмотрении в другом издательстве.
Вклад авторов. М. Мирсалиев - разработка концепции; проведение исследования; курирование данных; подготовка первоначального варианта рукописи. С. Тулеханова - разработка концепции; методология; научное руководство; рецензирование и редактирование рукописи. Д. Джаркенбекова - проведение исследования; курирование данных; рецензирование и редактирование рукописи. А. Алпысбаев - проведение исследования; ресурсное обеспечение; курирование данных; рецензирование и редактирование рукописи. А. Саткымбаева - проведение исследования; валидация; курирование данных; рецензирование и редактирование рукописи.

Этикалық аспектілер. Жұмыс қарқынды терапия бөлімшесінің күнделікті тәжірибесінде жоғары ағынды оттегі терапиясын қолдануды стандарттауға бағытталған медициналық көмектің сапасын жақсарту жөніндегі ішкі жоба шеңберінде жүргізілді. Талдау үшін күнделікті клиникалық практика барысында жиналған иесіздендірілген клиникалық және ұйымдастырушылық деректер пайдаланылды. Стандартты медициналық көмектен тыс пациент деңгейіндегі эксперименттік араласулар немесе қосымша рәсімдер жүргізілген жоқ. Осы сапаны жақсарту жобасына қолданылатын институционалдық тәртіпке сәйкес этикалық комитеттің жеке мақұлдауы және жеке ақпараттандырылған келісім талап етілмеді. Пациенттер деректерінің құпиялылығы жобаның барлық кезеңінде сақталды.
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Жариялау туралы мәлімдеме. Авторлар бұл материалдың бұрын жарияланбағанын және басқа баспада қарастырылмайтынын мәлімдейді.
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