

Written opinion of the official reviewer on the dissertation work completed as a series of articles on the topic “Organization and Development Strategy of Extracorporeal Membrane Oxygenation Service” by doctoral student Bekzhan Abdalimovich Permenov, submitted for the degree of Doctor of Philosophy (PhD) in the educational program 8D10139 – “Public Health”.

| Registration № | Criteria | Compliance with the criteria (underline one of the answer options). | Justification of the official reviewer’s position (comments should be provided in italics). |
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| 1. | Compliance of the dissertation topic (as of the date of approval) with the priority directions of scientific development and/or state programs. | <p>1.1 Compliance with the priority directions of scientific development and/or state programs:</p> <p>1) the dissertation was carried out within the framework of a project or target program funded from the state budget (indicate the title and number of the project or program);</p> <p>2) the dissertation was completed within the framework of another state program (indicate the title of the program);</p> <p>3) the dissertation corresponds to the priority area of science development approved by the Higher Scientific and Technical Commission under the Government of the Republic of Kazakhstan (indicate the area).</p> | <p>The dissertation research was carried out in accordance with the priority area of science development approved by the Higher Scientific and Technical Commission under the Government of the Republic of Kazakhstan: “Life and Health Sciences.”</p> <p>In addition, it is consistent with the Concept for the Development of Healthcare in the Republic of Kazakhstan until 2026 and the Concept for the Development of Higher Education and Science in the Republic of Kazakhstan for 2023–2029.</p> |
| 2. | Significance for science | The work makes / does not make a significant contribution to science, and its significance has / has not been demonstrated. | <p>The reviewed dissertation makes a significant contribution to science, and its relevance and importance have been clearly demonstrated.</p> <p>The dissertation work devoted to the strategic aspects of the organization and development of extracorporeal membrane oxygenation service is of considerable importance for public health science and represents a highly relevant scientific study. At the present stage,</p> |

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| | | | <p>extracorporeal membrane oxygenation has become one of the key areas of high-technology medical care used in severe and life-threatening cases of cardiopulmonary failure. In this regard, it is particularly important to consider ECMO service not only as a clinical technology, but also as an integrated healthcare service that requires effective organization, adequate staffing, rational resource allocation, continuity of training, and high-quality informational support.</p> <p>The analysis of the scientific literature demonstrates that the scope of ECMO application is steadily expanding; however, this field remains unevenly developed in organizational, staffing, and methodological terms. Differences in approaches to organizing ECMO services, standards, the level of specialist training, and resource provision across countries and medical institutions directly affect the accessibility and quality of this care. In addition, the shortage of trained personnel, the lack of standardized approaches, and the limited number of specialized units are regarded as major factors hindering the sustainable development of ECMO services.</p> <p>Another important aspect of the study is the assessment of the role of nurses in ECMO services. Current studies show that nurses are among the key professionals in ensuring continuous clinical and technical monitoring of patients, as well as in maintaining safety and quality of care. However, the issues of standardizing their professional training, ensuring balanced workload distribution, and improving specialized training systems remain highly relevant. This situation clearly demonstrates the need for a scientific reconsideration of the staffing model of ECMO services.</p> |
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| | | | <p>At the same time, issues related to the quality and reliability of information on ECMO in the digital information space are also of particular importance for public health. The qualitative heterogeneity of medical content posted on open platforms, the risk of dissemination of false or insufficiently evidence-based information, as well as users' strong interest in materials that are not scientifically grounded, all increase the importance of strengthening professional medical communication.</p> <p>A particularly valuable practical dimension of this dissertation is the inclusion of conclusions based on the five-year experience of implementing ECMO in a multidisciplinary hospital without on-site cardiac surgery. This significantly strengthens the applied relevance of the work, since it demonstrates how organizational solutions can be adapted to real clinical practice in healthcare systems with limited infrastructure and resources.</p> <p>From this perspective, the dissertation work of Bekzhan Abdalimovich Permenov entitled "Organization and Development Strategy of Extracorporeal Membrane Oxygenation Service" addresses a highly important scientific and practical issue for the modern public health system. The dissertation comprehensively examines the non-clinical aspects of ECMO service, namely its organizational, staffing, informational, and implementation-related sustainability dimensions, and presents scientifically grounded conclusions and practice-oriented recommendations aimed at improving this field.</p> <p>Therefore, the dissertation represents an important scholarly work that makes a significant contribution to defining the strategic directions for the development of</p> |
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| | | | extracorporeal membrane oxygenation service and to improving high-technology care in the field of public health. | | |
| 3. | Principle of independent writing | Level of independent writing: | The results of the dissertation research have been published in 5 scientific papers. The publication set demonstrates a high level of academic independence, consistency of scientific work, and substantial personal contribution by the doctoral student. The presented articles reflect the main objectives of the research and confirm the applicant's ability to independently formulate scientific problems, choose relevant methods, analyze the obtained results, and prepare publications in peer-reviewed journals. This publication activity meets the requirements for the award of the PhD degree. | | |
| | | 1) high; | | | |
| | | 2) average; | | | |
| | | 3) low; | | | |
| | | 4) not written by the student. | | | |
| 4. | Principle of internal unity. | 4.1 Justification of the relevance of the dissertation: | The relevance of the dissertation research is supported by a clear rationale. The stated relevance of the dissertation study is fully justified and corresponds to current priorities in the development of high-technology medical care and healthcare organization. | | |
| | | 1) justified; | | | |
| | | 2) partially justified; | | | |
| | | | | 3) not justified. | |
| | | 4.2 The content of the dissertation reflects the dissertation topic: | All 5 published articles fully disclose and define the topic of the dissertation research. The doctoral student published articles that consistently cover the key dimensions of the ECMO service. He published the article "Evaluating the Quality and Reliability of YouTube as a Source of Information on Extracorporeal Membrane Oxygenation: A Call to Publish More Quality Videos by Professionals" in the Journal of Korean Medical Science. He also published the article "Extracorporeal Membrane Oxygenation: Unmet Needs and Perspectives" and the article "Healthcare Professionals' Perceptions of Nurses' Qualifications and Roles in Extracorporeal Membrane Oxygenation: An Online Cross-Sectional Survey" in Rheumatology International. In addition, he published | | |
| | | 1) reflects; | | | |
| | | 2) partially reflects; | | | |
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| | | 3) does not reflect. | | | |

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| | | | <p>“Healthcare Professionals’ Views on Training, Standards, and Resources for Extracorporeal Membrane Oxygenation: A Cross-Sectional Survey” in the Croatian Medical Journal. The practical dimension of the topic is further reinforced by the publication “Practical Recommendations for ECMO Implementation in Multidisciplinary Hospitals Without Cardiac Surgery: Lessons Learned from the Five-Year Experience of the Heart Center Shymkent.”</p> <p>Taken together, these publications comprehensively reflect the dissertation topic and consistently reveal its strategic, organizational, staffing, informational, and implementation-related aspects.</p> |
| | | <p>4.3. The objectives and tasks correspond to the dissertation topic:</p> | <p>Thus, the article “Extracorporeal Membrane Oxygenation: Unmet Needs and Perspectives” corresponds to the first objective, “Healthcare Professionals’ Views on Training, Standards, and Resources for Extracorporeal Membrane Oxygenation: A Cross-Sectional Survey” corresponds to the second objective, “Healthcare Professionals’ Perceptions of Nurses’ Qualifications and Roles in Extracorporeal Membrane Oxygenation: An Online Cross-Sectional Survey” corresponds to the third objective, “Evaluating the Quality and Reliability of YouTube as a Source of Information on Extracorporeal Membrane Oxygenation: A Call to Publish More Quality Videos by Professionals” corresponds to the fourth objective, and “Practical Recommendations for ECMO Implementation in Multidisciplinary Hospitals Without Cardiac Surgery: Lessons Learned from the Five-Year Experience of the Heart Center Shymkent” corresponds to the fifth objective.</p> |
| | | <p>1) corresponds;</p> | |
| | | <p>2) partially corresponds.</p> | |
| | | <p>3) does not correspond.</p> | |
| | | <p>4.4. All sections and provisions of the dissertation are logically interconnected:</p> | <p>The internal consistency and logical integrity of the dissertation research are maintained throughout all stages of the study and across all published scientific articles. Each</p> |
| | | <p>1) fully interconnected;</p> | |

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| | | <p>2) partially interconnected;</p> | <p>article serves as a continuation and complement to the preceding one. A critical approach was applied to the analysis of the literature and sources, which made it possible to present the studied issue as objectively as possible. All data used in the research were obtained from reliable sources, and the results published in the scientific articles underwent peer review by experts of international journals.</p> <p>The logical sequence of the work is especially convincing because the dissertation moves from a broad analytical overview of unmet needs in ECMO, to the study of training and resource support, then to the clarification of the nursing role, followed by the assessment of the quality of public information on ECMO, and finally to a practice-oriented synthesis based on the real institutional experience of ECMO implementation in Shymkent. Such a structure ensures the internal unity of the work and demonstrates the author's ability to consistently develop one scientific theme through interrelated studies.</p> |
| | | <p>3) there is no connection.</p> <p>4.5 The new solutions proposed by the author (principles, methods) have been substantiated, evaluated, and compared with previously known solutions.</p> | <p>In the dissertation research, the conclusions and principles proposed by the author are scientifically substantiated and supported by the results of the conducted analysis. The organizational, staffing, informational, and practical aspects of ECMO service were examined in comparison with international experience, on the basis of which the current issues and limitations of this field were identified. The study findings were not based on personal opinion, but rather on authoritative scientific sources, international recommendations, peer-reviewed publications, and the author's own summarized implementation experience, which demonstrates the objectivity and scientific reliability of the obtained results..</p> |
| | | <p>1) there is a critical analysis;</p> | |
| | | <p>2) the analysis has been carried out partially;</p> | |
| | | <p>3) the analysis is based not on the author's own opinion, but on references to other authors;</p> | |
| | | <p>4) there is no analysis.</p> | |

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| 5. | Principle of scientific novelty. | 5.1 Are the scientific results and provisions novel? | The scientific results obtained during the dissertation research and the provisions submitted for defense are entirely novel and offer new scientifically grounded solutions in the field of public health. |
| | | 1) completely novel; | |
| | | 2) partially novel (25–75% is new); | |
| | | 3) not novel (less than 25% is new); | The conclusions presented in the dissertation fully comply with the requirements of scientific novelty established for dissertation research. The study results are distinguished by their originality and fully correspond to the stated aims and objectives. |
| | | 5.2 Are the conclusions of the dissertation novel? | |
| | | 1) completely novel; | |
| | | 2) partially novel (25–75% is new); | The organizational and practical solutions developed in the course of the study are scientifically substantiated and suitable for practical application. Within the framework of the dissertation, recommendations aimed at improving the organization of extracorporeal membrane oxygenation service, systematizing staffing support, enhancing the quality of informational support, and strengthening institutional readiness for ECMO implementation were developed and implemented into the clinical, educational, and research activities of the Shymkent City Multidisciplinary Hospital No. 2 (Municipal State Enterprise on the Right of Economic Management), the City Perinatal Center (Municipal State Enterprise on the Right of Economic Management), and the Regional Clinical Hospital (Municipal State Enterprise on the Right of Economic Management), where they are currently being used in practice (implementation acts, 2025–2026). |
| | | 3) not novel (less than 25% is new); | |
| | | 5.3 Are the technical, technological, economic, or managerial solutions new and substantiated? | |
| | | 1) completely novel; | |
| 2) partially novel (25–75% is new); | | | |
| 3) not novel (less than 25% is new). | | | |

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| 6. | Validity of the main conclusions. | All main conclusions are scientifically grounded in extensive evidence./ not substantiated (for training areas in qualitative research and in the arts and humanities). | The conclusions fully comply with the requirements for the presentation of scientific work and are based on the current scientific paradigm. The dissertation research is distinguished by the systematic presentation of scientific information, and no logical contradictions were identified in its content.. |
| 7. | Main provisions submitted for defense. | <p>Each provision should be answered separately with regard to the following questions:</p> <p>7.1 Has the provision been substantiated?</p> <p>1) substantiated;</p> <p>2) approximately substantiated;</p> <p>3) approximately not substantiated;</p> <p>4) not substantiated;</p> <p>5) it is impossible to verify from this statement whether the provision has been substantiated.</p> <p>7.2 Is it trivial??</p> <p>1) yes;</p> <p>2) no;</p> <p>3) It is not possible to verify from this conclusion whether the provision is trivial.</p> <p>7.3 Is it new?</p> <p>1) yes;</p> <p>2) no;</p> <p>3) It is not possible to verify the novelty of the provision from this conclusion..</p> <p>7.4 Level of application:</p> <p>1) narrow;</p> | The main provisions submitted for defense in the dissertation are characterized by their novelty and scientific validity, and they may also be applied in research within the field of healthcare. The principal findings of the candidate's work are supported by scientific publications in peer-reviewed journals, as well as by materials presented at international conferences and forums. The proposed results are practically applicable and possess an innovative character. |

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| | | 2) moderate; | |
| | | 3) broad | |
| | | 4) it is not possible to verify the level of application of the provision from this conclusion.. | |
| | | 7.5 Has it been demonstrated in the article? | |
| | | 1) yes; | |
| | | 2) no | |
| | | 3) It is not possible to verify from this conclusion whether the provision has been demonstrated in the article. | |
| 8. | Principle of consistency. | 8.1 The choice of methodology is well-grounded / the methodology is clearly described: | The selection of the research methodology and its application are described broadly and in detail in the scientific articles. The methods used in the dissertation are modern and generally recognized. In addition, the research methods and the mechanisms of their implementation are presented systematically and consistently on the basis of the study design, which made it possible to effectively address the main objectives of the dissertation. The planning and implementation of the research were approved by a positive opinion of the local ethics committee. |
| | Consistency of the sources and the information presented. | 1) yes; | |
| | | 2) no. | |
| | | 8.2 The results of the dissertation work were obtained using modern methods of scientific research, as well as methods of data processing and interpretation, with the application of computer technologies: | During the study, the doctoral student used modern information and communication technologies and statistical methods for data processing, including the SPSS software package (IBM SPSS Statistics, version 26.0), which ensured the objectivity and scientific validity of the obtained results.. |
| | | 1) yes; | |
| | 2) no. | | |

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| | | 8.3 The theoretical conclusions, models, identified relationships, and patterns have been substantiated and confirmed by experimental studies (for training areas in pedagogical sciences, the results are validated on the basis of a pedagogical experiment): | The theoretical conclusions, as well as the identified relationships and patterns, were substantiated and refined through the calculation of statistical indicators, analysis of survey data, content assessment, and synthesis of implementation experience. The results of the dissertation were presented and discussed at scientific-practical conferences and forums. |
| | | 1) yes; | |
| | | 2) no. | |
| | | 8.4 The important statements are supported / partially supported / not supported by references to accurate and reliable scientific literature. | The important data used in carrying out the dissertation work are supported by references to accurate and reliable scientific literature. |
| | | 8.5 The list of references used is sufficient / insufficient for the literature review. | The extensive and systematic scientific search conducted on the basis of global bibliographic databases fully complies with the requirements for a review of literature sources. The doctoral student covered a sufficient volume of scientific literature and used a substantial body of references in accordance with the studies conducted and the published articles. |
| 9 | Principle of practical value. | 9.1 Theoretical significance of the dissertation: | The dissertation research has theoretical significance. The proposed results make it possible to scientifically substantiate extracorporeal membrane oxygenation service as an integrated component of the public health system and to systematize its organizational, staffing, informational, and implementation mechanisms. In addition, the conclusions obtained complement the theoretical foundations of organizing high-technology medical care and deepen scientific understanding related to ensuring the effectiveness, accessibility, and safety of ECMO services. |
| | | 1) yes; | |
| | | 2) no. | |

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| | | 9.2 The dissertation has practical significance, and the possibility of applying the obtained results in practice is high: | The organizational and managerial solutions developed during the study are scientifically substantiated and suitable for practical application. Within the framework of the dissertation, methodological recommendations aimed at improving the organization of extracorporeal membrane oxygenation service, optimizing staffing support, enhancing the quality of informational support, and strengthening institutional preparedness for ECMO implementation were developed and implemented into the clinical, educational, and research activities of the Shymkent City Multidisciplinary Hospital No. 2 (Municipal State Enterprise on the Right of Economic Management), the City Perinatal Center (Municipal State Enterprise on the Right of Economic Management), and the Regional Clinical Hospital (Municipal State Enterprise on the Right of Economic Management). These recommendations are being used in practical, educational, and scientific activities, which is confirmed by the relevant implementation acts (2025–2026). |
| | | 1) yes; | |
| | | 2) no. | |
| | | 9.3 Are practical recommendations new? | |
| | | 1) completely new; | |
| | | 2) partially new (25-75% new); | The practical recommendations are entirely novel. |
| | | 3) not new (new less than 25%). | |
| 10. | Quality of writing and presentation | Academic writing quality: | The quality of academic writing is high, as it fully corresponds to the content of the dissertation work. The publication set presented for defense demonstrates a consistent scientific style, logical presentation of material, and a clear focus on solving an important scientific and practical problem in public health. The doctoral candidate has shown the ability to prepare analytical, empirical, and practice-oriented publications at a high methodological level. |
| | | 1) high; | |
| | | 2) average; | |
| | | 3) below average; | |
| | | 4) low. | |

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| 11. | Comments on the dissertation | <p>The scientific work has been carried out at a high level; however, a number of issues arise that require clarification:</p> <ol style="list-style-type: none"> 1. The dissertation research addresses the improvement of the organization of extracorporeal membrane oxygenation service, the systematization of staffing support, and the enhancement of the quality of informational support. In this regard, which organizational model do you consider to be the most effective for medical institutions with limited resources in the development of ECMO services? 2. Special attention in the study is given to the role and professional training of nurses within the ECMO team. In this regard, what priority directions would you propose for standardizing nurses' functions and implementing a specialized training system for them? 3. The dissertation includes practical recommendations based on the five-year experience of implementing ECMO in a multidisciplinary hospital without cardiac surgery. In this regard, which managerial and logistical components do you consider to be the most critical for ensuring the sustainability and scalability of such a model in other regional healthcare institutions |
| 12. | <p>Scientific level of the doctoral student's articles on the research topic (if the dissertation is defended in the form of a series of articles, the official reviewers examine the scientific level of each article related to the doctoral student's research topic).</p> | <ol style="list-style-type: none"> 1. Article: Extracorporeal membrane oxygenation: unmet needs and perspectives Scientific level: This review article comprehensively analyzes the current areas of application of extracorporeal membrane oxygenation, including COVID-19, pregnancy, rheumatologic diseases, coagulation management, antibiotic pharmacokinetics, clinical recommendations, survey-based studies, and rehabilitation issues. Relying on the Web of Science, Scopus, Medline/PubMed, and DOAJ databases, the authors systematized both the clinical and organizational aspects of ECMO service. The article scientifically substantiates the current unresolved issues in the use of ECMO and the prospects for its improvement; therefore, this work represents an important scientific review aimed at the development of high-technology medical care. 2. Article: Healthcare professionals' views on training, standards, and resources for extracorporeal membrane oxygenation: a cross-sectional survey Scientific level: This article presents the results of an international online survey conducted among healthcare professionals from 12 countries. The study was aimed at assessing issues related to staff training, certification, availability of standards, and resource support in the use of ECMO. The results identified high costs, a shortage of qualified specialists, and limited availability of equipment as the main barriers to |

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| | | <p>the implementation of ECMO services. This work is a practically valuable study that demonstrates the importance of standardized training and institutional preparedness for the safe and sustainable development of ECMO services.</p> <p>3. Article: Healthcare professionals' perceptions of nurses' qualifications and roles in extracorporeal membrane oxygenation: an online cross-sectional survey Scientific level: This study examines the role, competencies, level of training, and educational needs of nurses involved in ECMO services. The results of the international online survey identified nurses as playing a crucial role in patient monitoring during ECMO, prevention of complications, supervision of device integrity, and functioning within the multidisciplinary team. In addition, insufficient specialized training, staff shortages, and high workload were identified as the main challenges. This article is a scientifically and practically significant work aimed at improving the training system for ECMO nurses and developing a standardized competency framework.</p> <p>4. Article: Evaluating the Quality and Reliability of YouTube as a Source of Information on Extracorporeal Membrane Oxygenation: A Call to Publish More Quality Videos by Professionals Scientific level: This article systematically evaluates the quality and reliability of video materials on ECMO available on the YouTube platform. In the study, 55 videos were analyzed, and it was shown that some of them were of low quality or represented misleading sources of information, while the highest-quality videos were most often provided by physicians. Using validated instruments such as the GQS, modified DISCERN, JAMA Benchmark Criteria, and PEMAT-A/V, the authors scientifically assessed the quality of digital medical content. This work is an important scientific study from a public health perspective, highlighting the need to increase the amount of reliable informational materials on ECMO.</p> <p>5. Article: Practical Recommendations for ECMO Implementation in Multidisciplinary Hospitals Without Cardiac Surgery: Lessons Learned from the Five-Year Experience of the Heart Center Shymkent Scientific level: This article presents a practice-oriented analysis of the implementation of extracorporeal membrane oxygenation in a multidisciplinary hospital without an on-site cardiac surgery service, based on the five-year experience of the Heart Center Shymkent. The study summarizes key organizational decisions, logistical approaches, team-building strategies, and practical lessons learned during the gradual establishment and development of the ECMO service in a resource-constrained setting. Of particular scientific and practical importance is the fact that the article does not merely describe local experience,</p> |
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| | | but formulates applicable recommendations for other healthcare institutions facing similar structural and infrastructural limitations. The work significantly enriches the field of public health by translating real clinical-organizational experience into generalized managerial recommendations and may serve as a valuable model for the wider implementation of ECMO programs in regional and multidisciplinary hospitals. |
| 13. | Decision of the official reviewer to award the degree of Doctor of Philosophy (PhD) or Doctor by profile (in the case of a defense at a dissertation council under a higher and/or postgraduate education institution with special status), or to recommend submission to the Committee for awarding the degree of Doctor of Philosophy (PhD) or Doctor by profile (in the case of a defense at a dissertation council under a higher and/or postgraduate education institution without special status). | <p>Bekzhan Abdalimovich Permenov's dissertation research entitled "Organization and Development Strategy of Extracorporeal Membrane Oxygenation Service" is a completed scientific work distinguished by its internal coherence, practical value, scientific novelty, reliability, and full compliance with the principles of academic integrity.</p> <p>The dissertation work submitted for the award of the degree of Doctor of Philosophy (PhD) fully complies with the requirements of the current regulatory legal acts "On Approval of the Rules for Awarding Academic Degrees." In this regard, I consider the applicant, Bekzhan Abdalimovich Permenov, to be worthy of the degree of Doctor of Philosophy (PhD) in the educational program 8D10139 – "Public Health."</p> |

**Candidate of Medical Sciences, Associate Professor,
Head of the Department of Social Medicine,
Economics and Organization of Healthcare
of Danylo Halytsky Lviv National Medical University,
Lviv, Ukraine**

Taras Gutor

