UDC 616-08-039.76(075.8):616.89-008.441.1-08-059
DOI https://doi.org/10.32782/2226-2008-2025-1-12

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NEUROREHABILITATION IN THE FACE OF MODERN CHALLENGES: GLOBAL PRACTICES AND DEVELOPMENT PROSPECTS IN UKRAINE

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In Ukraine, neurorehabilitation is particularly pertinent due to the ongoing military conflict and its consequences. Neurorehabilitation is an interdisciplinary branch focused on restoring the functions of the nervous system that have been lost or impaired due to injury, disease, or psycho-emotional disorders. It encompasses a wide range of interventions, including medical, psychological, social, educational, and professional components.

The aim of the study was to study the world best practices and principles of neurorehabilitation, as well as the possibilities and features of organizing the provision of such assistance in Ukraine for patients with mental problems.

Materials and methods. The present study is interdisciplinary and review-analytical, aiming to systematize and comparatively analyze approaches to neurorehabilitation in both global and national contexts. The primary objective is to identify key concepts, structural elements, and organizational models for Ukraine.

Results. Studied global experience indicates that neurorehabilitation holds a vital position at the crossroads of neurology, psychiatry, psychology, physical therapy, occupational therapy, and social work. The most effective neurorehabilitation models are rooted in multidisciplinary teams. Normative and methodological principles are proposed, according to which neurorehabilitation can be developed and standardized in Ukraine. The integration of innovative tools (virtual reality (VR), neurocomputer interfaces (NCIs), transcranial magnetic stimulation (TMS), transcranial direct current stimulation (tDCS), and computerized biofeedback simulators) with traditional methods creates significant opportunities for personalizing the recovery process and enhancing the effectiveness of rehabilitation programs for patients with mental problems.

Keywords: neurorehabilitation, mental health, PTSD, psychosocial care, multidisciplinary team.

УДК 616-08-039.76(075.8):616.89-008.441.1-08-059

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НЕЙРОРЕАБІЛІТАЦІЯ В УМОВАХ СУЧАСНИХ ВИКЛИКІВ: ГЛОБАЛЬНІ ВИКЛИКИ ТА ПЕРСПЕКТИВИ РОЗВИТКУ В УКРАЇНІ
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Нейрореабілітація в Україні набуває особливої актуальності у зв'язку з військовим конфліктом та пов'язаними з ним наслідками. Метою роботи було дослідження світового передового досвіду та принципів надання нейрореабілітації, а також можливостей та особливостей організації надання такої допомоги в Україні, зокрема пацієнтам із ментальними проблемами. Найефективніші моделі нейрореабілітації базуються на мультидисциплінарних командах. Запропоновані нормативно-методичні принципи, за якими може розвиватися та нормуватися нейрореабілітація в Україні. Поєднання інноваційних інструментів із традиційними методами відкриває широкі можливості для персоналізації відновлювального процесу та підвищення ефективності реабілітаційних програм.

Ключові слова: нейрореабілітація, ментальне здоров'я, ПТСР, психосоціальна допомога, мультидисциплінарна команда.

Topic Relevance. The relevance of neurorehabilitation is underscored by numerous global, regional, and national factors that collectively impact healthcare systems, economies, and the social lives of nations. At the international level, demographic changes play a pivotal role. According to the World Health Organization (WHO) and the Institute for Health Metrics and Evaluation (IHME), global life expectancy is steadily rising, accompanied by an increase in the elderly population. This aging demographic has led to a surge in chronic and degenerative neurological and psychiatric conditions. Development of neurorehabilitation is driven by the increasing prevalence of chronic neurological conditions such as strokes, traumatic brain injuries, spinal cord injuries, Parkinson's disease, and multiple sclerosis. Additionally, the rising incidence of mental health disorders, including post-traumatic stress disorder (PTSD), depression, and anxiety, underscores the necessity of neurorehabilitation. Strokes, for instance, remain a leading cause of disability worldwide. WHO estimates that over 15 million people experience strokes annually, many of whom require prolonged rehabilitation to regain essential life skills.

Neurodegenerative diseases such as Parkinson's, Alzheimer's, and other dementias pose a significant challenge for healthcare systems globally. These conditions demand long-term, comprehensive care, encompassing support for daily activities and specialized rehabilitation strategies to address cognitive and motor impairments [1]. Additionally, the rising prevalence of autism spectrum disorders, cerebral palsy in children, and multiple sclerosis

necessitates high-quality neurorehabilitation to maximize social integration and improve the quality of life for both patients and their families.

Mental health conditions, including PTSD, depression, and anxiety disorders, have increasingly been recognized as global public health crises [2]. Factors such as rapid urbanization, socio-political conflicts, terrorist threats, climate change, and economic instability create a conducive environment for psychological trauma [3]. Without adequate psychosocial rehabilitation, affected individuals often withdraw from active participation in society, placing a strain on social services and their families. Consequently, the demand for a multidisciplinary approach that integrates medical, psychological, and social interventions is growing exponentially [4]. This collaborative approach addresses every facet of the patient's life, including physical mobility, speech and cognitive skills, emotional well-being, social interactions, daily living skills, and professional competencies.

Economically, the burden of disability, reduced productivity, and the need for long-term care weigh heavily on societies [5]. The Organization for Economic Cooperation and Development (OECD) reports a continuous increase in the costs associated with caring for chronically ill patients and individuals with disabilities. The absence of effective rehabilitation services exacerbates these costs, as it results in prolonged exclusion from the workforce [6]. Investments in neurorehabilitation, however, have the potential to alleviate this burden by enabling many individuals to return to active work and social life, yielding long-term economic benefits for states.

For Ukraine, the relevance of neurorehabilitation is particularly acute due to national circumstances. Ongoing military operations have led to a significant rise in cases of combat injuries, including traumatic brain injuries (TBIs), spinal and limb damage [7], and PTSD, often accompanied by comorbid mental disorders [8–11]. These individuals require not only medical and physical rehabilitation but also psychotherapeutic, social, and vocational support to regain normalcy in their lives [12]. Moreover, the prevalence of cardiovascular diseases, including strokes, high stress levels, and gaps in primary prevention add further strain to the healthcare system. Without an adequate neurorehabilitation infrastructure, these issues risk escalating into a critical mass of disabled individuals requiring long-term care.

In response to these challenges, international organizations such as WHO and the World Federation for NeuroRehabilitation (WFNR) [13] emphasize integrating rehabilitation into all levels of healthcare, from acute care following an illness or injury to long-term community-based support. These recommendations align with the broader framework of Rehabilitation 2030, a global WHO initiative aimed at expanding rehabilitation services worldwide [14]. This vision positions high-quality neurorehabilitation not only as a medical necessity but also as a strategic resource to enhance societal resilience and adaptability in the face of modern challenges.

Materials and Methods. The present study was carried out as part of the implementation of the state budget research work of the department "Complex psychosomatic rehabilitation of military and civilian groups affected by military operation in Ukraine". This study is interdisciplinary and review-analytical in nature, aiming to systematize and comparatively analyze approaches to neurorehabilitation in both global and national contexts. The primary objective is to identify key concepts, structural elements, effective interventions, and organizational models that can be adapted and implemented within the Ukrainian healthcare system, in particular for patients with mental problems.

The material for this analysis is drawn from authoritative international documents and recommendations, including the World Health Organization's strategic framework *"Rehabilitation 2030"*, as well as a joint document from the European Commission and the WHO Regional Office for Europe addressing mental health policy, neurorehabilitation, and the social integration of persons with disabilities [15]. Additional sources include recommendations and guidelines from professional organizations such as the International Society for Neurorehabilitation, the European Association of Rehabilitation Medicine, and the American Academy of Physical Medicine and Rehabilitation [14, 16, 17]; plus the national legal acts and official documents of Ukraine: orders of the Ministry of Health of Ukraine on the organization of rehabilitation care, implementation of rehabilitation service packages, requirements for equipment and staffing [18–22].

Articles containing original data, meta-analyses, and systematic reviews were selected based on targeted searches using keywords such as *"neurological rehabilitation"*, *"neurorehabilitation"*, *"psychosocial rehabilitation"*, *"multidisciplinary teams"*, *"brain-computer interfaces in rehabilitation"*, *"transcranial magnetic stimulation"*, *"VR rehabilitation"*, *"PTSD rehabilitation"*, *"community-based rehabilitation"*, *"rehabilitation in Ukraine"*, *"WHO rehabilitation guidelines"*, and *"mental health reform"*.

Although there are inherent limitations due to the diversity of sources and the scope of available data, the combination of a comparative analysis approach and critical interpretation facilitated the development of a comprehensive understanding of international trends in neurorehabilitation. This method also highlights opportunities for adapting these practices to meet the unique needs of Ukraine's healthcare system.

Discussion. The analysis of international practices and national realities underscores the growing recognition of neurorehabilitation as a strategically vital area within healthcare systems. An interdisciplinary approach, integrating medical, psychological, social, and vocational components, is acknowledged as optimal in most developed countries. Nevertheless, significant gaps persist between global standards and the Ukrainian context, necessitating systematic efforts and thoughtful adaptation.

In developed countries such as Germany, Sweden, and the United Kingdom, neurorehabilitation is part of an integrated network of medical and social services. Each stage – from acute hospitalization to long-term outpatient support – is clearly regulated through national strategic plans that outline priorities, standards, key performance indicators, and funding mechanisms. Implementing a similar national strategy in Ukraine could address the fragmentation of services and establish a cohesive rehabilitation

model, particularly crucial for individuals with neurological and mental disorders resulting from war-related trauma.

Multidisciplinary teams are the gold standard in countries like the United States, Canada, EU member states, and Australia. These teams provide patients with holistic support, coordinated by a physical and rehabilitation medicine doctor. Psychologists and psychotherapists focus on emotional stabilization, speech therapists and occupational therapists work on communication and daily skills, physical therapists enhance motor recovery, and social workers and counselors assist with employment, housing adaptation, and legal matters. This integrated approach prevents fragmentation of care, where patients must seek specialists independently. This is especially pertinent for Ukraine, where individuals with strokes, traumatic brain injuries, or PTSD often lack the resources or knowledge to access comprehensive care.

The global use of standardized assessment tools, such as WHO DAS, GAF, BADL, and MoCA, demonstrates their effectiveness in objectively measuring impairments and recovery progress. In Ukraine rehabilitation specialists use Order of the Ministry of Health of Ukraine dated 20.11.2024 No. 1946 "On Approval of the List of Recommended Tools for Assessing the Functioning, Disabilities and Health of a Person". So, standardization of evaluation methods would enhance the quality of rehabilitation, facilitate data collection, and support evidence-based government programs.

Advanced technologies, including NCIs, for example computerized simulators with biofeedback [23], TMS [24-29], VR [30], vagus nerve stimulation [31], cognitive behavioral therapy [32], and mindfulness techniques, are widely implemented in leading centers across Europe and North America. These innovations stimulate neuroplasticity, promote motor and cognitive recovery, and alleviate symptoms of anxiety, depression, and PTSD [2, 33]. In Ukraine, these technologies are emerging primarily in major cities, requiring significant investment in specialist training, funding, and the cultural adaptation of equipment and software for widespread use.

Structural and organizational challenges in Ukraine should also be noted. Ukraine's healthcare system is undergoing a transformation toward more flexible models of care, including outpatient, mobile, and home-based rehabilitation programs. According to the law of Ukraine "The Rehabilitation in the sphere of Healthcare" the rehabilitation specialists are: doctors of physical and rehabilitation medicine; physical therapists; occupational therapists; speech and speech therapists; prosthetists-orthotists; psychologists, psychotherapists; medical nurses for rehabilitation; assistants of physical therapists and occupational therapists. Educational programs must rely on modern standards that refer to global trends, further compounding the issue.

Infrastructure challenges also hinder effective rehabilitation. Many Ukrainian healthcare facilities lack inclusivity features such as handrails, adapted rooms, functional beds, verticalizers, and modern exercise equipment, limiting recovery opportunities. By contrast, such resources are standard in developed countries, mandated by regulations and quality standards.

Financing remains a critical challenge. While the National Health Service of Ukraine (NHSU) has implemented rehabilitation service packages, funding adequacy, distribution transparency, and cost-effectiveness remain areas for improvement. According to the Medical Guarantee Program in 2025, the following is provided for mental patients: "Psychiatric care for adults and children in inpatient conditions", "Psychosocial and psychiatric care for adults and children, organized by mental health centers and mobile multidisciplinary teams". So, it will be perspective that the existing neurorehabilitation packages in Ukraine, which are designed for the rehabilitation of neurological patients, will be modified for the purposes of the rehabilitation of patients with mental problems. It is vital to recognize that rehabilitation investment is not merely an expense but a long-term investment in human capital, reducing disability and enhancing productivity.

Universal models of neurorehabilitation need to be adapted to the realities of a wartime and post-conflict society. Ukraine faces unique challenges as a war and post-conflict society, with a significant number of military personnel and civilian victims requiring comprehensive support for physical recovery, PTSD treatment, and social reintegration [34]. International experience suggests that mobile multidisciplinary teams, proven effective in WHO pilot projects in Ukraine [35], could be an integral component of a broader strategy. Equipped with portable devices and diagnostic tools, these teams can deliver primary and secondary rehabilitation care directly to patients' homes, enhancing accessibility and continuity of care. Partnerships with local non-governmental organizations (NGOs), communities, religious organizations, and self-help groups could further improve social adaptation, particularly for patients with long-term disabilities or complex PTSD.

Despite its potential, the large-scale implementation of mobile teams in Ukraine faces logistical, financial, and human resource constraints. Geographical disparities in access to rehabilitation services are a common challenge. Australia's experience demonstrates that tele-rehabilitation – leveraging video conferencing, specialized software, and remotely controlled simulators – can effectively bridge this gap. This approach is particularly relevant for Ukraine, where remote populations and conflict conditions often impede access to healthcare facilities.

Based on the comparative analysis, several promising directions have been identified to improve the state of neurorehabilitation in Ukraine:

– **Development of a national strategy for neurorehabilitation**

A comprehensive strategy, approved at the government level, should establish priorities, define implementation stages, and identify funding sources for reforms. Collaboration with international experts and coordination with organizations such as the WHO, WFNR, and the EU can facilitate the integration of best global practices into the Ukrainian healthcare system.

– **Standardization of performance evaluation**

Implementing unified scales and assessment tools – such as MoCA, WHO DAS, GAF, and BADL – would enable the systematic monitoring of patient progress, evaluation of the efficacy of various methods and technologies,

and justification for financial investments. Standardized metrics will also support data-driven decision-making and research initiatives.

– **Development of human capital and educational programs**

The integration of rehabilitation medicine, psychology, occupational therapy, speech therapy, and innovative technologies into the curricula of medical universities, colleges, and postgraduate education institutions is essential. Opportunities for internships abroad, online learning platforms, and master classes led by international experts can expedite professionalization and skill development within the field.

– **Scaling up innovative technologies**

Technologies such as NCIs, TMS, VR, and others can become more widely accessible through the establishment of competence centers dedicated to training specialists in their application. Government grants and regional programs that stimulate innovation can address geographic inequalities in access to modern rehabilitation technologies.

– **Strengthening the role of communities and mobile teams**

Outpatient and mobile rehabilitation teams can bring services closer to patients, reduce hospital stays, lower treatment costs, and foster greater involvement of families and communities in the recovery process. Government-supported initiatives, including pilot projects and partnerships with NGOs and patient associations, can amplify the impact of these formats and contribute to comprehensive care delivery.

In the wake of Ukraine's post-conflict reconstruction, these measures will help unite the efforts of the medical, educational, social, and public sectors, laying the groundwork for sustainable development. Neurorehabilitation investments should be viewed as a means of preserving and enhancing human capital. Economic studies conducted in the EU and North America demonstrate that every dollar invested in rehabilitation yields returns through increased labor productivity, reduced strain on social welfare systems, and decreased costs for long-term care.

For Ukraine, the economic argument for neurorehabilitation is particularly compelling. With a pressing need to support large groups of individuals as they transition back to normal life, the financial feasibility of neurorehabilitation programs must be emphasized. Conducting cost-benefit analyses, calculating economic impacts, and disseminating this information to policymakers and the public can strengthen the case for prioritizing such initiatives. These efforts have the potential to convince both political leaders and investors of the strategic importance of neurorehabilitation, ensuring it becomes a cornerstone of Ukraine's recovery and development [36].

Conclusions. The study and analysis of international and national practices underscore that neurorehabilitation is a strategically vital, multidimensional, and dynamic component of the healthcare system. It transcends narrow clinical approaches, encompassing psychological, social, professional, and cultural dimensions essential for the recovery of patients with neurological and mental disorders. This field holds particular relevance for Ukraine, where the ongoing military conflict and its associated medical and social challenges have significantly heightened the demand for quality rehabilitation services.

A comparison of global best practices reveals that effective neurorehabilitation systems are founded on a multidisciplinary approach, standardized patient assessment protocols, and the integration of innovative technologies. The Ukrainian context highlights the urgent need for a comprehensive transformation of the rehabilitation sector to address challenges such as combined physical and psycho-emotional conditions, insufficiently trained personnel, outdated infrastructure and equipment, and the necessity of adapting international standards to local conditions.

Based on the material analysed, the following steps can be recommended**:**

– **Development of a state strategy**

A government-approved, holistic plan for the development of neurorehabilitation, complete with clear objectives, goals, and evaluation criteria, is essential. Such a strategy will guide management decisions, attract investments, and foster collaboration with international organizations.

– **Reforming the educational system**

The integration of rehabilitation medicine, psychology, occupational therapy, speech therapy, and innovative technologies into medical university and college curricula is critical. Establishing postgraduate programs, seminars, online courses, and opportunities for internships abroad will enhance the skills of specialists and professionalize the sector.

– **Improving infrastructure and funding**

Investments in modern equipment, facility adaptations for people with disabilities, and ensuring accessibility and inclusiveness are essential. Developing economic models that demonstrate the return on investment in rehabilitation, along with fostering public-private partnerships and securing international grants, will strengthen the financial sustainability of the sector.

– **Standardization of performance evaluation**

The mandatory use of standardized evaluation tools and protocols, maintaining patient registries, monitoring progress, and implementing electronic medical records and data analysis systems will establish an evidence-based foundation for policy-making, comparative research, and service improvement.

– **Tele-rehabilitation, mobile teams, and community engagement**

Developing outpatient and mobile rehabilitation teams, along with tele-rehabilitation platforms, will ensure equitable access to services across all regions of Ukraine. Collaborating with local communities, NGOs, religious organizations, and self-help groups will provide long-term support to patients and their families.

The formation of an effective neurorehabilitation system will have long-term positive outcomes:

– **Reduction in disability and increased productivity**

Enhanced neurorehabilitation systems will reduce disability rates, enabling individuals to re-enter the workforce and contribute to economic growth.

– **Improved psycho-emotional climate and social cohesion**

Effective rehabilitation will alleviate social tension, facilitate the reintegration of veterans and victims of military conflict, and foster a more cohesive society.

– **Strengthened international reputation**

By adopting modern standards and participating actively in international projects, Ukraine will elevate its

standing in the global healthcare community and create opportunities for experience exchange and partnerships.

– **Advancement of scientific research and innovation**

The development of innovative tools, techniques, and methods will spur scientific progress and open new avenues for international collaboration.

In conclusion, neurorehabilitation in Ukraine has the potential to become a driving force for improving the quality of life for hundreds of thousands of individuals, serving as an effective tool for post-conflict adaptation, social cohesion, and economic development. In addition to the standards of neurorehabilitation, which are regulated and effective applied for the rehabilitation of neurological patients in Ukraine, there is a need to develop standards and packages for the rehabilitation of patients with mental problems. By integrating international guidelines, standardized methods, innovative technologies, multidisciplinary teams, and ensuring accessibility and inclusiveness, Ukraine can establish a sustainable healthcare system capable of meeting current and future challenges.

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Надійшла до редакції 07.01.2025 р.
Прийнята до друку 27.03.2025 р.
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