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STRUCTURAL DYSFUNCTIONS AND PATHWAYS OF TRANSFORMATION OF PUBLIC PROSTHETICS POLICY IN UKRAINE UNDER MARTIAL LAW: AN INSTITUTIONAL-ECONOMIC ANALYSIS

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Background. The prosthetics system in Ukraine is in a deep crisis due to the full-scale war, which has shifted the priority to mass complex combat injuries, while exacerbating pre-war structural problems: the lack of national standards, a critical shortage of qualified personnel, and fragmented infrastructure. The emergence of high-tech charitable centers has created a precedent for a "two-speed" system, highlighting the need not for improvements but for a structural overhaul of the entire management system.

Aim. To determine the key determinants and effectiveness of public prosthetics policy in Ukraine under martial law, and to substantiate conceptual directions for systemic transformation aimed at creating a stable, fair, and quality model integrated into the national policy of barrier-free access.

Materials and Methods. The study employed a systemic approach, bibliosemantic, regulatory-legal, comparative, quantitative, and qualitative analysis. International (ISO, ISPO) and national standards for prosthetics and orthotics, national legislation, official statistical data, scientific publications, and reports were analyzed. The article provides a comparative analysis of the public policy on prosthetics in Ukraine and the institutionally stable model of the Republic of Lithuania.

Research Ethics. The work was conducted in compliance with the principles of academic integrity. All conclusions are based on the analysis of publicly available data and scientific publications with appropriate references. Since the research did not involve direct work with human subjects or the collection of personal data, approval from a bioethics committee was not required.

Results. A dynamic but contradictory model was identified: despite increased funding and the "money follows the patient" model, there is a concentration of funds among a limited number of centers. A "two-speed" system has formed with a critical technological gap between innovative charitable and technologically outdated state centers. A critical shortage of qualified personnel (approximately 220 specialists) and a significant wage gap between sectors were revealed. The monitoring system is limited to aggregated indicators, making it impossible to assess real quality.

Conclusions. Public prosthetics policy requires a transition from fragmented improvements to comprehensive reform. Its future effectiveness depends on ensuring financial sustainability through flexible multi-source planning, overcoming personnel shortages by creating a national system of education and certification according to international standards, and full integration into the National Barrier-Free Strategy until 2030. This will transform prosthetics from a medical service into a component of continuous medical-social rehabilitation and inclusion.

Keywords: *healthcare organization, rehabilitation, disability, traumatology, martial law, barrier-free access.*

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Introduction

Ukraine's prosthetics system has found itself at the epicenter of a profound humanitarian and managerial crisis caused by the full-scale armed aggression of the Russian Federation [1–3]. If, before February 24, 2022, the task of providing prosthetics primarily concerned persons with disabilities due to illness (vascular lesions, diabetes) or accidents [4–6], today the priority has become the scale and complexity of combat injuries [3; 7]. According to official communications from the Ministry of Social Policy of Ukraine, as of early 2024, among military personnel alone, more than 20,000 individuals required upper or lower limb prosthetics [8–10]. This figure, however, does not reflect the full picture. It does not include civilians who sustained injuries due to artillery shelling, missile strikes on residential and critical infrastructure, as well as mine-blast injuries.

According to the study by Lawry L.L. et al. (2025), Ukraine's trauma and rehabilitation system is under "unprecedented pressure," and the existing mechanisms are failing to adapt to the rapidly growing demand [11]. This situation unfolds against the backdrop of pre-war structural problems in the sector: the lack of unified national quality standards aligned with the requirements of the International Society for Prosthetics and Orthotics (ISPO) and the International Organization for Standardization (ISO) [12–14]; a critical shortage of qualified prosthetists-orthotists [15; 16]; fragmented infrastructure; and significant geographical inequality in access to services [17–20].

Paradoxically, the war has also accelerated the emergence of new institutional players – powerful charitable centers such as Superhumans and UNBROKEN. Funded by international donors (e.g., the Howard G. Buffett Foundation, Direct Relief, the governments of Germany and Lithuania), they demonstrate a fundamentally different, high-tech approach to rehabilitation [21–24]. This creates a precedent for a "two-tier" system, where standards and opportunities for different categories of patients differ drastically.

At the same time, the international scientific consensus, represented in the works of Black G.G. et al. (2022), Frossard et al. (2018), and Voigt J.D. et al. (2024), unequivocally proves the long-term economic and social rationale for investing in the most modern, even the most expensive, types of prostheses (including osseointegrated ones). This is because they lead to a radical increase in quality of life (QALY – quality-adjusted life year) and the restoration of patients' ability to work [25–28]. Under such conditions, traditional public policy, based on gradual modernization and administrative planning, proves ineffective. An urgent need arises not for adjusting individual parameters, but for a structural overhaul of the entire system—from its philosophy (transitioning from a purely medical to a social model of disability and inclusion) to specific mechanisms of funding, staffing, and quality control [29–32]. The relevance of this study lies precisely in a comprehensive analysis of this gap between new challenges, increased oppor-

tunities (including due to international aid), and the institutional inertia of the existing state management system for prosthetics in Ukraine.

The **aim** of the study was to identify the key determinants and effectiveness of the prosthetics public policy in Ukraine under martial law, and to substantiate conceptual directions for systemic transformation aimed at creating a sustainable, fair, high-quality, and accessible service delivery model, integrated into the national policy on barrier-free access and European integration.

Materials and Methods

The methodological basis of the study is a *systems approach*, which allows considering prosthetics policy as an integral, yet open and dynamic complex of interconnected elements: regulatory framework, financial flows, infrastructure, personnel, technologies, and outcomes. To implement this approach, a range of complementary methods was applied. The *bibliosemantic method* ensured the search, selection, and critical analysis of a wide range of sources: from fundamental international documents, such as the UN Convention on the Rights of Persons with Disabilities (CRPD) and the standards of the World Health Organization (WHO) and the International Society for Prosthetics and Orthotics (ISPO), to specific economic studies on the effectiveness of prostheses, particularly the works of Frossard L.A. et al. (2018) on osseointegrated prostheses and the 2019 report by Ontario Health (Quality) [25–27; 32–35]. *Regulatory analysis* covered national legislation of Ukraine, including the Laws "On Rehabilitation of Persons with Disabilities" and "On the Fundamentals of Social Protection of Persons with Disabilities", as well as subordinate acts of the Ministry of Social Policy regulating the procedure for providing technical rehabilitation aids [36–40]. The *comparative method* made it possible to compare Ukrainian practices with the requirements of international quality standards, such as ISO 10328 for structural testing

of lower limb prostheses, and to identify gaps in professional training [13; 14; 16; 41; 42]. *Quantitative analysis* was based on official statistical data published by the Ministry of Social Policy of Ukraine and the Social Protection Fund for Persons with Disabilities (SPFPD), particularly regarding funding volumes, the number of individuals provided for, and items issued for 2024–2025 [8; 38; 43–45]. Qualitative analysis was applied to interpret data from studies on the impact of war on the rehabilitation system, such as the work by Lawry L.L. et al. (2025), and to assess the activities of charitable centers [11; 21; 24; 46]. The final stage was a systems synthesis aimed at integrating the obtained heterogeneous data into a coherent picture of the problems and forming a coordinated set of proposals.

The article presents a comparative analysis of the prosthetics public policy in Ukraine and the institutionally stable model of the Republic of Lithuania. Its normative framework, headed by the Law "On the Health System," the financial mechanism through the Compulsory Health Insurance Fund, clinical protocols for prescribing prostheses, and the management procedures of the State Patients' Fund (VLK) were examined.

Research Ethics

This scientific work was conducted in compliance with all principles of academic integrity. All conclusions and statements are based on the analysis of publicly available data, official documents, and scientific publications. Direct quotations, statistical information, and ideas borrowed from other authors are accompanied by appropriate bibliographic references in the text. The study did not involve direct work with patients or the collection of personal data and therefore did not require approval by a bioethics committee.

Results

An analysis of the institutional architecture and financial flows, based on the regulatory framework and reporting data from the Social Protection Fund for Persons with Disabilities for 2023–2025, revealed

a dynamic yet internally contradictory model [8; 38; 43; 47]. The total volume of state funding for prosthetics and rehabilitation increased from approximately UAH 2.3 billion in 2023 to over UAH 5 billion in 2024, within which a separate program for military personnel with a budget of about UAH 1 billion is distinguished [8; 9]. Formally introduced after 2022, the "money follows the patient" model was intended to establish the right to choose among accredited providers [48; 49]. However, a detailed analysis of internal administrative documents of the SPFPD and data on concluded contracts showed that over 70 % of funds in 2024 were concentrated within a limited circle (about 15) of large state and private centers, predominantly located in regional centers of Western and Central Ukraine [9; 19]. This indicates not a full-fledged decentralized competition, but a de facto concentration of resources within powerful institutional nodes.

Technological and infrastructural dispersion has formed a phenomenon that can be characterized as a "two-tier" system [9; 46]. A comparative analysis of the material and technical base, based on official data, reports, and publications, revealed a critical gap [21; 50; 51]. On one hand, charitable centers such as Superhumans or UNBROKEN operate with state-of-the-art equipment: computerized 3D scanning and modeling systems, 5-axis CNC milling complexes, and laboratories for testing according to international standards [23; 24]. On the other hand, an inventory of equipment based on data from state tender announcements for repairs for a number of regional prosthetic and orthopedic enterprises showed an average machine park age of 12–15 years, a lack of modern scanning systems, and a predominance of manual technologies [17; 19]. This disparity directly impacts productivity: according to estimates derived from the analysis of work schedules, the average production time for a complex myoelectric upper limb prosthesis in a charitable center was 10–14 days, whereas in some state workshops, similar orders took 45–60 days to complete [9; 46].

Workforce inequality and shortage emerge as a systemic bottleneck requiring transformation in line with the requirements of national barrier-free access policy and European integration standards [30; 32–36; 52]. Regulatory analysis showed that the profession of 'prosthetist/orthotist' was only added to the Classifier of Professions in 2023, and the first educational specialization was approved by the Ministry of Health in 2024 [53–55]. Quantitative analysis of data from the medical workers' register under the closest available category revealed that only about 220 specialists across Ukraine have documented experience working with prostheses, with 65 % of them concentrated in the four largest cities [15; 56]. A survey among managers of regional enterprises, the data of which was published in specialized outlets, recorded a significant wage gap: as of the end of 2024, in the state sector it was UAH 25,000–35,000, while private and charitable centers offered UAH 50,000–80,000, which stimulated the outflow of qualified personnel [9; 15; 57].

A systematic review of publicly available reports from the Ministry of Social Policy and the SPFPD for 2020–2024 confirmed significant limitations in data availability for monitoring [8; 38; 45]. The reports predominantly contain aggregated indicators, such as the total number of items issued, but do not disclose key information: the distribution by type of complex prostheses, the average waiting time from application to delivery, geographical distribution, the percentage of repeat requests due to non-compliance, or a detailed financial report by expenditure items [9; 44; 45]. This lack of transparency makes it impossible to assess the real cost-effectiveness and quality of services provided, leaving the policy without outcome-based management [58–60].

Discussion

The obtained results allow for a deeper understanding of the institutional mechanisms operating within the system. The identified concentration of funding within a limited circle of centers, despite the formal "choice"

model, indicates not market competition but the formation of an oligopoly under crisis conditions [9; 19]. This aligns with the theory of "path dependence" in public administration, where existing powerful institutions, even after formal rule changes, continue to receive benefits due to their existing capacities, connections, and experience. Such results diverge from the official discourse on "equal conditions" but find parallels in studies on health system adaptation in conflict settings, where a similar centralization of resources in reliable centers for rapid response was observed, which in the long term deepened regional inequalities [17; 61; 62].

The analysis of the "two-tier" system of technologies and infrastructure points to consequences that extend beyond a simple funding deficit [9; 46; 51]. It reveals a deeper institutional problem – different managerial logics. Charitable centers operate under the grant-based logic of a "project" with clear goals, limited timeframes, and strict audits, which allows for the rapid attraction and adoption of innovations [21; 22; 24]. State enterprises, conversely, operate under the logic of a "permanent budgetary institution" with rigid procurement procedures and a focus on maintaining staff and infrastructure, which institutionally impedes technical renewal [17; 50; 61]. This confirms the conclusions of studies regarding the fragmentation and slow pace of implementing inclusive projects in Ukraine due to ineffective coordination [63]. However, an alternative interpretation is also possible, where charitable centers act as "pilot platforms" for testing advanced technologies [9; 64; 65]. The question lies in the existence of mechanisms for the state to subsequently scale up their experience. Our data on the absence of systemic joint training programs or processes for standardization according to unified international models indicate that such a transition channel has not yet been formed, and the two systems exist in parallel, with almost no interaction [12; 14; 16; 66].

The personnel problem, confirmed by the data, reveals a new, qualitative aspect

of the deficit related to the absence of a standardized competency model [16; 66; 67]. This leads to the situation where even the available specialists often work using outdated methods, and the system, in contrast to WHO recommendations for creating multi-level teams, is primarily oriented toward the technical executor [34; 35; 68; 69]. The difference in wages between sectors not only stimulates an outflow of personnel but also devalues the significance of state certification, making private certifications from leading manufacturers more economically and professionally advantageous [9; 57]. This creates a risk of forming two practically independent professional communities with different standards of qualification and work quality [16; 66].

Finally, the identified limitations in data and monitoring are not a technical shortcoming but an indicator of a managerial philosophy oriented toward controlling expenditures (input-based management) rather than achieving specific social outcomes (outcome-based management) [59; 60; 70]. Without detailed statistics, it is impossible to answer key questions about the real impact of prosthetics on patient functionality, mobility, and social reintegration [71–75]. This renders the policy blind, incapable of applying cost-benefit analysis economic models for justified investments in specific technologies within the Ukrainian context [25; 26; 28]. Therefore, transforming the system is impossible without radically enhancing transparency and reorienting the measurement system from the quantity of funds spent and items issued to the quality of life these items restore.

To compare the Ukrainian model of public prosthetics policy (*Fig.*), it is appropriate to refer to the experience of the Republic of Lithuania as a European Union member state with an institutionally stable health insurance system. In Lithuania, limb prosthetics is normatively regulated within the general healthcare system in accordance with the Law of the Republic of Lithuania "On the Health System" (Lietuvos Respublikos

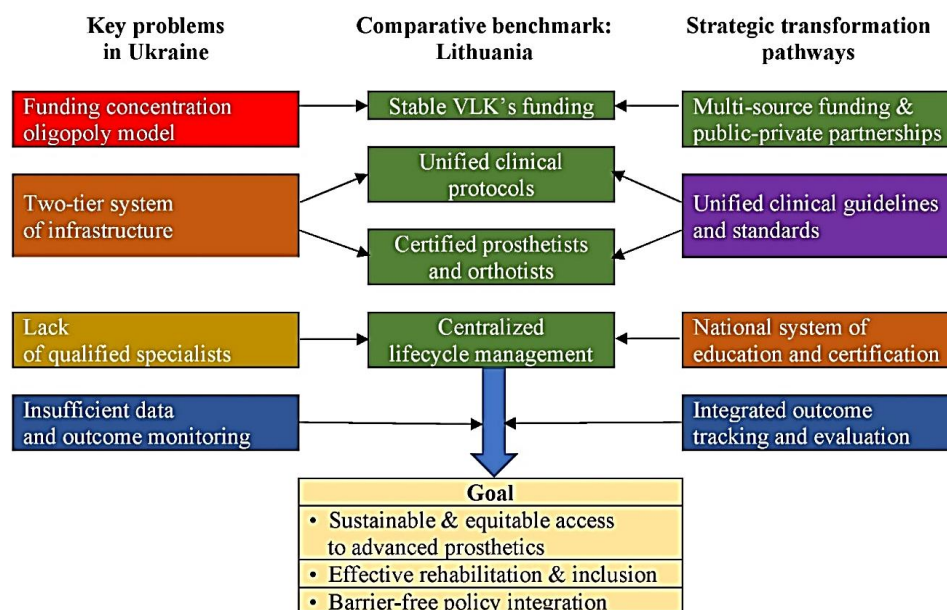


Fig. Structural dysfunctions and transformation pathways of public prosthetics policy in Ukraine under martial law: comparative analysis with Lithuania.

Note: VLK (Valstybinė Ligonių Kasa) – State Patients' Fund.

sveikatos sistemos įstatymas, Nr. I-552), which defines the role of the state in the provision of medical services and the regulation of medical devices, including prosthetic and orthopedic aids [76]. Funding for prosthetics is provided through the Compulsory Health Insurance Fund (Privalomasis sveikatos draudimo fondas), administered by the State Patients' Fund (VLK) under the Ministry of Health of Lithuania (Valstybinė ligonių kasa, VLK), which establishes unified rules for compensation of orthopedic technical aids and the procedure for their prescription based on medical indications [77].

Official data from VLK indicate a gradual increase in state expenditures on limb prosthetics – from 3.38 million euros in 2020 to 6.56 million euros in 2025. On average, about 1,000 persons with disabilities receive compensation for limb prostheses annually, while approximately 1,200 limb prostheses are manufactured and issued per year. Prosthetic provision is carried out through a network of orthopedic companies that have contracts with VLK (22 companies in 2025), and the manufacturing and fitting of prostheses are performed by certified orthopaedic technologists in accordance with national requirements [77].

The system for prescribing prostheses in Lithuania is distinctly protocol-based and multi-level: primary prostheses are prescribed by a board of doctors with the mandatory participation of a physical and rehabilitation medicine physician; standard permanent prostheses – by a physical and rehabilitation medicine physician; complex and high-tech prostheses (with hydraulic or microprocessor-controlled components, vacuum suspension systems, myoelectric prostheses) – by boards at secondary or tertiary level healthcare facilities with the mandatory participation of an orthopedic traumatologist [77]. Additionally, VLK centrally manages the lifecycle of prostheses, informing patients about the possibility of ordering a new device no later than 45 calendar days before the expiration of the usage period of the previous prosthesis.

The institutional capacity of the Lithuanian healthcare system is further evidenced by its involvement in international medical aid. According to official information from the Ministry of Health of the Republic of Lithuania, since the beginning of the full-scale war, over 300 wounded Ukrainian military personnel have undergone treatment and medical rehabilitation in Lithuania as part

of interstate cooperation, utilizing the existing clinical and rehabilitation infrastructure [78]. Government documents also state that Lithuania, in coordination with EU and NATO partners, has declared readiness to accept hundreds of patients from Ukraine for treatment and rehabilitation, which further indicates the systemic resilience and scalability of the national healthcare model [79].

As a result, the comparison of the Ukrainian and Lithuanian models demonstrates two distinct paths of development for public prosthetics policy: an adaptive-crisis model, with a high level of innovation but significant structural inequality, and a stable-institutionalized model, with predictable funding, clear protocol-based regulation, and formalized clinical decision-making procedures. The Lithuanian experience allows for defining strategic benchmarks for Ukraine's post-war transformation, particularly the necessity of transitioning from fragmented solutions to a unified protocol-based model with transparent rules for funding, personnel training, and the assessment of rehabilitation outcomes.

Conclusions

1. The public prosthetics policy in Ukraine after 2022 underwent a phase of operational adaptation, evident in a significant increase in funding, simplified procedures, and the introduction of market elements ("money follows the patient"). However, these measures did not overcome the system's deep-rooted structural dysfunctions, which were exacerbated by the state of war.

2. The system is characterized by a critical gap between growing demand and actual capacity, manifesting in the formation of a "two-tier" model: innovative charitable centers of international standard (Superhumans, UNBROKEN) exist in parallel with a technologically outdated part of the state network, creating inequality in access to quality and modern technologies for different categories of patients.

3. The main determinants of policy ineffectiveness are: the lack of detailed, transparent statistics and outcome monitoring; a chronic shortage of qualified personnel (prosthetists, orthotists, rehabilitation specialists), which

cannot be quickly resolved due to the absence of an established education and certification system; and institutional disconnection between funding, service provision, and the subsequent social integration of patients.

4. Economic studies, such as cost-benefit analyses of osseointegrated prostheses, justify the expediency of strategic long-term investments in high-tech solutions that provide significant improvements in quality of life, compared to short-term expenditures on less effective alternatives.

5. The future effectiveness of the policy depends on a transition from fragmented improvements to comprehensive reform, which must be based on three interconnected pillars: ensuring financial sustainability through flexible multi-source planning and public-private partnerships; overcoming the personnel deficit by creating a national system of education, certification, and continuous professional development for specialists according to ISPO and ISO standards; full integration of prosthetics policy into the National Barrier-Free Strategy until 2030, transforming it from a medical service into a link of continuous medical-social rehabilitation and inclusion in line with the principles of the CRPD and European integration requirements.

6. Lithuania's experience demonstrates a prosthetics model focused on stable funding, clear protocols, and centralized management, which serves as a strategic benchmark for building a unified and transparent post-war rehabilitation system in Ukraine. The practice of Lithuania's State Patients' Fund (VLK) regarding centralized management of the prosthesis lifecycle could be implemented in Ukraine to ensure the planned and timely replacement of technical rehabilitation aids.

7. The conducted comprehensive analysis revealed not only the symptoms but also the structural causes of the ineffectiveness of Ukraine's public prosthetics policy under crisis conditions, and provided a reasoned conceptual model for its transformation. This model is oriented towards building a sustainable, fair, and high-quality system capable of restoring dignity, autonomy, and a full life for everyone in need.

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Authors' Contributions

Contribution	A	B	C	D	E	F
Authors						
Nesterenko V.G.	+	+	+	+	+	+
Chernyak M.Ye.			+			+
Boiarska Z.O.			+	+		+
Shevchenko A.S.	+	+	+	+	+	+

Notes: A – concept;

B – design;

C – data collection;

D – statistical processing and interpretation of data;

E – writing or critical editing of the article;

F – approval of the final version for publication and agreement to be responsible for all aspects of the work.

Declarations

Conflict of interest is absent.

All authors have given their consent to the publication of the article, to the processing and publication of their personal data.

The authors of the manuscript state that in the process of conducting research, preparing, and editing this manuscript, they did not use any generative AI tools or services to perform any of the tasks listed in the Generative AI Delegation Taxonomy (GAIDeT, 2025). All stages of work (from the development of the research concept to the final editing) were carried out without the involvement of generative artificial intelligence, exclusively by the authors.

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СТРУКТУРНІ ДИСФУНКЦІЇ ТА ШЛЯХИ ТРАНСФОРМАЦІЇ ПУБЛІЧНОЇ ПОЛІТИКИ ПРОТЕЗУВАННЯ В УКРАЇНІ В УМОВАХ ВОЄННОГО СТАНУ: ІНСТИТУЦІЙНО-ЕКОНОМІЧНИЙ АНАЛІЗ

Актуальність. Система протезування в Україні перебуває в глибокій кризі через повномасштабну війну, яка змістила пріоритет на масові складні бойові травми, водночас посиливши довоєнні структурні проблеми: відсутність національних стандартів, критичний дефіцит кваліфікованих кадрів, фрагментованість інфраструктури. Поява високотехнологічних благодійних центрів створила прецедент «двошвидкісної» системи, що загострює необхідність не покращень, а структурної перебудови всієї системи управління.

Мета. Визначення ключових детермінант та ефективності публічної політики протезування в Україні в умовах воєнного стану, обґрунтування концептуальних напрямів системної трансформації для створення стійкої, справедливої та якісної моделі, інтегрованої в національну політику безбар'єрності.

Матеріали та методи. У дослідженні використано системний підхід, бібліосемантичний, нормативно-правовий, порівняльний, кількісний та якісний аналіз. Проаналізовані міжнародні (ISO, ISPO) та національні стандарти протезування та ортезування, національне законодавство, офіційні статистичні дані, наукові публікації та звіти. Проведено порівняльний аналіз публічної політики протезування України та інституційно стабільної моделі Литовської Республіки.

Етика дослідження. Робота виконана з дотриманням принципів академічної доброчесності. Усі висновки ґрунтуються на аналізі публічно доступних даних та наукових публікацій із належними посиланнями. Оскільки дослідження не передбачало безпосередньої роботи з людьми або збору персональних даних, схвалення біоетичною комісією не було потрібно.

Результати. Виявлено динамічну, але суперечливу модель: незважаючи на зростання фінансування та модель «гроші йдуть за пацієнтом», спостерігається концентрація коштів у обмеженому колі центрів. Сформувалася «двошвидкісна» система з критичним технологічним розривом між інноваційними благодійними та технологічно відсталими державними центрами. Виявлено критичний дефіцит кваліфікованих кадрів (близько 220 фахівців) та значну різницю в заробітній платі між секторами. Система моніторингу обмежується агрегованими показниками, що унеможливорює оцінку реальної якості.

Висновки. Публічна політика протезування потребує переходу від фрагментарних покращень до комплексної реформи. Її майбутня ефективність залежить від забезпечення фінансової стійкості через гнучке багатоджерельне планування, подолання кадрового дефіциту шляхом створення національної системи освіти та сертифікації за міжнародними стандартами, а також повної інтеграції в Національну стратегію безбар'єрності до 2030 року. Це дозволить трансформувати протезування з медичної послуги в ланку безперервної медико-соціальної реабілітації та інклюзії.

Ключові слова: організація охорони здоров'я, реабілітація, інвалідність, травматизм, воєнний стан, безбар'єрність.

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