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НАЦІОНАЛЬНА АКАДЕМІЯ ПЕДАГОГІЧНИХ НАУК УКРАЇНИ
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ДЕРЖАВНА СЛУЖБА УКРАЇНИ З ЛІКАРСЬКИХ ЗАСОБІВ ТА КОНТРОЛЮ ЗА НАРКОТИКАМИ
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III МІЖНАРОДНА НАУКОВО-ПРАКТИЧНА ОНЛАЙН-КОНФЕРЕНЦІЯ

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III. ПРИРОДНИЧІ НАУКИ

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HIGHER MEDICAL EDUCATION IN UKRAINE DURING WARTIME: FOCUS ON THE RESILIENCE, TRANSFORMATION, AND POST-WAR PROSPECTS

Abstract.

Introduction. The full-scale invasion of Ukraine in February 2022 imposed unprecedented challenges on the national higher medical education (HME) system, threatening its operational integrity, infrastructure, and human capital. The paper examines the systemic shock experienced by Ukrainian medical universities and analyses the subsequent adaptive strategies employed to ensure the continuity of education and scientific activity amidst active hostilities. This study aims to provide a comprehensive analysis of the resilience, transformation, and forward-looking innovations driving the sector's evolution.

Literature Review. Existing scholarly work on medical education during conflict frequently focuses on post-conflict reconstruction or regional stability issues. A significant gap exists regarding integrated analyses that capture the concurrent effects of mass internal displacement, infrastructure damage, immediate curricular reform (e.g., tactical medicine), psychological burden on staff and students, and the forced acceleration of digital transformation within a single, actively contested national educational framework. This study addresses this gap by synthesising these interwoven challenges and adaptive responses.

Methods. The present analysis employs a qualitative, mixed-methods approach, based on a review of institutional reports, policy documents from the Ministry of Health and Ministry of Education and Science of Ukraine, internal curricular adaptations, and documented accounts of international cooperation initiatives between 2022 and 2025. The methodology utilised in this study is anchored in the analysis of case studies of relocated institutions, complemented by content analysis of updated educational programmes, with a particular focus on military medicine, rehabilitation science, and digital health.

Results. The war resulted in widespread infrastructure damage and the forced relocation of several major medical universities. In response to these challenges, HME institutions have rapidly transitioned to blended and distance learning models. Curricula underwent radical transformation, integrating new core competencies in tactical medicine, combat trauma care, and psychological first aid. Moreover, there was a marked shift in scientific research priorities towards addressing pressing national needs, focusing on developing advanced prosthetics, reconstructive surgery, and large-scale mental health and psychosocial support programs (MHPSS). International cooperation was a crucial factor in providing the necessary stability, facilitated by shared research grants, the donation of equipment, and the establishment of robust academic mobility programmes.

Discussion. The findings indicate that the Ukrainian HME system exhibits extraordinary resilience and adaptive capacity. Initially driven by necessity, the transition to digital modalities has significantly accelerated the adoption of telemedicine and telepsychology, paving the way for a more accessible and future-proof health infrastructure. Nevertheless, challenges persist, particularly concerning maintaining high-quality clinical training despite limited access to traditional clinical bases, and addressing the long-term psychological distress among academic personnel and students, and integrating war-related specialisations positions Ukrainian medical graduates as world leaders in trauma and crisis medicine.

Conclusions. Ukrainian higher medical education has demonstrated survival and profound transformation during wartime. The lessons learned – particularly the reliance on digital innovation, the prioritisation of MHPSS, and the value of international partnership – are poised to form the bedrock of a modernised, digitally integrated, highly specialised post-war health system. This experience offers critical insights for planning global medical education in conflict and crisis zones.

***Keywords**: Ukrainian higher medical education, Ukraine during wartime, human capital and psychological impact, institutional adaptation, international support, post-war strategic development*

Introduction. The full-scale Russian invasion of Ukraine in February 2022 fundamentally transformed the landscape of higher medical education in the country, creating unprecedented challenges while simultaneously catalyzing remarkable innovation and resilience. Ukraine's medical universities, which had previously attracted tens of thousands of international students and maintained a robust domestic healthcare education system, found themselves operating

under conditions of active warfare, infrastructure destruction, and massive population displacement. However, the response of these institutions has been nothing short of extraordinary, demonstrating not only their commitment to educational continuity but also their capacity for rapid adaptation and transformation. The crisis has exposed the vulnerabilities and inherent strengths of Ukraine's medical education system, while creating unique opportunities for post-war reconstruction and modernisation. These opportunities could position Ukrainian medical schools as leaders in educational innovation and trauma-informed healthcare training [1].

Before 2022, Ukraine had a well-developed network of state medical universities and medical faculties integrated within comprehensive universities. These institutions offered programmes in both Ukrainian and English. The system was aligned with the Bologna Process, implementing ongoing reforms towards competency-based medical education and unified national licensing examinations. Ukraine had established itself as a regional hub for international medical students, particularly attracting learners from South Asia, the Middle East, and Africa. It was drawn by affordable tuition fees and English-language programs that maintained European educational standards. The nation's medical education infrastructure comprises contemporary simulation centres, state-of-the-art laboratories, and robust clinical collaborations with prominent hospitals. Ukrainian medical degrees hold international recognition, with the system undergoing a progressive integration of European Union directives on medical training. This process has been undertaken whilst maintaining its distinctive strengths in fundamental sciences and clinical reasoning.

Literature Review. Existing scholarly work on medical education during conflict frequently focuses on post-conflict reconstruction or regional stability issues. A significant gap exists regarding integrated analyses that capture the concurrent effects of mass internal displacement, infrastructure damage, immediate curricular reform (e.g., tactical medicine), psychological burden on staff and students, and the forced acceleration of digital transformation within a single, actively contested national educational framework [2].

Wartime Challenges and Immediate Disruptions. The war has had a profound and geographically uneven impact on educational infrastructure. Universities in frontline cities such as Kharkiv, Mariupol, Kherson, and Mykolaiv faced direct shelling, occupation, or complete suspension of operations. The Donetsk National Medical University, which had already been displaced since

2014, encountered further disruptions that exacerbated the challenges it was already facing. Many institutions were compelled to relocate their operations to more secure western regions or to divide their activities across multiple sites. This necessitated fundamental alterations to their organisational structures and capacities.

Notably, even universities in relatively safer regions were compelled to implement comprehensive emergency protocols, including constructing or reinforcing air raid shelters, modifying class schedules to accommodate frequent alerts, and investing in backup power systems and satellite connectivity to maintain operations during infrastructure attacks.

Educational Continuity in Adverse Circumstances. The transition to hybrid and distance learning became an immediate necessity rather than a gradual modernisation process. In response to these challenges, universities rapidly deployed learning management systems, implemented proctored online assessments, and established videoconferencing capabilities for lectures and seminars. However, this digital transition occurred in the context of significant challenges, characterised by intermittent connectivity, power outages, and the perpetual threat of air raids. These circumstances gave rise to distinctive challenges for both educators and students [3, 4].

The presence of particularly complex challenges characterised the clinical training phase. Concurrently, hospitals became inundated with war casualties, yet simultaneously served as pivotal training environments for medical students. This created an unprecedented situation in which students gained extraordinary exposure to trauma surgery, emergency medicine, and psychological support techniques. However, this was due to reduced access to routine medical procedures and specialised fields less relevant to wartime medicine.

Human Capital and Psychological Impact.

The displacement of students and faculty has given rise to several challenges in the short and long term. These challenges include, but are not limited to, operational issues and concerns regarding the loss of talent. It is estimated that millions of Ukrainians, including a significant proportion of the academic community, have been internally displaced or have sought refuge abroad. This mass migration has disrupted established mentorship relationships, resulted in the separation of students from their usual clinical training sites, and created complex logistical challenges for

the maintenance of coherent educational programmes. The psychological impact on the academic community cannot be overstated. Faculty members frequently juggled teaching duties with the provision of direct medical care to war victims. At the same time, students contended with the simultaneous challenges of continuing their education and witnessing unparalleled trauma and destruction. In response to these challenges, universities have augmented their counselling services, established peer-support networks, and cultivated trauma-informed teaching practices [5, 6].

Methods. The present analysis employs a qualitative, mixed-methods approach, based on a review of institutional reports, policy documents from the Ministry of Health and Ministry of Education and Science of Ukraine, internal curricular adaptations, and documented accounts of international cooperation initiatives between 2022 and 2025. The methodology utilised in this study is anchored in the analysis of case studies of relocated institutions, complemented by content analysis of updated educational programmes, with a particular focus on military medicine, rehabilitation science, and digital health.

Results and Discussion. The findings indicate that the Ukrainian HME system exhibits extraordinary resilience and adaptive capacity. Nevertheless, challenges persist, particularly concerning maintaining high-quality clinical training despite limited access to traditional clinical bases, and addressing the long-term psychological distress among academic personnel and students, and integrating war-related specialisations positions Ukrainian medical graduates as world leaders in trauma and crisis medicine. The following section outlines some of the most pressing contemporary issues being addressed, which necessitate particular consideration in the post-war era. The following section outlines some of the most pressing contemporary issues being addressed, which necessitate particular consideration in the post-war era.

Institutional Adaptation and Innovation.

1. Digital Transformation and Pedagogical Innovation.

Ukrainian medical universities have demonstrated remarkable agility in adapting their educational delivery methods. While initially driven by necessity, the rapid implementation of digital learning platforms has accelerated the adoption of innovative teaching methods that may have taken years to implement under normal circumstances. In response to these challenges, universities have significantly invested in simulation-based learning, leveraging virtual reality tools where available, and adopting hybrid

assessment methods that balance academic integrity with the accommodation of displacement and infrastructure challenges. Faculty members underwent intensive retraining in digital pedagogy to develop new approaches to clinical reasoning instruction, case-based learning, and practical skills assessment in virtual environments. This enforced innovation has established a basis for enhanced educational provision to benefit the system long after the war.

2. Curriculum Adaptation and Wartime Medical Training.

The war has profoundly impacted the structure of medical education curricula, with institutions rapidly incorporating training in trauma and emergency care, tactical combat casualty care, triage protocols, and prehospital medicine. The students and residents were provided with unparalleled exposure to cases of polytrauma, burn injuries, blast injuries, and haemorrhage control techniques. In response to these challenges, public health curricula have expanded to address issues related to war-related displacement, disruption to vaccination programmes, environmental health challenges, and outbreak response protocols.

Mental health and rehabilitation medicine became central components of medical training, addressing immediate wartime needs and preparing students for the long-term psychological and physical rehabilitation challenges that will persist well into the post-war period. This evolution in the curriculum has resulted in the development of unique expertise, positioning Ukrainian medical graduates with specialised knowledge that is highly relevant to global healthcare challenges.

Student and Faculty Civic Engagement.

The active involvement of medical students and faculty in humanitarian efforts has created an unprecedented integration of academic learning with real-world medical practice. Students volunteered in hospitals, assisted displaced persons, and participated in medical brigades, gaining invaluable practical experience while contributing to national emergency response efforts. This civic engagement has strengthened the social accountability mission of medical education while providing students with profound learning experiences that traditional clinical rotations could not replicate.

International Support and Academic Partnerships

1. European Union and Global Collaboration.

International cooperation has been identified as a critical factor in ensuring the continuity and quality of education. European medical schools established «twinning» arrangements, offering equipment donations, simulation resources,

curriculum sharing, guest teaching opportunities, and temporary placement programs for displaced students. The European Union's temporary protection directive facilitated these arrangements, with countries including Poland, Germany, and the Czech Republic hosting significant numbers of Ukrainian medical students.

These partnerships extended beyond emergency support to include long-term academic collaborations, joint research projects, and faculty exchange programs. In the context of Ukraine, there has been a notable increase in the utilisation of EU programmes such as Erasmus+ and Horizon Europe, along with philanthropic funding, to maintain laboratories, libraries, and digital infrastructure.

2. The provision of assistance by a professional organisation.

In the aftermath of the Russian invasion of Ukraine, medical organisations across Europe and North America have established mentorship programmes, research collaborations, and professional development opportunities for Ukrainian medical educators. These relationships provided immediate support and laid the groundwork for long-term academic partnerships that will continue to benefit Ukrainian medical education for decades.

Post-War Reconstruction and Strategic Development.

1. Infrastructure Modernization and Resilient Design.

Following the Second World War, the period offers a unique opportunity to rebuild Ukrainian medical education infrastructure according to 21st-century standards, rather than simply restoring pre-war facilities. This reconstruction should prioritise the creation of resilient, energy-efficient campuses with integrated emergency shelters, expanded simulation centres for skills training and objective structured clinical examinations (OSCEs), and modernised libraries with offline-capable digital repositories.

The focus should be on creating flexible, technology-integrated learning environments that can adapt to future challenges while supporting traditional and innovative pedagogical approaches. Investment in cutting-edge simulation centres will be pivotal in reducing reliance on variable clinical volumes while ensuring consistent, high-quality practical training opportunities.

Secondly, the issue of workforce development and regional healthcare needs is to be considered.

In the post-war era, strategic workforce planning will be essential to address regional healthcare shortages and emerging needs for medical specialisation. To meet the projected demand, medical education programmes

must augment their curriculum to encompass training in family medicine, emergency medicine, anesthesiology and critical care, rehabilitation medicine, mental health, and public health. The development of specialised tracks in trauma systems, prosthetics and orthotics, rehabilitation medicine, and mental health will be essential for addressing the long-term consequences of the conflict. In addition, it is recommended that universities increase their provision of nursing, physiotherapy, occupational therapy, and other allied health professions, with a view to supporting comprehensive healthcare delivery and rehabilitation services.

3. Curriculum Reform and Competency-Based Education.

The post-war curriculum must institutionalise competencies developed during wartime while maintaining alignment with international medical education standards. This includes the formalisation of training in disaster medicine, trauma systems, rehabilitation, environmental health, and health systems resilience as core components of medical education rather than elective specialisations.

Interprofessional education and team-based care should be embedded throughout the curriculum, reflecting the collaborative approach to healthcare delivery that has proven essential during the crisis. The assessment framework should maintain robust OSCE and workplace-based assessment methods while incorporating fairness safeguards for students affected by displacement or trauma.

4. Digital Health Integration and Research Capacity.

Integrating telemedicine, artificial intelligence-assisted diagnostics, and health data science into core curricula will prepare graduates for modern healthcare delivery. It is recommended that universities establish centres of excellence in the following areas: digital health, rehabilitation medicine, prosthetics and biomechanics, mental health, and trauma-related research. These centres should be linked with academic programmes, clinical networks, and international research collaborations.

Establishing national registries about trauma outcomes, prosthetic effectiveness, mental health interventions, and environmental health exposures is anticipated to generate substantial research databases, thereby facilitating the advancement of quality improvement initiatives and the development of evidence-based practices.

5. The institution prides itself on its commitment to quality assurance and the pursuit of international recognition.

To maintain and enhance international recognition of Ukrainian medical degrees, it is essential to ensure continued alignment with European directives on medical training and global quality assurance benchmarks. This encompasses the implementation of transparent accreditation cycles, the publication of educational outcomes data, and the provision of support for faculty development in medical education scholarship.

The expansion of English-medium programmes, coupled with rigorous quality assurance measures, is set to play a pivotal role in restoring international student confidence and preserving Ukraine's standing as a prominent regional hub for medical education. Endeavours must complement this internationalisation strategy to attract and retain high-calibre international faculty members and establish joint degree programmes with globally renowned institutions.

Policy Recommendations and Implementation Framework.

1. National Medical Education Recovery Plan.

Ukraine must establish a comprehensive Medical Education Recovery Plan that delineates clearly defined priorities and cost estimates for the reconstruction of facilities, the development of simulation laboratories, the enhancement of digital infrastructure, and the provision of mental health support services. This plan must incorporate performance indicators and regular assessment mechanisms to ensure effective utilisation of resources and facilitate ongoing progress monitoring.

2. Regional Academic Health Centers

Developing regional academic health centres that integrate universities with hospital systems will be essential for providing coordinated healthcare delivery, medical education, and research activities. It is recommended that these centres be allocated targeted funding and that governance structures be implemented to encourage collaboration while ensuring that academic independence and clinical excellence are maintained.

3. The following essay will explore the relationship between incentive programmes and brain gain strategies.

Implementing bonded scholarship programmes, housing allowances, and competitive research funding for medical graduates who commit to serving in high-need regions will be crucial for addressing geographic healthcare disparities. International exchange programmes must be meticulously designed to encourage the return of displaced Ukrainian medical professionals while facilitating ongoing collaboration with global partners.

4. Sustainable Financing and Investment.

Post-war medical education development will require diversified funding sources, including government investment, international donor support, philanthropic contributions, and strategic private sector partnerships. Establishing a national outcomes dashboard tracking graduate distribution, licensing examination pass rates, research productivity, and clinical outcomes will provide transparency and accountability for funding decisions.

Conclusion

Ukraine's higher medical education system has demonstrated extraordinary resilience and adaptability in the face of significant challenges. The innovations in digital pedagogy, curriculum development, and international collaboration that emerged from necessity during wartime have created a foundation for transformation that extends far beyond crisis response.

A combination of significant challenges and unprecedented opportunities characterises the post-war period. With strategic investment, sustained international partnership, and commitment to quality and innovation, it is asserted that Ukrainian medical education can emerge from this crisis not merely restored but fundamentally strengthened and modernised. The distinctive knowledge and skills acquired in trauma care, emergency medicine, rehabilitation, and crisis management position Ukrainian medical graduates to contribute substantially to global healthcare, while concurrently contributing to their nation's reconstruction needs.

The success of these efforts will be contingent upon maintaining the spirit of innovation and collaboration that has characterised the wartime response, whilst implementing systematic reforms that address long-term educational quality, workforce development, and international competitiveness. The resilience demonstrated by Ukrainian medical educators and students during this crisis provides confidence that they possess the determination and capability to build a medical education system that serves as a model for excellence, innovation, and social responsibility in the 21st century.

The transformation of Ukrainian medical education from a survival strategy in wartime to a leadership-oriented approach in the post-war era will necessitate the sustained commitment of domestic and international stakeholders. However, the foundations laid during these challenging years indicate that this ambitious vision is both attainable and unavoidable.

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НУТРІЄНТНИЙ СТАТУС ТА АЛІМЕНТАРНІ РИЗИКИ СЕРЕД ДОРОСЛОГО НАСЕЛЕННЯ, ЯКЕ МЕШКАЄ НА ЕКОЛОГІЧНО НЕСПРИЯТЛИВИХ ТЕРИТОРІЯХ ЖИТОМИРОСЬКОЇ ОБЛАСТІ

***Анотація**. Метою дослідження було вивчення нутрієнтного статусу та аліментарних ризиків у дорослого населення, що проживає на екологічно несприятливих територіях Житомирської області. Встановлено, що харчові раціони чоловіків і жінок характеризуються значними дисбалансами. Вияв-*