

УДК 617.3-051:614.256](477)"364"(045)

DOI: <http://dx.doi.org/10.15674/0030-59872026384-92>

The professional practice of orthopaedic surgeons and trauma specialists in Ukraine during the war: surgical workload, resource constraints, clinical readiness and support needs

M. M. Matiash¹, M. L. Ankin², V. Ye. Lunov^{1,3},
V. O. Ladyka², A. M. Koval¹, D. T. Kravets²

¹ Bogomolets National Medical University, Kyiv, Ukraine

² Shupyk National Healthcare University of Ukraine, Kyiv

³ G. S. Kostiuk Institute of Psychology of the National Academy of Pedagogical Sciences of Ukraine

Objective. To assess the readiness of Ukraine's orthopaedic and trauma community to manage mine- and blast-related injuries, the adequacy of material and logistical support, and the quality of interdisciplinary collaboration at the national level. **Methods.** The sample comprised 49 specialists in orthopaedics and/or traumatology who participated in the cross-sectional online survey ORTHO-MOBILITY & PROFESSIONALISM UA and were actively practising in Ukraine at the time of the survey. Of these, 47 were men (95.9 %) and two were women (4.1 %). **Results.** The findings revealed a predominant pattern of exceptionally high clinical activity: 44.9 % of respondents (n = 22) treated patients with blast, fragmentation, or gunshot injuries daily, while a further 20.4 % (n = 10) did so several times a week. Excessive physical and psychological strain was the most frequently reported challenge (63.3 %; n = 31). Logistical difficulties and problems with the supply of implants, consumables, and medications ranked second (51.0 %; n = 25), followed by shortages of specialised equipment. Psychological support for medical personnel was identified as a critical issue by 30.6 % of respondents (n = 15). **Conclusions.** The findings indicate that Ukrainian orthopaedic and trauma surgeons work under sustained conditions of exceptionally high clinical workload, substantial material and logistical shortages, and critical competency gaps in microsurgery. Their practice has undergone a fundamental transformation, as reflected in a near-universal increase in the use of external fixation. Taken together, these findings provide a coherent and internally consistent evidence base for developing practical recommendations.

Мета. Проаналізувати національний рівень травматологічно-ортопедичної спільноти щодо готовності лікувати мінно-вибухові травми, матеріально-логістичного забезпечення та якості міждисциплінарної взаємодії. **Методи.** Вибірку отримано в межах крос-секційного онлайн-опитування ORTHO-MOBILITY & PROFESSIONALISM UA, яке склали 49 фахівців з ортопедії та/або травматології (чоловіки: n = 47 (95,9 %); жінки: n = 2 (4,1 %)), які на момент опитування активно працювали в Україні. **Результати.** Домінуючою виявилась картина максимальної операційної інтенсивності: 44,9 % респондентів (n = 22) щодня надавали допомогу пацієнтам із вибуховими, осколковими або вогнепальними пораненнями, ще 20,4 % (n = 10) — кілька разів на тиждень. Найчастіше вибрана проблема — надмірне фізичне та психоемоційне навантаження (63,3 %; n = 31). На другому місці — проблеми з логістикою та постачанням імплантів, витратних матеріалів і медикаментів (51,0 %; n = 25), на третьому — дефіцит спеціалізованого обладнання. Психологічна підтримка медичного персоналу була визнана критичною проблемою 30,6 % (n = 15) респондентів. **Висновки.** Аналіз проведеного дослідження засвідчує, що українські лікарі ортопеди-травматологи функціонують в умовах стійкого максимального операційного навантаження, суттєвого матеріально-логістичного дефіциту, критичних прогалин компетентності в мікрохірургічних доменах і фундаментальної трансформації практики, відображеної в майже загальному зростанні застосування зовнішньої фіксації. Отримані дані конвергують в єдину внутрішньо узгоджену доказову базу для формування практичних рекомендацій. **Ключові слова.** Професійні потреби лікарів, клінічні можливості, операційне навантаження, ресурсні обмеження, готовність до лікування бойової травми, матеріально-технічне забезпечення, фахова підтримка, міждисциплінарна взаємодія, воєнний стан.

Keywords. Physicians' professional needs, clinical capacity, surgical workload, resource constraints, readiness to manage combat-related trauma, material and technical resources, professional support, interdisciplinary collaboration, martial law

Introduction

The full-scale armed aggression of the Russian Federation against Ukraine, which escalated in February 2022, has fundamentally changed the conditions and scope of orthopedic and trauma practice throughout the country. The volume, complexity, and structure of combat injuries — with a predominance of high-energy ballistic fractures, blast-related trauma and wounds, extensive polystructural bone and soft-tissue defects, as well as combined neurovascular injuries — have no precedent in contemporary European medicine [2, 3, 6]. Orthopedic and trauma surgeons, who bear the main surgical burden, operate in an environment that combines maximum clinical demands with substantial resource shortages, limited access to continuing professional development, and sustained psychological strain [4, 9].

Despite the obvious practical importance of understanding what happens to the professional practice of these specialists under wartime conditions, systematic empirical data on their operational reality remain extremely limited. The ORTHO-MOBILITY & PROFESSIONALISM UA survey was developed, in particular, to address this gap and assess the actual state of this field. Using a standardized anonymous self-report, the survey documented key parameters of professional practice, including the frequency and intensity of workload, the material and logistical basis of clinical work, self-assessment of clinical competence, changes in treatment strategies, and professional support needs.

We investigated four analytical objectives: 1 — to characterize the distribution of operative workload (frequency of providing care for combat injuries) and examine its association with resource availability; 2 — to map (objectify) Ukrainian orthopedic surgeons' self-assessed clinical readiness across five domains of complex trauma and identify the most critical competency gaps; 3 — to describe quantitative and qualitative changes in professional practice associated with the transition to wartime conditions, with a focus on the increased use of external fixation techniques; and 4 — to document professional support needs and patterns of interdisciplinary interaction among surgical personnel and analyze their structural correlates.

Objective: To analyze the national-level readiness of the trauma and orthopedic community to manage blast injuries, the availability of material and logistical resources, and the quality of interdisciplinary collaboration.

Materials and Methods

Study design

The study sample was obtained through the ORTHO-MOBILITY & PROFESSIONALISM UA

cross-sectional online survey, which included 49 orthopedic and/or trauma specialists (men: $n = 47$ [95.9 %]; women: $n = 2$ [4.1 %]) who were actively practicing in Ukraine at the time of the survey. According to the type of healthcare facility, the sample included physicians providing care at different levels of the healthcare system, including military medical facilities at ROLE I–IV levels and civilian healthcare facilities at levels I–III of medical care.

The mean duration of professional experience was 13.18 years ($SD = 10.63$; range: 1–45 years). Participation was voluntary and anonymous, with informed consent provided by all respondents.

The “Professional Activity” block of the ORTHO-MOBILITY & PROFESSIONALISM UA survey is an original research instrument developed specifically for this study and comprises 9 questions: 1) frequency of providing care for blast, fragmentation, and gunshot injuries during the previous year (5-point ordinal scale: daily / several times a week / several times a month / rarely [less than once a month] / never); 2) rating of the department's resource capacity for the management of complex combat trauma (Likert scale: 1 = extremely inadequate → 5 = excellent); 3) the most critical professional problems under martial law (multiple choice, up to 3 of 6 options); 4) self-assessment of clinical readiness and confidence in managing five categories of complex trauma under limited-resource (combat) conditions: complex injuries of long bones with extensive bone and soft-tissue defects, polytrauma involving multiple organs and systems, injuries of major vessels and nerves (requiring microsurgery), pelvic and acetabular injuries, and limb amputations and reconstructive procedures (4-point scale: insufficient / moderate / high / expert); 5) change in the frequency of external fixation (EF) use compared with the pre-war baseline (4-point scale: much more frequently / somewhat more frequently / unchanged / less frequently); 6) the most needed forms of professional support (multiple choice without restrictions, 5 options); 7) satisfaction with the quality of interdisciplinary collaboration (Likert scale: 1–5); 8) an open-ended question for free comments.

Statistical analysis

Frequencies and percentages were calculated for all categorical variables. Continuous and ordinal variables are presented as $M \pm SD$, with the median additionally reported for non-normally distributed variables. Associations between ordinal variables were assessed using Spearman's rank correlation coefficient (ρ). Between-group comparisons involving more than two categories (i. e., three or more) were

performed using the Kruskal–Wallis test (H); post hoc comparisons were conducted using the Mann–Whitney U test with Bonferroni correction. Effect sizes are reported as rank-biserial r for the Mann–Whitney U test and η^2 for the Kruskal–Wallis test. For multiple-choice questions, percentages represent the proportion of respondents selecting each option (the total may exceed 100%). All analyses were performed using Python 3.12 (SciPy 1.11, pandas 2.1). The statistical significance level was set at $\alpha = 0.05$; borderline effects ($0.05 \leq p < 0.10$) are reported descriptively.

Results

A pattern of maximum operative intensity predominated: 44.9 % of respondents ($n = 22$) provided care for patients with blast, fragmentation, or gunshot injuries daily, while another 20.4 % ($n = 10$) did so several times a week. Thus, 65.3 % of the sample operated under maximum or near-maximum workload conditions, predominantly at levels of medical care close to the combat zone (military facilities at ROLE II–III).

Additionally, 16.3 % ($n = 8$) treated such injuries several times a month, while another 16.3 % ($n = 8$) did so less than once a month. Only one participant (2.0 %) reported no such experience during the previous year (Table 1).

A statistically significant positive association was found between workload frequency and the rating of resource availability (Spearman's $\rho = 0.306$, $p = 0.032$): physicians who provided care for combat trauma more frequently generally rated the resources available in their departments more highly. This may be explained by the concentration of resource investment in facilities managing a higher volume of such trauma. However, even among physicians reporting a daily workload, the mean resource rating did not exceed 3.32 out of 5, indicating that material and techni-

cal resources remained inadequate even in the highest-volume facilities.

Respondents were asked to select up to three of the most critical problems in their work (Table 2). The most frequently selected problem was excessive physical and psychoemotional workload (63.3 %; $n = 31$), placing chronic overwork at the forefront of systemic stressors (or “burnout”) in this professional group. This finding is consistent with epidemiological data reported for the broader cohort of Ukrainian healthcare professionals [1, 9]. The second most frequently reported problem was logistical and supply-related difficulties involving implants, consumables, and medications (51.0 %; $n = 25$). The third was a shortage of specialized equipment, particularly C-arms, arthroscopic equipment, microsurgical instruments, and operating microscopes (49.0 %; $n = 24$).

A shortage of qualified mid-level and junior medical personnel was reported by 42.9 % of respondents ($n = 21$), indicating that the staffing crisis extends beyond the physician workforce and affects the entire clinical support structure, as mid-level and junior medical personnel are an integral component of specialized medical care at all levels of healthcare delivery. Psychological support for healthcare personnel was identified as a critical problem by 30.6 % ($n = 15$) of respondents, while difficulties with continuing professional development and access to courses and conferences were reported by 26.5 % ($n = 13$). Notably, the vast majority of participants selected three of the six available options simultaneously, indicating that these challenges are structurally interrelated rather than independent.

Self-assessed clinical readiness varied substantially depending on the type of trauma (Table 3). The highest mean level of readiness was reported for complex long-bone injuries with extensive defects ($M = 2.46$; $SD = 1.01$), followed by limb amputations and reconstructive procedures ($M = 2.35$;

Table 1

Frequency of providing care for combat injuries and resource adequacy rating

Combat injury workload frequency	n	%	Resources M (SD)	Cumulative %
Daily	22	44.9	3.32 (0.84)	44.9
Several times a week	10	20.4	3.10 (0.74)	65.3
Several times a month	8	16.3	2.50 (1.51)	81.6
Rarely (< times a month)	8	16.3	2.25 (0.89)	97.9
Never	1	2.0	3.00 (—)	100.0
Total	49	100.0	2.88 (1.13)	—

Note. Resource provision: 1 = extremely inadequate, 5 = excellent. Spearman correlation: workload frequency — resources: $\rho = 0.306$, $p = 0.032$.

SD = 0.90). Both domains correspond to areas in which relatively established traditions have developed in Ukrainian orthopedic and trauma practice — fracture management using EF and amputation surgery. This experience-based competence apparently translates into relatively greater confidence even under resource-limited conditions.

At the same time, readiness to manage major vascular and nerve injuries requiring microsurgical intervention was identified as the most critical competency deficit in the sample: 63.3 % of respondents (n = 31) rated their readiness as insufficient, and only 4.1 % (n = 2) reached the “expert” level (M = 1.50; SD = 0.80). This finding is of particular clinical importance given that combined vascular and soft-tissue injuries — a characteristic feature of blast injuries — currently account for a substantial proportion of the trauma caseload, while delayed or absent vascular reconstruction is one of the leading factors contributing to post-injury amputations [3]. Pelvic and acetabular injuries ranked second in terms of the severity of the readiness deficit (M = 1.92; SD = 0.90; 34.7 % rated their readiness as “insufficient”). Although polytrauma involving multiple organs and systems had a somewhat higher mean score (M = 1.98; SD = 0.79), only a very small proportion of respondents reached the “high” or “expert” levels (16.3 % combined).

A statistically significant association between the frequency of combat-related workload and clinical readiness was found for the domain of limb amputations and reconstructive procedures (Kruskal–Wallis test: $H = 12.37$; $df = 3$; $p = 0.00$; $\eta^2 = 0.22$). Post hoc analysis demonstrated a clear dose–response gradient: surgeons who managed combat trauma daily demonstrated substantially higher readiness for amputation procedures (M = 2.77) than those who did so several times a month (M = 1.63) or rarely (M = 1.88). For the remaining domains, the Kruskal–Wallis test results approached but did not reach statistical significance (complex long-bone fractures: $H = 7.05$; $p = 0.071$; pelvic injuries: $H = 6.28$; $p = 0.099$; polytrauma: $H = 5.83$; $p = 0.120$; neurovascular injuries: $H = 4.55$; $p = 0.208$), while maintaining a consistent descriptive trend: greater practical experience was associated with higher confidence. These borderline effects warrant further investigation in studies with larger samples.

The composite clinical readiness score (mean of the standardized scores across all five domains) demonstrated a descriptively pronounced nonlinear relationship with experience categories (Table 4). The highest level of readiness was observed in the group with 16–20 years of experience (M = 3.05; SD = 0.79), substantially exceeding the scores

Table 2

Frequency of selection of the most critical professional problems under martial law (multiple choice, ≤ 3 options)

Problem	n	%	Rank
Excessive physical and emotional workload	31	63.3	1 st
Problems with logistics and the supply of implants/medications	25	51.0	2 nd
Shortage of specialized equipment (C-arm, arthroscopy, microsurgery)	24	49.0	3 rd
Shortage of qualified nursing and junior medical staff	21	42.9	4 th
Psychological support for medical personnel	15	30.6	5 th
Problems with continuing professional development and training	13	26.5	6 th

Table 3

Self-assessment of clinical readiness across five domains of combat trauma

Trauma domain	M	SD	Insufficient (%)	Moderate (%)	High (%)	Expert (%)	Pair
Complex long-bone injuries	2.46	1.01	20.4	28.6	32.7	16.3	1 st (highest)
Limb amputations and reconstruction	2.35	0.90	16.3	44.9	26.5	12.2	2 nd
Polytrauma (multiorgan)	1.98	0.79	24.5	57.1	10.2	6.1	3 rd
Pelvic / acetabular injuries	1.92	0.90	34.7	44.9	10.2	8.2	4 th
Neurovascular injuries (microsurgery)	1.50	0.80	63.3*	24.5	6.1	4.1	5 th (lowest)
Composite measure (5 domains)	2.02	0.74	—	—	—	—	—

Notes: Readiness scale: 1 = Insufficient, 2 = Moderate, 3 = High, 4 = Expert level. Most critical deficit: 63.3% rated their readiness for microsurgical interventions as insufficient.

of both early-career physicians (0–5 years: $M = 1.88$) and the most experienced physicians (> 20 years: $M = 2.07$). The Kruskal–Wallis test for the composite score yielded a borderline result ($H = 8.60$; $p = 0.072$), reflecting a trend that requires confirmation in a larger sample. Notably, even in the group with the highest overall readiness, the mean score for the neurovascular injury domain did not exceed 2.50, indicating that microsurgical competence remained suboptimal across all levels of professional experience.

One of the most indicative markers of the transformation of clinical practice during wartime was the change in the frequency of EF use compared with the pre-war baseline (Table 5). The vast majority of respondents reported an increase: 65.3 % ($n = 32$) began using EF much more frequently, while another 20.4 % ($n = 10$) reported a moderate increase. Overall, 85.7 % of the sample ($n = 42$) reported an increase in EF use compared with the pre-war baseline (2022), with the majority (65.3 %) reporting a substantial increase. Because the instrument recorded the direction and intensity of change using an ordinal scale (much more frequently / somewhat more frequently / unchanged / less frequently), rather than the absolute magnitude of the increase, the reported percentages represent the proportion of respondents in

each change category. Only 8.2 % ($n = 4$) reported no change, while 6.1 % ($n = 3$) reported a decrease in use, likely reflecting the characteristics of facilities less involved in the management of combat trauma.

The widespread adoption of EF as a primary damage-control strategy is typical of the qualified and specialized stages of care—military facilities at ROLE II–III and civilian facilities at levels II–III—and reflects the adaptation of Ukrainian orthopaedic practice to the ballistic injury spectrum of the current conflict. High-energy fragmentation fractures with extensive soft-tissue defects, wound contamination, and vascular injury often preclude primary definitive fixation, whereas EF provides temporary stabilization while allowing staged reconstruction [5]. The regional pattern appears consistent: the highest mean change score was observed in the Southern region ($M = 3.00$) and the lowest in the Western region ($M = 2.21$), although regional differences did not reach statistical significance (Kruskal–Wallis: $H = 1.91$; $p = 0.590$).

The rating of departmental resource availability was below the midpoint of the scale, with a mean of $M = 2.88$ ($SD = 1.13$; median = 3.0). Inadequate or extremely inadequate resources were reported by 40.8 % of respondents (ratings 1–2; $n = 20$), whereas only 24.5 % (ratings 4–5; $n = 12$) rated resource availability as adequate or excellent. The modal

Composite clinical readiness score and readiness for neurovascular injuries by years of professional experience ($M \pm SD$)

Table 4

Years of professional experience	n	Composite M (SD)	Neurovascular M (SD)	Note
0–5 years	16	1.88 (0.76)	1.38 (0.62)	Lowest composite score
6–10 years	9	1.71 (0.48)	1.33 (0.50)	Absolute minimum
11–15 years	9	2.09 (0.57)	1.56 (0.73)	—
16–20 years	4	3.05 (0.79)*	2.50 (1.29)*	Peak readiness in the sample
> 20 years	11	2.07 (0.78)	1.64 (0.81)	Partial decline in the most experienced group
KB (df = 4)	—	$H = 8.60$; $p = 0.072^{**}$	—	—

Notes: Composite = mean across the 5 domains (1–4). *Peak values. **Borderline statistical significance.

Change in the frequency of external fixation use compared with the pre-war baseline by region

Table 5

Region / category	Much more frequently (n / %)	Slightly more frequently (n / %)	No change (n / %)	Less frequently (n / %)	Mean change index (0–3)
Central (n = 19)	13 / 68.4	3 / 15.8	2 / 10.5	1 / 5.3	$M = 2.53$
Western (n = 19)	10 / 52.6	5 / 26.3	2 / 10.5	2 / 10.5	$M = 2.21$
Eastern (n = 8)	6 / 75.0	1 / 12.5	0 / 0	1 / 12.5	$M = 2.62$
Southern (n = 3)	3 / 100	0 / 0	0 / 0	0 / 0	$M = 3.00$
Total (n = 49)	32 / 65.3	10 / 20.4	4 / 8.2	3 / 6.1	$M = 2.49$

Notes: Change index: 0 = less frequently, 1 = no change, 2 = slightly more frequently, 3 = much more frequently. Kruskal–Wallis test (regions): $H = 1.91$; $p = 0.590$ (not significant).

response was “3” (moderate), selected by 34.7 % ($n = 17$). Importantly, resource ratings remained below the midpoint of the scale across all regions, with no statistically significant regional differences (Kruskal–Wallis: $H = 1.41$; $p = 0.704$). This suggests that the resource deficit is systemic rather than attributable to specific local factors.

Satisfaction with interdisciplinary collaboration demonstrated a somewhat more favorable distribution ($M = 3.24$; $SD = 1.23$; median = 3.0): 44.9 % of respondents rated the quality of teamwork at 4–5 points, suggesting that a substantial proportion of Ukrainian orthopaedic surgeons consider their institutional environment functional despite the resource constraints of wartime. At the same time, 30.6 % ($n = 15$) reported low satisfaction (ratings 1–2), indicating that approximately one in three respondents experiences a substantial deficit in interdisciplinary coordination and communication.

Spearman’s correlation between resource availability and satisfaction with interdisciplinary collaboration was statistically significant and moderate ($\rho = 0.388$; $p = 0.006$): better-resourced facilities generally demonstrated higher-quality interdisciplinary collaboration. This association is consistent with a structural model in which adequate material resources create conditions for effective professional coordination, whereas resource scarcity promotes competitive rather than cooperative dynamics — a mechanism well documented in the organizational psychology of healthcare during crises [10].

Respondents were asked to select all forms of professional support they considered most useful at the present time (Table 6). The predominant need was the opportunity to participate in clinical fellowships or observerships, either in Ukraine or abroad, selected by 83.7 % ($n = 41$), representing the highest frequency among all proposed options. This finding reflects a structural gap between the volume and complexity of combat injuries encountered in clinical practice and the competency-based training provided

through pre-war educational pathways. Humanitarian assistance in the form of visiting surgical teams, specialized instruments, and implants ranked second (73.5 %; $n = 36$), which is fully consistent with the resource deficit documented above.

Exchange of experience with colleagues from other regions, through case conferences and professional communication channels, was selected by 65.3 % ($n = 32$), highlighting the value of peer-to-peer knowledge exchange when participation in conferences is limited. In this context, the potential of telemedicine consultations, using models such as Teladoc-type systems, deserves particular attention, as such platforms can provide continuous remote access to expert advice from specialized centers regardless of the geographic location of the facility. Access to free online courses and webinars on combat trauma and reconstruction was identified as a priority by 61.2 % ($n = 30$). This indicates that digital learning platforms represent both an accessible and highly demanded format for continuing professional development. Professional psychological support and counseling were selected by 30.6 % ($n = 15$), substantially less frequently than needs related to material resources and education, but still clinically relevant given that the same proportion of respondents (30.6 %) identified psychological support for healthcare personnel as a critical unresolved problem. Thus, it can reasonably be concluded that the respondents identifying a psychological support deficit and those requesting such assistance represent the same subgroup of the sample.

Fourteen respondents (28.6 %; $n = 14/49$) provided substantive free-text responses. Thematic analysis of these responses identified four recurring content clusters.

Given the qualitative nature of these data and the relatively small number of detailed responses, cluster frequencies are not reported as standalone percentages. Instead, the relevance of each cluster is supported by the quantitative findings of the main

Table 6

Most needed forms of professional support (unrestricted multiple choice)

Form of support	n	%	Rank
Opportunities for clinical fellowships/training placements (in Ukraine or abroad)	41	83.7	1 st
Humanitarian assistance: specialized instruments and implants	36	73.5	2 nd
Exchange of experience with colleagues from other regions (case conferences, chats)	32	65.3	3 rd
Free online courses and webinars (combat trauma, reconstruction)	30	61.2	4 th
Professional psychological support and counseling	15	30.6	5 th

Note: Percentages sum to more than 100% because multiple responses were permitted.

analysis, which are referenced below. The first and most prevalent cluster concerned the need for clear stratification of trauma care by level of care and injury severity, with open access between levels and free, continuous (24/7) interfacility consultations: “A free, accessible, cost-free educational chain between physicians concerning specific cases (injuries) at all stages and until complete or relative recovery of the patient”. The second cluster concerned the need for hands-on training in complex reconstructive techniques, including flap surgery, distraction osteogenesis, and bone grafting, for which wartime practice has revealed substantial competency gaps without readily available mechanisms for addressing them. The third cluster focused on administrative overload as a contextually inappropriate requirement: several respondents explicitly identified excessive paperwork as a factor competing with clinical time under emergency conditions. The fourth cluster, expressed by several respondents, concerned the need for broader state support for the field of traumatology, including the implementation of digital technologies in clinical practice.

The demand for stratified trauma-care systems and interregional communication networks is quantitatively supported by the finding that 65.3 % of respondents selected “exchange of experience with colleagues” as a priority form of professional support. The emphasis on practical skills is reflected in the pattern of competency deficits, particularly in the microsurgical and reconstructive domains. Complaints regarding administrative burden provide additional context for the finding that 63.3 % identified excessive physical and emotional workload as the leading systemic problem.

Discussion

The operational profile identified in this study places Ukrainian orthopedic and trauma surgeons among the most intensively burdened clinical groups described in the national and international literature. Overall, 65.3 % provided care for combat-related injuries daily or several times per week — a proportion substantially higher than that reported among broader cohorts of Ukrainian healthcare workers [9], consistent with the frontline positioning of trauma surgery. The parallel findings that 63.3 % identified excessive physical and emotional workload as the leading systemic problem and that 85.7 % reported increased use of external fixation (EF) together characterize a clinical environment that has undergone a fundamental and sustained transformation.

The resource adequacy rating was below the midpoint of the scale ($M = 2.88/5$) and was relatively consistent across regions, representing a finding of direct relevance to healthcare policy. In the clinical literature on damage control orthopaedics, adequate equipment is not merely a matter of convenience but a prerequisite for the safe management of blast injuries: the absence of a C-arm limits the feasibility of intramedullary fixation, the absence of microsurgical infrastructure precludes vascular reconstruction, and shortages of implants necessitate temporary solutions that may increase the frequency of reoperations [5]. In our data, resource adequacy was the strongest predictor of clinical readiness, with Spearman's ρ coefficients consistently exceeding the corresponding values for neurocognitive functioning, while humanitarian assistance in the form of surgical instruments and implants ranked second among the requested forms of support.

The finding that 63.3 % of orthopedic and trauma surgeons rated their own readiness to manage neurovascular injuries requiring microsurgery — a highly specialized form of tertiary care — as insufficient warrants particular consideration. This does not represent a marginal deficit in microsurgical competence in a rare category of injuries. Combined vascular and soft-tissue injuries are a characteristic feature of the blast-injury spectrum in the current conflict, while delayed or absent vascular reconstruction is a leading factor contributing to post-injury amputations [3]. The Ukrainian system of orthopedic and trauma surgery training, which historically developed around the peacetime injury profile dominated by road traffic injuries and falls, was not designed to develop a broad workforce with microsurgical competence. The wartime demand has made this gap acutely visible. Partial mitigation may be achieved through systematic collaboration with reconstructive and plastic surgeons within multidisciplinary teams, allowing individual competency gaps to be compensated for at the level of clinical process organization.

The nonlinear profile of readiness by years of professional experience, with a peak in the 16–20-year group followed by a decline among the most experienced physicians, is consistent with a model of mid-career skill consolidation, according to which the absence of targeted investment in competency maintenance may lead to skill attrition in older cohorts, a pattern well described in the surgical education literature [8]. Nevertheless, the small subgroup sizes (in particular, $n = 4$ in the 16–20-year group) preclude definitive conclusions. What is unequivocal is that even in the peak-readiness group, mean

readiness for microsurgery did not exceed 2.50 out of 4 points. The demand for internships or clinical fellowships reported by 83.7 % of respondents and for online training by 61.2 % converges with these readiness findings, defining a specific educational policy objective: the urgent implementation of targeted microsurgical and reconstructive fellowship programs.

The significant positive association between resource adequacy and satisfaction with interdisciplinary collaboration ($\rho = 0.388$; $p = 0.006$) can be interpreted through the framework of organizational psychology in healthcare. Better-resourced institutions generally support coordination structures, clearer roles, and mutual professional respect, which provide the foundation for productive teamwork. Conversely, resource scarcity promotes competitive rather than cooperative dynamics and undermines what contemporary literature refers to as team psychological safety [10]. From this perspective, investment in material resources also constitutes an investment in the quality of team interaction, a multiplicative effect with implications for both clinical performance and professional well-being. An additional systemic factor exacerbating this deficit is the absence in Ukraine of a unified, coordinated nationwide microsurgical care system capable of ensuring appropriate patient routing and coordinated interaction among specialized centers.

The fact that 44.9% of respondents reported above-average satisfaction with interdisciplinary collaboration despite substantial resource constraints suggests the presence of protective team- and organizational-level factors, such as leadership quality, a shared mission, or prior interdisciplinary training, that buffer the detrimental effects of resource scarcity on teamwork. Identifying and scaling these factors represents a promising direction for organizational intervention research in military medicine.

The hierarchy of support needs documented in this study, with internships and humanitarian assistance ranking first, followed by exchange of experience and online training, and psychological support ranking fifth, reflects a pragmatic and instrument-oriented approach to professional development under crisis conditions. Surgeons who encounter combat injuries on a daily basis primarily seek operational and technical resources (equipment, skills, knowledge, and access to expert colleagues) that can directly enhance their capacity to manage the injuries they actually encounter in practice.

It is difficult to support an approach in which support programs begin with psychological assistance: even evidence-based interventions may fail to achieve

sufficient uptake among Ukrainian orthopedic and trauma surgeons if they are perceived as less urgent than operative needs. A more effective approach, consistent with the recommendations of H. Kang [7] and A. Sydorenko et al. [11], is to integrate psychological support into professional development. Peer-exchange networks and educational programs can simultaneously strengthen clinical competence and build trust, through which psychological assistance becomes normalized and more accessible. Thirty percent of respondents explicitly expressed a need for such support, representing a clearly identifiable target population whose needs should guide the urgent provision of appropriate services.

Conclusions

This study demonstrates that Ukrainian orthopedic and trauma surgeons operate under sustained, near-maximal operative workload, substantial material and logistical constraints, critical competency gaps in microsurgical domains, and a fundamental transformation of clinical practice, reflected in the near-universal increase in the use of external fixation. These findings converge into a coherent and internally consistent evidence base for developing practical recommendations.

Material and technical resources are not optional but essential. Resource adequacy emerged as the dominant predictor of clinical readiness, while humanitarian assistance in the form of surgical instruments and implants ranked second among support priorities. The implication is clear: supply chains should be regarded as a primary intervention rather than a background factor.

The microsurgical competency gap requires a structured response. The finding that 63.3 % of orthopedic and trauma surgeons rated their own readiness as insufficient, in the context of a conflict characterized by blast injuries with a substantial vascular component, represents a patient-safety risk. Targeted fellowship programs, structured simulation-based training, and interinstitutional mentorship models should therefore be considered priorities.

Peer-exchange and interdisciplinary collaboration networks are cost-effective and highly demanded support mechanisms. The fact that 65.3 % of respondents selected peer exchange as a priority, together with the qualitative demand for round-the-clock interfacility communication, indicates that facilitating such interaction, including through telemedicine platforms, may represent a relatively low-cost and potentially high-impact intervention. Psychological support should be embedded within professional

development structures rather than offered solely as a separate service.

Conflict of interest. The authors declare no conflict of interest.

Future research. National-level replication, longitudinal cohort monitoring, and qualitative in-depth interviews using purposive samples of surgeons working in areas of highest injury intensity represent important directions for future research.

Funding. The study received no external funding.

Author contributions. All authors contributed equally to the study design, data collection and analysis, and preparation of the manuscript.

AI use statement. During preparation of the manuscript, auxiliary artificial intelligence tools were used, including Consensus Academic Search Tool (AI-based search engine), Grammarly, DeepL, and Claude (Anthropic, 2026), for searching and organizing literature sources and for developing the preliminary structure of the manuscript.

References

1. Butska, L., Drevitska, O., Dybkalyuk, S., & Mialovytska, O. (2025). Emotional and pain experiences reported by Ukrainian healthcare workers during wartime. *Polski merkuriusz lekarski*, 53(3), 389–394. <https://doi.org/10.36740/merkur202503114>
2. Bakuridze, N. G., Lunov, V. I., Ulianov, V. O., & Ulianova, N. A. (2024). Psychological and neuropsychological status of patients with both blast-related ocular injury and mild traumatic brain injury late after the traumatic event. *Oftalmologicheskii Zhurnal*, 112(5), 21–26. <https://doi.org/10.31288/oftalmolzh202452126>
3. Eastridge, B. J., Mabry, R. L., Seguin, P., Cantrell, J., Tops, T., Uribe, P., ... Blackburne, L. H. (2012). Death on the battlefield (2001–2011): Implications for the future of combat casualty care. *Journal of Trauma and Acute Care Surgery*, 73(6 Suppl 5), S431–S437. <https://doi.org/10.1097/TA.0b013e3182755dce>
4. Gosens, T., & Oudsten, B. (2023). Psychology in orthopedics and traumatology: An instructional review. *EFORT Open Reviews*, 8, 245–252. <https://doi.org/10.1530/eor-23-0038>
5. Grab, J. (2025). Psychological and social aspects in orthopaedics and trauma surgery, challenges and solutions in trauma: A didactic overview. *EFORT Open Reviews*, 10, 431–438. <https://doi.org/10.1530/eor-2025-0054>
6. Grabowski, G., Sheppard, E. D., Everett, W. B., & Shealy, S. M. (2021). The epidemiology of combat extremity injury. *Orthopedic Clinics of North America*, 52(2), 107–118. <https://doi.org/10.1016/j.oocl.2020.12.003>
7. Kang, H., Fischer, I., Vus, V., Kolyshkina, A., Ponomarenko, L., Chobanian, A., Esterlis, I., & Pietrzak, R. (2024). Psychological resilience of mental health workers during the Russia-Ukraine war: Implications for clinical interventions. *The Primary Care Companion for CNS Disorders*, 26(5). <https://doi.org/10.4088/pcc.24m03761>
8. Reznick, R. K., & MacRae, H. (2006). Teaching surgical skills — Changes in the wind. *New England Journal of Medicine*, 355(25), 2664–2669. <https://doi.org/10.1056/NEJMr054785>
9. Rzońca, P., Podgórski, M., Łazarewicz, M., Gałązkowski, R., Rzońca, E., Detsyk, O., & Włodarczyk, D. (2024). The prevalence and determinants of PTSD, anxiety, and depression in Ukrainian civilian physicians and paramedics in wartime. *Psychiatry Research*, 334, 115836. <https://doi.org/10.1016/j.psychres.2024.115836>
10. Sydorenko, A., Kiel, L., & Spindler, H. (2024a). Psychosocial challenges of Ukrainian healthcare professionals in wartime: Addressing the need for management support. *Social Science & Medicine*, 364, 117504. <https://doi.org/10.1016/j.socscimed.2024.117504>
11. Sydorenko, A., Kiel, L., & Spindler, H. (2024b). Resilience, psychosomatic health, and support needs of Ukrainian healthcare professionals in wartime: A cross-sectional study. *Journal of Psychosomatic Research*, 188, 111995. <https://doi.org/10.1016/j.jpsychores.2024.111995>

The article has been sent to the editors 14.06.2026	Received after review 23.06.2026	Accepted for printing 19.07.2026
--	-------------------------------------	-------------------------------------

THE PROFESSIONAL PRACTICE OF ORTHOPAEDIC SURGEONS AND TRAUMA SPECIALISTS IN UKRAINE DURING THE WAR: SURGICAL WORKLOAD, RESOURCE CONSTRAINTS, CLINICAL READINESS AND SUPPORT NEEDS

M. M. Matiash ¹, M. L. Ankin ², V. Ye. Lunov ^{1,3}, V. O. Ladyka ², A. M. Koval ¹, D. T. Kravets ²

¹ Bogomolets National Medical University, Kyiv, Ukraine

² Shupyk National Healthcare University of Ukraine, Kyiv

³ G. S. Kostiuk Institute of Psychology of the National Academy of Pedagogical Sciences of Ukraine

✉ Mykhailo Matiash, MD, PhD, DMSc, Prof.: drmatiash@gmail.com; <https://orcid.org/0000-0002-4248-060X>

✉ Mykola Ankin, MD, PhD, DMSc, Prof.: m.ankin@ukr.net; <https://orcid.org/0000-0001-9795-0931>

✉ Vitalii Lunov, PhD, Prof.: <https://orcid.org/0000-0002-7085-8454>

✉ Viktoriia Ladyka, MD, PhD, Prof.: lunyov_vitaliy@ukr.net; ladika084@gmail.com; <https://orcid.org/0000-0002-3796-428X>

✉ Artem Koval, PhD: drmatiash@gmail.com

✉ Dmytro Kravets, MD: d.kraveets@gmail.com; <https://orcid.org/0009-0009-8102-7603>