The Emergence of MOVES SLC Life-Support System Equipment for En-Route Trauma Care in Ukraine During a Qualitative Assessment

Article *in* Military Medicine · September 2024

DOI: 10.1093/milmed/usae440

CITATION
1

READS
63

9 authors, including:

Jessica Anne Korona
Henry M Jackson Foundation
41 PUBLICATIONS **116** CITATIONS
SEE PROFILE

Miranda Janvrin
Uniformed Services University of the Health Sciences
22 PUBLICATIONS **78** CITATIONS
SEE PROFILE

Oleh Berezyuk
Danylo Halytsky Lviv National Medical University
10 PUBLICATIONS **9** CITATIONS
SEE PROFILE

Tracey Koehlmoos
Uniformed Services University of the Health Sciences
289 PUBLICATIONS **5,363** CITATIONS
SEE PROFILE

The Emergence of MOVES SLC Life-Support System Equipment for En-Route Trauma Care in Ukraine During a Qualitative Assessment

Lynn Lieberman Lawry, MD, MSPH, MSc[1]; Jessica Korona-Bailey, MPH[1,2]; Tiffany E. Hamm, PhD[2]; CDR John Maddox, MD, MC, USN[1]; Luke Juman, MPH[1,2]; Miranda Janvrin, MPH[1,2]; COL John B. Holcomb, MD (Ret.)[3]; Oleh Berezyuk, MD[4]; Tracey Perez Koehlmoos, PhD, MHA[1]

ABSTRACT

Introduction:

Ukraine's health and trauma system has been detrimentally impacted since the Russian Federation invasion in February 2022. The number and extent of injuries experienced in Ukraine because of trench warfare and high-intensity large-scale combat operations has not been seen in recent conflicts. Understanding attitudes and perceptions around the use of devices and products including MOVES (monitor, oxygen concentrator, ventilator, and suction system) and its use in the large-scale combat operation environment can inform lessons learned for improved prehospital care in Ukraine, as well as in other future conflicts.

Material and Methods:

We conducted qualitative key informant interviews with military and civilian Ukrainian health care workers during the ongoing conflict using an expanded version of the Global Trauma System Evaluation Tool. We focused the analysis on identifying and understanding the capability of MOVES Micro-integrated Life Support System (SLC).

Results:

Thirty-six participants were interviewed; 56% were military and 44% were civilians and representative of all NATO roles or levels of care. Sixty-one percent of participants were male. Seventy-two percent of participants were stationed in the Eastern and Northern regions. The mean age was 34.9 years. Sixty-seven percent of care providers reported using MOVES SLC and the remainder stated they wanted the device. The device was sometimes referenced as a "portable ventilator." Of other donated surgical equipment, MOVES SLC was described as "unique." A stabilization modification was suggested as a need given the *ad hoc* vehicles used for en-route critical care. Participants reacted positively to using MOVES SLC and the capabilities and improvements in care that MOVES SLC can provide for en-route care of critically injured patients.

Conclusions:

MOVES SLC is well regarded by Ukrainian trauma care providers. Training may be necessary to increase the quality of care when utilizing these devices, and vehicle modifications may be necessary for use given some concerns over the equipment falling during transport. There is a need to study how this equipment improves the ability of limited medical personnel to provide prolonged care for a larger number of patients with reduced medical resupply.

INTRODUCTION

The Russian Federation invasion of Ukraine in February 2022 stressed the Ukrainian health system and provided opportunities for novel improvements.[1,2] Before the invasion, the Ukrainian health system was undergoing reforms to improve care despite significant financial constraints.[1,2] The current conflict has led to an ongoing loss of personnel and infrastructure because of indiscriminate attacks targeting health care facilities. The 1,409 attacks on health facilities as of March 2024 resulted in 118 health care providers killed, 253 providers injured, and overall degradation of the health care infrastructure.[1] Ongoing evacuation of medical personnel to Western Ukraine or abroad has reduced the health care workforce in locations with increasing care needs.[3] The many medical personnel who remain in the East face the challenge of providing care to a large number of wounded patients with limited equipment and fewer personnel.[4,5] To date, it is estimated that 31,000 Ukrainian military members have been

[1]Center for Health Services Research, Uniformed Services University, Bethesda, MD 20814-4799, USA

[2]Henry M. Jackson Foundation for the Advancement of Military Medicine, Inc., Bethesda, MD 20817, USA

[3]Department of Surgery, University of Alabama at Birmingham, Birmingham, AL 35294, USA

[4]Lviv National Medical University, Lviv 79010, Ukraine

Corresponding author: Lynn Lieberman Lawry, MD, MSPH, MSc (lynn.lawry@usuhs.edu).

doi:https://doi.org/10.1093/milmed/usae440

killed since the invasion in 2021.[6] Therefore, maximal reliability and efficiency is required of all resources to meet the demands of care.

The number and extent of injuries experienced in Ukraine because of trench warfare and high-intensity large-scale combat operations (LSCOs) has not been seen in recent conflicts. Estimates show that more than 70% of injuries are polytrauma impacting multiple organ systems.[7] Patient survival from such injuries depends on high-quality, efficient, and reliable prehospital care. A resounding theme of studies assessing the Ukrainian trauma system during the conflict is the need for robust prehospital care.[8,9] Increasing trauma care capacity through lessons learned and Ukrainian training are paramount in guiding aid efforts.

A major challenge in providing early trauma care is maximizing the capabilities of the Roles 1 and 2 medical personnel. The current battlefield environment in Ukraine lacks the ability to get wounded to stabilization points. Aeromedical evacuation is not possible because of contested airspace and ground movement is constrained because of targeting of medical personnel and drone surveillance.[1,7] As a result, forward medical personnel are resorting to prolonged field care requiring efficient, resilient, and easy-to-operate medical equipment.[8,10] Developed to meet the U.S. DoD needs and specification for a portable patient life support system that was lighter, smaller, with a decreased reliance on oxygen tanks, Thornhill Medical integrated several critical care capabilities, creating the MOVES (monitor, oxygen concentrator, ventilator, and suction system) platform, deployed by the U.S. Marine Corps in 2014.[11]

The next-generation technology, MOVES SLC, is a U.S. FDA, Conformity European and Health Canada approved compact, rugged, portable, and battery-operated integrated vital signs monitor, oxygen concentrator, ventilator, and suction system weighing 40 pounds.[11] This allows for prolonged field care with reduced cube, weight, power demands, or the need for oxygen tanks[12] (Figure 1). Modernizing in 2023, the U.S. Marines utilize the MOVES SLC to transport patients from Role 2 to Role 3 care, as part of the Authorized Medical Allowance List (AMAL) 647 for En Route Care.[12] The MOVES SLC system was also recently deployed by the U.S. Navy and is used by others around the world for emergency, disaster relief and combat needs.[13] In support for Ukraine, Thornhill Medical donated multiple units to support prehospital care in the conflict zone.[14] To improve the quality of trauma care, the Government of Canada with Non-Governmental Organization partners also donated the life-support system equipment known as MOVES SLC to Ukraine.[15,16]

This current manuscript emerged from a larger assessment of the health and trauma system in Ukraine following the full-scale invasion by the Russian Federation since the start of the war in February 2022 and developed an understanding of the current situation to inform current and future medical operations and support for Ukraine, the United States, and NATO. During this larger assessment, there was an organic yet universal inclusion of the MOVES SLC product that demanded immediate dissemination. Understanding attitudes and perceptions around the use of devices and products including MOVES SLC and its use in the LSCO environment can inform lessons learned for improved prehospital care in Ukraine, as well as in other future conflicts.

METHODS

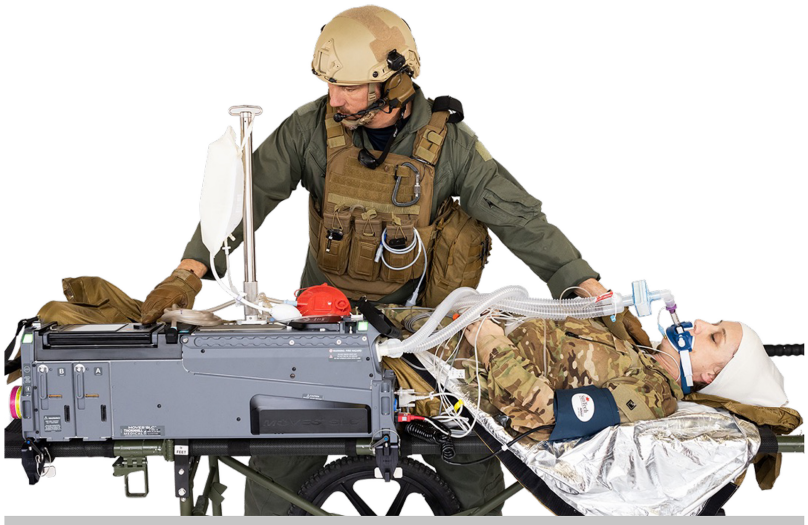
Study Design and Participants

We conducted a qualitative study composed of semi-structured, in-depth key informant interviews of Ukrainians working in the health and trauma system of Ukraine during the current conflict to obtain detailed descriptions of their experiences and needs related to Ukraine's trauma care system. Participants were from all regions of Ukraine.

Participants were included if they were health care or health care-adjacent (those who work within the trauma system but are not clinical, for example administrators or logisticians) personnel who were currently working in some capacity supporting health and trauma care in Ukraine across applicable NATO levels of care.[6] These include small unit/prehospital/Role 1, Role 2/small aid clinic (no surgical care), Role 2+ (limited surgical care), Role 3 (District hospital, some specialty care), and Role 4 (Academic hospital, specialty care, rehabilitation). Individuals who did not work in a health care or health care-adjacent capacity during the current conflict were excluded. Participants were recruited from trauma and combat casualty care-related themed symposia and the Advanced Surgical Skills for Exposure in Trauma (ASSET) training events held from June 2023 to February 2024 in Warsaw, Poland. At these events, participants were recruited for participation via purposive and snow-ball sampling methods and attended either an in-person or virtual interview.

Instrument

We adapted the Global Trauma System Evaluation Tool (G-TSET) developed by military and civilian trauma specialists as an assessment tool for use in low- and middle-income countries.[17] The adapted Ukraine Trauma System Assessment Tool (TSAT) evaluates trauma systems by assessing the functional capacity of domains, including leadership and organization, prevention of injuries, access to injury care, initial injury care, acute injury care, rehabilitation, education, research, and quality improvement. The first component of the TSAT collects quantitative demographic information including the date of the interview, study region, subject interview ID number, affiliation (military or civilian), position title and description, rank, and service if military, organizational affiliation, time in current position, and experience with trauma. The remainder of the tool collects qualitative data from participants in different domains of the trauma system (**Table 1**, Supplementary Figure S1). The semi-structured directed qualitative instruments were developed in cooperation with the consortium



MOVES® SLC™ combines an oxygen concentrator, a unique O2 conserving ventilator, suction and complete vital signs monitoring in a lightweight, compact, rugged, portable, battery-powered unit without the need for heavy, dangerous oxygen tanks. The image represents a simulated scenario.

Figure 1. Simulated Scenario of MOVES SLC for Casualty Care

involved in this study and its stakeholders. These interviews provided an in-depth understanding of the complicated health and trauma system as understood by individuals working in Ukraine's health and trauma system during the current conflict. The instrument was written in English and translated to Ukrainian to account for culturally sensitive wording while holding true to the intent of the instrument. The Ukrainian version was back translated for consistency and correctness, reviewed for content validity, and pretested among 6 health care workers. Changes were made to establish clarity of questions and cultural appropriateness.

Procedures

Invitations for symposia and ASSET training events were sent to participants via email based on existing relationships through volunteer work and recommendations from the Ukrainian Ministry of Health and Ministry of Defence. Interviews ($n = 36$) were conducted in Warsaw, Poland, from September 28 to February 28, 2024, in a setting that offered privacy and confidentiality. Two researchers and a translator conducted interviews. One researcher asked questions in English and the discussion was translated to Ukrainian if necessary. Another researcher took digital notes using the KoboToolBox platform. Probes were used to gather as much details as possible along the TSAT domains. A subset of interviews occurred virtually over Zoom using the same methodology as used for in-person interviews because of scheduling issues or travel changes. The sample size was determined by saturation (where no new themes emerge from further interviewing), which was reached at 36 interviews.

Table 1. Domains of the Ukraine Trauma System Assessment Tool (TSAT)

Leadership/Command and Control	Critical Care in Definitive Care Facilities
Planning and Coordination	Telemedicine in Definitive Care Facilities
Resource Assessment	Injury Patterns in Definitive Care Facilities
Logistics and Supply	Blood Product Use in Definitive Care Facilities
Communications	Disease and Non-Battle Injuries (DNBI) in Definitive Care Facilities
Mass Casualty Plan	Mental Health
Logistics and Supply	Rehabilitation
System Triage and Patient Transfer	Injury Registry, Epidemiology, and Process Improvement
Prehospital Care/Emergency Medical Services	Technology/Products/Devices
Prehospital Chemical, Biological, Radiological, Nuclear, and Explosives	Injury Prevention
Prehospital Training	Environmental Factors and Dental Trauma
Prehospital Training Definitive Care Facilities	Summation Questions

Data Analysis

Deductive thematic content analysis was used to identify patterns or themes in the data and was guided by the assessment objectives and research questions using NVivo and open coding techniques.[17] We used the G-TSET tool as our framework for analyzing the TSAT to identify patterns that we expected

to see in the data.[18] Any new patterns were identified and recorded through open coding where themes are identified as they are found in the data. NVivo was used to organize the data and pull-out themes identified. The research team then manually summarized, categorized, and compared interview data and NVivo results to identify common themes from transcribed documents, including expected themes from the G-TSET tool and any new themes. For the purposes of this analysis, emphasis was placed on the utility of lifesaving equipment that has now been tested. We also focused the analysis on sections within these data in which specific questions were asked of devices and then the broader data searched using specific key terms related to MOVES SLC such as "ventilator" or "portable ventilator." Research team members selected and agreed upon illustrative quotes for each prevailing theme identified to limit any biases, subjectivity, assumptions, and experiences that may shape the research process and outcomes.

RESULTS

Demographics

Between June 2023 and February 2024, 36 civilian and military health care or health care-adjacent participants were interviewed, including 22 (61%) males and 13 (36%) females (missing $n = 1$). Participants were between the age of 28 and 55 years (mean; 34.9 years) (**Table 2**). Most of the participants worked in Eastern and Northern areas of Ukraine. The study was able to obtain experience from across all NATO roles. Of those in the military who reported rank, 60% were officers. Participants were mostly from the Ukraine Ministry of Defence or Ministry of Health.

Table 2. Demographics of Study Participants

Age, years; mean (range)	**34.9 (28–55)**
Region, *n* (%)	
Southern	4 (11.1)
Eastern	13 (36.1)
Western	4 (11.1)
Northern	13 (36.1)
Missing	2 (5.6)
Sex, *n* (%)	
Male	22 (61.1)
Female	13 (36.1)
Missing	1 (2.8)
Occupation, *n* (%)	
Trauma Surgeon	5 (13.9)
Physician	5 (13.9)
Chief of Medicine	3 (8.3)
Nurse	3 (8.3)
Anesthesiologist	3 (8.3)
Director, Emergency Services	2 (5.6)
Researcher	2 (5.6)
Medic	1 (2.8)
Chief, Rehabilitation	1 (2.8)
Commander, Role 2	1 (2.8)
Mental Health Services Associate	1 (2.8)
Head, Moral Psychological Service Branch Combat Stress Control Group	1 (2.8)
Deputy Director, Health Care Innovations	1 (2.8)
Deputy Director, Health Development Department	1 (2.8)
Other[a]	4 (11.1)
Missing	2 (5.6)
NATO role equivalent, *n* (%)	
Prehospital/Role 1	4 (11.1)
Role 2	3 (8.3)
Role 2+	7 (19.4)
Role 3	7 (19.4)
Role 4	4 (11.1)
Other	6 (16.7)
Missing	5 (13.9)
Civilian/military provider, *n* (%)	
Military	20 (55.6)
Civilian	16 (44.4)
Military rank, *n* (%) ($n = 20$)	
Major	1 (2.8)
Captain	1 (2.8)
Lieutenant	4 (11.1)
Sergeant	4 (11.1)
Missing	10 (27.8)
Organization affiliation, *n* (%)	
Ministry of Defence	17 (47.2)
Ministry of Health	12 (33.3)
Ministry of Interior	1 (2.8)
National Guard	2 (5.6)
Commercial Company	1 (2.8)
Charity	1 (2.8)
Missing	2 (5.6)
Years in current position; mean (range)	4.6 (0.33–19)

[a]Other: Grant Manager, Deputy Director—General, Project Lead—Commercial Company, Sergeant.

Equipment Questions

Several questions were asked about devices and equipment the Ukrainians were using or wanted. The interview guide section headings and actual questions are in **Table 3**. The probes were only read if the respondent had difficulty answering the question.

Use of MOVES SLC Devices

Overall, 67% of clinical providers (12/18) reported using MOVES SLC with the remainder stating they wanted the device. The device was sometimes referenced as a "portable ventilator." One respondent noted that the device had been delivered but they had not been able to use it yet.

> *"…had Thornhill MOVES® SLC™ delivered but have not used it yet, the tool to measure pressure has arrived but we have not used them yet"* (Role 2+ Chief of Medicine located; East)

Another respondent discussed how the MOVES SLC device stood out compared to other surgical equipment that had been donated, as everything else seemed to be standard, but MOVES SLC was unique.

> *"The only thing that I use during this wartime and not before is MOVES® SLC™; Everything else is straightforward surgical equipment"* (Role 2+ Physician; East)

Table 3. Interview Guide Section Headings and Questions Pertaining to MOVES SLC

Technology/products/devices
What other US and/or NATO provided medical devices or products are you using?
What devices work well?
What devices or products do not work well?
What devices do you want?
System triage and patient transfer
What are the barriers to transport and providing en-route care?
Prehospital chemical, biological, radiological, nuclear, and explosives (CBRNE)
Have you had any CBRNE events requiring use of the plan?

Several individuals reported that MOVES SLC and ventilators, in a list of other devices, work well, *"MOVES® SLC™, ultrasound portable, oxygenator, x-ray portable, fridges, Qin-Flow (Don't know where it comes from though). A lot of cool stuff"* (Role 1 Medic; South)

Need for Devices Such as MOVES SLC

When asked what devices they would like, 4 participants specifically mentioned MOVES SLC. Two other participants mentioned oxygen concentrators, which is also a function of MOVES SLC.

> *"… we need improvement of medical devices, like MOVES® SLC™ ventilators"* (Role 3 Chief of Rehabilitation)

Whether or not participants knew about the capabilities of MOVES SLC, many listed them in their lists of desired equipment among other desired devices or supplies. One physician indicated that vehicles need some modifications, so that they do not fall during transport.

> *"…oxygen concentrators, ventilation like anti-fall attached to the car, monitor for medevac, infusion devices for severely injured, tourniquets, and devices for hemorrhage, clamps, system for mobilization of point, stretcher to fix back/neck, truncal tourniquets, hypothermia kits, heater for fluids"* (Role 1 Nurse; East)

Many participants discussed the lack of equipment as a challenge to providing en-route critical care.

> *"…low equipped cars, it's a serious limitation."* (Role 2+ Physician; East)

> *"[en-route evacuation] might not have oxygen, ventilators, [there are] low equipped cars in general with low resources."* (Role 2+ Physician; East)

Another use case for MOVES SLC devices is in terms of chemical, biological, radiological, nuclear, and high-yield explosives events. One respondent discussed a chemical gas event and stated:

> *"They were on their own and did not have enough oxygen to breathe. "MOVES® SLC™ is already demonstrating utility and there are still additional use cases."* (Role 2 Nurse; North)

Overuse of Medical Devices

While none of the participants discussed any challenges with the use of MOVES SLC devices, many discussed overuse of the [new] devices in general.

> *"All new medical devices and consumables (everything) even if it's a good medical device, it [has] gone crazy because of overuse … [including] ventilators, concentrators"* (Civilian Grant Manager of Communications; North)

Training for New Devices

Another participant discussed the challenge of using new devices that they had not been trained to use.

> *"Again, if we take a real nice product and we can use it and we know how it use it…I can say that in many times if we get something new and don't know how to use it for in real time, they don't work. I saw it too many times…if you train people, no problem; if no, they don't work."* (Civilian Director of Emergency Services; North)

Quality of Devices

Multiple participants noted the quality of devices supplied by the United States to be superior from other countries of origin, although MOVES SLC is a Canadian-made device. Despite concerns of overuse, the overwhelming sentiment was positive for use of and need for medical devices. Participants reacted positively to using MOVES SLC and the capabilities and improvements in care that MOVES SLC can provide for en-route care of critically injured patients.

DISCUSSION

The 31,000 Ukrainian military members killed since the most recent Russian Federation invasion support the need for upgraded medical capability, given the need for prolonged field care.[19] Timely evacuation and transfer of patients between facilities impacts the effectiveness of trauma care in Ukraine.[7,20] Out-of-hospital care includes 2 phases, including self-aid and buddy care termed tactical combat casualty care, which is shown to reduce mortality, and a longer phase termed en-route care, which includes care rendered as the casualty is moved from the point-of-injury to surgical capability.[21,22] Initial emergency life-saving surgery and prompt, aggressive resuscitation is happening in Ukraine with much of this happening under austere conditions, albeit often with prolonged evacuation times.[7,23,24]

Improved safety and fewer adverse events are observed during interfacility transfer of critically ill patients with increased vigilance, appropriate equipment, and well-trained personnel.[20] Aeromedical evacuation, which reduces evacuation times, is not feasible in the current contested airspace

of Ukraine.[7,25] Reliance on ground and rail transportation equipped with mobile life-support systems for critical care are necessary. Modified trains equipped to support en-route critical care of combat casualties are a capability not seen at this scale since the Korean conflict.[23] Trains and non-medical vehicles of opportunity are used to transport patients, especially from point-of-injury to Roles 1, 2, and 3. An efficient, resilient, easy-to-use, portable life-support system is critical to supporting these non-traditional patient movement platforms.[8]

This study suggests that these life support systems (e.g., "portable ventilators") are well regarded by Ukrainian providers, especially at Role 2 and Role 2+ facilities, and are one of the most requested devices by the providers interviewed. Furthermore, a universal response, which emerged organically, demonstrating an interest in MOVES SLC is a unique occurrence in qualitative research that rarely happens and deserves immediate dissemination. Some vehicle modifications may be necessary for use given some concerns over the equipment falling during transport. Anecdotally, some other identified limitations of MOVES SLC that were espoused outside of the study included its proprietary nature and the difficulty of resupply for some integral parts. Improved access to appropriate training material for the equipment is necessary based on interview data. Critical care is primarily delivered by physicians in the Ukrainian system. Improved training and enhanced utilization of nurses and "feldsher" (paramedics) in conjunction with integrated life support systems may improve the efficiency of the limited personnel resources available to care for combat wounded.[8] An efficient equipment set combined with integrated personnel, all operating at the top of their credentials, will increase overall access to and quality of care.[7,25]

CONCLUSION

MOVES SLC is well regarded by Ukrainian trauma care providers who were interviewed. Training may be necessary to increase the quality of care when utilizing these devices, and vehicle modifications may be necessary for use, given some concerns over the equipment falling during transport. There is a need to study how this equipment improves the ability of limited medical personnel to provide prolonged care for a larger number of patients with reduced medical resupply. Future research is required to determine the strengths, limitations, and capabilities of products and devices, including MOVES SLC for its use in Ukraine and for future LSCOs.

Limitations

Not all the respondents mentioned MOVES SLC; therefore, for the few interviewers who used the probes, it is unlikely the probes influenced or biased the responses. Respondents' perspectives are limited to their location and the timeframe of June 2023 to February 2024. As a qualitative study, these data represent those interviewed and cannot be generalized to all trauma care providers in Ukraine. The study volunteers interviewed represent their experiences in conflict-related trauma. This study does not represent views of non-conflict trauma systems. Interviewers were careful to explain that there would be no material gain by participation in the study; however, respondents may have underestimated or exaggerated responses if they thought it would be in their interest to do so.

ACKNOWLEDGMENTS

This study would not be possible without the assistance of Aspen Medical, Frederick Gerber, Terry Rausch Jr., Warren Dorlac MD, Sraddha Fonseka, and Karen Davis, from the Henry M. Jackson Foundation for the Advancement of Military Medicine. The authors express gratitude to Vivitha Mani for serving as a scribe for interviews and Kateryna Radchenko, Olena Vdovychenko, and Zlata Fedorova for assisting in the search of Ukrainian language references relevant to the trauma system since the start of the conflict. The authors would also like to express their deepest gratitude to the interpreters who assisted in the execution of the key informant interviews, and most importantly, the Ukrainian volunteers for their time and candid discussions without which this study would not be able to provide the positive impact on improving trauma and combat casualty care on the Ukraine and future modern battlefields.

SUPPLEMENTARY MATERIAL

Supplementary material is available at *Military Medicine* online.

FUNDING

This study was funded by the DoD, Defense Health Agency, Grant # HT942523P0013. The funding agency played no role in the design, analysis, or interpretation of findings.

CONFLICT OF INTEREST STATEMENT

Dr. John B. Holcomb has the following disclosures. He was paid consultant on the Thornhill Military Advisory Council from March to November of 2022. He is a co-founder and on the Board of Directors of Decisio Health, on the Board of Directors of QinFlow, CCJ Medical and Zibrio, a Co-inventor of the Junctional Emergency Tourniquet Tool, receives royalties from UT Health, and a consultant to Aspen Medical and the Wake Forest Institute of Regenerative Medicine. The remaining authors have no conflicts of interest.

DATA AVAILABILITY

Data that support these findings are curated by the study team and are not available for public distribution.

INSTITUTIONAL REVIEW BOARD (HUMAN SUBJECTS)

Ethical approval for this study was granted through the WIRB-Copernicus Group (23-17597) and the Ethics Committee, First Territorial Medical Unit of Lviv. All participants provided consent before participation. The study objectives and voluntary nature of the study were explained to participants. "All methods were carried out in accordance with relevant guidelines and regulations." Oral rather than written consent was approved by the IRBs because of the need for this information to remain confidential. Confidentiality was assured by using a numerical code for each interview to deidentify transcripts.

INSTITUTIONAL ANIMAL CARE AND USE COMMITTEE

Not applicable.

INSTITUTIONAL CLEARANCE

Institutional clearance approved.

INDIVIDUAL AUTHOR CONTRIBUTION STATEMENT

L.L.L., T.E.H., and T.P.K. designed the study. The instruments were adapted by L.L.L., T.E.H., J.M., J.B.H., and T.P.K. Interviews were completed by L.J., M.J., J.K.B., L.L.L., T.P.K., J.M., and J.B.H. L.J., M.J., J.K.B., and L.L.L. completed data analysis. All authors contributed to writing and/or editing of the manuscript and have reviewed the final version before submission.

REFERENCES

1. World Health Organization. Physicians for human rights. Destruction and devastation: one year of Russia's assault on Ukraine's health care system. Surveillance System for Attacks on Health Care (SSA): Ukraine. February 21, 2023. Accessed November 3, 2023. https://extranet.who.int/ssa/Index.aspx
2. Haque U, Naeem A, Wang S, et al. The human toll and humanitarian crisis of the Russia-Ukraine war: the first 162 days. *BMJ Glob Health*. 2022;7(9):e009550. 10.1136/bmjgh-2022-009550
3. Blogs BG. The impact of the war on the healthcare system in Ukraine. BMJ Global Health blog. Accessed August 9, 2022. https://blogs.bmj.com/bmjgh/2022/08/09/the-impact-of-the-war-on-the-healthcare-system-in-Ukraine/
4. ReliefWeb. Continuity of Essential Health Services during the war in Ukraine (2022–2023) - assessment results - Ukraine. Accessed October 12, 2023. https://reliefweb.int/report/Ukraine/continuity-essential-health-services-during-war-Ukraine-2022-2023-assessment-results
5. The Lancet. Russia's invasion of Ukraine: an attack on health. *Lancet*. 2023;401(10377):617. 10.1016/S0140-6736(23)00387-2
6. ATO Role Definition from the NATO Logistics Handbook. Chapter 16 Medical Support. Accessed January 4, 2024. www.nato.int/docu/logi-en/1997/lo-1610.htm
7. Epstein A, Lim R, Johannigman J, et al. Putting medical boots on the ground: lessons from the war in Ukraine and applications for future conflict with near-peer adversaries. *J Am Coll Surg*. 2023;237(2):364–73. 10.1097/XCS.0000000000000707
8. Lawry LL, Korona-Bailey J, Juman L, et al. A qualitative assessment of Ukraine's trauma system during the Russian conflict: experiences of volunteer healthcare providers. *Confl Health*. 2024;18(1):10. 10.1186/s13031-024-00570-z
9. Quinn J, Panasenko SI, Leshchenko Y, et al. Prehospital lessons from the war in Ukraine: damage control resuscitation and surgery experiences from point of injury to role 2. *Mil Med*. 2024;189(1-2):17–29. 10.1093/milmed/usad253
10. Lesperance RN, Adamson S, Gurney JM. Lessons learned during prolonged care of combat casualties by a minimally manned surgical team. *Mil Med*. 2021;188(7-8):usab299. 10.1093/milmed/usab299
11. Peterson LCD. Corpsmen test new moves. Marine Corps Systems Command. 2014. Accessed January 17, 2024. https://www.marcorsyscom.marines.mil/News/News-Article-Display/Article/509591/corpsmen-test-new-moves/
12. Thornhill Medical. Medical technology innovator thornhill medical's MOVES® SLC™ is acquired for United States marine corps en route care modernization and added to Authorized Medical Allowance List (AMAL) 647. 2023. Accessed December 6, 2023. https://thornhillmedical.com/moves-slc-is-acquired-for-united-states-marine-corps/
13. Michael@clear-med.com. November 17, 2023: Moves® SLCTM deployed as part of US Navy's first EN-route care system. Thornhill Medical. Accessed January 25, 2024. https://thornhillmedical.com/moves-slc-deployed-as-part-of-us-navys-first-en-route-care-system/
14. Lemo. When Breathing Sciences lead to a mobile life-support device. IEEE Spectrum, 2023. Accessed January 4, 2024. https://spectrum.ieee.org/portable-life-support-device?utm_campaign=post-teaser&utm_content=c6ul0cyt
15. Michael@clear-med.com. August 2, 2023: Canada-Ukraine Foundation delivers 100 Moves® SLCTM life-support systems to Ukraine. Thornhill Medical, 2023. Accessed February 13, 2024. https://thornhillmedical.com/canada-Ukraine-foundation-delivers-100-moves-slc-life-support-systems-to-Ukraine/
16. Maple Hope Foundation. Delivery of 30 MOVES® SLC™ Life-Support Systems to Ukraine. Accessed January 4, 2024. https://www.maplehopefoundation.org/projects/delivery-of-30-moves-slc-life-support-systems-to-Ukraine/
17. Remick KN, Wong EG, Chuot Chep C, et al. Development of a novel global trauma system evaluation tool and initial results of implementation in the Republic of South Sudan. *Injury*. 2014;45(11):1731–5. 10.1016/j.injury.2014.08.004
18. Braun V, Clarke V. Using thematic analysis in psychology. *Qual Res Psychol*. 2006;3(2):77–101. 10.1191/1478088706qp063oa
19. AP News. 31,000 Ukrainian troops killed since the start of Russia's full-scale invasion, Zelenskyy says. AP News, 2024. Accessed March 25, 2024. https://apnews.com/article/Ukraine-troops-killed-zelenskyy-675f53437aaf56a4d990736e85af57c4
20. Waydhas C, Schneck G, Duswald K. Deterioration of respiratory function after intra-hospital transport of critically ill surgical patients. *Intensive Care Med*. 1995;21(784):789. 10.1007/BF01700959
21. Morrison JJ, Oh J, DuBose JJ, et al. En-route care capability from point of injury impacts mortality after severe wartime injury. *Ann Surg*. 2013;257(2):330–4. 10.1097/SLA.0b013e31827eefcf
22. Kotwal R, Montgomery H, Kotwal B. Eliminating preventable death on the battlefield. *Arch Surg*. 2011;146(12):1350–8. 10.1001/archsurg.2011.213
23. Walravens S, Zharkova A, De Weggheleire A, et al. Characteristics of medical evacuation by train in Ukraine, 2022. *JAMA Netw Open*. 2023;6(6):e2319726. 10.1001/jamanetworkopen.2023.19726
24. Holcomb JB, Dorlac WC, Drew BG, et al. Rethinking limb tourniquet conversion in the prehospital environment. *J Trauma Acute Care Surg*. 2023;95(6):e54–60. 10.1097/TA.0000000000004134
25. Saleh O, Ro G, Gaievskyi S, Habicht J, Clarinval C. Emergency medical services in Ukraine: current capacities and opportunities for future development. World Health Organization, Regional Office for Europe. 2020. Accessed November 2, 2023. https://iris.who.int/handle/10665/358904?locale-attribute=ru&show=full

Military Medicine, 00, 0/0:1, 2024, doi:https://doi.org/10.1093/milmed/usae440, Brief Report