



Mobile Integrated Life Support and Oxygen Delivery System:

MOVES[®]SLC[™]

Ukraine's War Experience

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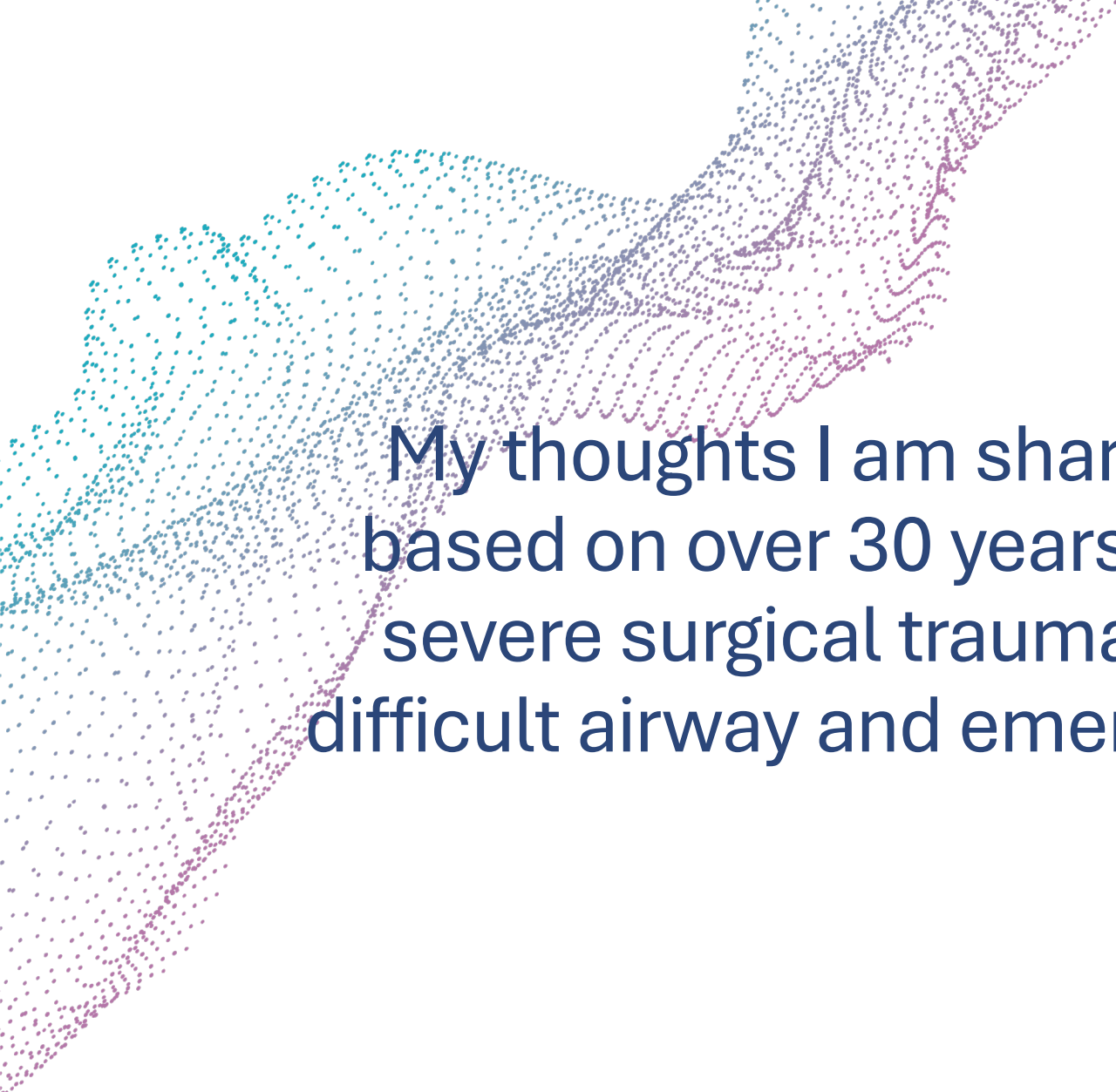
Disclaimers and COI

- I am an original creator of the MOVES concept and one of main designers of MOVES 300 and MOVES SLC.
- I am one of the Directors of Thornhill Medical
- Views and opinions presented here are my own with no legal binding on either University Health Network, where I practice as transplant and cardiothoracic anesthesiologist, or Thornhill Medical.



To Discuss Today

- Brief context as to why high concentration oxygen is important for casualty care
- How MOVES SLC is enabling oxygen delivery for top level and timely care to patients with trauma or injury during staging surgery or prolonged en-route care, based on experiences in the current Ukraine conflict.



My thoughts I am sharing with you today are based on over 30 years of managing the most severe surgical trauma cases, with the most difficult airway and emergency airway protocols.

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Oxygen is a huge part of trauma care, but only a PART

- Oxygen must be a part of an “operational cockpit”
- It is there when you need it, but you do not see it
- Worrying about oxygen supply must not interrupt your operational capability
- More resources and cube and weight is spent on oxygen logistics, less mobility and less resources available for surgical and medical supplies – it is a “**zero-sum game**”

This is my cockpit, and I do my daily job (on an appendix or ruptured aorta) equally well

This is his cockpit, and he can do his job on routine sortie or most dangerous mission equally well

DO you see ANY oxygen tanks me or him need to carry? It is all included.



Oxygen runs out – my patient dies or get injured



Oxygen runs out – he and warfighters die or get injured

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This is not conducive to effective, high level medical care.



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Availability of unlimited oxygen in high inspired concentrations IS IMPORTANT for three reasons

① TIME is always of the essence (**Blood loss**)

1. As blood trickles away, the heart gets **EMPTY** and cannot pump and blood pressure drops /shock /**death**.
2. To keep a patient alive, one **MUST** fill blood vessels up with whatever you have available (blood if you have it, or crystalloid), while trying to stop bleeding.
3. Once you dilute to hemoglobin of 4.5 or 5.0 g/dL, if you give close to 100% O₂, it will restore up to 30% of his oxygen delivery to vital organs, his heart rate/pressure will more normalize, it is estimated by some to be equivalent of 2 units of red cells.

Anesth Analg. 2010, Dai et al; Anesthesiology, 2011, Feiner et al; High Oxygen Partial Pressure Decreases Anemia-Induced Heart Rate Increase Equivalent to Transfusion

② TIME is always of the essence (**Airway/Asphyxia**)

1. As patient cannot breathe because of a) Mechanical obstruction due to trauma, or b) severe head injury and resulting coma:
2. To keep the patient alive, you **MUST** give enough Oxygen to live or he/she will suffer cardiac arrest within 7 minutes or so (can't intubate/can't ventilate scenario).
3. If you can't give him full breaths, a very small amount of gas you squeeze into his lungs will keep him alive **ONLY IF** you use high inspired O₂.
4. High CO₂ DOES NOT kill people, Lack of Oxygen ALWAYS DOES!
5. It is estimated airway compromise and its unsuccessful management was the **SECOND LEADING CAUSE** of potentially PREVENTABLE Death before reaching a Role 2 facility for combatants in Afghanistan*.
6. One has to wonder, whether results would be better if skills of airway management and high concentration O₂ were more commonly available closer to site of injury.

* Military Medicine, 2020, Hudson et al.

③ TIME is always of the essence (**Surgery/Anesthesia**)

1. Every anesthetic and surgery done in Role 2 is done for only ONE REASON:
 - Impending loss of life or limb
 - Hemodynamic or respiratory instability caused by severe trauma
2. **EVERY TIME** you put a patient in anesthetic coma, you inject a lethal cocktail and take over control of the patient's vital functions (who is already unstable and potentially with blood in airway or lung/chest penetrating injury)
3. Preoxygenation with high concentration of O₂ is absolutely vital because IT BUYS YOU TIME.
4. Instead of 1-2 minutes, you can have up to 7 minutes to manage his/her airways before catastrophic hypoxia or death ensues.



Bottom line : one needs high inspired O2 availability
for daily use in the trauma casualty care



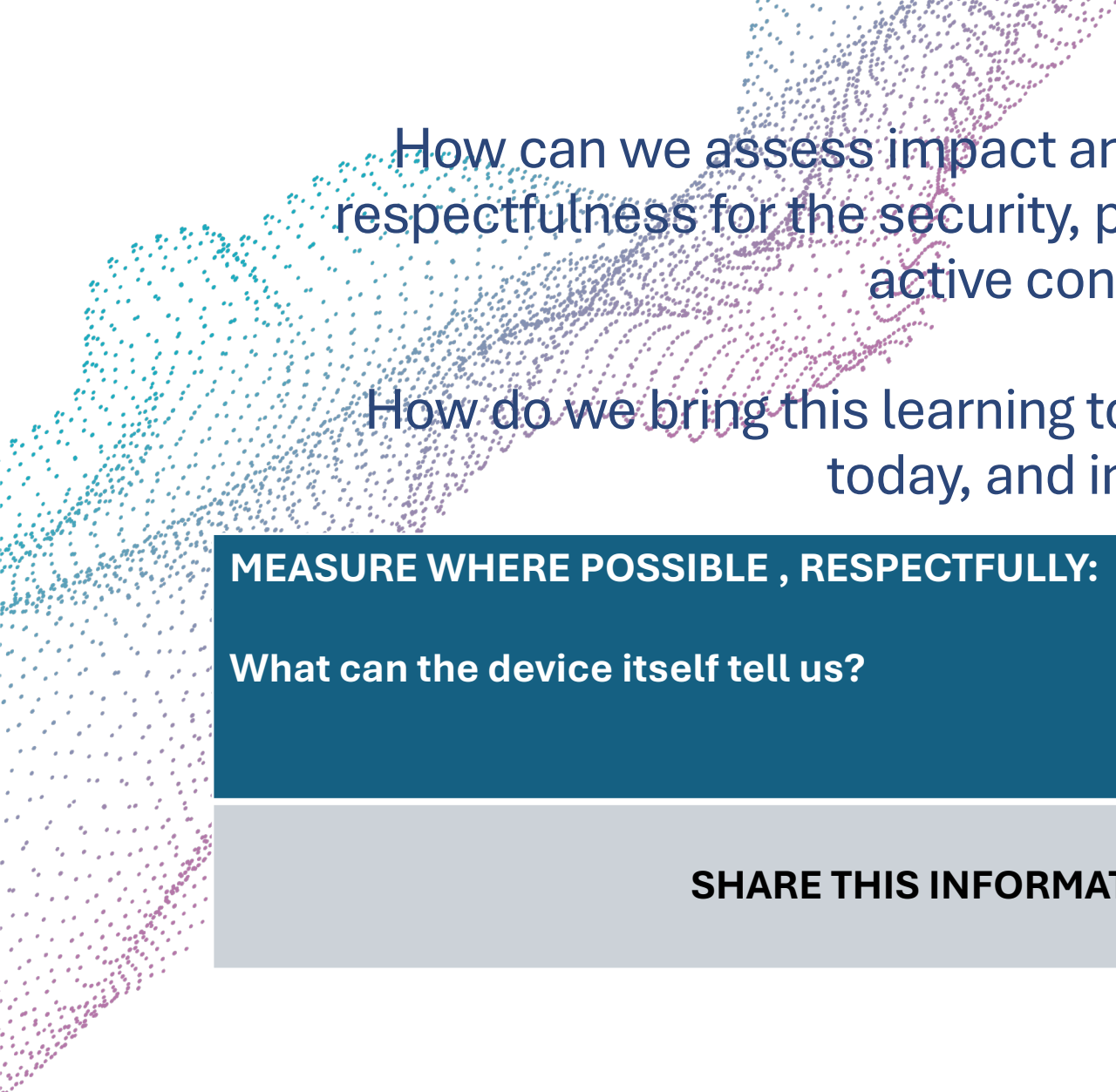
Mobile Integrated Life Support and Oxygen Delivery System:

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Ukraine's War Experience

180 MOVES SLC units are currently deployed in Ukraine's large scale combat operation, for en-route care and level 2 staging surgeries / stabilization points.

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How can we assess impact and effectiveness – with utmost respectfulness for the security, privacy and sensitive nature of an active conflict zone?

How do we bring this learning to others to help save more lives today, and in the future?

MEASURE WHERE POSSIBLE , RESPECTFULLY:

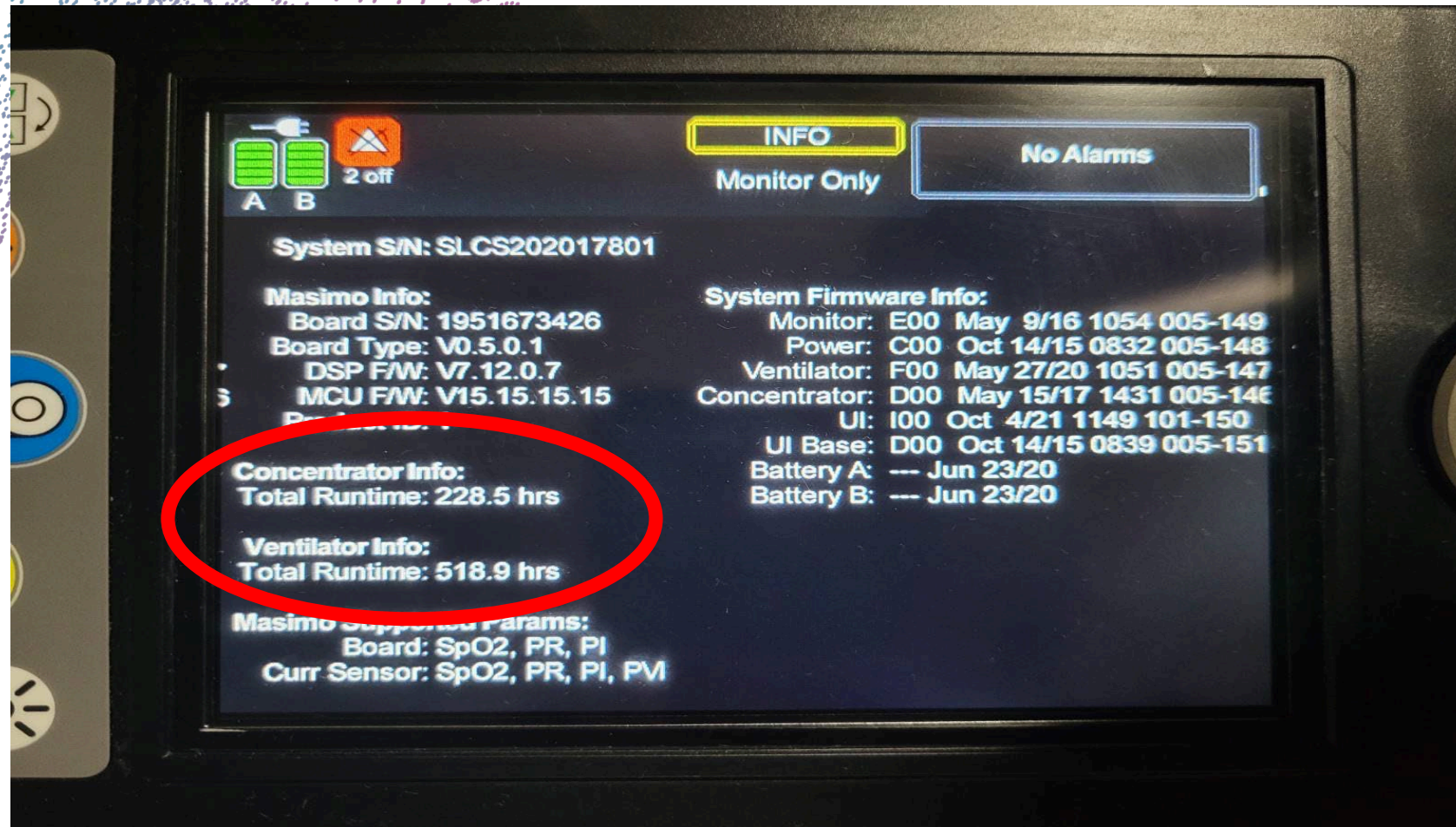
What can the device itself tell us?

LISTEN AND LEARN:

Testimonials, Feedback, Images, Videos. Case reports


SHARE THIS INFORMATION AT VENUES LIKE THIS

What can the device itself tell us? Each has an Info Screen.



Analyzing data from 5 MOVES SLC Info Screens: Stabilization Points and Train Evacuation.

	# of hours of ventilation	# of hours of oxygen concentration	Litres of oxygen produced by MOVES SLC	Equivalent Litres of oxygen: open circuit ventilator	Equivalent D cylinders (in open circuit)/hr vent at 6L/min	Weight of full D-cylinder at 6.9 pounds
MOVES SLC #1	94.9	87.4	13,110	34,164	95	656
MOVES SLC #2	268.1	156.9	23,535	96,516	268	1849
MOVES SLC #3	106.5	68.6	10,290	38,340	106	731
MOVES SLC #4	518.9	228.5	34,275	186,804	518	3574
MOVES SLC #5	131.7	76.5	11,475	47,412	132	911
TOTAL	1120.1	617.90	92,685	403,236	1,229	7,721



In a random sample of info screens of just 5 (five) MOVES SLC in operation in Ukraine, MOVES SLC delivered **400,000 liters of oxygen.**

- Just these 5 MOVES SLC eliminated 1,229 D-Cylinders of Oxygen, weighing about 7,700 pounds (about 3.5 tonnes). **No need to:**
 - Acquire or produce this oxygen
 - Trans-fill to high pressure cylinders via about 1.2 Million hours of POG assuming 30 units in operation
 - Transport and distribute to forward services
 - Distribute to various, rapidly changing locations with no safe routes of delivery
 - Carry compressed oxygen under fire
 - Worry that your patient will not have oxygen to survive long-distance transport

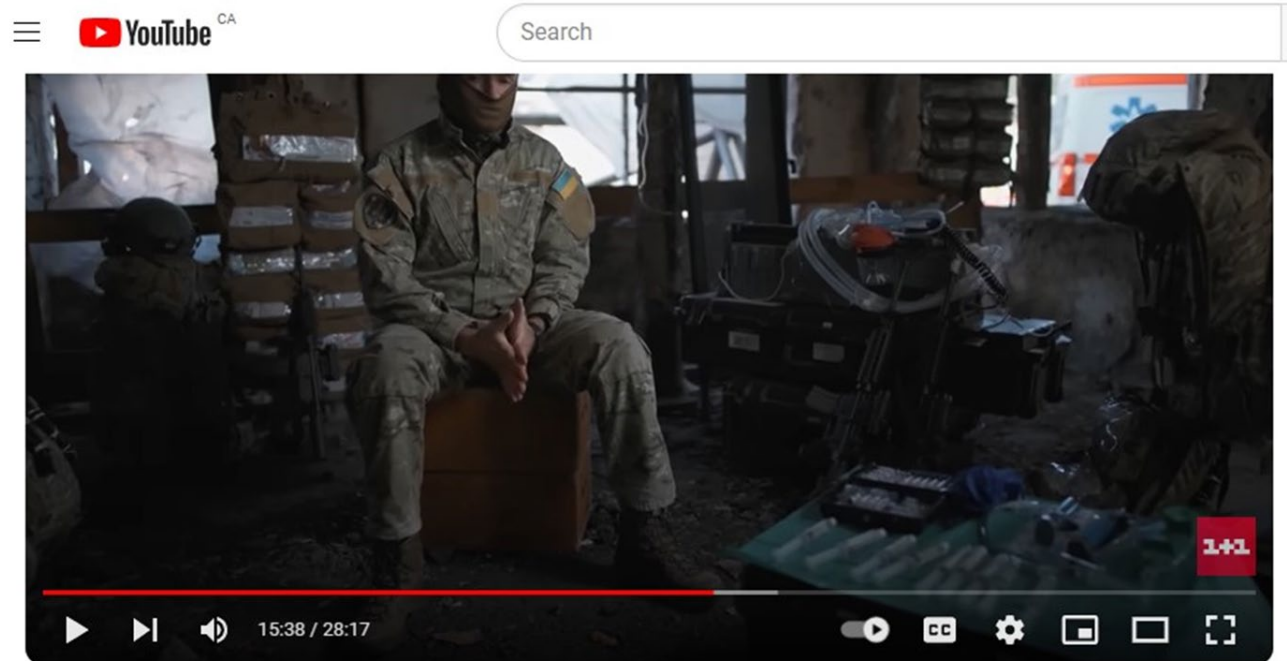
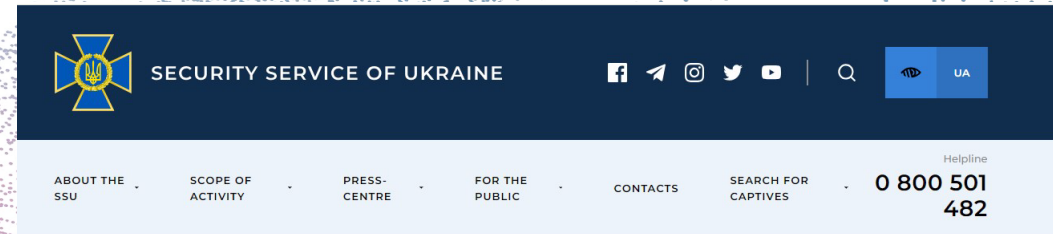
Now contemplate the full impact: There are 180 units deployed over 600 miles of the front line and evacuation routes in this active conflict zone with hundreds of wounded every day.



MOVES SLC becomes “drop-and-forget” from an oxygen logistics point of view .

The cube and weight savings significantly decrease the logistics burden and change the game to create mobile, agile and self-sufficient front line teams.

Ukraine: On the Front Line. Dec 2023. Security Services of Ukraine.



Бойові медики. Смерть зачекає – СБУ. Спецоперації перемоги. Фільм 4



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Дивіться четвертий фільм з циклу документальних фільмів "СБУ. Спецоперації перемоги" про унікальне медичне бойове крило ЦСО "А", де хірурги спецпідрозділу СБУ щодня героїчно рятують життя українських захисників.

Contacts of the Press-Centre

SSU medics save Ukrainian defenders' lives in hottest spots of war –Vasyl Maliuk

NEWS

PHOTO GALLERY

21:50, 15 December 2023

Vasyl Maliuk

Center of Special Operations "A"

State security

Protecting Ukraine together

VIDEO GALLERY

“Selected equipment is of extremely small size, moreover, part of the equipment can be called “combines”, it’s when one device combines two, three or even five pieces of equipment.”

“Narkoz” anesthesiologist in the Center for Special Operations “A” at Security Service of Ukraine

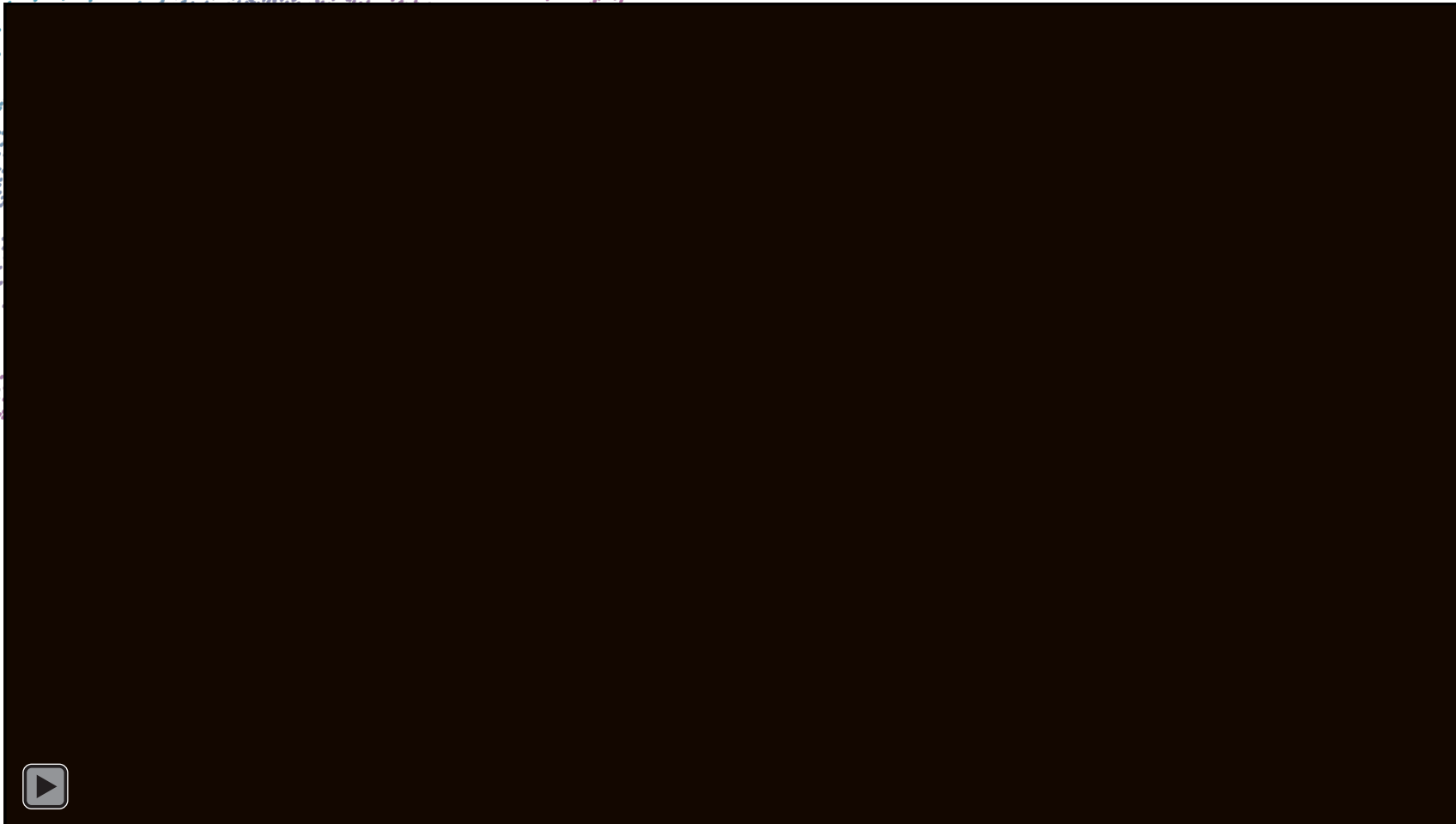
WATCH HERE:

<https://youtu.be/wgVTatU4oKc?si=tfqohXMhc9JY7487>

The appearance of visual information does not imply or constitute endorsement.

In Ukraine: bring the operating room with you in 3 backpacks and MOVES SLC

<https://www.youtube.com/watch?v=wgVTatU4oKc&rco=1>

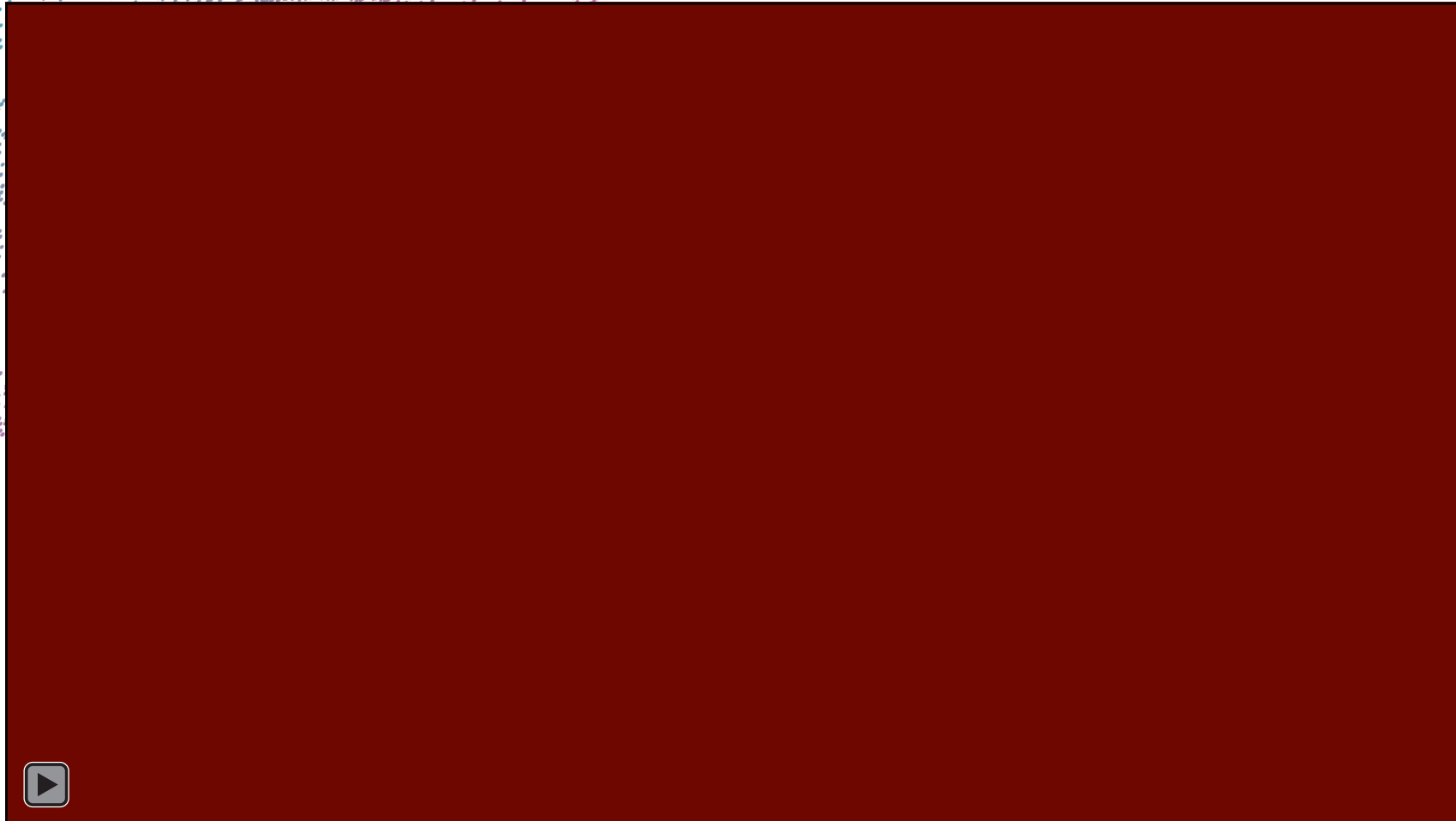


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MOVES SLC Comprehensiveness, lack of need for oxygen and one electrical socket instead of five matters in austere environments

<https://www.youtube.com/watch?v=wgVTatU4oKc&rco=1>

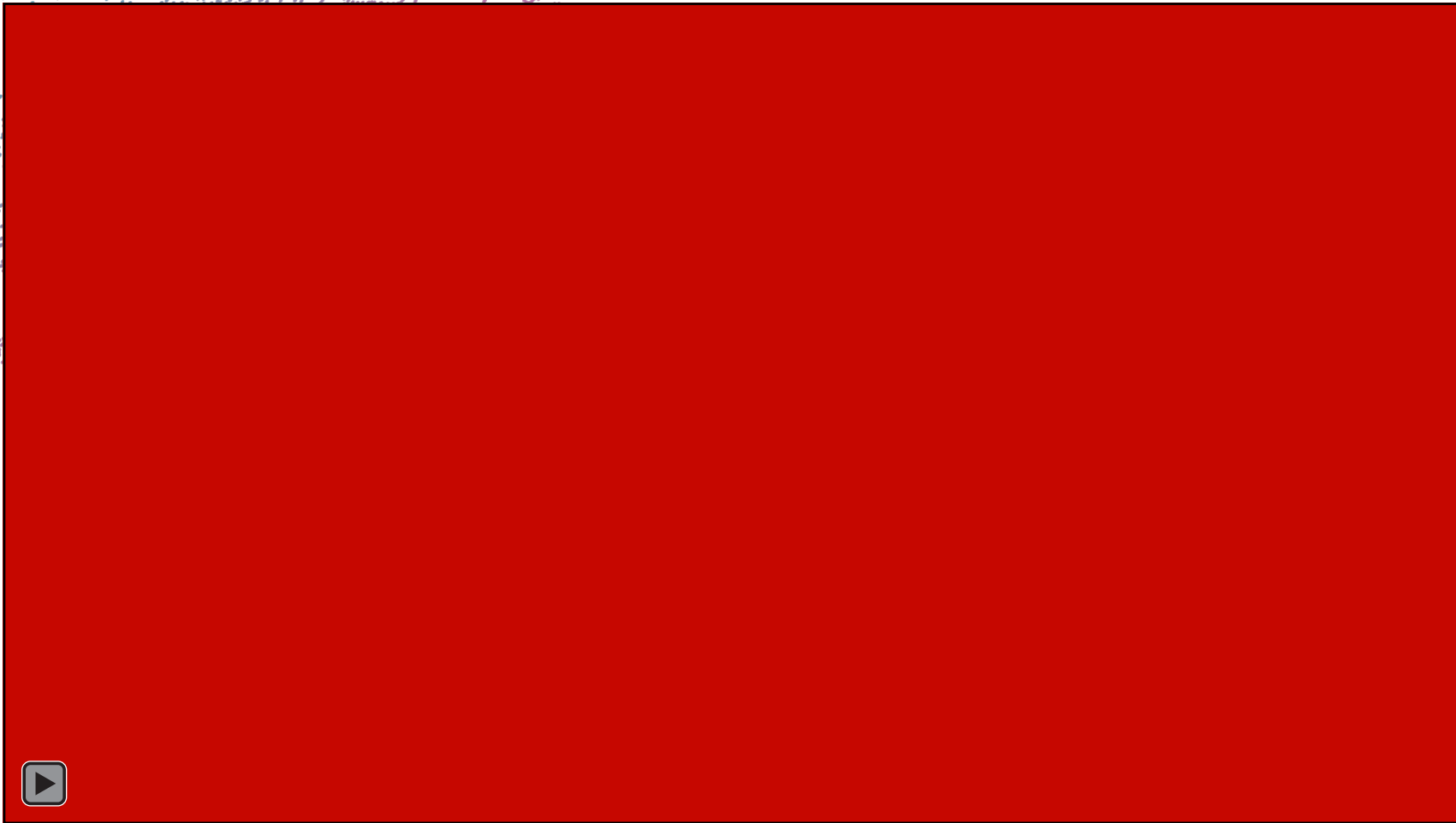


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MOVES SLC has been routinely used for staging surgery

<https://www.youtube.com/watch?v=wgVTatU4oKc&rco=1>



Feedback from an anesthesiologist:

“I will say one thing: the presence of MOVES SLC, defibrillator and syringe pump, whether in a dugout, basement, non-adapted premises, civilian car, armored vehicle, turns that place into a full-fledged, hardware-equipped operating room or resuscitation vehicle:

They (MOVES) have proved to be 200% effective and have already saved many of our soldiers along the entire contact line with the invader.

1. The stabilization center.....has been in operation for over a year and a half. The hardwareat our point meets the standards of an "emergency room" with some military peculiarities

Feedback from an anesthesiologist:

3. Thanks to MOVES SLC, we finally got rid of O2 cylinders. There is no point in listing the positive aspects of solving this issue (cylinders explode and kill, they run out of O2, the nearest O2 refueling station is 50-100 km away). This is very good.

4. Luckily, the oxygen in our cylinders did not explode, and for this reason no one died. However, evacuation vehicles with O2 cylinders were repeatedly damaged by shell fragments, as well as the stabilization center itself at the beginning of its operation. For these reasons, I consider the decision to refuse high-pressure oxygen to be rational and prudent.

Front Line Ukraine: Stabilization Point

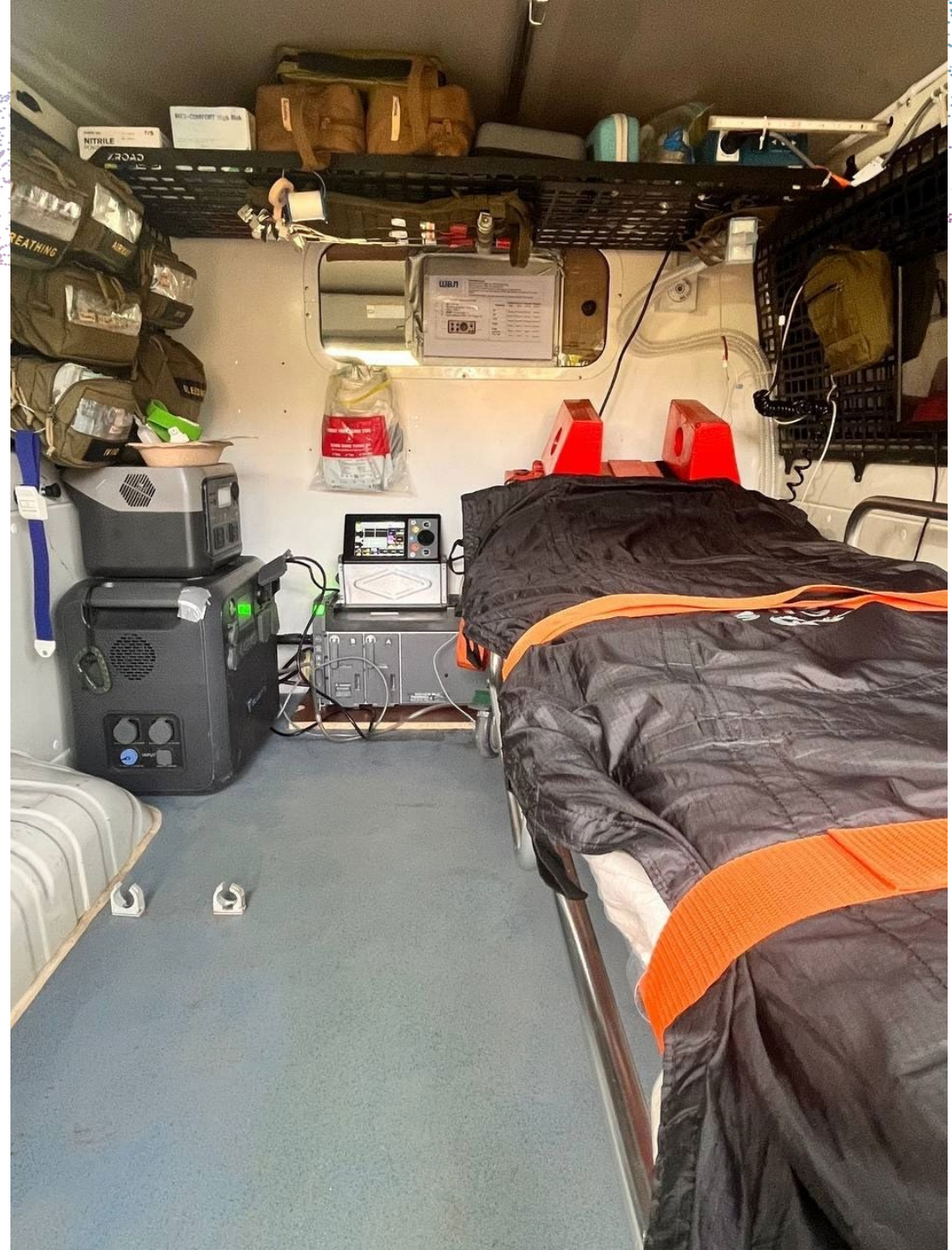


The appearance of visual information does not imply or constitute endorsement.

Front Line Ukraine: Armored Car Unit

“**MOVES works great**, consultations with our anesthesiologists for medevac medics are enough for now, thank you. MOVES actively work as oxygen concentrators, ventilator mode - for quick supply of oxygen to breathing patients.”

Medic, MOVES® SLC™ user, October 26, 2023 via Signal



Front Line Ukraine

Pirogov First Volunteer Mobile Hospital. July 1, 2023.

“For the last month we have been actively using three MOVES SLC device to treat sick and wounded on the front line in Bakhmut direction, Lyman direction and near Rivnopil in the north, where the most significant battles take place. We would like to express our gratitude for the provided devices, they are wonderful!”

Source: Letter to Thornhill Medical

<https://www.instagram.com/p/Cv2mivJNhNI/?igsh=NGpqZ3lzZGpoeWZx>

The appearance of visual information does not imply or constitute endorsement.



Source: Instagram Post

Front Line Ukraine: Stabilization Point and En-route care. Dec 2023.



The appearance of visual information does not imply or constitute endorsement.

Ukraine: A2/AD Anti-access/Area Denial



ICU Evacuation Trains

European Commission President Visits Ukraine

European Commission President Ursula von der Leyen, left, accompanied by Ukraine's President Volodymyr Zelensky, visits a railroad car equipped with medical equipment at the railway station in Kyiv, including Thornhill Medical's MOVES SLC. (Ukrainian Presidential Press Service via AFP)

November 04, 2023
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<https://www.president.gov.ua/news/prezident-ukrayini-razom-iz-prezidentkoyu-yevrokomisiyi-priv-86789>

Scalability versus Vulnerability

- 1:1 ratio - one patient bed capacity to one MOVES SLC
- Oxygen generation capacity is distributed to patient beds
- Failure of central Oxygen generation or failure of supply chain does not affect whole operation
- Failure of MOVES SLC reduces capacity only by one and is easily replaced
- If one has 25 bed facility failure of one MOVES will reduce it by 1/25
- if facility supported by POG30s is targeted by enemy it can be relocated only if there is enough compressed oxygen cylinders available for transport currently ventilated patients
- If facility is supported by MOVES it can be moved in minutes without disruption of care
- If enemy or mechanical failure destroys electrical power supplying POG30 there is no Oxygen to whole facility and compressed oxygen needs to be supplied
- If there is electrical supply failure all the MOVES supported beds function normally for at least 2 hours including full monitoring



In Summary

- Continuing implementing flow-through ventilators solutions is not a workable Oxygen solution for large scale operation. It is dangerous path, as it assumes that all the logistic elements of oxygen supply required for flow-through based systems to work will not be interrupted by the enemy's action
- MOVES SLC as an integrated oxygen source and life support system fulfilled well multiple role requirements in the forward casualty care in Ukraine
- Integrated and small footprint nature of the system allows for enhancement of other logistical requirements in casualty care