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Specifics of providing emergency pre-medical assistance and evacuation in water operations

Generalization of military experience of operations in 2022–2024

SPECIFICS OF PROVIDING EMERGENCY PRE-MEDICAL ASSISTANCE AND EVACUATION IN WATER OPERATIONS

Generalization of military experience of operations in 2022–2024

CO «ICF «COME BACK ALIVE»

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Introduction

Carrying out current water warfare is a new experience for the Armed Forces of Ukraine. Therefore, the specifics of providing first aid/emergency pre-medical assistance in such conditions are not reflected either in doctrinal documents or in the training system for combat medics.

Performance of divisions in such a special area advances high requirements as to planning and training, equipment, physical and psychological condition of personnel involved in operations. Primarily, planning and providing assistance and evacuation of the wounded in case of water warfare brings in multi-level threats – air, surface, and deep waters, where evacuation itineraries and time are dictated by the presence of the enemy in the air and weather conditions. This creates a series of challenges for the system of providing emergency pre-medical assistance, which negatively reflects on soldiers who received wounds or fell ill and need urgent evacuation.

Experience highlighted below is the result of selfless combat and analytical work of combat medics of different units, who daily not only save hundreds of lives of the Ukrainian soldiers but also work on improvement of the current medical assistance system. To ensure generalization, interviews with combat medics and medical staff of different units were conducted (TrO – Territorial Defense, SV – infantry, SSO – Special Operations Forces, GUR – Defense Intelligence of Ukraine, NGU – National Guard of Ukraine, DPS – Road Patrol Service of Ukraine).

We extend special gratitude to Mr. Yevhen Lata (senior combat medic, 126 Obr of territorial defense of the 30th Marine Corps), "Surgeon" (a commander of the 3rd assault squad of the «Ranger» center of Special Operations Forces), and "Oko" (a combat medic of the «Azov» brigade), Timur's special unit of the Defense Intelligence of the Ministry of Defense of Ukraine for the provided experience, documents, pictures, and video materials collected over water warfare.

Conclusions and Recommendations

1. Coordination of action

In long-term operations involving movements through aquatic obstacles, it is necessary to have a high level of coordination and interaction. This can be achieved by creating a command point position for a coordination officer responsible for the coordination of action. Such an officer will have information about tactical situations in the warfare area, evaluate current resources and opportunities for providing all types of support, assess weather conditions, the safety of movement along different potential routes, calculate the time of arrival at the points of transmission of the wounded, and coordinate the actions of all units involved in the evacuation.

Informal horizontal interaction is extremely important. First and foremost, this means the creation of collective chats, as well as individual radio channels for medics of different units working in the area. This allows not only for high and equal situational awareness, but also for coordinated actions, timely involvement of assistance, if necessary, rational distribution and use of resources, better preparedness for receiving the wounded at each evacuation stage, exchange of experience, and help in locating wounded who were evacuated by other divisions.

2. Role of combat medics

All activities in planning medical assistance and evacuation on the water must involve the participation of senior combat medics. They should be involved in terrain reconnaissance, establishment of routes, and definition of places for the creation of intermediate points for providing assistance and necessary resources. Only direct involvement in the process of organizing emergency pre-medical and medical assistance to the wounded allows one to clearly understand the specifics of the process, threats, the impact of the area, and resource needs. Minor details not known or not accounted for by other military specialists in combat situations can cost the lives of soldiers.

It is necessary that specifically combat medics, not commanders of divisions, influence the adoption of the most important decisions regarding evacuation (priority, time, and route). Facilitation of the evacuation of the wounded remains the task of commanders. If such an approach is not adhered to, the risk of mistakes increases, leading to the use of evacuation resources that might have been postponed or resulting in unnecessary losses.

3. Creating clear algorithms of actions and checklists

Planning to provide medical assistance and secure evacuation on the water or near water requires the creation of a clear algorithm of actions for the combat medics and the forces supporting them.

Functioning according to the same protocol significantly increases the efficiency of actions across all links in the case of emergency evacuation requests: provision and use of evacuation forces and means; reconnaissance and support for evacuation routes and points of interception, casualty collection; provision of necessary resources (medical,

fire support, UAVs). Additionally, a joint protocol should include hourly calculations for providing assistance and evacuating the wounded in various scenarios under different tactical and weather conditions, as well as contact information for various services of adjacent units (including UAV and fire support units).

4. Creation of interception points and casualty collection

Considering the dependence of medical evacuation through water on many factors (tactical situations, weather conditions), the effective solution involves setting up casualty collection points (on the evacuation route, in some prepared shelters). The possibility of setting up such a casualty collection point allows for the collection and stabilization of the wounded, as well as reassessment of their condition to enable evacuation procedures and postpone evacuation until the most favorable tactical conditions.

Given the restrictions due to the water warfare situation, the importance of prior casualty collection is increasing significantly. All medics taking part in the operation must know casualty collection protocols and share a common approach to casualty collection. Incorrect or biased casualty collection creates risks not only for the wounded but also for everyone involved in the evacuation, as it affects the deployment of vehicles and personnel.

Basic equipment for the casualty collection point includes battery chargers (battery charger and generator), a refrigerator, Starlink, and medical kits (primarily blood supplies and hypothermia prevention products).

If it is impossible to create a protected space for casualty collection or conditions for long-term evacuation, one or several casualty collection points are established. These points are positioned away from zones of direct contact.

5. Additional efforts to extend stabilization time

A deferred, and sometimes even uncertain, evacuation period for a wounded person on the water requires active actions from a combat medic aimed at stabilizing the wounded while awaiting a more favorable moment.

In such conditions, blood transfusion skills become essential for a combat medic working with a group at launching, where blood or dry plasma are important elements for rescuing soldiers suffering from severe blood loss.

Some divisions create their own blood banks by collecting blood from soldiers (after checking blood groups and suitability for transfusion). Blood (most often from universal donors) is stored under appropriate conditions and, if necessary, is taken for surgeries or transported to another riverbank via boats and drones for transfusion.

To extend the "golden" hour for a wounded person, oxygen concentrators are used.

6. Special attention to hypothermia

Even in the summertime, when the wounded remain by the water or on the water for extended periods, this leads to significant thermal loss and negatively affects blood clotting. Therefore, medical assistance in such conditions requires much more control over the condition of the wounded and active prevention of hypothermia.

Experience of divisions demonstrates that, to reduce losses among soldiers due to hypothermia, conditions can be created for storing and heating infusions and blood at stabilization points and in medevacs. This includes active use of heating blankets at all stages of evacuation, Gore-Tex blankets, placement of heating pads over nodal vessels, use of autonomous diesel heaters, and warming bottled liquids throughout the evacuation process.

7. Use of telemedicine

Restrictions due to operations on the water – such as high isolation and delayed evacuation time – can be partially compensated for through telemedicine: remote coordination of actions undertaken by a combat medic on another riverbank using communication tools. For this purpose, all available channels can be used: dedicated radio channels, chat rooms (in cases where Starlink is available), and video communication. In addition to improving the quality of assistance provided to the wounded, this also positively affects the situational awareness of all evacuation links and offers a better opportunity to prepare for receiving the wounded.

8. Personnel preparation for actions on water

An enormous number of threats and specifics of the aquatic environment require separate preparation of soldiers for action. It is necessary to conduct a thorough examination of terrain, get prepared for movements and actions on the water, on the shore, and in watercraft, and learn the equipment and emergency procedures. One of the effective decisions allowing a better level of preparation is the creation of checklists for each combat medic, where one will get access to all the information that a combat medic should know, remember, or do before the kick-off of the mission.

With the help of these checklists, it is recommended, from time to time, to conduct knowledge testing and check the ability of soldiers to understand the level of preparation per each soldier individually and the same for the unit as a whole. Taking into account new experience gained in different tactical situations, these checklists must constantly be updated.

9. Preparation of boat and equipment

A boat will always be a bottleneck throughout the entire evacuation process on the water since, in case of its loss, the whole process will be blocked until the moment another watercraft is able to move in the same direction. That is the reason why the

unit working on the water must constantly create a reserve of boats and crews that will be working with them.

As experience has proven, the type of boat that can be effectively used for the medical needs of units and equipment with the respective means strongly depends on the specifics of the area and tasks performed by units during operations. For river operations and work in floodplains, solid hull small boats will be a good match, whereas for marine, powerful inflatable boats will be a proper choice. It is worthwhile to consider that the smallest boat has to hold at least a driver, a combat medic, and a minimum of one seriously injured person on a stretcher.

The basic toolkit on a boat should comprise rescue means on the water, a tool for route clearance, preferably spare fuel, and electronic warfare equipment for protection from FPV drones. It is necessary to have a must-have bag of a combat medic (with active blankets, heating pads, catheters or intraosseous injectors, syringes of key sizes (5 and 20 ml), analgesic, additional tourniquets, hemostatic bandages, and bandages), and rescue vests.

If a boat is leaving on evacuation, it is also equipped with the means transmitted from the evacuation shore (stretchers, active blankets, tourniquets) to keep them to replace those leaving together with the wounded. For river operations, it is necessary to place electronic warfare devices on the boat for protection from hostile UAVs. For independent navigation, it is preferable to have a tablet with the 'Nettle/Mesh' application.

10. Combining transportation means

Hard-to-navigate and varied terrain where evacuation is carried out (open, swampy localities, and the necessity to overcome aquatic obstacles) requires the unit, at the planning stage, to calculate which means and in what quantities will be used for moving a wounded person to the evacuation points.

The basic means of transportation is a solid stretcher. A solid stretcher provides a stable position and fixation of the wounded, allows involvement of only two soldiers for moving, and offers relative convenience when loading on board/from the side of the floating vehicle. Meanwhile, the solid stretcher is heavy. Therefore, combat medics should always have in stock user-friendly stretcher kits. The use of evacuation trolleys is ineffective in many areas. It is impossible to move them where there are too many stones, branches, swamp terrain, soft soil, or sand.

In the case of creating a stable bridgehead on another riverbank, a quad bike is used to speed up the evacuation of people and save resources. This allows delivery time to evacuation points to be reduced by 3–4 times and does not require involvement of a large number of soldiers.

11. Use of UAVs to foster assistance and evacuation

UAVs have to be used to support combat medics in all operations on the water. Yes, the involvement of UAVs for intelligence allows planning of evacuation routes and arranging of points of interception–casualty collection for the wounded. Besides, in some cases (in the case of good communication and coordinated actions), UAVs (DJI Mavic) are used to accompany boats when passing complex routes in floodplains. The drone may help control the passage of the route by an evacuation boat and directly show the proper direction.

UAV bombers are used for the delivery of required treatment and stabilization means to another riverbank or isolated plots.

12. Continuous analysis and change of actions

Continuous revision and evaluation of conducted actions, and examination of the situations that emerged, is an important part of the effective performance of combat medics on the water. The most effective units, after each series of evacuations, review and improve an evacuation algorithm, taking into account the experience gained. It is also an effective practice to pay visits to surgeons and anesthesiologists at stabilization sites and hospitals to discuss the efficiency of emergency pre-medical and primary medical care and to clarify how to improve the evacuation process.

An important component of such evaluation is that its results need to be discussed not only among doctors working in evacuation, but also with the leaders of medical units, commanders of different levels, directors, and representatives of the services involved in the evacuation actions.

Chapter 1

Planning and Getting Ready for Emergency Pre-Medical Assistance and Evacuation

Water space, or a combination of water spaces with terrain areas, is an area that is unfavorable for evacuation. Primarily, specifics of relief—open aquatic spaces or narrow bays necessary for the evacuation crews to move along, and in the most complex cases—their combination, swampy terrain, and steep shores—all remain of priority importance for the underpinning processes and interaction during preparation and planning of emergency pre-medical preparation and evacuation.

Another feature is the development of modern surveillance systems on the battlefield that enable permanent monitoring of the area via UAVs and attacks by artillery and FPV drones. Disguised movement and finding shelter in case of the enemy's fire attack is extremely complicated, and it is sometimes impossible. On almost every trip, the boat is attacked by shelling, resulting in the loss of people, damage, or loss of the boat itself. Besides, military units suffer significant losses at the evacuation points during the waiting period for boats, where it is impossible to create conditions for a disguised stay.

Mining of current and potential evacuation routes for the wounded is another threat. Anchor mines installed under the water surface are almost impossible to discover; moreover, they can move along because of the current's impact.

Remaining complicated for the arrangement of disguised positions, the space near water reservoirs and rivers makes it difficult to create casualty collection points for the wounded, where the isolation of such a space and undefined evacuation deadlines complicate the work of medics in providing support to the wounded.

An additional challenge is that movement along water via watercraft presents significant constraints to the protection of the wounded and the evacuation team—in case of extraordinary situations (damage to watercraft, capsizing, flooding), they may fall into the water. Considering that boat crews often move from one shore to another and back a few times per day (transporting people, warfare means and ammunition, medical evacuation), the largest losses often occur among this category of soldiers.

All this leads to a sharp gap in the average evacuation time for a seriously injured person in water operations compared to the benchmarked TCCC protocol and can reach up to 7–12 hours.

Key challenges to consider while planning water evacuation

- long evacuation time and the need for support of the wounded waiting as long as possible for favorable conditions for evacuation;
- the vulnerability of the evacuation routes to hostile surveillance means and attacks;
- high isolation of the first aid sites and the impossibility of creating hidden and protected places for casualty collection points, as well as remoteness from medical institutions;
- landscape with several aquatic obstacles and a limited number of sites to moor a boat; change of landscape due to trees and branches overthrown because of shelling, their movement by the flow, and the necessity of permanent changes in the routes or their clearing;

- high dependence on weather conditions (water routes are not always passable by boats due to waves, ice, and fog);
- need for special preparation of people (loading onto the boat, unloading from a boat, behavior and movement on a boat, emergency actions, and actions in case of falling into the water, etc.)

Additional challenges during marine operations also suggest:

- necessity to overcome long distances during the evacuation period;
- extremely unfavorable conditions for emergency pre-medical assistance and stabilization of the wounded (waves, low temperature, limited space)

For the defense intelligence units or forces of special operations carrying out one-time tasks, the **vertical** management model of operations proved the best, where, even at the planning stage, there is clear planning of the scenario of actions, calculation of all feasible risks, necessary resources, and the leadership of the group coordinates all the actions.

Units facing water obstacles as part of their daily rotation routes, logistics, and evacuation are often deprived of opportunities to move in a disguised and unexpected way, since, over time, all water routes and some terrain routes are scouted by the enemy and are under their fire control. Operations in such conditions require other planning and management models. This is one of the reasons why some units developed and implemented models that **combine vertical and horizontal** interaction during evacuations.

In such cases, **horizontal interaction** and the operative exchange of information among units working in this area become a priority. It is necessary to aim for models of interaction where all doctors and crews operating along the evacuation links are united into a community.

Advantages of coordination of actions

- fast exchange of information, high situational awareness among the evacuation crews;
- consistency of action, opportunity to call for assistance in case of necessity;
- rational distribution of resources (evacuation means, people);
- opportunity for involvement of friendly UAVs and fire support during evacuation;
- opportunity for fast search of the wounded who were evacuated by other units;
- exchange of experience and possibility of statistics management for the injuries on sites (as some divisions do for permanent improvement of efficiency);

Effective solutions, that were implemented for the achievement of high horizontal interactions entailed:

- creation of collective chats involving all medics working along the lane;

- creation of a separate radio channel where exchange is carried out only in cases of evacuation;
- selection of positions at command points to enable instructions on medical evacuation directions.

Thanks to such interaction, in emergency situations (puncturing of medevac car wheels in an open area, an attack, or boat capsizing), and to assist the crew, a vacant crew of the unit or an adjacent unit will set off. This way, the wounded will not lose valuable time, and combat medics themselves will provide rescue assistance.

A vertical component in such a model significantly decreases but requires the establishment of a special operational officer on duty from headquarters to partially handle the management of processes during evacuation. Their responsibilities include:

- to follow the evacuation process via reports (radio and in chat) and data collected from UAVs;
- to follow changes in conditions in the area (weather conditions, activity of hostile UAVs, preparation and carrying out of shelling, movement of hostile groups) and raise the situational awareness of medics and evacuation groups;
- to collect and transfer information about the current situation—primarily, the number of the wounded and their needs;
- to promote evacuation by transportation means;
- to promote informing and support evacuation by other units working all along the lane (informing about the passage on board in certain areas, fire support requests, and rescue inquiries).

Experience demonstrated that planning medical evacuation on the water must always be based on the work of the senior combat medics, who must be involved in reconnaissance actions and medical planning operations, directly visiting the areas, establishing main and reserve evacuation routes, choosing places for the creation of intermediate points of assistance, and establishing necessary resources.

Planning exclusively «on a paper map» or without the involvement of combat medics will always bring certain restrictions, since only a person who is directly involved in the operations of the organization and evacuation has a clear understanding of the process, threats, and the impact of the area and resources on the evacuation process. Small details that other soldiers may not be informed of or may forget in combat situations can cost the life of a soldier.

While carrying out intelligence scanning, landing places are established in locations that are hidden enough and allow for setting up a primary stabilization point (i.e., basements, concrete overlaps located below the land surface). In case such places are not available, equipped areas are established to carry out casualty collection of the wounded without being noticed by the enemy, provide urgent assistance, stabilize the wounded, and prepare for further evacuation.

All planning should necessarily be accompanied by aerial reconnaissance. In addition, to carry out this work, it is necessary to search for and involve local residents functioning on the water (poachers, smugglers, fishermen).

While planning actions on the water, it is **mandatory** to take into account the time for evacuation of the wounded (time of movement to the stabilization point and from the stabilization point to the hospital, and the possibility of missing one of the links) and the connection among them. Each evacuation point should be aware of when the wounded will approximately arrive, their condition, the scope of assistance provided, and be ready to meet them.

Weather conditions (humidity, temperature of air, and water) are an important component of planning evacuation on the water. Yes, bad weather conditions (especially rain) make it impossible to carry out aerial reconnaissance by the enemy, which, on the one hand, fosters disguised movement, whereas, on the other hand, this makes it impossible to support the movement via UAV and complicates navigation. Low water temperature and elevated air humidity, reinforced convection, require additional means and equipment for boats, since hypothermia quickly worsens the condition of the wounded.

Planning of evacuation has to continue continuously, being built on changes and searches for new routes. Neither route evacuation nor points of descent for watercraft and mooring sites can be considered safe, since the situation constantly changes. Attack and detection risks will always remain, as well as the risk of mining the already existing routes. Besides, the water surface is very changeable. Because of currents, unexpected obstacles can arise (flooding of mooring sites or, on the contrary—the receding of water; the appearance of overthrown branches or trees that complicate or make movement impossible, etc.)

The best solution is to create and set up the work of a separate team of sapper engineers engaged in monitoring the condition of structures where watercraft is moored, as well as in regular monitoring of evacuation routes. This applies to terrain plots, possible remote mines, and water areas where new anchor mines and IEDs are continuously placed and where those established earlier can change their location in the water.

In case the basic evacuation route is arranged on the water, where there is such a possibility (tactical situation, change of combat collision lines, movement of friendly units and the enemy), it is necessary to re-evaluate the current situation and attempt to create additional terrain routes (even if evacuation along them will take longer). On terrain evacuation sites, despite the fact that bushes and trees foster disguised movement, additional work on the assessment of their passability and its improvement should be conducted. Passage through vegetation must be sufficient enough to enable at least four people to move the wounded on a stretcher through it. It is better to set up not a linear layout for such aisles but rather to arrange them as curved lines ("snakes") that provide additional disguise and protection.

Points of evacuation, delivery of ammunition, and personnel should constantly change so that it is more difficult for the enemy to predict actions. Considering that during

evacuation, all the loading sites for watercraft will eventually be scouted by hostile intelligence UAVs, and shelling will begin, it is necessary to carry out high-quality reconnaissance and set up multiple such sites. While choosing these sites, it is necessary to take into account the relief features (which help to hide the boat), the possibility of building the route to the site in a maximally disguised manner, and ensuring convenience of use. Yes, when possible, it is better to have a disguised boat on the landing side. If it is not possible to disguise a watercraft, it should arrive from the opposite bank to collect the wounded and return.

Additional evacuation routes also gain importance in the case of mass injuries. By using them, one can not only avoid substantial load on the key evacuation route (which will eventually lead to its detection and attack) but also deliver necessary means for providing assistance (blood, medications, stretchers, etc.). For this purpose, reserves are created (a minimum of two or three boats that are on duty in a disguised location). As soon as one boat sets off for evacuation, the second boat should begin standby rotation and get ready to move forward if needed.

In planning landings on the hostile shore, assault actions, consolidation, and maintenance of positions, combat medics must necessarily be included in the composition of landing groups. However, bringing to the frontline experienced medics capable of providing professional resuscitation and medical aid is not advisable. The loss of experienced medical specialists—who cannot be replaced—worsens the provision of assistance in the unit and negatively affects survival rates among soldiers. A more rational approach is to raise the training level among soldiers to CLS level (combat lifesaver) with a focus on control of bleeding, stabilization of the wounded, reassessment of their condition, assessment, movement, and conversion of tourniquets[1].

Planning will also account for psychological and physical preparation of people (ability to swim, to behave in a watercraft, on water) and planned fire attack against the enemy (it is easier to start watercraft during a fire attack to cover the noise of boat engines).

Considering the probability of attack by hostile ammunition or FPVs, possible extraordinary situations during movement may emerge where the risk that people will end up in the water remains high enough. Such a scenario is very dangerous since soldiers move around in armor and with weapons, and they may be wounded when the water temperature is often threateningly low. To reduce the negative consequences of such factors, it is necessary at the planning stage to foresee the creation of special evacuation groups on water, which will be ready to come forward quickly and provide aid.

The best result of evacuation planning on the water is to create a **clear-cut algorithm of actions** for combat medics and the forces supporting them. This protocol should contain a detailed description of the following:

- order of actions for all the links in case of an emergency evacuation request;
- evacuation means and forces (transportation and managing people);

1 https://tccc.org.ua/guide/tourniquet-replacement-tactical-field-care-cmc

- evacuation routes and points of interception, casualty collection;
- necessary resources (medications, fire support, UAVs);
- time calculations (scenarios under different tactical and weather conditions);
- communication means and contacts of all involved in evacuation (medics at each evacuation stage, those providing support via UAVs, those responsible for transport, those in charge of fire support, etc.).

This algorithm should be communicated to everyone, including the heads of the medical units and command brigades. Before combat launching, the algorithm is discussed with everyone involved in the evacuation and providing assistance, senior sergeants, and the company. If possible, it is better to conduct a couple of discussions to make sure that each person understands his area of responsibility and order of actions, as well as the responsibilities and order of actions undertaken by others. The combatants involved in the performance of actions on the water should know the locality and the area of tasks.

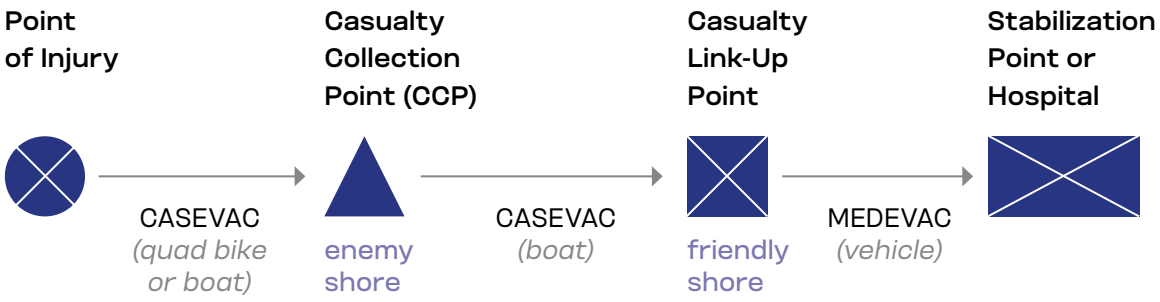
A good planning and preparation result for lifesaving and evacuation operations would be to create a separate checklist of available medical rescue means, security means, and actions in the area of tasks. Verification by the checklist of all combatants of the unit leaving for the purpose of the combat task should be conducted each time by a commander or senior combat medic.

An important feature of duty distribution that should be established at the planning stage is the understanding that senior combat medics run evacuation and establish the priority of evacuation for the wounded. The role of combat unit commanders should be limited to facilitation—for example, quick provision of kits, support (fire, UAVs), and allocation of additional combatants. If this regulation is not adhered to, then the order of evacuation steps based on the wounded's condition may be influenced by other factors (for example, the personal relationship of the commander with the wounded or the perceived value of a specific wounded person for the unit). This puts at risk the life and health of both the wounded and the medics. To prevent such outcomes, for example, the protocol of one of the units includes a clear rule requiring confirmation by medics of the necessity for evacuation.

All the protocols that are created during evacuation planning in the conditions of aquatic obstacles must be compatible with the tactical and geographical circumstances. For example, during landing operations on large water reservoirs or at sea, in the case of receiving a heavy wound on a boat, return will be the most probable scenario of actions.

If actions take place on one shore and a bridgehead is set up there while key medical capabilities are located on the opposite shore, the best solution will be the preparation of an intermediate collection point for the wounded (dugout or other protected shelter). Organization of such a protected site allows for casualty collection and stabilization of the wounded to evaluate their condition, build up priorities for evacuation, and, if necessary, postpone evacuation until the most favorable tactical conditions.

River Operations



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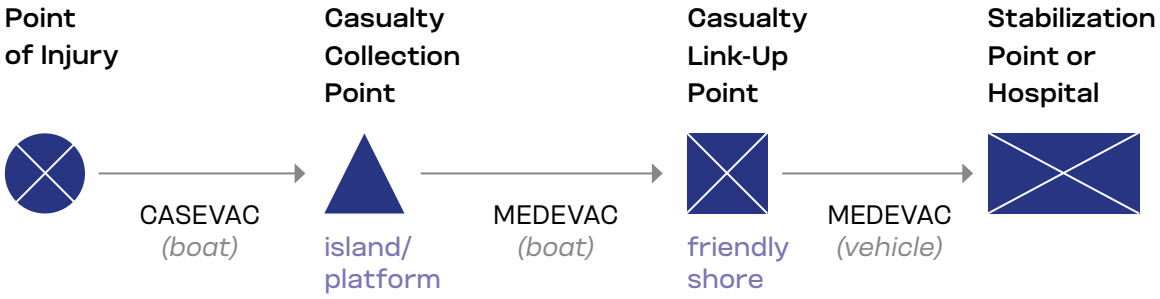

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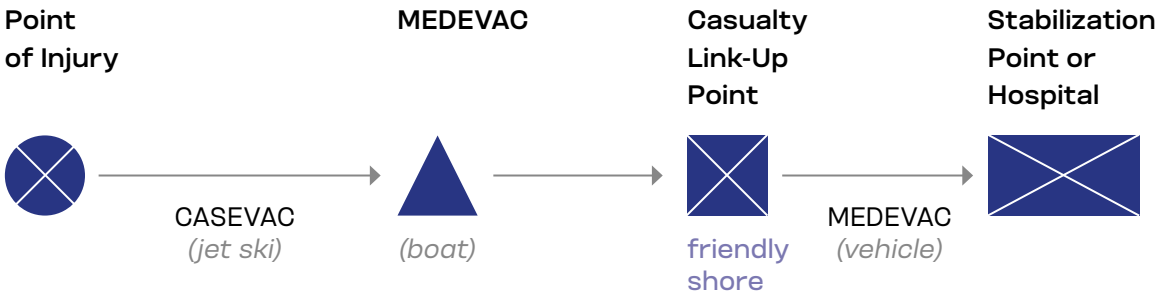

Fig. 1. Possible schemes for organizing the evacuation process of the wounded during waterborne operations

Where tactical conditions allowed, a separate protected dugout was prepared, which was equipped with an L-shaped entrance and a protected ceiling (in three layers of depth). Such a dugout should be no less than 3 meters in height, and the width should

not be less than 4x4 meters. In some situations, there should arise the possibility to occupy protected premises (such as a basement) of those dimensions or larger.

In such premises, there must be adequate space for combat medics and at least two wounded. The number of medics depends on the number of combatants involved in the operation at the landing site and the intensity of combat actions. Planning the number of combatants at such a point of interception must always account for a minimum of two combat medics to provide emergency pre-medical assistance, stabilize and conduct casualty collection of the wounded, and a minimum of one person to accompany the evacuation of the wounded to the following evacuation points by boat.

It is necessary to equip such a dugout or shelter with a powerful battery charger (Bandera, Ecoflow, or analogues), refrigerator, Starlink, and generator. In the refrigerator at such a site, blood (universal group) or its components can be stored, allowing medics to support the wounded and save time before a safer opportunity for evacuation emerges.

Equipment of the Starlink point of connection allows quick transfer of information to other stages of evacuation to get a grasp of what to expect and start preparation for meeting the wounded. It is required to place the generator and Starlink lower than the land surface to protect them from debris damage.

In case of the impossibility of creating protected space for the wounded and conditions for the long-term expectation of evacuation, one or several intermediate casualty collection points for the wounded will be created, which are dislocated from areas vulnerable to direct attacks by the enemy.

Considering restrictions caused by the current situation around operations on the water (unspecified evacuation times, evacuation risks, limited number of watercraft and available space in them), the value of prior casualty collection is growing significantly. All medics partaking in the operation should know casualty collection protocols and share a common approach to the casualty collection of the wounded.

Wrong and biased casualty collection creates risks not only for the wounded but for all involved in the evacuation, since it affects the involvement of transportation and personnel.

For example, some units use the casualty collection model by categories: urgent need of evacuation, priority but not urgent evacuation, and ordinary evacuation. Casualty collection criteria can differ across different units and circumstances, but the key remains that everyone working with the wounded should know the casualty collection criteria and adhere to them.

The condition of the wounded and the necessity of evacuation must be constantly re-evaluated by a combat medic to save the lives of the wounded and the evacuation group.

Considering that the wait for opportunities to carry out evacuation at points of interception may last for an unspecified time, and the wounded need assistance here and now, it is necessary to use all available opportunities for granting assistance under current conditions, and to constantly evaluate the condition of the wounded.

Telemedicine is a solution that should be used during operations on the water, as well as in the case of an isolated casualty collection point on terrain, when a more experienced medic instructs the combat medic or directly manages his activities remotely. For this, all available communication channels can be used—for example, radio channels or chats (if Starlink is available). This, on the one hand, partially removes responsibility from the less professional and experienced provider of first aid and, on the other hand, makes the process more controlled. In addition, it increases the awareness of all evacuation links about all actions taken for the wounded, their condition, and dynamics, which allows better preparation for receiving the wounded.

One of the directions of telemedicine is a camera installed in an evacuation vehicle, where video is transmitted to the medical forces of the battalion. It is used to inform all evacuation links and grant assistance, and it allows the use of additional professional resources.

Delivery of drugs and rescue means to the casualty collection and interception points, in conditions of isolation, is carried out via UAV bombers, where the useful load can reach up to 10–12 kg. Medications, bandage materials, blood, or dry plasma are delivered this way.

It is noteworthy to mention that although craniocerebral injuries and acubarotrauma are not usually a priority in evacuation (but with the exception of heavy cases), yet they are subject to permanent reassessment. In case of neither external harm nor significant complaints, serious consequences can be yet disguised, for example, gradual cerebral edema which over time may lead to the lethal consequences.

Chapter 2

Instructing Soldiers on Water Operations

All the combats (including medical staff) who are involved or may be involved in participation in operations on rivers, in the bays, and in the sea definitely should pass training, which will allow:

- to study the area (directly and on a map);
- to overcome fear before reservoirs and get used to the locality features;
- to study and work out accommodation in a vessel, distribution of roles and responsibilities, and actions with the boat;
- to study and work out movement and response in critical situations, water and river bank (movement by ford, in the reeds, in the swampy terrain, in floodplains; behavior on the water in different situations, behavior rules in case of hitting the side – moving balance along the board to enable the boat to save buoyancy, know elements of fastening equipment and train skills of their quick drop – armor, helmet, weapon; rescue actions on the water);
- to recalibrate ambulance landing (distribution of roles, sequence of work, loading/unloading of the wounded with various types of injuries, and, where necessary, control of sectors and shooting from boats (on the water)).

Special units that are getting prepared to work on the water usually recalibrate different situations that can arise during missions:

- Human beyond the board and search of the wounded in the water;
- Actions during the daytime and at night;
- Working with the wounded in boats where each team member recalibrates, granting emergency pre-medical assistance.

Recalibration of all actions will be necessarily undertaken by the entire team where a medic should know and be able to do everything that a soldier can, and a soldier should know and be capable of granting emergency pre-medical assistance on the water and in the conditions of limited resources. That is the reason why the combat medics supporting the wounded on the boat must be knowledgeable about moving by the boat, balance, and management of a watercraft (in case the boat driver is wounded or lost). The same applies to all other means of evacuation, e.g., car, quad bike; a combat medic should know how to run and replace the wheel in case of necessity.

Besides, user skills for radio communication and the 'Nettle/Mesh' application are required. Considering that in foggy conditions radio communication is complicated, movement often happens at night in the absence of landmarks, and use of a tablet with 'Nettle/Mesh' is an effective decision for navigation.

The creation of checklists for each combat medic is a good decision that allows for an increased level of preparation, where there is an indication of everything that the combat medic should know, remember, or do before the mission. Via these checklists, it is recommended, from time to time, to conduct knowledge testing and verify the skills of combats to understand the level of preparation in the case of each soldier and the unit

as a whole. Taking into account new experiences, which are obtained during different tactical situations, these checklists must constantly be updated.

Equipment of soldiers while launching on the water should include:

- Rescue vest (better—automatic, self-inflating), worn **only** on a bulletproof vest. If a bulletproof vest is on top of the rescue vest, the current risk will involve that in a case where the second vest demonstrates restraints, strangulation will occur (due to compression of chest cells and lungs). In case of nighttime work or in large aquatic spaces, it is better to equip the vest with a beacon (mandatory on a rescue vest) or a whistle that will make it easier to conduct search operations on the water.
- Slings and carbines on personal equipment and devices (to fasten them in case of falling into the water).
- Floats on weapons, walkie-talkies, and other important elements of equipment. You can tie them to a rescue vest.
- First aid kit assembled in accordance with the checklist (see appendix) ;
- 1 evacuation sling per department (sewing sling of 5 cm behaves best since it can be used without gloves safely, having no fear of receiving injuries).
- Carabiners for evacuation (slings on equipment do not bear the load and are torn).
- Considering the negative influence of low temperatures on the physical condition of soldiers in the water, a group should necessarily possess a sufficient number of chemical heating pads and thermal blankets.
- A sealed bag with more than one set of clothes that is worn after transfer.
- Token, bracelet, or another object allowing identification of a deceased person are mandatory accessories, as it is difficult or even impossible to carry out identification of the deceased after a long stay in the water.

Ignoring the necessity to wear rescue vests, or incorrect selection of the rescue vests and other rescue means, leads to a substantial increase of losses among people during the actions on the water, even in the absence of injuries. The best solution is to prepare rescue means like this in such a way that will enable zero or positive buoyancy of a well-equipped soldier (it doesn't matter whether it is the wounded or not).

Using neoprene costumes is not a solution that has proved its benefit in operations by the water and on the water. Considering that their purpose is to protect from hypothermia the one who is constantly in the water, they are not suitable for long-term wearing on the shore, even if there is contact with the water. The suit is designed in such a way that it warms in the water but does not squeeze out moisture, leading to permanent sweating on the shore when hypothermia occurs.

An amphibious wetsuit is yet another solution for the protection of people from hypothermia during lengthy stays upon contact with water and near the water environment. Such a wetsuit has an ergonomic cut which allows freedom of movement and overcoming obstacles.

Its external layer holds the main mechanical load, where the average contains a vapor-permeable and waterproof membrane made of PU (polyurethane) or PTFE (Teflon), and the inner one protects the membrane from pollution and provides additional strength.

Such wetsuits provide:

- protection from contact with water;
- protection from hypothermia;
- drainage of unnecessary moisture;
- protection of sensitive places from mechanical damage;
- protection from the influence of flame; mechanical and thermal influence of sparks during assault actions and in case of red-hot sleeves – during the fire;
- reduced optical visibility by reducing heat radiation.

However, both in a wetsuit and in a dry costume, it is hard to establish the probable place of injuries. But in case of wrongly calculated buoyancy of equipment, wounds where a soldier stays in an amphibious dry wetsuit can quickly become lethal.

Chapter 3

Watercraft

During evacuation on the water, the boat and its driver are the most vulnerable points throughout the entire process. In case of their loss, the entire evacuation process will be blocked until the moment when another boat is able to start the itinerary. That is the reason why preparation, equipment, maintenance of the watercraft, and raising the professional level of their crews are the most important aspects of success for the evacuation operations on the water.

Considering the limited number and the high price of special watercraft, units of defense used mostly small civilian boats. Besides, the use of large landing boats with powerful motors in riverboat operations was made complicated since their passage capacity through difficult plots without damage to the boat screws is worse. Apart from that, large boats find it hard or impossible to moor by the shallow shore, which complicates or makes impossible the loading-unloading of the wounded.

Metal boats demonstrated themselves at best, whereas motor boats were the best match for the large tasks of evacuation or support. It is better to deploy, as a reserve in very extreme cases, civilian rubber boats only where other watercraft are missing. Therefore, it is hard to navigate boats on currents since they are vulnerable to hits from debris, collisions with snags, and waves from explosions. Besides, it is impossible to cover the floor in a quality manner to reduce the hypothermia of a lying soldier, and it is hard to place a wounded person in a way that enables monitoring of his condition and maintains the balance of the boat. In winter, if the water surface is covered with ice, it is impossible to use it because the ice cuts the body of the boat.

Experience of special forces suggests that effective deployment of inflatable boats is possible, but in cases where it is necessary to quickly overcome the water threshold and land on the shore, mostly. Such rubber boats must be of a certain type—for example, structured by a certain number of cylinders that allow safe buoyancy in case of partial damage—and they should be equipped with powerful engines. Alongside that, the actions of the crew on such a board in case of puncture require training and consistency. For example, it is necessary to quickly move from the stern to the nose of a boat to provide the balance necessary for securing buoyancy and speed of movement. This imposes certain limitations on granting emergency pre-medical assistance on a watercraft, where the priority in this situation is preserving buoyancy. That is the reason why granting assistance is limited exclusively to stopping bleeding and fast evacuation of the wounded to the stabilization point.

For winter works, «nosed» metal boats and pole oars are required. The use of metal boats with solid bodies in freezing conditions will allow slow movement alongside breaking ice. For this, a boat should be swinging gradually, breaking ice sideways by slowly approaching the ice with the nose and breaking the ice. In winter, it is also necessary to continuously control the condition of a motor that has to be underwater, which slows down its icing and protects the gear and pump from damage due to freezing. In conditions of risk with iced motor screws, one can keep in stock a thermos with boiling water, which is used for defrosting.

On big aquatic obstacles, metal powerful motorized boats are needed. Optimal dimensions of the boats for movement in floodplains are 4–6 meters in length. On average, while getting prepared for movement on the water, it is necessary to have

2 boats per unit (5 people amount to a minimum of 600 kg). The engine of the motorboat should be no less than 40 cubic centimeters, where optimal engines for use are 4-stroke engines (50–70 hp), with the possibility of fixing the engine position in several settings. For the passage of hard-to-reach places, it is enough to enable minor diving of the rowing screws into the water, which allows continued movement at lower speed.

It is better to use the rowing screw made from stainless steel with a minor propeller (cargo). Meanwhile, it is better to set up mounted motors for easy elevation (in case of landing on the coast at speed).

Attempts to equip boats with automobile engines are impractical. Primarily, such an engine occupies a large area of the boat. Secondly, it is a lot more difficult to maintain.

Dimensions of the boat should allow, if necessary, to hold—apart from a driver and combat medic—a minimum of one seriously injured person on a stretcher, together with an EcoFlow charger and radio electronic weaponry. The minimum holding capacity for such a boat should be two sitting and one lying person.

It is better to paint boats in gray color.

Besides, one can use a punt boat (for open sections — a keel), but it is limited in maneuvers in open areas. In some cases, while navigating the floodplains of the «corridor-tunnel» type, kayaks and canoes on oars were used, which allows movement in a disguised manner along areas considered impassable by the enemy.

Considering permanent risks at intersections of open space on water and the presence of the wounded on board, a boat needs to be in good technical condition and have fuel in stock. In some units, maintenance rests on a steering officer of boats (each to be accountable for his boat), or specially assigned people are engaged in it (those having contacts with local residents, volunteers, and capable of promptly resolving problematic issues).

Minimum equipment required for a boat:

- Lifebuoy ring or 5–6 liter flask which makes it easy to find a boat in case of necessity;
- Rope for mooring tied to the boat nose;
- Bottom covered with wooden or other flooring to prevent direct contact of the lying person with the bottom of the boat (this increases hypothermia);
- Bag of a combat medic (CLS-bag) for two seriously injured fighters that is stored in a special box that allows permanent access to the active blankets or chemical heating pads (protecting from hypothermia), catheters, syringes of key sizes (5 and 20 ml), painkiller, additional tourniquets, hemostatic bandages, and bandages;
- Additional stretcher;
- Rescue vests per each member of the crew + minimum two;
- Oars;
- Stock of fuel;

- Special pole-oar, pike pole (slate bar in winter);
- Boats are equipped with autonomous electronic warfare systems with a battery that, by setting relevant situations with frequencies, significantly strengthens protection during evacuation on the water;
- Considering that the predominant number of evacuations on the water takes place at night – night-vision device is important equipment for the boat;
- Tablet with the 'Nettle/Mesh' application.

Considering the permanent danger that enemy UAVs suggest (primarily FPV, but also those working with attacks), it is preferable to have on board additional prevention means. This is primarily regarding detection (drone detectors) and attack (smooth-bore weapons). However, the use of these means requires placing additional people on board, which is not always possible.

Launching boats on the water from carriages is dangerous. This sharply complicates disguise and may be used only for transferring vessels from their zone of responsibility into the zone of neighbor responsibility.

Chapter 4

Tools and Their Application

Anti -cooling (hypothermia)

Hypothermia is one of the most dangerous factors that affects the condition of the wounded in case of evacuation on the water. Even in summertime, long-term stay of the wounded by the water or on the water leads to significant heat losses and launches dangerous processes. So in the conditions of hypothermia, blood clotting significantly decreases, and the wounded without external injuries can die from internal bleeding. Besides, contact with water leads to effectiveness losses of tamponade and restarted bleeding, where longer stay in the water causes hypothermia, which reduces blood clotting.

That is the reason why in medical assistance during operations on the water/by the water, control over the condition of the wounded and prevention of hypothermia need permanent attention, where tamponade would rather be closed with an occlusive bandage to prevent soaking of tamponade material in the wound.

Upon placement and transportation of the wounded with a threat of hypothermia, it is necessary to wrap in several layers materials providing protection from water and conservation of warmth (foam mat, or cover for the surfaces to place a wounded, moisture-proof material, wrapping up a wounded in blankets, sleeping bag and additional cover of insulating moisture-proof material).

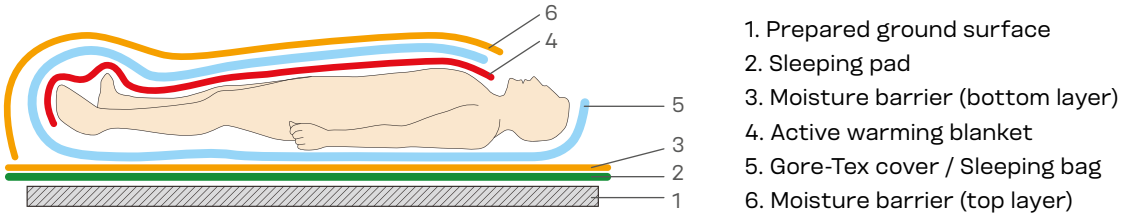

Fig. 2. Casualty insulation scheme to prevent hypothermia

Among the counter-solutions to the negative influence in case of hypothermia, which were elaborated by combat medics, one can highlight the following:

- location of mobile refrigerators/heaters for infusions and blood at stabilization points and in medevacs, which allows saving and heating solutions to the relevant temperatures;
- heaters for infusion solutions allowing the support of permanent temperature;
- use of active thermal blankets at all stages of evacuation (including those charged by batteries);
- installation of autonomous diesel heaters on medevacs and at stabilization points to retrofit them with tubes and direct heat on the wounded;
- heated liquid in bottles during evacuation;
- ordinary thermal blankets (in general, for each wounded, not less than 3 thermal blankets are used).

In limited tactical conditions, medics necessarily must have in stock:

- thermal blanket;
- active warming blankets;
- Gore-Tex capes;
- heating pad for hands (reusable) overlapped on key lymph nodes (neck, armpits, and groin zone);
- bags for corpses (if a sleeping bag is placed inside, they will protect well from water and hypothermia, but do not release moisture);
- thermal stretchers (specifics of using them during evacuation is that although they help save a fighter from hypothermia, since they are made like a sleeping bag, they make it more difficult to re-evaluate the fighter's condition, as they do not allow permanent access to multiple areas of injuries — for example, limbs. Due to this, it becomes more difficult to control and evaluate the condition of the wounded during conversion of tourniquets, and there is also a danger of immobilization for the wounded in case of a threat of capsizing a boat).

In case of long-term waiting, when possible, wet clothing is cut off with scissors since wet clothing provokes hypothermia. Besides, it helps to visualize the places of injuries and harm.

Use of various means of transportation to the evacuation point

The most optimal means for moving a heavily wounded or an immobile wounded person who cannot move by himself is a solid stretcher. For transportation by such a stretcher, there is a need for two humans, and they provide a more stable position for the wounded. Meanwhile, combat medics use different types of stretchers—from foldable soft stretchers (they are quite compact) to the plastic modular frame rescue stretchers of Skedco type/Leleka (portable).

Using spinal shields in multiple combat situations and during evacuation on the water is extremely difficult and ineffective since they occupy too much room. It should be clear that, in the case of water operations, resources are always extremely limited. Therefore, transportation and placement of a wounded person is based on tactical conditions, where settlement of non-critically threatening conditions is rescheduled to the next stages of evacuation. But, in case of opportunities, any re-loading of a severely wounded person from the boat to the shore and from the shore to the boat should preferably be done on a stretcher. Re-loading a wounded person from stretcher to stretcher is dangerous, as this requires significant effort and additional time.

Besides, there is gained experience of transporting a wounded person on a special stretcher on his back, where the structure allows carrying a wounded person as a backpack so that the hands of a portable soldier will remain free. Alongside, the use of such a stretcher suggests many restrictions.

An important aspect is also that in case of movement to the boat and evacuation of a wounded or a deceased on a stretcher, an arriving watercraft has to bring another

stretcher as a replacement so that a military unit does not lose an extremely important means of evacuation.

Using evacuation trolleys is ineffective in many areas. They are impossible to carry where there are too many stones, branches, swamp terrain, soft soil, or sand.

In conditions where a stable bridgehead to another shore is set up, for accelerated export of people and resource savings, ATVs are used. In case of such a possibility, a cargo vehicle should be deployed; otherwise, two people will have to handle evacuation of a lying wounded person, holding such a soldier between themselves in a sitting position. The possibility of evacuation by a quad bike allows the reduction of delivery time to the evacuation points by 3–4 times and does not require the involvement of multiple soldiers.

Medications

Special first aid kits for on-water and river-sea operations are an effective individual means for granting emergency pre-medical assistance in operations on water. Such first aid kits are packed hermetically and located under a bulletproof vest, fixed with the help of Velcro. In case of impossibility to get such a first aid kit, some divisions produced them independently via plastic packages of relevant size and vacuum cleaners.

Application of **tourniquets** in case of water operations requires special training, where stopping bleeding in the water with a tourniquet is a non-trivial task—not only because in the water it is more difficult to control your movements, but also since it is much more difficult in the water to find and evaluate a wounded person, assess the speed of blood loss, and ensure the proper use of tourniquets. Additionally, in case of long stays in the water, or in conditions of long-term heavy soaking, requirements for the quality of the tourniquet increase, as it may gradually lose tension and pressure on vessels.

Blood or dry plasma are the most important rescue elements for soldiers with significant blood loss, following the recommendations of the TSSS protocol.

The possibility of creating blood stock for transfusion and delivering blood and dry plasma to the points of interception and stabilization is a critically important option, which allows, in conditions of deferred evacuation or indefinite evacuation time, stabilization and support of the wounded while they wait for favorable conditions.

Among the solutions developed by the combat medics during operations on the water, a blood bank of a unit or that of a combat group can be created. For that, blood groups are verified with the soldiers and the suitability of their blood for transfusion. A local blood bank is created at the level of a medical unit. Commonly, such a bank is created by universal blood donors, but in the case of rare blood groups, their blood stock can also be created. Next, this blood in hemacones is stored under special conditions and, in case of necessity, it is taken for surgeries (in conditions where storage is possible) or is transported via boats and drones to another shore for transfusion. Such a decision also requires certain preparation of medics working in the unit.

Oxygen therapy allows for the extension of a «golden» hour for a wounded person. Alongside that, oxygen cylinders in an evacuation vehicle or at a casualty collection

point are a huge risk since they are explosive items. As a solution, user-friendly oxygen concentrators (e.g., Saros 3000) were used, where there is no need to fill them with oxygen and where they can work up to 90 minutes from batteries. They are non-explosive, compact, and weigh 5 kg; with replaceable batteries, they can also be delivered by a UAV or by boats. Such a concentrator allows effective help to the injured with acubarotrauma and low saturation. Also, such an apparatus can be connected to mechanical ventilation and Ambu bags.

As a compact, safe analgesic for the wounded who can breathe independently, a methoxyflurane inhaler is used. Such an inhaler allows for fast anesthesia for 30 minutes to carry out necessary procedures (e.g., replacement of bandages during transportation) and does not require any time loss on installation, for example, venous access. Ketamine together with a fentanyl sticker is another anesthesia solution in use. This allows effective anesthetizing on the way to evacuation. However, the use of such drugs requires mandatory mention in the card of the wounded and monitoring of breathing and consciousness.

For the effective application of such solutions at the points of interception and stabilization (there may be several), it is required to have on rotation a soldier-medic with resuscitation skills and a preparation level of «medevacs.» If sites are protected and disguised, they can also be equipped with sets for intubation, a minimal set of surgical equipment, means for storage and blood transfusion, and other means of resuscitation and recovery from severe states. Besides, such a point is equipped with a generator and power bank.

It is also required to have a larger stock of **occlusion stickers**. Wounds after tamponade can be plastered with an occlusive sticker that is placed directly on the skin, providing protection from water and minimizing the risk of material soaking in the wound and, as a consequence, recurrence of bleeding. It is inappropriate to stick them on clothes or wetsuits since there will remain a risk of water penetration under the sticker.

Considering long-term evacuation and contact with water in case of a wound, it is necessary to apply a triad: painkillers (ketorolac, methoxyflurane), non-steroidal anti-inflammatory drugs (meloxicam, nefopam, paracetamol), and broad-spectrum antibiotics. If the wounded can swallow, these means must be placed in a standard pill pack; if not, they will be injected.

All the equipment and medications, while being transported on the water, are folded into airtight bags or simple garbage bags, with floats, lifebuoy vests, and beacons attached to make it easier to find the equipment in case of contact with water.

Chapter 5

Specifics of Transportation and Evacuation of Wounded by Water

The decision about the optimal time for evacuation on the water is taken each time based on the tactical situation. Often, this is evening–morning time («in grey time»), since during this period it is harder for enemy UAVs to conduct reconnaissance (due to deterioration of image quality on daytime cameras, and at night – insufficient image quality), or at night. But, at the same time, the activity of hostile surveillance means and damage on the potential routes of movement, even during this time, makes evacuation extremely dangerous. All movement during the daytime is very noticeable and will be attacked by the enemy with high probability. There are also natural factors that influence the situation, i.e., change of water level, wind, humidity, fog, and others. That is the reason why additional planning and discussion of actions and resources involved in the evacuation is necessary and takes place constantly. Every change in the tactical situation and weather conditions will necessarily lead to changes in evacuation actions.

Considering all the difficulties that arise, or may arise, each separate medical evacuation on the water requires support resources as for a separate operation. Therefore, for example, it is necessary to use UAVs both for intelligence and for the support of boats. Among UAV methods to accompany the movement of groups on the water, the following can be deployed:

- Drone hanging in the air remotely and transferring the image to a control point, which, via radio, will adjust the movement;
- Drone hanging ahead of the boat for navigation of the crew (soldiers literally watch the drone and move according to its directions). The drone, when necessary, projects signals by up–down, right–left movements, and also with the slopes of its body. However, this option implies certain restrictions. This is due to the fact that the crew is not always aware whether it is a friendly or hostile UAV, and the combination of factors (engine noise, connection issues, the crew being occupied with control and the wounded) does not leave an opportunity to clarify it. Therefore, some units have refused this method.

Control after a boat's passage along the route is also exercised by a UAV, where a regular operative officer calculates the arrival time and informs the medevac groups when they have to arrive at the point of unloading. The process has to be maximally synchronized, as the terrain does not allow for any opportunity of lengthy waiting time for the medevac vehicles.

Besides, it is often necessary to provide fire support to evacuation, i.e., work on early discovery of hostile means, potential places of their location, areas, and suppression of explicit and potential activities of hostile means. In case of the enemy's attack on an evacuation team, the azimuth from which the fire is carried out is transmitted alongside the time of the projectile approach, and significant fire support to the evacuation by square blocks is provided. For that, there is successful experience of fire support to evacuation using FPVs.

Support with radio-electronic warfare allows closing square blocks where the evacuation route runs to create maximum complexity for the movement of enemy UAVs.

In case of evacuation on the rivers and in floodplains, trees which, because of natural factors or shelling, fell into the riverbed often create barriers for movement and

placing on boats of the loading markers. Besides, mining remains an important problem, i.e., homemade explosives, anchor devices, and other mines not only periodically are established by the enemy, but they move because of currents and other factors. Therefore, creation of fast and safe routes requires not only engineering reconnaissance, preparation (polishing or cleaning obstacles, demining), and constant revaluation of routes and implementation of actions on their support. If there is no opportunity for regular review of evacuation routes on the water regarding obstacles which could arise because of shelling and natural conditions on the evacuation route, it is advisable to have a chainsaw on the board for fast elimination of problems. But its use on the water requires special skills.

Evacuation, especially in the conditions of floodplain, requires support for permanent interactions during launching and movement, where it is necessary to communicate with commanders and neighbors about events in their zone of responsibility. Besides, it is necessary to notify neighbors about your watercraft that is moving, since in some tactical conditions, in case of detecting boats where movement was not reported earlier, fire usually starts (otherwise, the boat may leave the zone of attack in 5–7 seconds).

To ensure sustainable connection with the other shore of the communication services, additional repeaters on the shore landing are established. Maintenance of sustainable communication at all stages of evacuation allows for receiving and transferring reports along the entire line of evacuation. Command, scouts, and groups which perform tasks in the zone of evacuation must be necessarily informed about:

- time and route of passage for an evacuation watercraft through their zone of responsibility;
- type, color, dimensions of the boat;
- quantity of soldiers on the boat.

With the help of communication, arrival time will be established, and it leaves not before and not later than required; otherwise, waiting will be required (both for the boats and the wounded with escort). The site is disguised. It is important to adhere to correct and concise reports at all stages of evacuation for the wounded. Some divisions use the standard protocol of the NATO armies — MIST REP, where:

M — mechanism of injury

I — type of injury (severity)

S — signs (condition and dynamics)

T — treatment given and what needs to be done.

It is important to avoid data transmission in an open manner, where tables of signals are developed and updated constantly. Information for each wounded is dropped into a common chat which involves medics of a unit and adjacent units along the line. Such protocols of actions allow early preparation for reception and calculation of arrival time for each of the stages. Early notification at all stages of evacuation and granting medical assistance about the number of the wounded, character of injuries, and necessary assistance allows for the calculation of the resources that will be pulled

together to meet a group on the shore, i.e., number of soldiers, machines, equipment, resuscitation, and stabilization. Experience of some units has shown that collection of such reports allows for maintaining injury statistics, correcting the protocols of evacuation actions, granting assistance, and exchanging experience.

In case of receiving information about the arrival of a new wounded person and understanding the type of wound, it is necessary to prepare and ensure early heating of containers with medicines and/or with blood and warm up chemical heating pads, so as not to spend time on it after arrival.

For the security of the wounded and the evacuation group at each stage of movement upon evacuation, revision of the expediency for further movement in terms of the condition of the wounded and the tactical situation is conducted.

It is required to adhere to the policy of filling out cards of the wounded, since this is a mandatory procedure that allows not only for understanding the picture of injuries and dynamics, but it is also an important primary medical document that will later be useful for the wounded himself. In case of an opportunity, it is better to duplicate all the data entered into the card as text in messages to ensure that the next stages of evacuation and assistance are clearly aware of the nature of injuries, changes in the condition of the wounded, assistance granted, and which medicines were used. In some cases, information must be recorded or submitted as voice messages, followed by translation into text.

In case of absence of such an opportunity to equip points of collection and a casualty collection point, a wounded person is simply moved away and looked after until windows for evacuation emerge. Besides, the points of stock replenishment are extremely important, where they can be placed at different distances along the evacuation route, which allows for replenishment of used means or gaining wider access to resources.

In case of sufficient quantity of boats, it is better to launch with two boats to enable one to back up the other if it is attacked or if its engine fails. The engine is a vulnerable issue since it is not protected from FPV strikes or debris. But it is worthwhile to take into account that crowds of people and accessories, especially during evacuation, always provoke increased interest from the enemy.

In case of massive injuries, it is possible to expect the arrival of one or several combat medics on the shore from where evacuation occurs and where the possibility for fast and effective assistance and casualty collection has been created. Availability of additional medics allows for support to the wounded on the boat on the way back and preserves resources for granting assistance on the shore where evacuation occurs. A combat medic arriving with the wounded on board can re-evaluate the condition of the wounded, control the passability of his upper respiratory airways, and control bleeding after the conversion of tourniquets.

However, taking into account the high danger of movement by boat during evacuation, another solution may involve engaging combat medics exclusively on the evacuation vehicles meeting the boats. On the one hand, this weakens emergency pre-medical assistance on the landing shore and control over the condition of the wounded on the boat, and, on the other hand, allows for preservation of a valuable resource for the total

chain of medical evacuation and ensures quality actions on stabilization of the wounded at further stages of evacuation. Use of such an approach requires an increase in the average preparation of soldiers in tactical medicine, where they allegedly work on the landing bridgehead. On top of their skills, it is necessary to add the skill to do blood transfusion, provide long-lasting care after injuries independently, or via telemedicine.

Placing of the wounded on the boat is a very important aspect that constantly has to be improved. Although the limited space of the majority of boats dictates conditions for their filling, experience has demonstrated that in the case of river operations, where there is a threat of mining, the most dangerous place on the boat is under the engine. In addition, it's better to place the head of the wounded in the direction toward the boat nose. Primarily, under waves, all unattached items in the boat slide down the boat, and in case the boat begins to sink in the water, the head of the wounded can end up in the water and additional effort will be needed to support his head so that he does not choke. For placing on the boat, there should be an assigned boat motorist, who usually, by experience, knows what weight to take on board and how to locate everything so that the boat can maintain balance.

The medic should be better placed by the pelvis of the seriously wounded to have an opportunity to see all parts of the body, evaluate his condition, and assist. But in case of limited space in the boat, it is necessary, at least, to put the wounded with the wounded part as close as possible to the medic's position. This is necessary because, in case of getting wet, the risk of restarted external bleeding grows significantly.

All weight in the boat has to be distributed so that the boat can quickly move and not lose balance.

To put a wounded person on the unprepared bottom of the boat is dangerous. In this case, they will be in constant contact with metal, water, or rubber, and their condition may deteriorate because of hypothermia. Therefore, it is better to cover the bottom of the boat with wood, common and active thermal blankets. It is not sufficient to use exclusively an active thermal blanket. In civilian rubber boats, such a solution is hard or impossible to apply. Therefore, they are used only in extreme cases. In case of changing tactical situation, if there is a threat, the injured will be fastened to the stretcher in case of contact with water. A wounded person should necessarily wear a life-saving vest and various warming elements.

Shelling of the evacuation point dictates the necessity to move away and look for another point. Another strategy is guidance of the boat into shelter if FPV sound is audible and temporary leaving of the watercraft to follow it. For this, it is necessary to conduct permanent reconnaissance of the places where one can hide themselves and hide the equipment.

All movement along the boat at the time of movement is very dangerous and requires certain skills. Steering officers often have to refer to dangerous maneuvers and sharp movements in the conditions of FPV chase, which leads to losing some soldiers overboard. That is the reason why a life-saving sling and carabiner, flashbang lighthouse must be among the ammunition in each soldier's rescue vest. Besides, chemical light

will apply. On top of that, it is possible to demonstrate an anxiety signal on the water by splashing palms on the water surface.

In hard tactical conditions, under shelling, it is not mandatory to pull out a soldier. Sometimes it is enough to drop a rope and transport the soldier overboard. While rescuing on the water, the boat should approach from the side of the soldier's legs in the water. Next, they are picked up by the vest from the side of the nape, where the second soldier picks up the soldier's legs and the movement continues. If tactical conditions allow, the soldier will be dragged into the boat through the board.

If it is necessary to move the wounded from one watercraft to another, boats stand board to board, where several soldiers will hold boards of each other and the wounded will quickly move on the solid frame or other available stretcher.

In case of the floodplain, it is better to go small in order to move in a disguised manner and hide in the reeds without leaving traces on the water. Full pace will be a solution only in the conditions of extreme necessity. But it is preferable not to overstep the boundaries of average pace, so that the enemy does not know the opportunities of your boat and cannot predict your actions. In such a case, upon threat of damage by barraging ammunition, the boat will be capable, at the moment of necessity, to move at maximum pace and dodge.

The specifics of evacuation at night are that the route is not visible. It is impossible to become attached to landmarks. But the current may also interfere. All this increases the movement time on the water. It is also necessary to take into account that movement against currents increases the time necessary for overcoming water obstacles. At points of loading and unloading, there should be people in place who will help with orientation via beacons, chemical lights, and red lanterns. The availability of NVD and a thermal imager on board is also important, even if the boat is leaving for evacuation in the daytime, since it is impossible to predict an accurate time for the movement back. Infrared lamps for backlighting are also used, but their light is easy to see, especially at night.

Constant communication with the boat allows maximum synchronization of actions between the boat and the medevac on the shore, informs about the current situation, the condition of the wounded, and his needs, and allows maximum preparation for meeting the wounded and granting necessary assistance.

Chapter 6

Specifics of Marine Operations

Important specifics of marine operations are that crews have to overcome large distances on the water, often in harsh weather conditions. Besides, in marine operations, isolation of crews is increasing since there is no possibility of creating casualty collection points for the wounded. Accordingly, the level of medics working in crews should be high. Each crew should have a few soldiers with the skills of blood transfusion, resuscitation, and stabilization.

One of the solutions for marine operations is the preparation of an equipped motor boat with specialists (anesthesiologist, paramedic) carrying out the functions of the casualty collection point for the wounded remotely from the combat zones, where evacuation of the severely wounded with high-speed means (boats or jet skis) is set up.

Waves are an important factor that affects transportation of the wounded and granting him help. Often, even while moving soldiers to the facility, bulletproof vests are removed, taking into account the permanent shaking of the motor boat on the waves. Besides, it is straight the instability of transportation surfaces dictating use of exclusively solid stretchers with attachment and transportation of the wounded by rear parts of the boat, by motors. In other cases, there is a risk of additional injury, in particular to the head, due to jumping off the boat on the waves at high speed. Besides, while moving the wounded, communication with the skipper is important.

It is required to have among the equipment and on the boards carabiners-fixers to prevent the risk of being dragged away beyond the board while moving boats across big waves. While working with the wounded on the waves, fixation should be done with two carabiners from different sides to ensure minimal stability.

On boats, it is necessary to ensure the availability of blood plasma, heaters for infusions, intraosseous infusion medications, and high-pressure injectors for drugs and blood. Use of a catheter in a vein while working on boats in the sea is extremely difficult, especially on the waves or at night. Use of a catheter is possible at the interception point for the wounded. Besides, first aid kits for soldiers must contain ondansetron, Osetron/Zofran (centrally acting antiemetics), since it is hard for many wounded to cope with marine swaying.

For search and rescue on the water, it is better to use infrared beacons on a helmet or on rescue vests that activate in case of contact with water; they effectively allow detection of the soldier's location on the water.

It is hard to report arrival time during marine operations, but points of arrival are more protected. That is why long-term waiting there is feasible. Time of evacuation significantly depends on current weather conditions.

Chapter 7

Follow-up

An important part of effective work conducted by the combat medics on the water is constant revision and rating of action, and examination of emerging situations. The most effective divisions, after completion of each series of evacuations, carry out analysis of action performance (AAP) and review algorithms of preparation and implementation of evacuation, details of equipment, and list of means for granting assistance. Sometimes videos with GoPro are used, where they were shot at the time of evacuations and allowed for recording the order of granting assistance, where statistical data is important material for the AAP.

Besides, combat medics visit surgeons and anesthesiologists at headquarters and at hospitals, discuss with them the condition of evacuees and the efficiency of primary aid. Results of such assessments in the future will be taken into account in changes to the protocol of actions.

It is necessary to communicate the results of such assessments not only to the medics working on evacuation but also to the leader of a medical unit, commanders of different levels, bosses, and soldiers involved in the evacuation actions.

Appendix 1

Typical Models of Boats, Their Description and Use

Rigid-hull flat-bottomed boat		**Advantages:** ▪ It has small draft which makes it convenient for movement in shallow, water bodies, floodplains. ▪ Thanks to its flat hull, it is stable in calm water and can overcome areas where water height does not exceed 50 cm. **Disadvantages:** ▪ Lack of keel does not allow for effective maneuvering - the boat can drift heavily or capsize. ▪ Strong speed restrictions. ▪ Unstable on waves. **Use:** ▪ For use in shallow water bodies, in floodplains.
Rib boat (rigid-hull inflateable boat)		**Advantages:** ▪ Inflatable sides absorb wave impacts and reduce lateral swaying. ▪ The boat is stable, protected from capsizing while maneuvering- ▪ Inflatable cylinders consist of many sections, which increases damage resistance and buoyancy. ▪ Fast. When planing, the boat only touches water with its bottom surface. **Disadvantages:** ▪ If the cylinders are damaged, it loses speed and maneuverability. ▪ Less space than all-metal piling boats, but requires more powerful engine. ▪ If it runs aground, it takes a lot of effort to get back on the water. ▪ If the hull material is plastic, repair is complicated. **Use:** ▪ For use in large reservoirs and in the sea. ▪ To be used where it is necessary to demonstrate pace and maneuverability.

Solid -hull metal keel boat		**Advantages:** ▪ Thanks to keel, it is highly maneuverable. ▪ With proper engine, it can be very fast. ▪ It has lots of usable space. ▪ Resistant to waves, well suited for use in large water bodies. ▪ Resistant to damage and relatively easy to repair. ▪ Capable to run in case of light icing on water reservoirs. **Disadvantages:** ▪ Vulnerable to shoaling. It is difficult to move it towards water. ▪ To install powerful engine, it is necessary to strengthen transom. **Use:** ▪ For use in large reservoirs and in the sea. ▪ To be used where it is necessary to demonstrate pace and maneuverability.
Fully inflatable boat		**Advantages:** ▪ In case of a powerful engine, it can develop high speed. **Disadvantages:** ▪ Has very limited maneuverability. ▪ Vulnerable to damage. ▪ Vulnerable to waves **Use:** ▪ As backup watercraft for small water bodies.

Appendix 2

Sample Checklist for Unit's Combat Medic Before Operation

Sample checklist for unit's combat medic before operation

(checklist developed and provided by MR. Yevhen Lata, senior combat medic of the 126th Brigade of the 30th Marine Corps)

These checklist items are created for specific operations in specific direction of specific unit for specific level of training and support and cannot be used for any other unit without changes and additions.

Knowledge of mission, tasks, operational objectives, evacuation possibilities and own personnel	
Regarding planned task, I have information and answers to the questions WHO, WHAT, WHERE, WHEN, HOW, WHY.	
I know key and backup evacuation points and evacuation procedure.	
I know rules of casualty collection and evacuation of wounded.	
I have information about presence of enemy, enemy forces, resources.	
I have thoroughly studied map of area (satellite, OSM, General Staff).	
I marked on map of area (e.g. in Kropyva) evacuation points, landmarks, locations of friendly and enemy positions, and headquarters.	
I have alternative way to navigate terrain in case if pipeline way doesn't work.	
I know table of passwords, codes, call signs.	
I know rules of radio communication and backup types of communication (passwords, hand signals, light signals, sound signals).	
I know mission personnel, their illnesses, allergies.	
I know adjacent units, I have interacted with other medics and evacuation teams.	
I know procedure for conducting telemedicine (consultations with doctors).	
I know all locations of my and adjacent combat medics and stabilization points.	
I met with unit's chief medical officer and received instructions from him regarding medical planning of mission.	
Individual device	
I checked weather and made sure all my gear and clothing was packed according to forecast.	
I took quality sapper shovel.	
I packed sleeping kit: sleeping bag, emergency bivouac thermal blanket (in warm weather), sleeping mat.	
I made sure I had food and took extra supplies of Idlo food and quick snacks.	
I made sure I would be provided with water and took an extra supply of water, a water filter, disinfectant tablets, and isotonic solution.	
I made sure I had spare trekking socks and warm thermal underwear and fleece clothing (taking into account number of days).	
I protected myself from rain: raincoat, poncho, rain cover for a backpack, airtight bag for things inside, airtight blanket for sleeping bag.	

I took power bank and cables for all necessary gadgets, and I also know procedure for recharging devices during mission.	
I took spare batteries and headset for walkie-talkie, as well as spare batteries for necessary medical or electronic devices.	
I took mosquito, tick, and parasite remedies: mosquito nets, anti- itch creams , etc.	
I took hygiene products: toilet paper, wet wipes, disposable shower caps, sunscreen, toothbrush and toothpaste, etc.	
I took flashlight with red light.	
I took personal body armor (helmet, bulletproof vest, additional body armor, glasses, headphones).	
I chose my uniform and shoes based on weather, task, and terrain.	
I took life jacket (for water operations).	
I took PNB and spare batteries.	
I took food utensils, mini burner, and gas cans.	
Medical equipment and supply	
Unit's combat medic has assembled backpack (some items may be missing or replaced depending on skills)	
Pocket M — Massive bleeding	
Hemostatic bandage (Quikclot Combat Gauze, Celox Gauze, Bloodsaver, Hemostatic)	
Ordinary Ukrainian gauze bandage, or compressed gauze bandage NAR	
X-Stat Injection Applicator	
IT-Clamp	
Israeli bandage - 4 inches	
Israeli bandage - 6 inches	
Israeli bandage - 8 inches	
Medical nitrile gloves	
Pocket A — Airway	
Nasopharyngeal airway	
(26, 28 sizes)	
I- Gel depending on size of military personnel	
Emergency kit cricotomies	
Water-based lubricant	
Medical nitrile gloves	
Pocket R — Respiration	
Occlusion sticker - HyFin Vent, Halo Seals, Fox Seal	
Decompression needle	

Pocket BVM ventilation bag	
Digital thoracotomy set	
Pulse oximeter	
Phonendoscope	
Medical nitrile gloves	
Pocket C — Circulation	
Catheters 20G, 18G, 16G	
Syringes 2, 5, 10, 20 ml	
Drip system	
Donor-recipient blood transfusion kit	
Infusions (depending on skills, mission, and availability in unit)	
Alcohol wipes	
Intraosseous injector	
Plaster roll	
IV Access harness	
Tonometer	
Medical nitrile gloves	
Pocket H — Hypothermia	
Ordinary thermal blankets	
HEAT REFLECTIVE SHELL thermal blanket	
Reusable hand warmers	
Disposable chemical hand warmers	
Thermal Bag Lifesystems Thermal blanket	
Pocket Other	
SAM Splint mobilization tape	
Non-tactical medications (cold, GI, etc.)	
Pen and marker	
Wounded cards printed out	
Sports nutritional gels	
Energy bars	
Externally	
Rescuer's scissors tied to backpack with trench coat	
CAT type harness	
Nodal turnstile	
Soft tactical evacuation stretchers	
Ampoule with necessary medicines	

I picked up stretcher for relief operation	
I have collected required amount of infusion solutions .	
I have agreed and clearly know procedure for replenishing medical supplies and consumables	
I collected necessary amount of medicine for somatic diseases (colds, cardiovascular problems, etc.)	
I checked expiration dates of all medications and solutions.	
I know forces and means of unit's evacuation teams	
I know planned average time for evacuation of victims of various degrees of severity	
I have skills to re-evaluate, convert, and move turnstiles!!!	
Checking availability of medical equipment and knowledge among all soldiers of unit nominated for task	
With all soldiersI checked presence of original turnstile available at one and same place.	
I checked that each soldier has at least 2 original turnstiles.	
I checked that all soldiers have first aid kits at one and same place on their armor or belt-shoulder system	
With all soldiers I checked same contents of first aid kits:	
Original turnstile - 1 pc.	
Quikclot Combat Gauze hemostatic bandage / Celox Gauze - 2 pcs.	
Elastic bandage (6 inches) - 1 pc .	
Gauze bandage 7/14 - 2 pcs.	
Nasopharyngeal airway + lubricant - 1 pc.	
Occlusion sticker - 2 pcs .	
Decompression needle - 1 pc.	
Wounded card - 1 pc.	
Thermal blanket - 1 pc	
Atraumatic scissors - 1 pc.	
Military pill set (meloxicam - 15 mg, paracetamol - 1000 mg, moxifloxacin - 400 mg) - 1 pc.	
Medical gloves - 2 pairs	
Blue marker - 1 pc.	
I made sure that each wounded's card was filled out (full name, unit, allergies, blood type and Rh factor).	
I have verified that all soldiers passed internal theoretical testing on knowledge of MARCH CLS protocol.	
I checked that all soldiers had undergone practical medical training in conditions close to real life.	
I checked that all the soldiers know procedure of action to following medical SOPs:	

Self-help in case of injuries	
Helping wounded mate	
Assistance to civilians, children, and prisoners of war	
Availability of evacuation points and procedures for requesting evacuation	
Turnstile conversion and relocation rules, need assessment for turnstile	
I made sure that all soldiers with chronic diseases did not forget their medications.	
I made sure that all soldiers had insignia (badges).	
Safety measures	
I left all unnecessary gadgets and relevant documents .	
I deleted all confidential information and social media exchange from my phone.	
I turned off all radio devices on myself (watch, GoPro , tablet, etc.).	
I made sure my relatives had access to bank accounts, etc.	
I made sure I had my badge on.	