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KAPITEL 1 / *CHAPTER 1* [1]
MILITARY MEDICAL ORGANIZERS: CLASSIFICATION, STRUCTURAL AND COMPOSITIONAL FEATURES AND MANUFACTURING MATERIALS

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Introduction

The current military-political situation in Ukraine, which has developed in connection with the full-scale invasion, has led to an urgent need to improve the system of medical support for military personnel.

Medical forces are one of the most important branches of the Armed Forces of Ukraine, because they provide medical support to troops, especially in conditions of active hostilities. Military medics occupy a special place among the personnel, as they participate in the evacuation of wounded and sick military personnel, and also provide them with emergency assistance directly on the battlefield. Their duties include not only the practical provision of medical assistance, but also instructing soldiers on actions during shelling or clashes with the enemy: how to evacuate the victim, stop intense bleeding, apply a bandage, etc.

Military medical organizers are of particular importance - specialized products designed for compact, orderly and protected placement of medical equipment and instruments. Their main task is to ensure the fastest possible access to the necessary materials in critical situations, when minutes count, and the life of the wounded person depends on the organization and convenience of the contents. Medical organizers are used both as part of the individual first-aid kits of a serviceman and in collective kits used by medics during evacuation, providing assistance on the battlefield, as well as in deployed field hospitals. They allow for the effective transportation and storage of dressings, tourniquets, hemostatic agents, infusion systems, respiratory support tools and other necessary components.

Research results

In the world practice of tactical medicine, considerable attention is paid to the

[1] **Authors:** *Oliinyk Halyna, Rubanka Alla, Lutsker Tetiana, Ostapenko Nataliia, Mamchenko Yana, Rashkivska Iryna*

standardization of medical organizers and first aid kits in accordance with NATO protocols (TCCC - Tactical Combat Casualty Care). In addition, the Alliance member countries use unified IFAK (Individual First Aid Aptec) kits, which constitute the minimum necessary set to stop critical bleeding, ensure airway patency and stabilize the condition of the wounded until evacuation. Organizers in these systems are developed taking into account ergonomics and quick availability, which allows for the maximum reduction of the time of providing assistance.

Ukraine is gradually integrating these approaches into its own system of medical support for the army. Military medical organizers used in the Armed Forces of Ukraine are increasingly designed according to modern Western models, but taking into account the specifics of national conditions - the intensity of hostilities, climatic features and availability of materials. This makes the topic of analyzing modern military medical organizers relevant in the context of increasing the combat capability of the army and saving the lives of servicemen.

The main consumers and users of medical organizers are volunteer organizations and military medics working in the combat zone, evacuation points or field hospitals.

A military medic is a medical worker (paramedic, paramedic or doctor) who is part of a combat unit or works at a stabilization point. He has basic or advanced training in tactical medicine (TCCC - Tactical Combat Casualty Care) and regularly works in combat conditions. His task is to provide first aid to the wounded on the battlefield or during evacuation.

A volunteer is a civilian who is engaged in the procurement, assembly and supply of medical supplies to military units. Often these are people with experience in logistics, medicine, business or community activism. They cooperate with foundations, charitable organizations or act autonomously.

Apart from the main consumers – military medics and volunteers, there is also a secondary audience that actively uses medical organizers for educational, training and simulation purposes. These are first aid instructors, educational institutions and training organizations that prepare both civilians and military personnel for emergency situations. First aid instructors are qualified specialists who conduct courses in tactical

and civilian first aid (TCCC, MARCH, BLS – Basic Life Support, CLS – Combat Life–Saver, etc.) for military, police, rescuers, volunteers and civilians. They work in certified training centers or within charitable/community initiatives.

The importance of medical organizers lies in:

– quick access to tools and medicines. Time is an important component during emergency care, every second is important for saving a person's life;

– protection of tools and medicines. During movement and transportation, the organizer provides protection with its body;

– organization of the workplace. In conditions of limited space, the organizer helps to save free space.

Medical organizers are divided into two main groups: static and portable (Figure. 1).

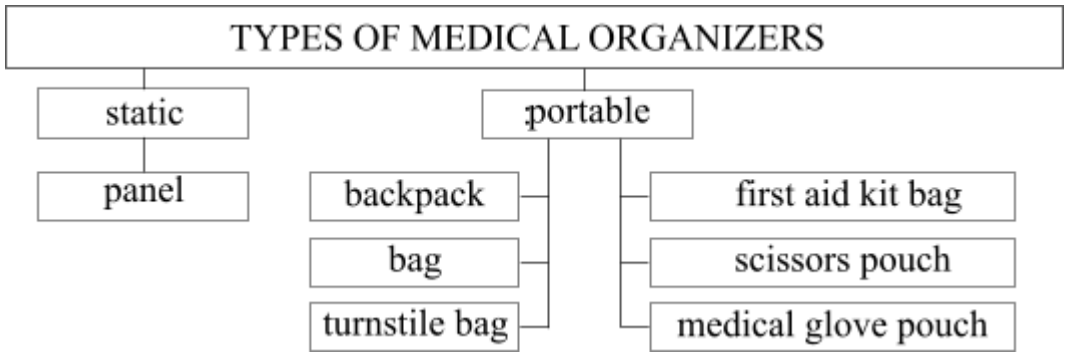


Figure 1 – Diagram of types of medical organizers

*A source: constructed by the authors based on the analysis conducted [**1-9**]*

Static organizers are panels used in the equipment of medical evacuation vehicles and stabilization points (Figure 2). Static organizers can be with:

– elastic band cells (for holding scissors, markers, incubation tubes, ampoules, syringes, etc.);

– pockets (the configuration of the pockets can be different, for example, open or closed with a valve or a zipper tape; different sizes; with a transparent window for visibility of the contents; from different materials, both from the main and from the mesh, or completely from PVC film);

– MOLLE system (fastening system for equipment, pouches and backpacks);

– textile fastener (soft side for attaching pouches, portable ampoules, textile stickers, etc.);

– plastic frame for better shape retention;

– eyelets or fastex for fastening.

Figure 2 - Appearance of types of static organizers

A source: constructed by the authors based on the analysis conducted [1-3]

Stationary organizers come in various sizes and configurations, making it possible to create individual combinations for ease of use. In stabilization points or vehicles, they are mounted near the emergency room. In a vehicle, they are placed in the passenger compartment on the sides or on the ceiling, directly attached to the wall or left suspended, and can be attached to the seats using a fastex fastener (Figure 3).

Figure 3 – Examples of placement of organizer panels

A source: constructed by the authors based on the analysis conducted [4]

Portable organizers are designed to carry tactical medical equipment and medications, and to set up a temporary emergency care location. The mandatory requirements are:

– strength of the material and thread connections;

– ease of opening (textile fasteners, zippers should facilitate quick opening, including with one hand, and access to the contents;

– ease of carrying and fastening (adjustable straps, textile fasteners, MOLLE systems should provide reliable fastening);

– capacity (dividers and pockets allow you to organize the contents);

– camouflage (tactical accessories should be made of fabric, the color of which helps reduce the visibility of the products in the environment) [5]

Various types of portable medical organizers are a medical backpack; a medical bag; a first-aid kit pouch, and specialized pouches for a tourniquet, scissors, medical gloves, and evacuation stretchers (Figure 4).

medical backpack | medical bag

first aid kit bag | turnstile bag | medical glove pouch | medical scissors pouch

Figure 4 – Appearance of types of medical summary reports

A source: constructed by the authors based on the analysis conducted [6-12]

The backpack is the largest product among portable medical organizers. It has a significant number of functional elements (pockets, built-in mounts, etc.) and can be equipped with additional accessories. The main components of the medical backpack include:

– internal and external MOLLE system for attaching additional accessories;
– parts with a large number of cells made of elastic webbing of different widths;
– textile fastener (soft side) sewn on the inside and outside;
– pockets with a zipper.

Additional elements that can be equipped with the backpack:

– pouches for first aid kits;
– medical bags;
– bags for tourniquets;
– additional panels with a textile fastener for tools and medicines;
– waist belt (for ease of carrying when the backpack is fully filled);
– modular handles for comfortable carrying;
– modular stretchers [13-14]

Medical bags are designed to carry medicines and tactical medical equipment. They should provide quick access to a first aid kit for rapid assistance to a wounded person on the battlefield or in other extreme situations. They are smaller than a backpack and have a less diverse content. Medical bags are equipped with:

– a handle;
– a removable, adjustable shoulder strap;
– an integrated tourniquet attachment;
– additional pockets on the outside and inside;
– parts with the MOLLE system for attaching additional pouches.

Pouches are a key part of every soldier's equipment. These are small bags that are attached to a belt or vest. One of the main advantages of military pouches is their convenience, accessibility and compactness. They provide the opportunity to quickly get the necessary items without distracting from combat operations [15].

First aid pouches have the same purpose as bags. They are small in size, open along the entrance line by 180° for convenient use in positions, the inner part has a sufficient number of cells made of elastic tape with and without overlaps for storage and quick access to tactical medicine. For convenience, the pouches are made in both

vertical and horizontal positions.

Among the universal pouches for the first aid kit are specialized for a tourniquet, for scissors, for medical gloves and evacuation stretchers.

The pouches are attached to the equipment in special ways, the most common of which are Natick Snap, Reverse Snap, Tactical Tailor MALICE Clips, Condor MOD Straps, National Molding MOLLE Stix, etc. (Figure 5) [16].

a b c d e

Figure 5 – Appearance of various types of first aid bag fastening systems: Natick Snap (a), Reverse Snap (b), Tactical Tailor MALICE Clips (c), Condor MOD Straps (d), National Molding MOLLE Stix (e)

A source: constructed by the authors based on the analysis conducted [16-17]

Natick Snap is a standardized attachment for equipment bags that closes with a regular or metal snap in one direction.

Reverse Snap is an attachment that closes with a regular or metal snap in the opposite direction to the Natick Snap.

Tactical Tailor MALICE Clips are one of the most common external attachment systems for equipment bags. The molded plastic vertical element has a hole at the running end that is passed through a special hole with a lever and blocks its reverse movement.

Condor MOD Straps are a detachable vertical sling with a button that is attached to a bend in the lower part.

National Molding MOLLE Stix is a connection that has a quick release. The position of the plastic vertical elements is locked by clamping a platform that holds them on horizontal textile slings. A rope is attached to the platforms, when pulled, the pressure on the platforms decreases and the vertical elements are released [16, 17].

Analysis of the military medical organizer market allowed us to analyze and

systematize the materials for their manufacture (Figure 6):

– top and lining materials made of synthetic fibers, resistant to mechanical stress, with high wear resistance, waterproof;

– lining materials, shock-absorbing, resistant to deformation and tearing;

– metal or plastic fittings with increased reliability.

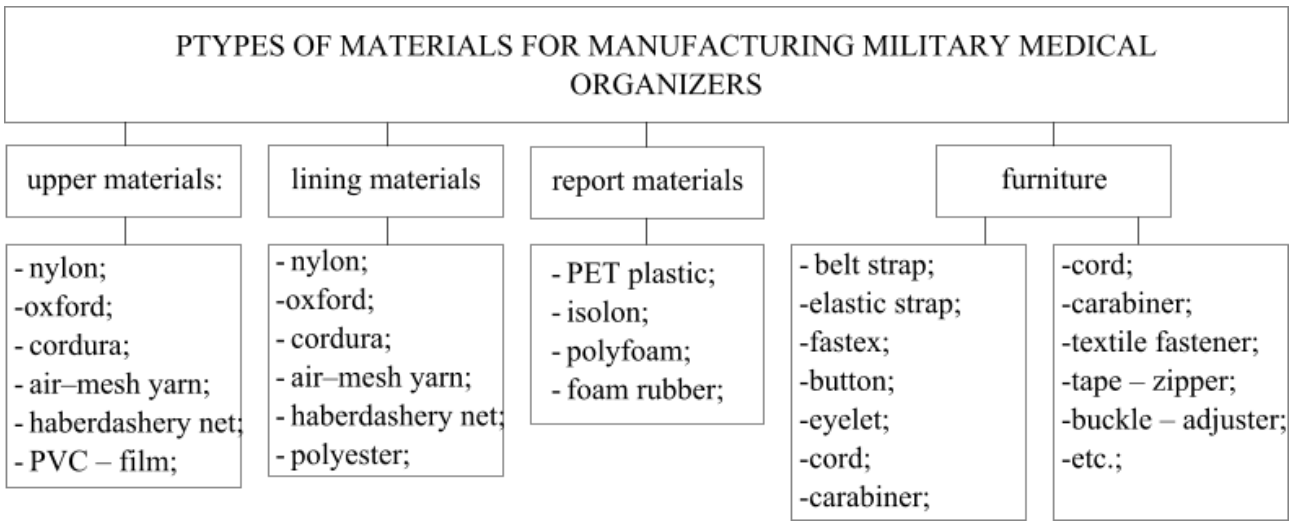


Figure 6 – Systematization of types of materials for the manufacture of military medical organizers

*A source: constructed by the authors based on the analysis conducted [**1-9**]*

The materials used to make the panels must meet a number of requirements: tear and puncture resistance; water resistance; ease of disinfection; resistance to blood, antiseptics, UV radiation; shape retention; light weight; environmental safety (absence of toxic fumes).

One of the most common types of treatment is polyurethane coating (PU), which provides the fabric with water-repellent properties, gives additional strength and wear resistance while maintaining softness. Fabrics with PU coating are convenient for repeated use and withstand treatment with disinfectants.

Another option is thermoplastic polyurethane coating (TPU), which gives the fabric increased strength, water resistance, wear resistance and flexibility. TPU - the coating forms a thin film or layer on the surface of the fabric.

In products where high tightness and protection against liquid penetration are required, polyvinyl chloride (PVC) coating is used. It creates a dense protective layer

that does not let water or air through. Fabrics with PVC coating have high strength indicators, but are less environmentally friendly and heavier compared to PU and TPU.

Among the newest types of treatment, DWR (Durable Water Repellent) should be distinguished - water-repellent impregnation. DWR forms a hydrophobic film on the surface of the fabric that repels water droplets, while maintaining the breathable properties of the material. DWR treatment does not completely protect against water under pressure, but significantly increases resistance to getting wet in the rain or in a humid environment [18].

Antibacterial impregnation also plays an important role, in particular based on silver, copper or zinc ions. Such treatment prevents the growth of bacteria, fungi and the appearance of unpleasant odors.

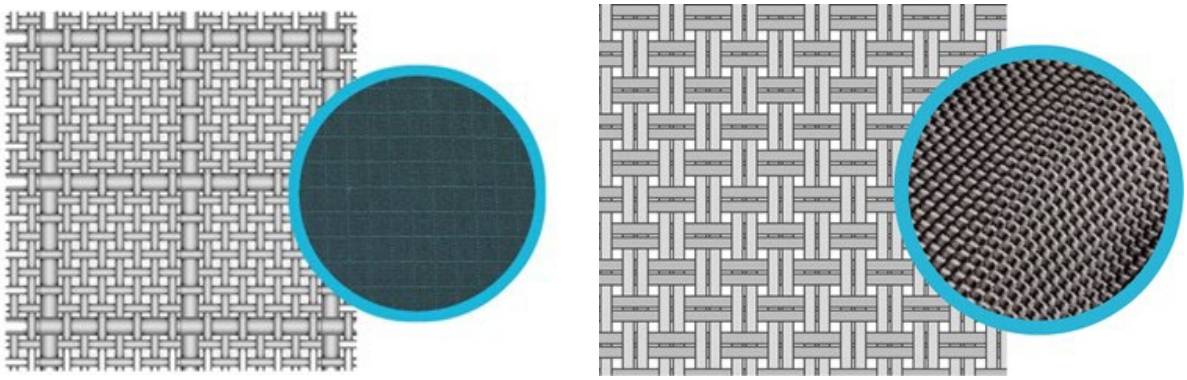
The main materials for the manufacture of military textiles, in particular panels-organizers, are synthetic fabrics based on polyester and nylon, which, thanks to various processing technologies, acquire increased performance characteristics. Among them, such fabrics as Cordura, Oxford and Rip-Stop are most often used. Additional materials for the manufacture of medical organizers are reinforced and PVC film.

Rip-stop is a universal technical material that has been widely used in the production of various industries. Its difference from conventional fabrics lies in the specific structure of the interweaving of threads: thickened reinforcing fibers are introduced at certain intervals, which form a characteristic mesh pattern (Figure 7, a). This design gives the material increased resistance to mechanical damage. In the event of a puncture or tear, the reinforcing mesh localizes the damage and prevents its further spread, which ensures high operational reliability of the fabric [19-20].

To produce Oxford fabric, a “mat” weave is used. It has a characteristic ribbed appearance, which is formed due to the alternation of warp and weft threads. Two or more warp threads are intertwined with one or more weft threads (Figure 7, b). This creates a characteristic relief effect on the surface of the fabric. Visually, the pattern resembles three-dimensional cubes. This weave gives the material additional strength. Oxford is often treated with polyurethane impregnation after manufacture [21-22].

The strongest nylon fabric is Cordura. It differs from Oxford in the processing of

each fiber separately. Nylon threads are subjected to a special impregnation, which increases their strength and resistance to external factors. The weaving of Cordura fabric is the same as that of Oxford - "matting" (Figure 7, b). The resulting fabric is again impregnated with special polyurethane or silicone compounds, which improve its water resistance, dirt resistance and strength. Cordura is 4-5 times stronger than Oxford, but it is quite heavy and costs more [23-26].



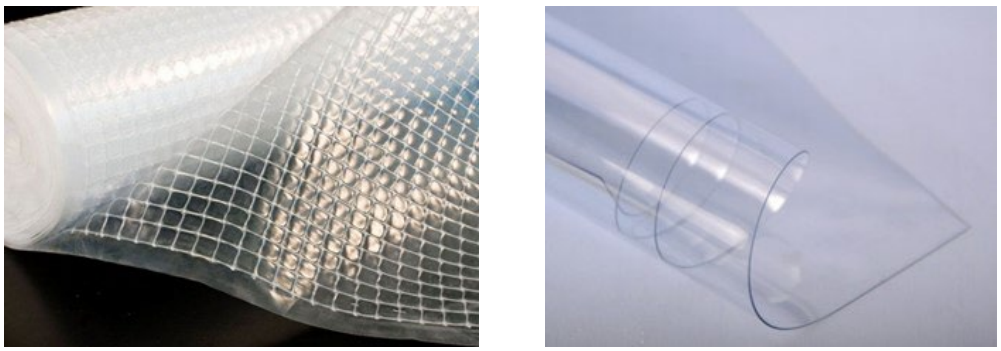
a b

Figure 7. Schematic representation of rip-stop fabric weaving (a), Oxford/Cordura (b)

A source: constructed by the authors based on the analysis conducted [19-26]

Reinforced film is a multilayer material consisting of a mesh frame (reinforcing mesh), to which layers of polyethylene film are welded on both sides (Figure 8, a). Due to this structure, the film has increased strength and resistance to stretching and tearing. Even if the canvas is damaged, the cut or tear will not spread beyond one cell. This makes it easy to restore the integrity of the film by simply sealing the damage with tape or a patch [27].

PVC film is produced in a different range of thicknesses. The thinnest varieties, with a thickness of 20 to 100 micrometers (0.02–0.1 mm). Medium-thick film, from 0.1 to 0.5 mm. Thicker versions reach 0.5–1.5 mm. Reinforced types of film, thickness from 2 to 5 mm and more (Figure 8, b). In the context of medical panels - organizers, transparent PVC film with a thickness of 0.2–0.5 mm is most often used [28-29].



a b

Figure 7. Appearance of reinforced film (a), PVC film (b)

A source: constructed by the authors based on the analysis conducted [27-29]

The main accessories most often used for the manufacture of medical organizer panels include: belt tape, edging tape, textile fastener, elastic tape (rubber band), eyelets, buttons, zipper, reinforced threads. Auxiliary accessories include fastex, frames, straps, carabiners, elastic cord, regulator-cord lock [1-9, 15-18].

Summary and conclusions.

As a result of the research, a comprehensive analysis of the modern range of military medical organizers, as well as materials and fittings used for their manufacture, was carried out. The main types of medical organizers, their design and technological features, functional characteristics and areas of application were determined. The classification of military medical organizers by design features, functional purpose and method of use (static and portable) was systematized. The main types of portable organizers were characterized - backpacks, medical bags, pouches for a first aid kit and specialized pouches (for a tourniquet, scissors, gloves, stretchers, etc.). Modern fastening systems and fittings that ensure ergonomics, reliability and quick availability during use in combat conditions were analyzed. Information is summarized on materials for the manufacture of military organizers, in particular synthetic fabrics (Cordura, Oxford, Rip-Stop) and film materials (reinforced, PVC film), their properties, types of coatings (PU, TPU, PVC, DWR) and special treatments (antibacterial, water-repellent).

The scientific novelty lies in the systematization of types of military medical

organizers and materials for their manufacture, as well as in the isolation of characteristic structural and compositional features of each type. The practical significance of the results obtained lies in the possibility of their use in further design, improvement of designs and increasing the ergonomics of military medical products.

The results obtained will contribute to the development of effective, reliable and user-friendly organizers that will meet the modern requirements of tactical medicine and will contribute to increasing the level of medical support for military personnel in combat conditions.

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Chapter 2.

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