

The object of the study is special clothing for burn patients. The insufficiency of the range of special general-purpose clothing significantly reduces the possibilities of using medical technologies, slows down the provision of medical care, reduces the quality of life of patients in the treatment period. Consideration of protective functions and a functional and constructive approach to the development of special clothing for burn patients are important, given that such clothing should protect the patient from infections and facilitate medical procedures by medical personnel. As a result of the study, a set of special general-purpose clothing for burn patients was developed from the medical fabric «Panacea PP 180» with the antibacterial finish CleanOK, taking into account the requirements of functionality, specific features of medical procedures. The features of designing special clothing for patients with thermal skin lesions proposed in this study create more comfortable conditions for the patient compared to standard hospital clothing. The use of mesh fabric in the side parts ensures compliance with hygienic requirements for clothing that form the microclimate of the under-bed space; taking into account the peculiarities of medical procedures and the topography of their implementation, the development of functional and constructive solutions for a set of special clothing is effective. The practical significance of special clothing for burn patients lies in its protective function against infections, the effectiveness of the rehabilitation effect on the body of a sick person, as well as improving the quality of medical procedures performed by personnel in stationary conditions

Keywords: special clothing, burn patient, medical procedures, classification, functional and constructive approach

UDC 687.1

DOI: 10.15587/1729-4061.2023.272742

DEVELOPMENT OF SPECIAL CLOTHING FOR BURN PATIENTS

Gulnar Shaizadanova

Corresponding author

Lecturer

Department of Design*

E-mail: shaizadanovaagulnar@mail.ru

Kaldygu Kucharbaeva

Candidate of Technical Sciences, Associate Professor

Department of Technology, Design of Products and Goods*

Kamilya Abilkalamova

PhD, Senior Lecturer

Department of Design*

Zhazira Baizhanova

Candidate of Technical Sciences,

Associate Professor, Head of Department

Department of Technology of Light Industry and Design

Kazakh University of Technology and Business

Kayym Mukhamedkhanov str., 37 A, Astana,

Republic of Kazakhstan, 010000

Alima Sabitova

Candidate of Technical Sciences, Associate Professor

Department of Design*

*Almaty Technological University

Tole bi str., 100, Almaty, Republic of Kazakhstan, 050012

Received date 30.11.2022

Accepted date 01.02.2023

Published date 28.02.2023

How to Cite: Shaizadanova, G., Kucharbaeva, K., Abilkalamova, K., Baizhanova, Z., Sabitova, A. (2023). Development of special clothing for burn patients. *Eastern-European Journal of Enterprise Technologies*, 1 (1 (121)), 6–13. doi: <https://doi.org/10.15587/1729-4061.2023.272742>

1. Introduction

Burn injuries are the most important medical and social problem of modern society, due to their prevalence, high mortality, significant indicators of temporary labor losses and primary disability [1]. The problem of designing special clothing for patients with thermal skin lesions is quite new and relevant. The limited range of special-purpose clothing significantly affects the possibility of using high medical technologies, reduces the level of medical care and the quality of life of patients with various diseases. In medical institutions, when choosing hospital clothes, patients prefer household clothes – dressing gowns, pajamas, tracksuits. Such clothes are not comfortable, not hygienic and do not meet the requirements of medical institutions for medical treatment procedures.

The lack of specialized hospital clothing for burn patients increases the likelihood of infection of wounds, increases the time of medical procedures due to the lack of functional and structural elements that facilitate medical manipulations and creates discomfort for the patient himself.

Analysis of regulatory and technical documentation has shown that the existing standards for special clothing for hospital patients do not take into account the peculiarities of various types of diseases, the properties of modern materials that not only improve the ergonomic properties of products, but also contribute to improving the quality of life and the fastest recovery of the patient. The range of clothing regulated by GOST standards is monotonous, does not meet modern functional, ergonomic, hygienic and aesthetic requirements, is extremely limited compared to world practice.

Currently, a number of domestic and foreign companies are engaged in the production of medical and hospital clothing: «Empire of overalls», «Silvert's», «BUCK&BUCK», «Adaptive Apparel», «Easy Access Clothing», etc. [2–6]. However, the range of clothing for patients, as shown by the analysis conducted in hospitals in Almaty, is limited: firms supply only men's and women's hospital suits and women's hospital gowns of the old model. Workwear should perform a protective function, while maintaining the normal functioning of the human body [7]. Analysis of foreign developments has shown that the range of models being developed

is more diverse, but the main disadvantages of the presented models are: the presence of discomfort from the layering of clothing parts when using the «smell» principle; a decrease in the possibility of independence when removing and putting on due to fasteners on the back. Based on the study of existing products, it was found that there is no information about the availability of clothing for patients used in the treatment of thermal skin lesions. In most cases, the developed models are aimed at preventing scarring of the skin, that is, compression underwear.

Therefore, research on the development of special clothing for burn patients, taking into account protective functions and functional and constructive solutions, is relevant.

2. Literature review and problem statement

The work presents the results of research on new technologies in the treatment of burns. It is shown that successes have been achieved in the field of burns treatment: the correct use of the Parkland formula, ensuring the patency of the respiratory tract with high-frequency oscillatory ventilation, early enteral nutrition, accurate assessment of the burn depth by active dynamic thermography, Mica skin transplantation, the use of Integra® artificial skin, a Class III agent, the use of a two-stage replacement strategy with skin grafts, the use of compression clothes with and without silicone, as well as corticosteroid injections give good results [8]. In this study of burn injuries, environmental factors affecting burn injury were investigated. It has been proven that the most common manifestations faced by medical workers are thermal burns and that access to burns is needed more than the burn itself [9]. In the study of occupational disorders in patients with extremely severe mass burns during the recovery period after injury, comprehensive rehabilitation treatment after burns, including wearing sealed clothing, ultrasound treatment, semiconductor laser and red light irradiation, motor function training, and so on, were studied. Within 2 years after the injury, the five most serious violations of professional activity with a frequency exceeding or equal to 16 times were dressing and undressing, bathing, cleaning the perineum, wearing overalls, caring for children, visiting relatives and friends. Self-care disorder ADL was more serious than mobility disorder, and the disorder of individual self-care activity was still the most serious disorder of professional activity of patients at this stage [10]. In the study of the experience of wearing compression underwear after a burn injury, three main topics related to wearing compression underwear were identified: what it's like to wear compression underwear, what it's like to be a patient in a burn service and the impact of clothing on the life and recovery of patients. The results revealed many factors influencing the individual experience of wearing clothes, emphasizing the need for a patient-centered approach on the part of burn service providers. A functional and constructive approach to the development of special clothing for burn patients may be an option to overcome the corresponding difficulties [11–13]. The paper presents the results of a study of the workflow and comparability of compression garments (CG), automatically linked based on 3D body scan data (3DBSD), with data obtained manually for the treatment of scars. In terms of fit, comfort, fitness, Vancouver Scar Scale, patient and observer scar assessment scale, stiffness and microcirculation, this was a promising pilot study. Stiffness and blood flow were increased in the

scars compared to normal skin. The highest rank correlations were found between pain and itching, stiffness and the patient and observer scar assessment scale, the Vancouver Scar Scale and Pain [14]. However, this approach was used in the study of a portable device for measuring the pressure of compression clothing on hypertrophic scars from burn injury during compression therapy, objectively confirmed the effect of pressure therapy with clothing in maintaining the therapeutic pressure range for hypertrophic scars. It is shown that sixty-five participants (aged 20 to 70 years) with partial or full thickness burns, a Vancouver scale scar score of ≥ 4 and hypertrophic scar $\geq 4 \times 4$ cm were included in the study. The compression pressure was measured weekly using a portable pressure monitoring device to regulate this pressure at 15–25 mmHg for 2 months. But, there were no significant differences in melanin levels, transepidermal water loss, or changes measured with Cutometer® between the two groups. In this study, in order to obtain the best clinical results during compression therapy, the need for periodic monitoring and adjustment of compression clothing to maintain compression pressure at an optimal therapeutic level was confirmed, rather than the classical method of compression treatment at monthly intervals or in accordance with the subjective feeling of pressure by the patient [15]. Analysis of the work on new technologies in the treatment of burns has shown that various medical procedures are carried out in the treatment of burn patients, which must be taken into account when developing special clothing for burn patients. The data of the study on the violation of professional activity in patients with extremely severe mass burns during the recovery period after injury confirms that the development of special clothing for burn patients, taking into account medical and nursing procedures, facilitates self-care and provides comfort to the patient. A functional and constructive approach to the development of special clothing for burn patients can be an option to overcome the corresponding difficulties of the experience of wearing compression underwear after a burn injury. The study of rank correlations between pain and itching, stiffness and the patient and observer scar assessment scale, the Vancouver scale of scars and pain, gives the researcher an additional field for further additional research when developing special general-purpose clothing for burn patients. An option to overcome the corresponding difficulties may be to study the pressure of clothing on the human body. This approach was used in the work on the use of a portable device for measuring the pressure of compression clothing on hypertrophic scars from burn injury during compression therapy. But, this study takes into account the pressure of only compression clothing, which is worn only for a certain period, whereas special clothing for burn patients is designed for longer wearing, both during treatment and during rehabilitation. All this allows us to assert that it is advisable to conduct research on the development of special general-purpose clothing for burn patients, taking into account the requirements of functionality, specific features of medical procedures.

3. The aim and objectives of the study

The aim of the study is to consider the protective functions of special clothing and a functional and constructive approach to the development of special clothing for burn patients undergoing treatment.

To achieve the aim, the following objectives were accomplished:

- to determine specific requirements for special clothing for burn patients, taking into account medical procedures;
- to develop a set of special clothing for burn patients, taking into account the requirements of functionality, specific features of medical procedures.

4. Materials and methods

4.1. Topographic method

To determine the list of medical procedures carried out in the treatment of burns, an analysis of the disease was carried out based on the international classification of diseases ICD-10. All procedures are grouped according to the topography of their implementation on the surface of the human body. Thus, based on the analysis, 18 zones were identified, which are indicated by Arabic numerals [16]. Fragments based on the results of the study of the systematization of performed medical procedures and the topography of their implementation are shown in Fig. 1.

The topography of the affected areas of the human body presented in Fig. 1 is necessary for further mathematical processing of the initial information.

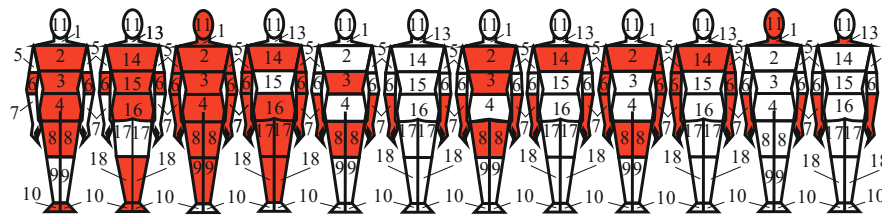


Fig. 1. Topography of the affected areas of the human body

4.2. Method of mathematical processing of the initial information

For mathematical processing of the initial information, a code from A to S was assigned to each site and a data array was formed containing information about the topography of medical procedures and the severity of thermal lesions, in the form of an 18×5 matrix (Table 1). The row of the matrix corresponds to the degree of burn, and the column corresponds to the access zone on the human body for medical procedures. Elements of the matrix a_{ij} ($i=I, II, IIIA, IIIB, IV; j=1, 2, 3, \dots, 18$) are the signs «+» and «-», determined by the ratio:

$$a_{ij} = \begin{cases} +, i\text{-th degree of burn requires} \\ \text{access to the } j\text{-th zone,} \\ -, i\text{-th degree of burn does not need} \\ \text{access to the } j\text{-th zone.} \end{cases}$$

The resulting matrix is the basis for identifying characteristic groups of clothing for burn patients and the corresponding types of diseases that require a single constructive solution for clothing. Following the theory of taxonomic analysis [17, 18], bimodal distributions of classification features are compiled according to the obtained matrix, in which capital letters mean the presence of a feature, and small letters mean the absence:

$$3A+2a=5, 5B+0b=5, 2R+3r=5, 2S+3s=5. \quad (1)$$

Table 1

Matrix of topography data for medical procedures

Code of the topographic site		Degree of burn				
Digit	Latin letter	I	II	IIIA	IIIB	IV
1	2	3	4	5	6	7
1	A	-	-	+	+	+
2	B	+	+	+	+	+
3	C	-	-	+	+	+
4	D	-	-	+	+	+
5	E	+	+	+	+	+
6	F	+	+	+	+	+
7	G	+	+	+	+	+
8	H	-	-	+	+	+
9	I	-	-	-	-	+
10	K	-	-	-	-	+
11	L	-	-	+	+	+
12	M	-	-	-	+	+
13	N	-	-	-	+	+
14	O	-	-	-	+	+
15	P	-	-	+	+	+
16	Q	+	+	+	+	+
17	R	-	-	-	+	+
18	S	-	-	-	+	+

Bimodal distributions allow us to calculate the weights of the coincidences of the presence of ω_{++} or the absence of ω_{--} features using the formulas:

$$\omega_{++} = (x) / (X),$$

$$\omega_{--} = (X) / (x), \quad (2)$$

where (x) is the number of diseases that do not have a classification feature X ; (X) is the number of diseases that have this feature. The weights of the mismatched features are determined by the ratio:

$$\omega_{+-} = \omega_{-+} = -1. \quad (3)$$

For bimodal distributions (1) according to (2), the weights of the coincidences of the presence and absence of classification features are calculated, which is presented in Table 2.

Table 2

Weights of matches of the presence or absence of features

Feature	ω_{-++}	ω_{--}
A	$2/3=0.6667$	$3/2=1.5$
B	$0/5=0$	not defined
C, D	$2/3=0.6667$	$3/2=1.5$
E, F, G	$0/5=0$	not defined
H	$2/3=0.6667$	$3/2=1.5$
I, K	$4/1=4$	$7/4=0.25$
L	$2/3=0.6667$	$3/2=1.5$
M, N, O	$3/2=1.5$	$2/3=0.66667$
P	$2/3=0.6667$	$3/2=1.5$
Q	$0/5=0$	not defined

The next step of classification is the calculation of intra-group (t_{ii}) and intergroup ($t_{i,k}, i \neq k$) taxonomic relations.

4. 3. Regulatory and technical requirements for the material properties

The quality of special general-purpose clothing depends on the properties of the materials. The choice of materials for special general-purpose clothing for burn patients is determined by the type of disease and the area of operation.

As a result of the analysis of normative and technical documentation (GOST 11518-88, GOST 11209-85, GOST 29298-92, GOST 11209-2014), it is recommended to make clothes from mixed materials.

5. Results of the development of special clothing for burn patients

5. 1. Requirements for special clothing for burn patients, taking into account medical procedures

Special clothing for burn patients should be considered in the «man-clothing-environment» system. This system is characterized by a combination of factors that interact and form the state of comfort/discomfort of a burn patient. Such clothing should be functional and take into account the specifics of the patient’s illness. When designing special general-purpose clothing, it is necessary to base on the study of operating conditions, identification of requirements and system analysis of functional and structural elements of general-purpose clothing. The identification of requirements for materials and their choice also affect the design results. Practical recommendations are the choice of optimal solutions for the results of experimental wear (Fig. 2).

Identification of the requirements for special general-purpose clothing was carried out on the basis of a questionnaire among patients in the burn department of the City Clinical Hospital No. 4 in Almaty [19].

Based on the analysis of operating conditions, features of medical procedures, types of burns and severity of diseases, significant requirements for general-purpose clothing for burn patients were identified (Table 3).

Table 3

Requirements for special general-purpose clothing and possible ways to solve them

Requirements	Ways to solve them
Protective	Protection against infections
Ergonomic	Freedom of movement
	Convenience of dressing/removing clothes
Functional	Functional and structural elements and details
Hygienic	Breathability
	Hygroscopicity
	Minimum weight of the product
Aesthetic	Choosing the optimal color solution
Operational	Color stability

The significance of the requirements for special clothing for burn patients makes it possible to develop high-quality, functional, aesthetically beautiful special clothing.

Thus, the fabric «Panacea PP 180» with a fibrous composition – 65 % polyester, 35 % viscose was selected for the manufacture of special general-purpose clothing for burn patients. Weight – 160 g/sq.m., plain weave, for light suits, blousons, dressing gowns [20].

This fabric has the advantages of a blended fabric: polyester is durable, wear-resistant, thin, lightweight; viscose is hygroscopic and resistant to light, vapor permeable, does not cause skin irritation. A dirt-removing (GRU) finish, which can also be applied to fabrics of this group, provides ease of washing off dirt of various origins (blood, food stains, general contamination), which allows you to significantly save on clothing care products [21]. According to the results of tests in the Research Laboratory of Textile Materials Safety Technology of the Almaty Technological University, it was revealed that the finishing of the GRU fabric «Panacea» reduces infection of wounds – blood rolls off without being absorbed into the fabric. The fabric retains its properties throughout the entire service life [22]. All indicators of this fabric conform to the standards and meet the protective and specific properties of special-purpose clothing.

5. 2. Designing a set of special clothing for burn patients, taking into account the requirements of functionality, features of medical procedures

The development of a design drawing of a set of special general-purpose clothing for burn patients was carried out according to the

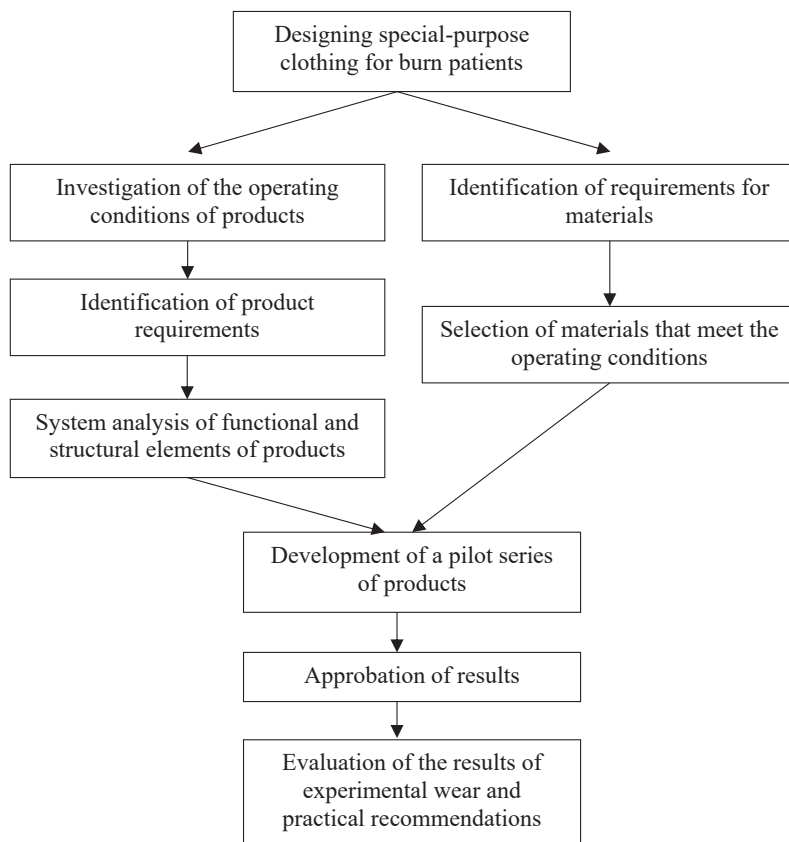


Fig. 2. Design of special general-purpose clothing for burn patients

method of the Unified methodology for designing clothes of Countries of Mutual Economic Assistance [23] in the Grafis automated system [18, 24], which reduced the time for developing models and layouts, improved the quality of patterns and the possibility of reproducing patterns in increments [25]. The developed model design of a set of clothes for burn patients in the Grafis automated system is shown in Fig. 3. The developed model of a set of special general-purpose clothing has protective properties due to the use of antibacterial fabric and specific features, due to the design and technological solution of the components of the product parts.

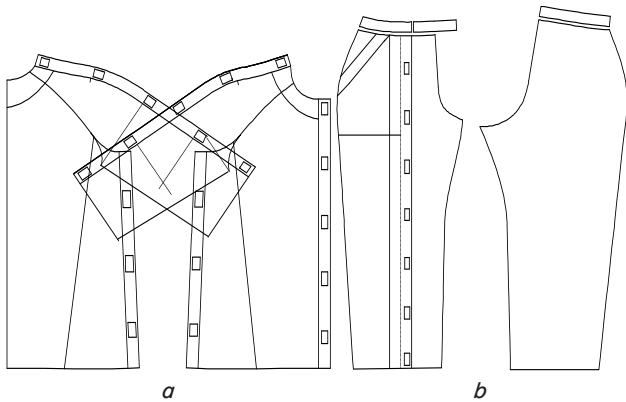


Fig. 3. Development of a model design of a set of clothes for burn patients in the Grafis system: *a* – model design of a jacket, *b* – model design of trousers

A distinctive feature of the set is that for carrying out medical procedures for burn patients, detachable parts of the raglan sleeve, shelves and backs along the shoulder section and the upper section of the sleeve were developed. The detachable parts are adjustable and fixed with a «Velcro» tape. The side part is made of mesh fabric, which provides good breathability and dries quickly. Side seam, unbuttoned/fastened for the convenience of carrying out medical procedures in this area (Table 2). Single-breasted clasp on a «Velcro» tape.

Trousers along the middle line of the front half are detachable, which allows for catheterization and other medical procedures without undressing or disturbing the patient. The detachable parts are adjustable and fixed with a «Velcro» tape. The waistline is treated with an elastic tape, which provides comfort and convenience in wearing. There are patch pockets for the catheter on the front half. The set of clothes meets hygienic requirements, which ensures the normal functioning of the body, keeps the human body clean, protects against chemical and biological influences [26]. The detachable parts are designed to provide access to various parts of the patient's body during medical procedures and not to completely open the victim's body.

5. 2. 1. Functional and constructive solution of clothing parts






The functional and constructive solution of the set parts was developed taking into account the analysis and research of the performed medical procedures and the topography of their implementation (Table 4).

The developed set of special general-purpose clothing for burn patients has been tested in the State Clinical Hospital No. 4 in Almaty, with positive feedback from both patients and medical personnel and meets hygienic requirements, which contributes to the normal functioning of the

body and protection of the human body from adverse effects. The use of various functional and constructive techniques facilitates the conduct of medical procedures and provides comfort to a burn patient in a medical institution.

Table 4

Functional and constructive solution of parts of a set of general-purpose clothing

No.	Drawing	Options for functional and constructive solutions of parts
1		An unbuttoning/buttoning board in case of damage to the anterior corners of the armpit, chest, anterior abdominal wall
2		An unbuttoned/buttoned side section when the side of the trunk is affected. To ensure the breathability of clothing, the side part is made of mesh material
3		Unbuttoning/buttoning along the shoulder section and the upper section of the sleeve when the upper and front parts of the trunk, upper and lower parts of the upper extremities are affected
4		Stretchable/adjustable belt, patch pocket for the catheter
5		Unbuttoning/buttoning along the middle line of the front half of the trousers, when the lower part of the trunk, the lower limb are affected from all sides

5. 2. 2. A set of special general-purpose clothing

When designing special general-purpose clothing, the requirements of patients and all of the above indicators were taken into account: functional and structural elements and parts were developed taking into account the topography of the affected areas and the specifics of medical procedures (Table 3, Fig. 4).



Fig. 4. A set of special general-purpose clothing for burn patients

5. 2. 3. Classification of the range of special clothing for burn patients

Calculation of intragroup (t_{ii}) and intergroup ($t_{i,k}, i \neq k$) taxonomic relations is carried out by the formula:

$$t_{ik} = \frac{1}{18} \sum_{x=A}^S \omega_{xi}, \quad i = \overline{1;5}, \quad k = \overline{1;5}, \quad (4)$$

where ω_X is equal to the corresponding weight determined by (2) and (3) for the sign X .

The analysis of the calculations of intra-group taxonomic relations t_{ii} showed that it is advisable to design clothes on one basis with the use of additional functional and structural parts or elements.

When comparing an object (the severity of a burn) with each one according to the values of taxonomic relations, taxon blocks are formed, which can be considered as options for a constructive solution of special general-purpose clothing for patients with thermal lesions. The division of objects into taxa is the final stage of classification [24]. As a result, four taxa were obtained, combining the types of burns into four

groups. The classification of the range of special clothing for patients with thermal lesions is shown in Fig. 5.

This classification allows the doctor, depending on the severity of the burn lesion, on the purpose of treatment, to provide the patient with thermal lesions with special clothing for burn patients in the shortest possible time, after diagnosis.

6. Discussion of the results of the study on the development of special clothing for burn patients

During the research of the fabric «Panacea PP 180» in the Research Laboratory of Textile Materials Safety Technology of the Almaty Technological University according to standard methods, the following quality indicators were confirmed:

- the fabric has an air permeability of more than $40 \text{ dm}^3/\text{m}^2\text{s}$, hygroscopicity of more than 11 %;

- oil-based pollution protection – oil repellency (initially/after 5 washes) – 5/4 points; water-based – water repellency (initially/after 5 washes) – 100/95 conl.units;

- tear resistance – breaking load (based on/according to the duck) – 870/540 N, coloring to dry friction – 5 points, to wet friction – 4.5 points.

All indicators conform to the standards and meet the protective and specific properties of special clothing for burn patients. Based on the analysis of the planned specific solutions and taking into account the task of developing universal design solutions with detachable parts of products corresponding to the medical procedures carried out, the results of a patient survey and analysis of the initial model designs of shoulder and waist clothing were used. When designing special general-purpose clothing for burn patients, a set of jackets and trousers was developed (Fig. 3, 4). A distinctive feature of the set is that removable parts of the raglan sleeve, shelves and backs along the shoulder section and the upper part of the sleeve were developed for carrying out medical procedures for burn patients. The removable parts are adjustable and fixed with a «Velcro» tape. This feature, unlike hospital gowns, allows access to the upper torso and arms. The side part is made of mesh fabric, which provides good breathability and dries quickly. Unlike medical hospital gowns, the developed model has a side seam that is unbuttoned/fastened for the convenience of medical procedures in this area (Table 2), without turning over or disturbing the patient. The single-breasted clasp on a «Velcro» tape, unlike button fasteners, allows you to easily remove and put on special clothes, once again without injuring the patient.

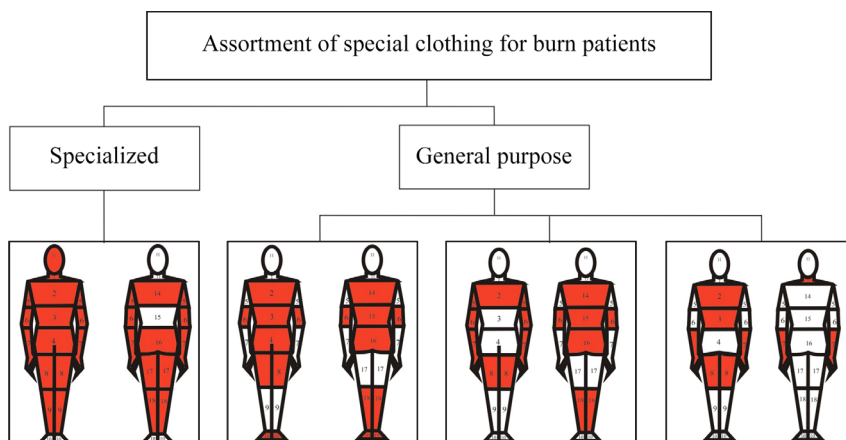


Fig. 5. Classification of the range of special clothing for burn patients

Trousers along the middle line of the front half are unfastened, unlike simple trousers, which allows for catheterization and other medical procedures without undressing and without disturbing the patient. The removable parts are adjustable and fixed with a «Vilcro» tape, which makes it easy to unbutton and fasten this area of trousers. The waistline is treated with an elastic band, which, unlike the zipper closure, provides comfort and convenience when wearing due to the elasticity of the belt, the trousers stretch along the belt to the required width. There are patch pockets for the catheter on the front half. Unlike the side pockets of trousers of simple models, it does not injure the patient's skin from the inside. The set of clothes meets hygienic requirements, which ensures the normal functioning of the body, keeps the human body clean, protects against chemical and biological influences [26]. The detachable parts are designed to provide access to various parts of the patient's body during medical procedures and not to completely undress the victim's body.

The limitations of this study are methodological in nature: there are few past scientific studies on the development of special clothing for burn patients, which limits the ability to conduct comparative analyses of the results of the study.

This study has limitations of a thematic nature: the limits of applicability of the proposed solutions and the results obtained also imply the scope of application, that is, special clothing for burn patients. The ranges of input data (topography and features of medical procedures in Fig. 1) within which the results obtained are adequate (the data matrix in Table 1 and the weight of matches in Table 2) can be reproduced, leading to the stated solutions (Table 3, Fig. 3, 4).

The COVID-19 pandemic and related social restrictions, such as isolation and restricted movement, affected the sample size in the questionnaire survey. With the improvement of the epidemiological situation, the study can be supplemented with a large number of respondents.

The disadvantages of this study are the timing of testing (up to 6 months) and the number of special clothing for burn patients (7 units). In the future, it is necessary to carry out testing for more than 6 months and produce more than 15 units of special clothing.

Difficulties are associated with the specifics of the disease, depending on the degree of burn, the problem of limited access to burn patients.

The development of this study may consist in induction through the study of a single representative of a certain class, that is, a deeper and detailed study of the specifics of treatment with the development of special clothing for each degree of burn separately. Difficulties may be experimental in nature, related to the specifics of the disease, depending on the degree of burn, the problem of limited access to burn patients.

7. Conclusions

1. According to the international classification of diseases ICD-10, the proposed medical procedures were analyzed and grouped into 18 main zones.

Processing of the initial information consisted in the fact that each site was assigned a code from A to S with further formation of a mass of data containing information about the topography of medical procedures and the severity of thermal lesions, in the form of a matrix of dimension 18×5.

As a result of the calculations performed and according to the division of objects into taxa, the range of special clothing for burn patients is classified into two main groups: specialized and special general-purpose clothing.

The requirements for special clothing for burn patients were determined on the basis of a questionnaire survey of patients and medical staff of the burn department of the City Clinical Hospital No. 4 in Almaty and also on the basis of an analysis of operating conditions, features of medical procedures, types of burns and severity of diseases of burn patients. Significant requirements are as follows: protective, ergonomic, functional, hygienic, aesthetic, operational.

2. A set of special general-purpose clothing for burn patients, made of medical fabric «Panacea PP 180», has been developed and tested, which provides ease of washing off dirt of various origins. The use of mesh fabric in the side parts ensures compliance with hygienic requirements for clothing that form the microclimate of the under-bed space (temperature, hygroscopicity, breathability), which allows the developed clothing to provide a burn patient with comfortable conditions in the premises of a medical institution.

Conflict of interest

The authors declare that they have no conflict of interest in relation to this research, whether financial, personal, authorship or otherwise, that could affect the research and its results presented in this paper.

Financing

The study was performed without financial support.

Data availability

Data will be made available on reasonable request.

References

1. Brusselaers, N., Monstrey, S., Vogelaers, D., Hoste, E., Blot, S. (2010). Severe burn injury in europe: a systematic review of the incidence, etiology, morbidity, and mortality. *Critical Care*, 14 (5), R188. doi: <https://doi.org/10.1186/cc9300>
2. Empire of overalls LLP. Available at: <https://overall.kz>
3. Silverts Adaptive LLC. Available at: <http://www.silverts.com/>
4. Buck & Buck. URL: <https://www.buckandbuck.com/>
5. Personal Touch Health Care Apparel Inc. Available at: <http://www.nursinghomeapparel.com/>
6. Easy Access Clothing. Available at: <http://www.easyaccessclothing.com/>
7. Production of workwear in the Republic of Kazakhstan: report on the results of marketing research. National Chamber of Entrepreneurs of the Republic of Kazakhstan «Atameken». Nur-Sultan, 74.

8. Kearney, L., Francis, E. C., Clover, A. J. (2018). New technologies in global burn care - a review of recent advances. *Int J Burns Trauma*, 8 (4), 77–87.
9. Mayer, C. L., Werman, H. A. (2019). Management of Burn Injuries. *Relias Media*. Available at: <https://www.reliasmedia.com/articles/143698-management-of-burn-injuries>
10. Shi, J. J., Shen, A. M., Sun, Y., Li, Z., Jiao, L. (2018). Occupational activity disorders of extremely severe mass burn patients in recovery period after injury: a cross-sectional survey. *Chinese Journal of Burns*, 34 (9), 624–628. doi: <https://doi.org/10.3760/cma.j.issn.1009-2587.2018.09.012>
11. Coghlan, N., Copley, J., Aplin, T., Strong, J. (2019). The experience of wearing compression garments after burn injury: «On the inside it is still me.» *Burns*, 45 (6), 1438–1446. doi: <https://doi.org/10.1016/j.burns.2018.08.014>
12. Coghlan, N., Copley, J., Aplin, T., Strong, J. (2019). How to improve compression garment wear after burns: Patient and therapist perspectives. *Burns*, 45 (6), 1447–1455. doi: <https://doi.org/10.1016/j.burns.2019.04.018>
13. DeBruler, D. M., Baumann, M. E., Zbinden, J. C., Blackstone, B. N., Bailey, J. K., Supp, D. M., Powell, H. M. (2020). Improved Scar Outcomes with Increased Daily Duration of Pressure Garment Therapy. *Advances in Wound Care*, 9 (8), 453–461. doi: <https://doi.org/10.1089/wound.2020.1161>
14. Kisch, T., Stang, F. H., Mailaender, P., Schleusser, S., Michel, D., Trieb, R. et al. (2021). Smart Scar Care-Industry 4.0 in Individualized Compression Garments: A Randomized Controlled Crossover Feasibility Study. *Plast Reconstr Surg Glob Open*, 9 (7), e3683.
15. Joo, S. Y., Cho, Y. S., Yoo, J. W., Kim, Y. H., Sabangan, R., Lee, S. Y., Seo, C. H. (2022). Clinical Utility of the Portable Pressure-Measuring Device for Compression Garment Pressure Measurement on Hypertrophic Scars by Burn Injury during Compression Therapy. *Journal of Clinical Medicine*, 11 (22), 6743. doi: <https://doi.org/10.3390/jcm11226743>
16. Shaizadanova, G. S., Kucharbayeva, K. Zh., Mokeeva, N. S. (2020). Research of constructive and technological solutions for the development of special-purpose clothing for burn patients. *Bulletin of ATU*, 2 (127), 43–49.
17. Smirnov, E. S. (1969). *Taxonomic analysis*. Moscow, 191.
18. Bilon, E. (2019). Using Bloom's Taxonomy to Write Effective Learning Objectives: The ABCDs of Writing Learning Objectives: A Basic Guide. Independently published, 25–28.
19. Kucharbayeva, K. Zh., Mokeeva, N. S., Shaizadanova, G. S. (2019). Development of a set of clothes for patients with thermal lesions. *Bulletin of ATU*, 4 (125), 82–87.
20. Tchaikovsky textile. Available at: <https://textile.ru/products/speccloth/med/160p>
21. Forma-odezhda. Available at: <https://forma-odezhda.com/search/?search=%D1%82%D0%BA%D0%B0%D0%BD%D1%8C%20%D0%BF%D0%B0%D0%BD%D0%B0%D1%86%D0%B5%D1%8F>
22. Shaizadanova, G. S., Kucharbayeva, K. Zh., Mokeeva, N. S. (2019). Research and selection of materials for special-purpose clothing for burn patients. *Innovative development of food, light industry and hospitality industry: Materials of the International Scientific and Practical Conference*. Almaty, 205–207.
23. The methodology of designing a capacious COMECON. *Tkanix.info*. Available at: <https://www.tkanix.info/shitye/metodika-konstruirovaniya-emko/>
24. Bykovskaya, E. V., Sitnikova, O. G. (2013). Systems of classification of reserves for the growth of the quality of functioning of production systems. *Tambov: Publishing house of FGBOU VPO «TSTU»*, 104.
25. Surikova, G. I., Surikova, O. V., Kuzmichev, V. E., Gnidenko, A. V. (2019). Designing of light industry products in CAD (clothing CAD). *Moscow: ID «FORUM»: INFRA-M*, 336.
26. Shaizadanova, G. S., Kucharbayeva, K. Zh. (2019). Development of special-purpose clothing for patients with thermal lesions. *Mater. International Scientific and Practical conference «Global Science and Innovations V»*. Gdansk: Eurasian Center for Innovative Development DARA, 302–306.