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CREATING A SYSTEM OF MEDICAL AND PSYCHOLOGICAL REHABILITATION OF EXTREME PROFESSIONS REPRESENTATIVES (FIREMEN-RESCUERS AS A MODEL)

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Abstract

Background. Working conditions of representatives of extreme professions (firemen-rescuers are a good example), are connected with disregulations and disorders of physiologic functions, fatigue accumulation and disadaptation. The medical and psychological rehabilitation is an effective way for occupational health and reliability restoration. However, last one is characterized by an empirical approach and conducted by priority of medical component, that significantly reduces effectiveness of the undertaken measures. So, it is necessary to develop a system of combined medical and psychological rehabilitation (MPR).

Materials and methods. In this project MPR was carried out in 238 specialists of three professional groups: firemen-rescuers (146), fire-engine drivers (44) and inspectors of fire safety (48 - control). Psychophysiological examination included the computerized program “MORTEST”, variant “SPAS-14” performance, answers to the individual-typological questionnaire (ITQ) and Eysenck personal test (EPT). The levels of epinephrine (E), norepinephrine (NE), dopamine (DA) and dioxyphenylalanine (DOPA) urinal excretion, the vanillylmandelic (VMA) and homovanillic acids (HVA) levels in urine were also defined. The survey is conducted three times: at the beginning, middle and the end of a 12-day rehabilitation course. Statistical data processing was carried out by common programs in Microsoft Excel.

Results and discussion. The studies have shown that the attributes to identify individual-typological differences are indicators of extroversion-introversion and anxiety in tests ITO and EPT. The results were divided into three clusters: extroverts with low anxiety (52.9%); ambiverts with low (27.7%) and high anxiety (19.4%). Simultaneously it was assigned different types of SAS response in the rehabilitation process: basic or balanced, epinephrinic, norepinephrinic, and with low secretory activity. Low efficiency of rehabilitation measures occurred in $40.7 \pm 5,1\%$ of surveyed firefighters with epinephrinic response type and SAS functional exhaustion. The type of SAS response allocated 3 levels of stress in fire-rescuers: adequate to professional load, with the signs of hormonal and mediatorial dissociation, and dangerous - with the depletion of all links of SAS.

Conclusion. According to the results of the performed researches it was developed a system of MPR, which allows to conduct a differentiated remediation of firemen-rescuers in the view of occupational features, individually-typological properties of the rehabilitants' personality, the nature and degree of changes in the central nervous, autonomic and hormonal systems. The developed approaches included in the elaborated Methodical Guidelines, implemented in practice.

Key words: extreme professions, firemen-rescuers, medical and psychological rehabilitation, psychophysiological assessment, psychological markers, catecholamines excretion, effective measures elaboration.

Introduction. Stress-producing working conditions of representatives of extreme professions (firemen-rescuers can be a good example), are connected with disregulations and disorders of physiologic functions, fatigue accumulation and disadaptation [1-3]. That is why the questions of medical and psychological rehabilitation (MPR) of the given contingents (most of them operators) are exceptionally important [4,5]. At the present time in Ukraine medical and occupational rehabilitation of firemen-rescuers is carried out mainly in the Specialized rehabilitation center at the base of the health resort «Odessky» [6]. However the measures taken are characterized by empirical approach, fragmentarity and priority of medical (pathogenic) component, which considerably negates its effectiveness. That is why creation of a complex system of MPR of firemen-rescuers, which includes both medical and psychophysiological components, is very important and of great current interest at the present time. This determined the purpose of the given work.

The purpose of the study was the scientific substantiation, development and implementation of psychophysiological and psychological rehabilitation of fire rescuers as an effective measure of restoring their occupational safety and health.

Materials and methods. Under observation were 238 specialists of the uniformed forces of the Government Service of Ukraine for Emergency Management, who underwent MPR in the above mentioned rehabilitation center. Three professional groups were singled out: firemen-rescuers (146), fire-engine drivers (44) and inspectors of fire safety (48 - control). The average age of examined people was $36,5 \pm 1,3$ years, the length of work was $12,9 \pm 1,3$ years.

Psychophysiological examination was carried out with the help of the automated and computerized program "MORTEST" (its variant «SPAS-14») [7]. It included a range of such pattern as reaction to a moving object (RMO), lability of nervous processes (LNP), attention dividing and attention switch according to Schulte-Psjadlo and Schulte-Gorbov Tables. Current emotional state was estimated on the basis of criteria of the modified pairwise eight-color Lüscher test and the HAM (Health, Activity, Mood) questionnaire. Personal and individual typological characteristics were defined by L.N. Sobchik PTQ questionnaire [8] and Eysenck Personality Questionnaire (EPQ) [9]. Examination was carried out in the beginning, in the middle and at the end of the 12-day rehabilitation course.

The levels of free and fixed catecholamines (CA): epinephrine (E), noraepinephrine (NE), dopamine (DA) and also dioxyphenylalanine (DOPA) excretion with urina were defined by spectrofluorometric method with the help of the apparatus SM 2203 «Solar» [10]. The levels of excretion of vanillylmandelic (VMA) and homovanillic acids (HVA) were defined by immunoenzymometric assay (IEMA) with the help of standard sets of chemical reagents, the immunoenzymometric analyser RT-2100C «Rayto» was used for registering the results. Statistical data processing was carried out with the help of a package of standard computer programs in Microsoft Excel [11].

Results of the investigation. The developed system of MPR presupposes presence of psychological, psychophysiological and medical components. The results of years-long researches conducted by the authors, according to which in firemen-rescuers decrease of the indicators of psychological and psychophysiological status, functional disorders in physiological systems' activity and the high level of accumulated chronic pathology were detected, showed the necessity of such combination, which is reflected in a range of publications [12 - 15].

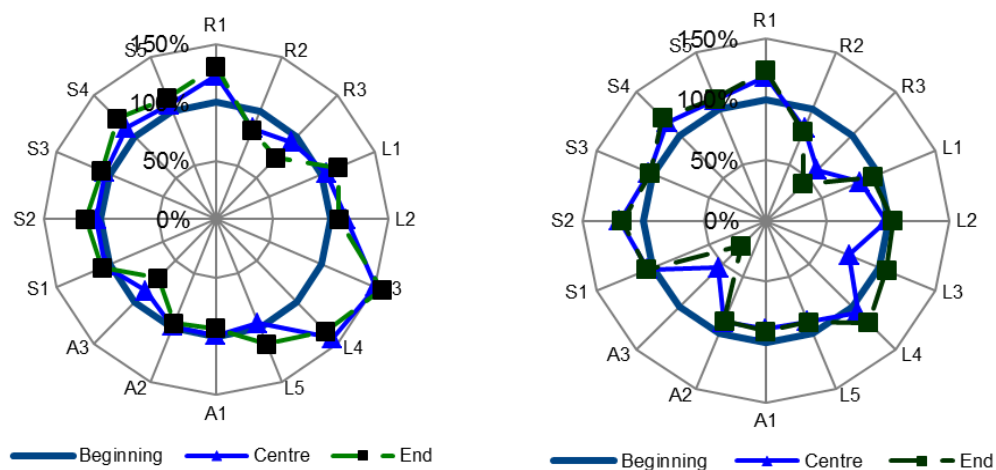
The suggested psychodiagnostic complex allows to discover different dynamics of psychophysiological changes in the process of MPR depending on PTQ, which gives us the possibility to estimate the changes which occur qualitatively as well as quantitatively. In complex diagnostics the original functional state of a rehabilitant, psychophysiological status as of the date of examination, and also his personal peculiarities are taken into consideration.

For detecting intragroup personalistic and typological differences among firemen-rescuers indicators of introversion and anxiety on the basis of the PTQ test were chosen as determining

characteristics [14]. The obtained data was divided into three clusters. Extroverts with a low level of anxiety came into the first cluster, the second cluster was formed by ambiverts with a low level of anxiety and the third – by ambiverts with a high level of anxiety (there were no evident introverts among the examined).

The results of the cluster-based analysis testify about the various personalistic and typological patterns of the selected groups, each of them has a set of peculiarities. People, who came into the first cluster (more than 52,9 per cent of the examined), are characterized by maximum extroversion, minimum introversion, evident leadership qualities, the lowest level of individualism and dependence, which is inherent for behaviour of a hyperthymic type of personality. The second cluster (27,7 per cent of the examined) occupies the intermediate position and is characterized by the lowest level of proneness to conflict in comparison with the two others. And, finally, the representatives of the third cluster (19,4 per cent of the examined) are characterized by the highest sensitivity (sentimentality, commitment to authority of a more strong personality), anxiety, agreeableness and ability to compromise, which is characteristic of hypothythic constitutional structure of a vexatious type of personality [15].

Figure 1 illustrates the dynamics of the functional state of firemen- rescuers with different personalistic and typological pattern in relative units (per cent), however the indicators as of the date of admission to the rehabilitation center were taken as a starting point (significance of differences at the level of $p < 0,05$).

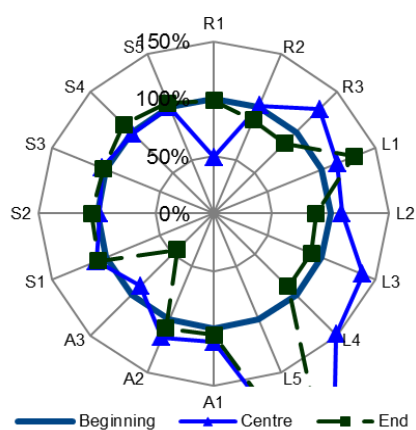


A

B

Abbreviations:

- A1 Schulte test, time
- A2 Schulte-Gorbov test, time
- A3 Schulte-Gorbov test, errors
- S1 Health
- S2 Activity
- S3 Mood
- S4 Motivation
- S5 Interest
- R1 RMO. Tranquility
- R2 RMO. Error
- R3 LNP
- L1 Vegetative coefficient
- L2 Total deviation
- L3 Psychic tension



C

Fig. 1 Psychophysiological measures dynamics in the process of medical-psychophysiological rehabilitation. Subfigures A, B, C describe profiles of clusters 1-3 respectively

The cluster of extroverts with a low level of anxiety is characterized by a gradual increase of interest, motivation, mood, activity and improvement of health in the middle and, especially, at the end of the rehabilitation course, which reflects their psychological readiness to psychocorrective influence during the given period. Herewith the quantity of errors while doing attention tests is also orderly decreasing, the balance of excitation and inhibition is increasing, LNP and the vegetative coefficient grow. However some growth of the level of anxiety and psychoemotional tension as a reaction of reorganization of adaptational mechanisms to prospective changes should be noted.

Dramatic growth of indicators of interest, motivation, mood, activity and health already from the middle of the course occurs in the cluster of ambiverts with a low level of anxiety. The same dynamics is a characteristic of RMO and LNP errors. Among attention indicators besides lowering of the quantity of errors there is also cutting time for doing Schulte and Schulte-Gorbov tests, which reflects more dynamic recovery of attentional capacity and attention switch. The vegetative coefficient decreases in the middle of the course, and then equalizes to the state of balance. In psychoemotional sphere decrease of psychic tension in the middle of the course and some increase of it by the end of rehabilitation is observed. In totality with dynamics of emotional stress we can speak about reaching the optimum level of functioning, necessary for continuing work activities.

In the cluster of ambiverts with the high level of anxiety inessential change of the HAM (Health, Activity, Mood) test indicators happens, among which only motivation considerably grows. With that the balance of excitation and inhibition considerably decreases in the middle of the course at the expense of predominance of excitatory reactions, by the end of the course this indicator returns to the initial level. The same as in the previous clusters the quantity of RMO errors

decreases by the end of the rehabilitation period. Dynamics of the quantity of LNP errors also relates to particular persons: at first it decreases, and then increases, however it remains within the range meeting the professionally important qualities requirements of the given contingent. The vegetative coefficient orderly grows during the whole rehabilitation period. During the first week of rehabilitation in the given group the total deviation from the autogenous norm increases, as well as psychic tension, emotional stress and the level of anxiety according to Lüscher as a reaction of adaptation to new living environment. On the 10th-12th day of rehabilitation these indicators decrease and reflect the dynamics of the psychoemotional status as a result of positive influence of rehabilitation measures. It should be noted that psychic tension equalizes in all the clusters at the end of rehabilitation and is within the limits of $2,3 \pm 0,05$ points, emotional stress for this cluster also corresponds to the minimum level of $2,0 \pm 0,05$ points. The high level of anxiety is a personalistic and typological characteristic of this cluster and reflects hypersusceptibility to changes, quickness of reaction, sensitivity to external influences. At the same time the level of situational anxiety in absolute terms according to Lüscher is minimum in reference to two other groups, in spite of increase of this indicator during the rehabilitation. Now it can be seen that the obtained data reflects the main peculiarities of dynamics of psychophysiological indicators for the rehabilitants with various personalistic and typological patterns, their adaptive capabilities and objective laws of rehabilitation process in reference to genetic factors. The obtained dynamics testifies about different speed, and in some cases different directionality of changes occurring in similar under personalistic and typological properties groups and reflects the necessity of such dynamic observation for improving MPR quality, as well as for estimating its effectiveness in every particular case.

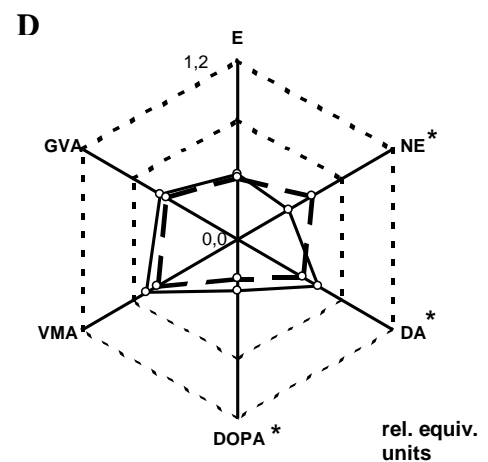
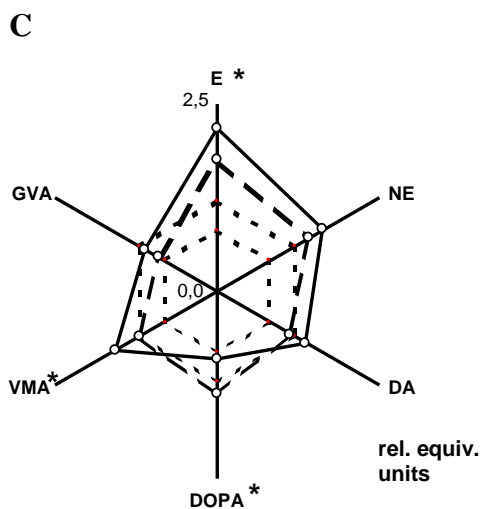
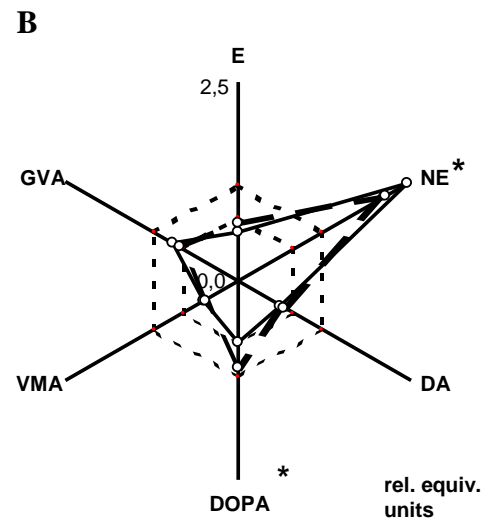
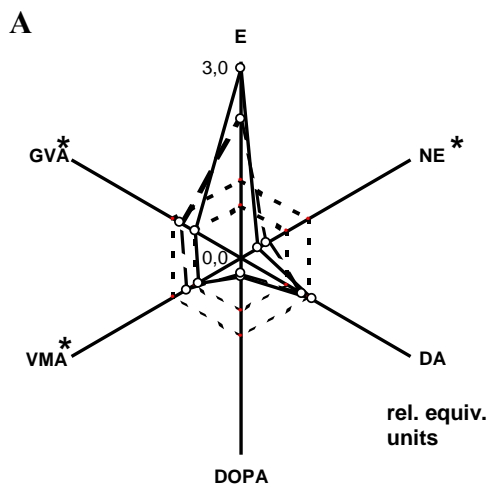
The investigation of MPR effectiveness was carried out not only according to the indicators of psychophysiological status of firemen, but according to the indicators of activity of the sympathoadrenal system (SAS). This being selected of the following types of the SAS reaction, singled out as: the main or balanced, "epinephrinc", "norepinephrinc" and the type with the reduced secretory activity of SAS, in these types different effectiveness of recovery and rehabilitation measures was determined. Decrease of occurrence of hormone - mediatorial dissociation was observed in persons with "epinephrinc" variant of SAS functioning (ref. fig. 2A), but the ratio of E to NE did not reach the control indicators at the end of the rehabilitation, the sufficient recovery of SAS reserves was not detected. However 18 per cent of observed people had some evidences of type inversion, on the 12th day they belonged to the balanced type of SAS.

After 12 days of MPR the decrease of activity of the mediatorial link of SAS was observed, excretion of E and DA somewhat increased, the reserves of SAS considerably grew in firemen,

who were assigned to the norepinephrinic variant according to the type of SAS activity (ref. fig. 2B).

On the 12th day decrease of excretion of E, NE and DA by $21,4 \pm 2,2$; $14,6 \pm 1,5$ and $18,1 \pm 1,9$ per cent was determined in people with the balanced variant, who had authentically higher ($p < 0,05$) levels of excretion of E and NE than the indicators of the control group upon admission to MPR. (ref. fig. 2B). SAS reserves authentically grew - the level of DOPA excretion increased by $38,1 \pm 4,1$ per cent, the ratio of (E+NE+DA) to DOPA decreased by $40,5 \pm 4,2$ per cent. Occurrence of hormone - mediatorial dissociation decreased.

At the end of rehabilitation in firemen with the reduced secretory activity of SAS the activity of SAS remained low; the activity of the mediatorial link of SAS authentically grew ($p < 0,05$), the speed of NE synthesis significantly increased (ref. fig. 2D).



Remarks:* - authentically differs from the indicators of the 1st day of rehabilitation, $p < 0,05$;

..... limits of norm; — 1st day; - - - - - 12th day.

Fig. 3. Dynamics of secretory activity of SAS in firemen with different types of its reaction: A - epinephrinic, B - norepinephrinic, C - balanced, D - with the reduced secretory activity of SAS

The speed of CA inactivation decreased, facilitating retention of the active CA in the body, which should be considered as a positive effect. However decrease of activity of DA- and DOPA-links testifies about significant suppression of SAS and its reserves in firemen of this group and allows to bring up an issue of prolonging the term of rehabilitation of the given people.

On the basis of the research done the levels of professional stress load according to the SAS state and reaction were determined:

The 1st level had corresponds to adequate professional load. SAS is in mobilization state, this level is characterized by increase of general secretory activity of the system, predominance of free CA particles over the fixed ones.

The 2nd level is boundary, it is characterized by tension in the SAS activity, which is manifested in hormone - mediatorial dissociation with predominance of the hormonal link and decrease of CA inactivation speed and SAS spare capacities.

The 3rd level is dangerous, it is characterized by significant exhaustion of all the links of SAS.

It is shown that effectiveness of medico-psychological rehabilitation of firemen-rescuers differs in people with different personalistic and typological peculiarities. High effectiveness of rehabilitation measures was determined in people with the balanced and noradrenalinic types of SAS activity decrease of the levels of catecholamines' excretion, growth of the quantity of their fixed forms in reference to free, growth of the SAS reserves, decrease of occurrence of hormone - mediatorial dissociation). Low effectiveness took the place in people with the adrenalinic type of reaction and with evidences of functional exhaustion of SAS ($40,7 \pm 5,1$ per cent of the examined firemen).

The suggested system allows to estimate a person's state on all the levels of medico-psychological organization of the examined:

- of a personality with the use of contemporary methods of psychodiagnostics;

- of an individual with the help of elaborated by us automated computer system «MORTEST» in its modification «SPAS 8-14»
- of a body, estimating the functional state of physiologic systems and their regulatory mechanisms, which endure professional overpressure.

This lets us consider rehabilitation measures as harmony of psychophysiological and medical components of recovery of professional potential and health of the specialists working in extreme conditions.

Conclusion

The carried out years-long studies provide the basis for creation of the complex system of MPR [16], which is successfully implemented and is actively used in Center of medical and psychological rehabilitation, created at the base of the health resort «Odessky». Figure 3 illustrates the main blocks of psychosomatic changes and of the elaborated the three-stage system.

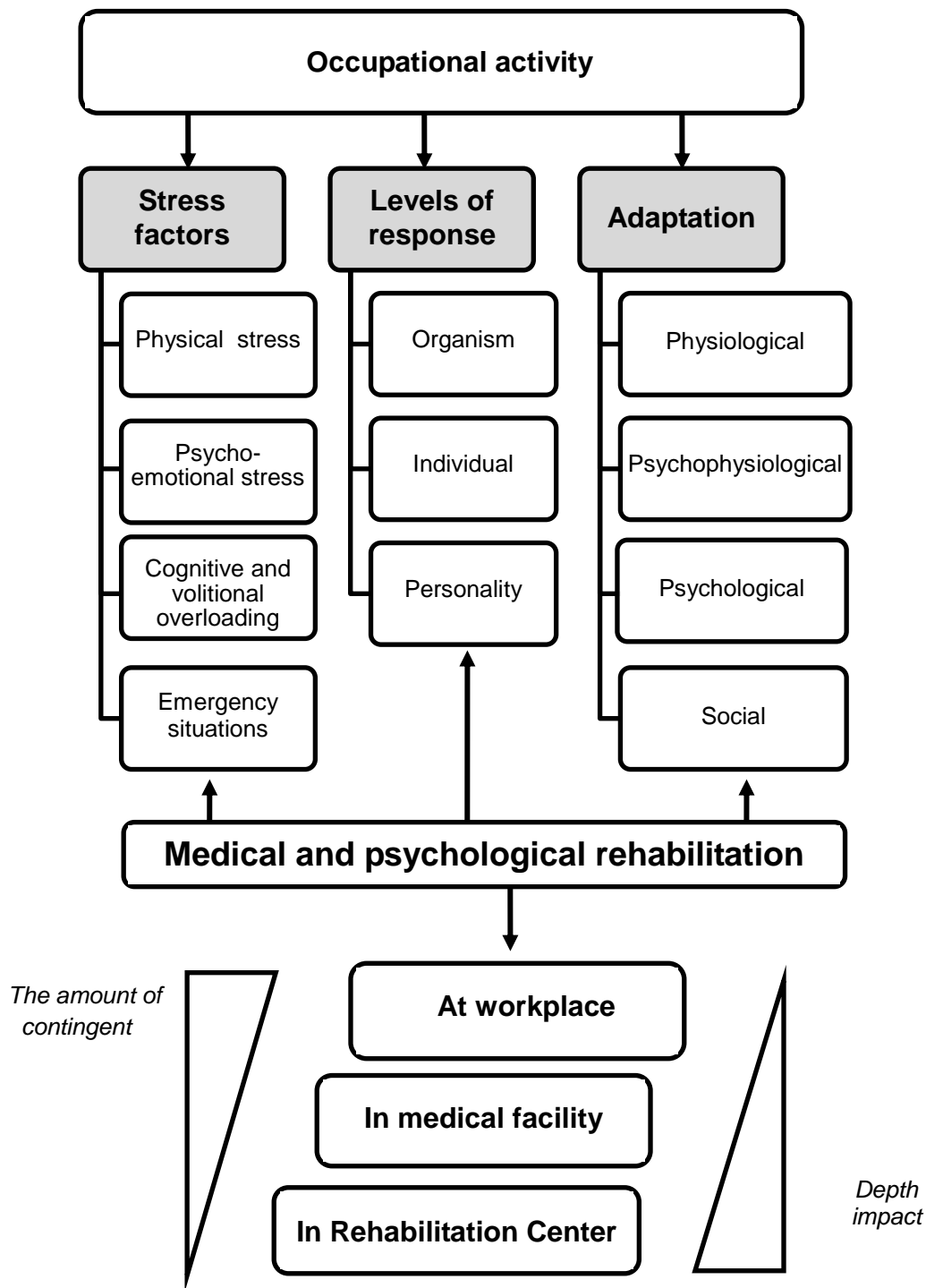


Fig. 3. The complex system of MPR of firemen-rescuers

The complex system of MPR includes a medical, psychophysiological and psychological components and allows to estimate the functional state of the rehabilitants integrally according to the changes of the indicators of reaction of the neurohumoral, cardiorespiratory and neuromuscular systems, and also according to the degree of professional stress load. The system gives the possibility to estimate the effectiveness of MPR in an integrated manner, to make a further forecast and to give recommendations for health maintenance of a worker after the rehabilitation period.

The suggested system can be implemented in medical subdivisions and rehabilitation centers of fire and rescue service for emergency situations.

The system can be used in the rehabilitation of transport workers, combatants and other contingents of specialists working in extreme conditions. This will facilitate the more effective recovery, of functional disorders and pathological states correction, which appear under influence of occupational stress factors.

It was created an automated workplace (AWP) of a psychophysiological – recreation therapist (fig. 4).

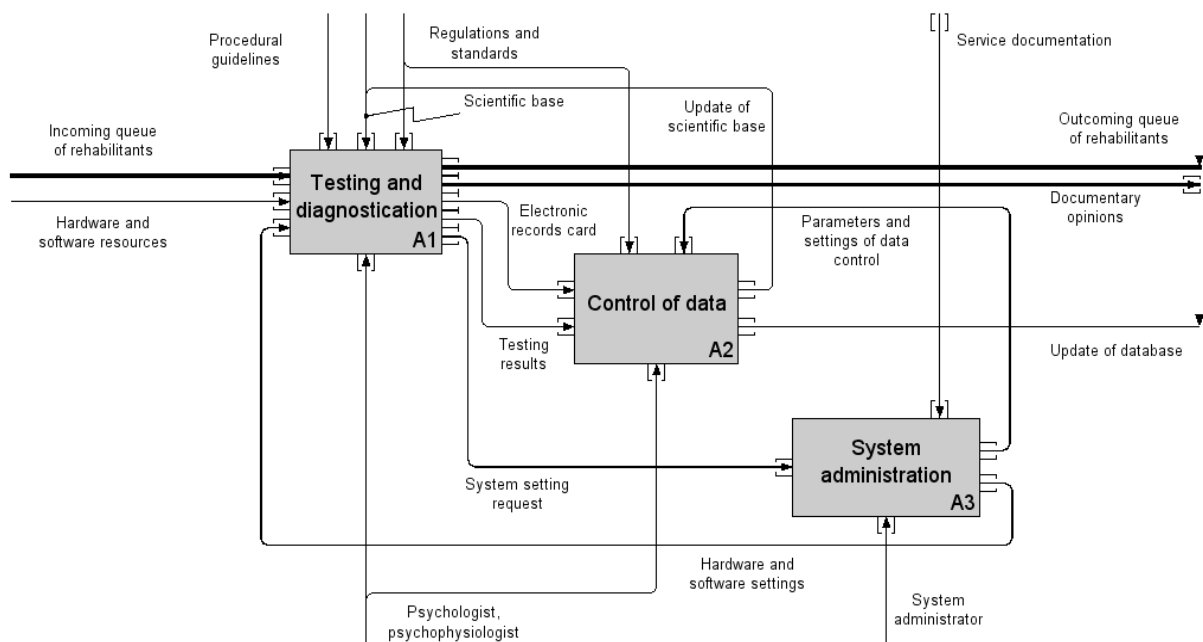


Fig. 4. Block schematic diagram of an automated workplace of a recreation therapist and psychophysiologicalist

It helped to provide, besides a software solution, material and technical resources for carrying out diagnostic, treatment and prevention actions and managing psychosomatic health of the uniformed force is a promising direction of development and improvement of the given system.

All spent to create a MRP system on efforts will allow to carry out the more qualitative psychophysiological support, to analyze the character and directionality of the changes happening during a long period of observation through all the professional life journey of the given contingent taking into account personal approach.

Implementation of the AWP of the recreation therapist and psychophysiologicalist in practice will give new possibility to standardize the procedure of research and rehabilitation. The given

approach to the MPR problem will allow to carry out longitudinal researches, on the basis of which the further gathering and analyses of data will be possible/ Such analysis is necessary for improvement and update of scientific based methodological funds and the existing regulations in the field of occupational health of the contingents, working in extreme conditions.

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