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Interaction of a physician and a specialist on physical rehabilitation at violations of activity of the musculoskeletal system

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Purpose: *the improvement of cooperation and the interaction of an attending physician and a specialist on physical rehabilitation at violations of activity of musculoskeletal system.*

Material & Methods: *physical rehabilitation is considered as a difficult system with the hierarchically-ordered structure. The analysis of references and the system analysis are applied.*

Results: *the modern approaches to coordination of centers of decision-making and the management in hierarchical systems are analyzed. The ways of the interlevel coordination in organizational systems are revealed. The need of coordination of activity of an attending physician and a specialist on physical rehabilitation is proved. The content and the direction of coordination signals for the system of physical rehabilitation at violations of activity of the musculoskeletal system are determined.*

Conclusions: *the coordination of activity of an attending physician and a specialist on physical rehabilitation at violations of activity of the musculoskeletal system has to occur in certain ways: on purposes, on restrictions, in time, on input and output parameters.*

Keywords: *physical rehabilitation, musculoskeletal system, coordination signal.*

Introduction

Physical rehabilitation can be considered as the difficult hierarchical system which works in variable conditions. The increase in efficiency and flexibility of the mechanism of coordination in adoption of operational, tactical and strategic decisions [1] is one of the directions of the improvement of functioning of such systems.

Providing rehabilitation services in medical institutions is regulated by the order of the Ministry of Health of Ukraine No. 176 of 29.03.2011. Such duties are assigned to a doctor on medical physical culture and a nurse (instructor) on medical physical culture [2; 3].

The analysis of duty regulations showed that the task and duties of an instructor and a doctor of physical therapy, which directly concern holding rehabilitation actions, considerably coincide. The exception is made by the control function of a doctor of medical physical culture and its task – to introduce new effective techniques on medical physical culture. The existence of several centers of decision-making among which there is an attending physician, a doctor of medical physical culture, an instructor of medical physical culture, a patient, puts the problem of their effective cooperation and interaction [4].

Experts, who have the higher sports education, can be appointed to the instructor's position on medical physical culture. These experts are considered such which have special preparation on physical therapy [3]. Thus, specialists on physical rehabilitation can hold the instructor's on position physical therapy. In medical institutions they very often directly interact with attending physicians as positions of doctors of physical therapy are absent in most medical institutions and offices. For this reason establishing of the effective cooperation of a specialist on physical rehabilitation and an attending physician is the important scientific and practical problem.

Communication of the research with scientific programs, plans, subjects

The work was performed within the Built plan of the research work in the sphere of physical culture and sport for 2011–2015 on the subject 4.2 "Physical rehabilitation of disabled persons with violations of activity of the musculoskeletal system".

The purpose of the research:

the improvement of cooperation and interaction of the attending physician and the specialist on physical rehabilitation at violations of activity of the musculoskeletal system.

Research task:

1. To open modern approaches to the solution of the problem of coordination of activity in social systems with the constant hierarchically-ordered structure.

2. To analyze practical and theoretical aspects of cooperation of the doctor and specialist on physical rehabilitation at violations of activity of the musculoskeletal system.

3. To offer ways of the improvement of cooperation and interaction of the attending physician and the specialist on physical rehabilitation at violations of activity of the musculoskeletal system.

Material and Methods of the research

Physical rehabilitation is considered as difficult system with hierarchically-ordered structure. Research methods: analysis of references, system analysis.

Results of the research and their discussion

The principle of hierarchy (multilevel, co-subordination) is one of the universal principles of the organization of difficult systems [5]. Hierarchy is called the arrangement of parts and elements in certain order: from higher till lower. The distribution of administrative functions between authorities or subsections of different level is in systems with hierarchical structure. The operating body of some level of hierarchy can direct one or several authorities of the lowest level which submit to it, and itself is guided by the body of the higher level [6].

The large number of simple tasks is solved in hierarchical structures of management at the lowest level, and at the highest levels – small amount of complex challenges. Usually, the general task of optimum control of hierarchical systems is set as the static optimizing task that is the problem of functioning is considered on rather wide intervals of time during, which it is possible to neglect the dynamics of the course of system processes [7].

The certain autonomy of separate governing bodies of intermediate and lower levels has to be provided in the sense that each of them independently, within the powers determined by the functions and the set restrictions charged to it operates the subsections subordinated to it in hierarchical systems with distribution of functions of management behind levels. The operating body (the operating system) makes the operating information (orders, instructions, teams), sends it to venue of management (the operated system), and then obtains and analyzes the return information on his behavior. The new operating information which is sent by the operating body is corrected or made depending on results of the analysis of information on condition of venue of management. If people or social systems act as venues of management, it is transferred in type of oral or written orders, or by means of telecommunication means: phone, fax, e-mail [6].

The control system is formed by such main components:

– the subject management (the operating body, the operating system) which generates the operating influence performs functions of the management, that is influences venue for the purpose of its transfer to a new state;

– the venue management (the operated venue, the operated system) which functions under the operating influence of the subject;

– the operating influence, or direct connections, – complex of purposeful and organizing teams, actions, techniques, methods by means of which influence on venue is carried out and are reached real changes in it;

– feedback that is information for the subject of management on result of the operating influence on venue and changes in it [8].

The studied interaction can be effective only in case when it will be built taking into account the general features of functioning of hierarchical structures. Such belong to them:

– vertical submission;

– priority of actions of subsystems of the highest level (right of intervention);

– interdependence of actions of the highest and lower levels of structure;

– elements of the top level of hierarchy deal with big subsystems and with broader aspects of behavior of the system in general;

– decision-making periods for elements of the top level are more, than for elements of the lowest levels;

– top levels deal with slower manifestations of system;

– description of problem at the top level is less structured and formalized, contains more uncertainty [6].

Physical rehabilitation is the open difficult system as consists of separate subsystems, such as the specialist in physical rehabilitation, the patient, the rehabilitation purpose. At the same time it can be considered as subsystem in health system and as venue of its management. The health care in this case acts as the system of the highest level (meta-system) which element is the attending physician. He plays the role of the subsystem which carries out the operating influence that is the control system for the operated system – physical rehabilitation. As physical rehabilitolog and the patient treat the system of physical rehabilitation, and interact of the doctor and the rehabilitolog should be considered through the prism of management of the studied system.

The purpose of functioning of system of physical rehabilitation is renewal of motive functions, activity and health of the patient. The purpose is achieved by the realization of rehabilitation potential of the patient. It is the complex of biological and psychophysiological characteristics of individual, and also the socially-surrounded factors which allow realizing in this or that degree its potential abilities [9].

Rehabilitation potential and its realization are connected with resources which are at the disposal of system of physical rehabilitation: material, financial, power, human, organizational, information, time. Physical rehabilitation as any other system, functions in the conditions of deficiency of resources therefore their effective use is condition of timely realization of rehabilitation potential and achievement of purposes of rehabilitation.

Mutual influence of subsystems in the course of their functioning happens in the presence of the general restrictions which can be the general resources. Strengthening of activity of one subsystem will entail the reduction of part of resources another and vice versa. Resources can be distributed under the influence of random factors, or the compromise solution will be made for subsystems. The governing body of the highest level has to make decisions in that case for the benefit of the whole system [6].

Cooperation and interaction of the doctor and physical re-

habilitolog consists in the general effective use of system resources, especially the patient's resources. Such general resources, which predetermine mutual influence of meta-system and the studied system, are time and energy in medical and rehabilitation processes.

The resource of energy concerns reserve opportunities of organism of the patient and is shown by the individual reaction to conservative or expeditious treatment and therapeutic exercise stresses. It is connected with the work of immune system, functional potential of life support systems, adaptation reserve and compensatory opportunities of cardiovascular and respiratory systems. The resource of energy enters the rehabilitation potential of the patient.

The resource of time of the energy is closely connected with the resource. First, it limits the simultaneous or parallel solution of the different purposes of treatment and rehabilitation, forces, to define priorities and to plan activity taking into account the speed of recovery processes in each case. Secondly, longer periods of renewal and vice versa provide big expenses of physical energy the patient.

The purpose of coordination of activity of the attending physician and physical rehabilitolog is expeditious adoption of the optimal solution of rather rehabilitation process by the exchange of information of management of different levels between centers: the attending physician – the highest, physical rehabilitolog – lower. Such approach is applied concerning all difficult hierarchical systems which function in the multitask mode in dynamic conditions [1].

The exchange of information between meta-system of health protection and its system of physical rehabilitation is carried out through the communication "attending physician – physical rehabilitolog". It needs to be formed as the close vertical connection of management (functioning) and interactions (coordination) by means of which the leading function of the attending physician is implemented in the medical-rehabilitation process.

The cooperative nature of this communication has to provide the agreement (coordination) of the purposes of rehabilitation and treatment when the first submit to the second. The synergy effect of cooperation of the attending physician and the physical rehabilitolog will be lost without such submission.

The task of definition of the optimum coordinating signal that allows directing activity of the centers of decision-making of different levels to the achievement of the global purpose of functioning of system appears in difficult systems from rather constant hierarchically-ordered structure [7; 10].

The inter-level coordination can happen in such a way in organizational systems:

– coordination on purposes: criterion function of subsystem is formed by the highest level, and for the planned period the control system of the highest level establishes quantitative values of certain indicators of functioning for subsystem;

– coordination on restrictions: the system of the highest level imposes restriction from system positions on number of parameters of functioning of subsystem taking into account its purposes;

– coordination in time: work of subsystem is synchronized with the work of system;

– coordination on input or output parameters [7; 11; 12; 13].
The problem of inter-level coordination and interaction of meta-system (system) of health protection and system (subsystem) of physical rehabilitation needs to be resolved in all described ways. It is very important to physical rehabilitolog to obtain from the attending physician the relevant information for the coordination of the purposes of rehabilitation with the purposes of treatment and accurate coordination of the rehabilitation process with medical in time.

The attending physician has to provide to physical reabilitolog information on the whole treatments with which it is necessary to coordinate the whole rehabilitations for *coordination on the purposes*. Rehabilitolog works on the achievement of the purposes by means of rehabilitation technologies and if it is possible, defines result quantitatively. Examples which concern the musculoskeletal system can be such:

– reduction of hypostasis: measure grasp by centimetric tape;

– reduction of pain: measure points on visual analog scale of pain;

– improvement of mobility in joints: measure in degrees by the goniometer;

– renewal of force: define in points by manual muscular testing or dynamometer in newton.

Coordination on restrictions consists in the accurate formulation by the attending physician of individual contra-indications and cautions to performance of rehabilitation actions at violations of activity of the musculoskeletal system. Restrictions mainly concern the range of movements, postural poses, power and functional loadings. Let's give examples of possible contra-indications:

– restriction for performance of active or passive movements of certain range of rather certain axes which could entail damage of postoperative hems (the doctor specifies the resolved range of movement in joint in degrees);

– prohibition of partial or full transferring of weight through the injured lower extremity at gait with supportive applications (the doctor can define the resolved loading as light touch, partial, half of body weight or to emergence of sensations of pain);

– performance of passive movements or adoption of separate provisions after the carried out metalloosteosynthesis of spine, pelvis or extremities;

– restriction of encumbrances when performing power exercises which can entail repeated injury of muscles of sinews or bones (the doctor specifies the most resolved power loading in kilograms);

– restriction of functional loadings for patients with the accompanying pathology of cardiovascular and respiratory systems (the doctor limits duration and intensity of loadings) [14].

Physical rehabilitolog has to obtain such data for *coordination*

in time:

– the predicted duration of individual application of techniques of conservative treatment of the musculoskeletal system: skeletal endurance, plaster immobilization;

– to give the planned operative measures;

– the predicted individual terms of healing;

– the predicted terms of stay in medical institution.

The noted information will make possible synchronization of rehabilitation actions with medical.

Coordination on input or output parameters needs specification of these concepts for the system of physical rehabilitation.

The data from the case history which concern, first of all, the course of disease, the carried-out treatment, and their possible influence on the motive sphere of the patient, are the input parameters:

– passport data;

– date of hospitalization;

– profession;

– main diagnosis, date of establishment, clinical picture (set of displays of disease), complication;

– associated diseases;

– data on the executed surgeries.

Input parameters have to be surely considered by physical rehabilitolog already at the stage of planning of all rehabilitation actions.

Concerning the output parameters, aggregation of information, which is transferred to the top level of management, is one of the features of hierarchical systems [15]. The center of decision-making of the highest level interests not current state of all elements or systems of the lowest level, and only the main indicators of their activity on certain interval of time. This information helps to solve effectively coordinating problem of management [16].

Coordination on output parameters is the main feedback thanks to which the meta-system of health protection is informed on activity of the system of physical rehabilitation. Output parameters can rearrange the work of the attending physician. The achievement or not achievement of the planned (desirable) indicators of renewal of range, force, function, the new stage of treatment (conservative, surgical) gives the chance to begin, or not to begin, for example:

– the translation of discordant contracture by means of rehabilitation technologies in concordant will remove the need of operative measure in joint and will make possible conservative treatment;

–the requirement of operative measure will disappear at renewal by physical exercises of force of the acceptable level which is partially broken off to muscle;

– the impossibility to functionally compensate articulate instability as a result of the partial rupture of forward crossed ligament of knee actualizes the question of its plasticity.

It is inexpedient to physical rehabilitolog to inform the attending physician on the current functional state of the patient constantly. His task – is to collect, to aggregate, and write down professional information and in certain time or on demand to transfer the main indicators. It will be in such a way provided to the feedback, and the doctor as the center of decision-making of the highest level, will be able to solve the effectively coordinating problem of management of the medical-rehabilitation process.

Conclusions

1. Timely realization of rehabilitation potential of the patient and the achievement of purposes of physical rehabilitation are possible on condition of the realization of modern approaches to the coordination of activity and to the management in hierarchically-ordered systems.

2. The coordination of activity of the attending physician and the specialist in physical rehabilitation at violations of activity of the musculoskeletal system has to happen in certain ways: on purposes, on restrictions, in time, on input and output parameters.

3. The improvement of cooperation and interaction of the doctor and the specialist in physical rehabilitation can happen in several ways:

1. Study to features of professional interaction of future doctors and specialists in physical rehabilitation at the stage of receiving basic education.

2. Study of the practicing experts at the stage of post-degree education.

3. Improvement of official instructions and regulations.

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References

1. Pliuta, N. V. & Homeniuk, S. I. (2010), "Recent trends of development of the mathematical theory of coordination in complex hierarchical

systems", *Visnyk Zaporizkoho natsionalnoho universytetu. Seriia : Fizyko-matematychni nauky*, No 1, pp. 104–109, available at: http://web.znu.edu.ua/herald/issues/2010/mat_2010_1/2010_1/104-109.pdf. (in Ukr.)
2. MES Ukraine, (29.03.2011) No 176 "On approval of sample job descriptions and qualification characteristics to improve medical and physical service in Ukraine", available at: http://www.moz.gov.ua/docfiles/N176_dod.pdf, Prymirna posadova instruktsiia likaria iz likuvalnoi fizkultury. (in Ukr.)
3. MES Ukraine, (29.03.2011) No 176 "On approval of sample job descriptions and qualification characteristics to improve medical and physical service in Ukraine", available at: http://www.moz.gov.ua/docfiles/N176_dod.pdf, Prymirna posadova instruktsiia sestry medychnoi (instruktora) z likuvalnoi fizkultury. (in Ukr.)
4. Hertsyk, A. M. (2015), "On the issue of decision-making in physical rehabilitation", *Slobozhans'kij naukovo-sportivnij visnik,* Vol. 46 No 2, pp. 48–52, dx.doi.org/10.15391/snsv.2015-2.008 (in Russ.)
5. Popechytelev, E. P. (1997), *Metody medyko-byolohycheskykh yssledovanyi* [Methods for biomedical research. System aspects], Zhytomyr, ZhYTY, 186 p. (in Russ.)
6. Sharapov, O. D., Derbentsev, V. D. & Semonov, D. Ie. (2003), *Systemnyi analiz* [System analysis], Kyiv, KNEU, 154 p. (in Ukr.)
7. Katrenko, A. V. & Savka, I. V. (2008), "Mechanisms of coordination in complex hierarchical systems", *Visnyk Natsionalnoho universytetu «Lvivska politekhnika». Seriia: Informatsiini systemy ta merezhi*, Vydavnytstvo Natsionalnoho universytetu «Lvivska politekhnika», Lviv, pp. 156-166. (in Ukr.)
8. Kolpakov, V. K. (1999), *Administratyvne pravo Ukrainy* [Administrative Law Ukraine], Yurinkom Inter, Kyiv, 736 p. (in Ukr.)
9. Lyseniuk, V. P., Samosiuk, I. Z., Samosiuk, N. I. & Tkalina, A. V. (2012), "Rehabilitation Medicine: basic concepts and definitions", *Mezhdunarodnyi nevrolohycheskyi zhurnal*, No 8(54), available at: http://www.mif-ua.com/archive/article/34537. (in Ukr.)
10. Altunin, A. Ye. & Semukhin, M. V. (2000), *Modeli i algoritmy prinyatiya resheniy v nechetkikh usloviyakh* [Models and algorithms of decision-making in fuzzy terms], Tyumen, Izdatelstvo Tyumenskogo gosudarstvennogo universiteta, 352 p. (in Russ.)
11. Mesarovich, M. & Takakhara, Ya. (1978), *Obshchaya teoriya sistem* [General Systems Theory], Mirб Moskow, 312 p. (in Russ.)
12. Nachane, D. M. (1985), Optimization methods in multilevel systems: a methodological survey, *Eur. J. Oper. Res*, No 1, pp. 25-38.
13. Findeisen, W. & Malinowski, K. Two-level control and coordination for dinamisal systems, *Archiwum automatiki i telemechaniki*, T. XXIV, P. 3-27.
14. Hertsyk, A. M. (2007), "On the construction of the rehabilitation process and monitor its effectiveness", *Fizicheskoe vospitanie studentov tvorcheskikh spetsialnostey*, No 5, pp. 55-62. (in Russ.)
15. Aliev, R. A. & Liberzon, M. I. (1987), *Metody i algoritmy koordinatsii v promyshlennykh sistemakh upravleniya* [Methods and coordination algorithms in industrial control systems], Radio i svyaz, Moskow, 208 p. (in Russ.)
16. Shumyhai, D. A. (2012), "Systematic approach to the problem of coordination in complex technological complexes", *Avtomatyka, Automatics 2012: materialy XIX mizhnarodnoi konferentsii z avtomatychnoho upravlinnia* [Automation, Automatics 2012: Materials XIX International Conference on Automatic Control], NUKhT, Kyiv, pp. 289-290. (in Ukr.)

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