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Conference Paper · February 2018

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# Information system for adaptive correction of newborns motor disorders

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**Abstract** — In this paper we consider the structure of the system for correction of newborns motor disorders. This system provides the restoration of newborns motor functions by electrical stimulation of the corresponding muscles. The effect of such stimulation is determined by the test influence on a donor, which has a normal development of the motor function. The resulting donor and recipient EMGs, which obtained during such influences, allow us to construct a strategy for the restoration of motor functions, to determine the progress of treatment, etc.

**Keywords** — *medical information system; correction of motor disorders; rehabilitee; newborns motor disorders; information system.*

## I. INTRODUCTION

The analysis of medical information systems that are developed to improve the effectiveness of the medical diagnostic process and improve the quality of medical care allows us to confirm, that problems of managing this process on the basis of decision support systems are existing [1].

Treatment of motor disorders syndromes are requires continuous monitoring and maintenance, especially with medicament treatment, as well as an individual approach to each case of the disease.

Solving the multifaceted tasks of monitoring patients with motor pathology and their rehabilitation and social adaptation can be most effectively carried out with computer information support. Thus, within the framework of a single system is provided:

- Integration of current medical information about the patient.

- Exchange of data on treatment and rehabilitation in various health care institutions.
- Recommendations on step-by-step events of psychological and pedagogical character.
- Data for adoption of social decisions.
- Analysis of the effectiveness of treatment and rehabilitation measures and the forecast of the course.
- Prevention of relapse of the disease after treatment.

Thus, in this article the structure of the system will be offered, which provides the solution of this problem in the field of treatment of motor function disorders.

## II. ADAPTIVE CORRECTION OF MOTOR DISORDERS

Adaptive correction of motor disorders is a research process of real, potential, positive and negative factors of influence, which is carried out in order to obtain information. This information is necessary for the adoption of effective medical decisions and the use of medical, pharmacological, physiotherapeutic and other therapeutic effects [2]. Such a set of procedures is used to form and implement an adaptive correction for the development of newborns with motor disorder syndrome. This research should be carried out systematically and comprehensively, since its components are interdependent and affect each other. In its process, it is necessary to determine which of the factors is most influential, and the change of which can lead to potential risks and complications for the patient.

The management process of adaptive correction of motor disorders is an integral part of the general medical and diagnostic process of the perinatal center [3]. It allows are presented the adaptive correction process as an element of information provision of the perinatal center's work process.

On the other hand, it can be assumed that the process of managing adaptive correction of motor disorders is health-preventive work, since, by analogy with [1], its final purpose is to eliminate abnormalities in the child's health at the early stages of manifestations disease.

The process of controlling adaptive correction of newborns motor disorders in the perinatal period, from the classical point of view, is a management contour, which includes [2]:

- Collection and processing of information about the newborns health.
- Diagnostics (referring the state of newborns health to one of the known classes).
- Making a decision on adjusting the state.
- Implementation of the decision.

### III. STRUCTURE OF SYSTEM

The task of this system is to partially move some of the functions of a specialist neurologist to a computer program, which function correction of motor disorders in children with brain lesions [4]. The list of functions which this expert system has been provided can be formulated as follows:

- Information support for the work of the doctor at the expense of the information reference subsystem, which contain information about strategies for treatment, symptoms, drugs, etc.
- Maintenance of the patient's electronic medical card with registration of a plurality of the patient's parameters, his personal data, history of illness and intermediate medical research.
- Analysis of treatment and rehabilitation courses with the statistical processing of quantitative and qualitative medical indicators.
- Construction of prognostic conclusions about the chosen strategy of treatment or rehabilitation.
- Selection of possible tactics of treatment or rehabilitation, which based on the set of anamnesis data and indicators, which obtained during the process of treatment and rehabilitation measures.

In accordance with these functions, the structure of the system consisting of functional blocks, terminals, interfaces and databases, which implemented in the form of doctors automated work places, servers and terminals, was formed. There elements are connected with diagnostic and laboratory equipment of third-party manufacturers.

The structure of such system is presented in Fig. 1

In accordance with the developed information model of adaptive correction of motor disorders [2], the system provides test impulse's control, which affect donor and corrected impulse's control, which affect recipient. The system determines the magnitude, duration, and shape of impulses using the control unit, which sends commands to generators. Generators are computer-controlled systems that support digital interfaces, through which they connect to a personal computer.

At the same time, the system receives physiological information from the donor and the recipient such as ECG and EMG. The first one serves to monitor the respondent's functional status and determines the extent of his perception of the rehabilitation process. An EMG is used to determine the degree of recipient's motor function development and its compliance with the functioning of the donor.

The block of visual effects provides visual stimulation of the patient, performing an auxiliary function of the motor reflexes' development.

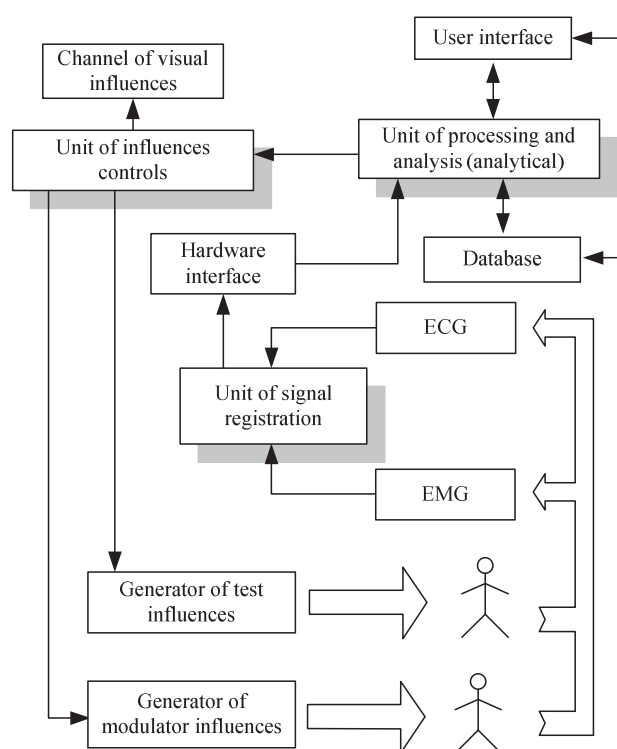


Fig. 1. The structure of the system

Receipt of this information takes place using a signal registration unit that has a hardware connection interface to a personal computer. Information from it is registered in a digital form by an system.

The unit of processing and analysis is used to manage the treatment and rehabilitation process. This block is specialized software whose task is to determine the strategy of treatment and rehabilitation measures, monitor the recipient and donor status and inform the doctor about the progress of treatment.

An important element of this system is a database, which containing information on three subject areas:

- Medical personal information (information about patients, history of their illnesses, data about the strategies and the course of each treatment, etc.);
- Medical reference information (available databases of diagnoses, medicines, prescribing procedures, types of reference donor micrograms, treatment strategies, etc.);
- Rules for determining the state of fatigue, compliance and correction of the rehabilitation strategy, ECG and EMG analysis, the formulation of previous diagnoses and other determinant information for expert system.

The unit of processing and analysis accesses the database using queries and uses the saved data for its functioning.

Such structure of the system is due to the fact that the experts procedures allow taking into account the interrelations between the indicators of health. This provides to formulation of the subject area's rules and forms a list of indicators that adequately reflects the most significant aspects of correction of motor disorders for each newborn.

The task of creating a database is to compare and generalize the medical diagnostic information, and to present in the form of formalized knowledge (a set of facts and rules). The quality of the decisions which made by the system depends on the completeness of the space of signs, including the relationship of symptoms, the developed database and the accuracy of the formulated conclusion algorithms.

The development of a database system for diagnosis and counseling in decision-making took place in stages (similar to [5]):

- The standard descriptions of the diagnosis are formed (the most complete set of characteristic signs of anamnesis, current clinical symptoms, results of laboratory and special studies). They must be specific to a specific diagnosis;
- The space of signs as the union of subsets is formed. It is included in the description of the diagnostic findings, formed at the first stage of the creation of the database;
- Next, an algorithm is formed, that allows us to get a diagnostic conclusion.

The user interface is a set of programs for implementation of an interactive dialogue with the specialist, which corresponds to the tasks of the system, provides high speed with algorithms minimizes the number of human errors in the process of working with the system, is easy to use.

The feature of this system is two stages of control over the influences parameters. In the first stage automated control of parameters is carried out. In the second stage there is a control of medical appointments after automated control and a doctor's decision.

To determine the optimal and adequate effect of therapeutic influences, test medicated, stimulation and physiotherapeutic influences are given on patients, which make it possible to determine the correctness of the chosen

treatment tactics or to make correction of therapeutic influences, individually for each patient.

Based on the results of the test influences, a correction of the previously selected treatment tactics and the parameters of treatment and rehabilitation influences are carried out. After that, individual rehabilitation program is being developed. This rehabilitation takes into account the physiological, physical, psycho-emotional features of the patient, the individual intolerance of certain pharmacological medications, the inaccessibility or ineffective use of a therapeutic influence or procedure.

Formation of bioelectrostimulation course, method selection, selection of parameters are carried out taking into account existing indications / contraindications for bioelectrostimulation under the obligatory control of stimulation influences parameters. At the same time, there are take into account individual physiological peculiarities of the patient, functional disorders and expected positive dynamics in the patient.

Correctly selected method of individual complex rehabilitation of motor disorders provides a steady positive result and allows to carry out clinical monitoring of a patient in a hospital setting or to conduct remote monitoring and telemedicine support of regenerative rehabilitation of patients under the constant control of specialists-rehabilitants. In the generalized form, all of the above can be represented by a scheme of rehabilitation correction of newborns with motor disorder syndrome (Fig. 2).

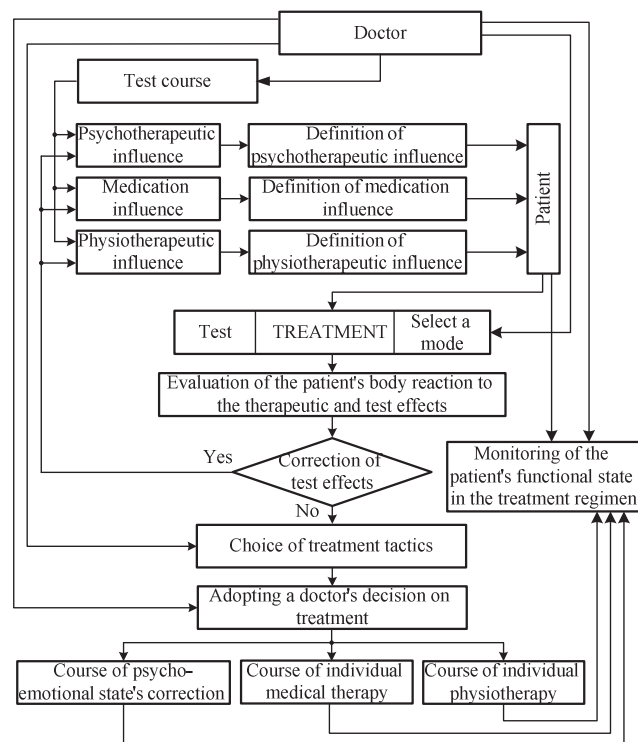


Fig. 2. Scheme of rehabilitation correction of newborns with impaired motor function

After complex implementation of procedures and application of therapeutic stimulation, physiotherapy, pharmacological influences, the patient's current state is estimated. Positive changes and a lasting remediation effect are determined.

A generalized algorithm for providing medical care using the proposed system can be presented in Fig. 3.

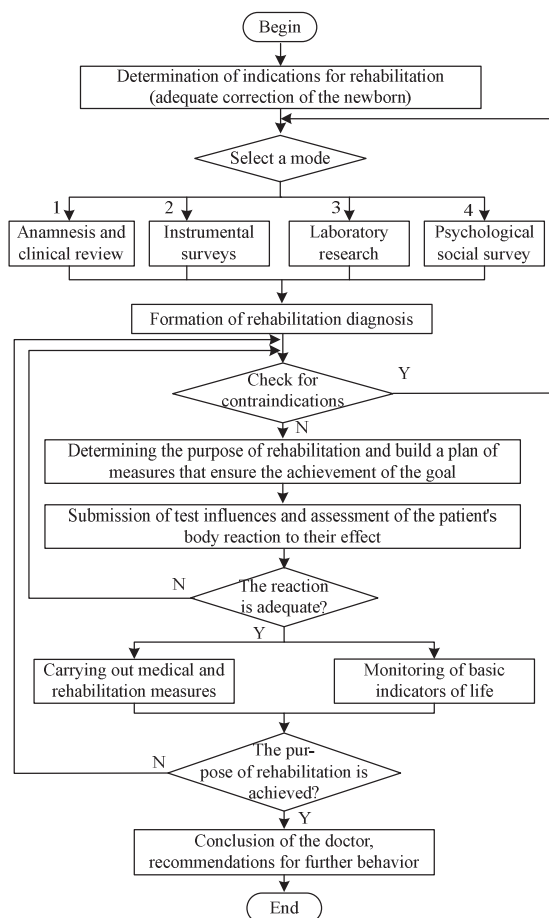


Fig. 3. Scheme of rehabilitation correction of newborns with impaired motor function

#### IV. CONCLUSIONS

Thus, the proposed method of constructing the information system of the perinatal center involves the creation of some adaptive medical space that possesses the properties of universality, flexibility and adaptation to the needs (or tasks) of a particular doctor. This medical space does not have in its structure a strict attachment to specific medical equipment and parameters, there had classified patients.

In the process of using medical information technologies, data collection is carried out on the places of information creation. The information about patients are entered and saved in the database. The completeness, reliability and operational value of the material collected are depends on the quality of these operations. Receipt of information to processing places is carried out using means of transmission / reception of data.

Information provision of this system determines its construction technology. It uses:

- Modular principle and the possibility of its increase and modification;
- A hierarchy of capabilities and functions with the creation of a complex network topology;
- Adaptation to the system of previously created mathematical, imitation, software and hardware tools;
- Regular updating of classifiers used, including reference information and diagnoses (syndromes);
- Automatic formation of medical documents according to approved forms;
- Duplication of the current information on the external database server.

The method of functional bio-management has been improved through the modification of strategic and tactical levels, with the construction of this system. The current condition of the newborn is determined at the tactical level, which ensures the formation of the previous correction's program. The strategic level provides the adjustment of the previous correction's program based on the results of the test influences and its adaptation to a particular newborn. This allows systematically approach to the problem of diagnosis and treatment of motor disorders in newborns with the most effective result.

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