Electronic Archive on the Topics "Neurorehabilitation", "Neurorehabilitation in Rare Diseases" and "Robotic Neurorehabilitation"

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Abstract. The frequency of neurological diseases and neurosurgical conditions is increasing in last decades, especially in Eastern Europe. This fact imposes the necessity of amelioration of the quality of care, and, subsequently – of the quality of education of medical specialists and health professionals - members of the rehabilitation team. We prepared educational materials and we created an electronic (e-) archive on the topic. Current article presents the structure of the e-archive and its significance for the level of theoretical knowledge and practical skills of our students and trainees in the area of neurorehabilitation (NR), NR in rare diseases, NR with neurorobots and virtual reality.

Keywords: Electronic Archive, Neurorehabilitation, Rare Diseases, Robot, Neurorobot, Virtual Reality, e-Book.

1 Introduction

The frequency of neurological diseases and neurosurgical conditions is increasing in last decades, especially in Eastern Europe.

1.1 Neurological Diseases in Bulgaria

For our country, the socially-important problems in the area of neurology and neurosurgery of adults include: cerebro-vascular diseases, multiple sclerosis, Parkinsonism, traumatic brain injuries, cerebellar ataxia, brain aneurisms, brain tumours; spinal cord injuries, medullar tumours, poliomyelitis and post-polio-syndrome; diabetic polyneuropathy, discal hernia with cervico-brachial and lumbo-sacral radiculopathy, traumatic injuries of peripheral nerves, Guillain-Barre syndrome, Bell's palsy. For children, the most frequent conditions are: cerebral palsy, cerebellar tumours, obstetrical palsy (of the brachial plexus).

A typical example of the social importance of neurological conditions in Bulgaria is the cerebro-vascular disease – with a very high level of stroke morbidity, subsequent disability and mortality. According Eurostat Database for the last year before the pandemic of COVID-19, the rate of stroke mortality in our country is 311 per 100 000 population (OECD/European Union, 2022).

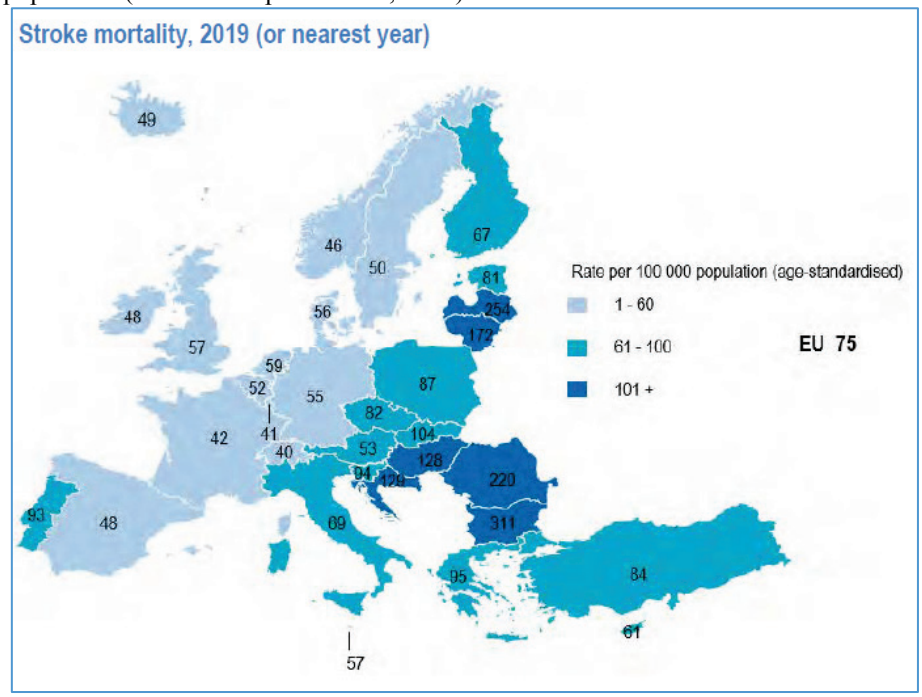


Fig. 1. Stroke mortality, 2019 (OECD/European Union, 2022) (page 97).

The increasing frequency of neurological diseases and neurosurgical conditions imposes the necessity of development of neurorehabilitation (Barbeau., 2003; Kalra et al., 1993).

1.2 Neurorehabilitation

Neurorehabilitation (NR) is a medical interdiscipline, requiring elements of the theoretical knowledge and practical skills of the domains of neurology, neurosurgery, physical and rehabilitation medicine.

NR is based on clinical principles of traditional medical specialty "Physical and rehabilitation medicine /PRM/" (Gutenbrunner et al., 2007; European PRM Bodies Alliance, 2018), using the International Classification of Diseases (X^{-th} revision) and the International Classification of Functioning, Disability and Health (WHO, 2001). In NR-clinical practice, we apply a holistic, patient-centered approach.

The classic PRM-algorithm includes a detailed functional assessment and a synergic combination of different natural and preformed physical factors (Hayes, 2003; Koleva

& Avramescu, 2017; Koleva, 2009). The NR-program emphasizes on active exercises, grasp and gait training with different devices (including neurorobots), functional electrical stimulations (FES), pain management (with low frequency electric currents, magnetic field), balneotherapy and balneophysiotherapy (underwater exercises, underwater extensions, SPA relaxing techniques). Important elements of NR-program are: control of risk factors, patient education, systematic physical activity, technical aids, home adaptations, prevention measures.

1.3 NR with Robots and Virtual Reality

During last decades, we observe an introduction of modern information and communication technologies (ICT) in the rehabilitation practice, as robots, virtual reality, systems for grasp and gait training (Aprile et al., 2020; Benedek & Vanta, 2023; (Burdea & Coiffet, 2003; Gimigliano et al., 2021; Janjarasjitt, 2022; Piron et al., 2005).

1.4 Rare Diseases

According Orphanet (INSERM, 1997), rare diseases have a low or very low prevalence: about 1 in 1500 or 2 000 people. Is estimated that rare diseases affect about 350 million patients worldwide. The last day of February is celebrated as Rare Disease Day (for the current year – 29 February 2024). Most of rare diseases have not effective treatment (with "orphan drugs"), they provoke severe disability and premature mortality, they create serious problems for public health.

The neurological spectrum of rare diseases, common for NR in our country, includes: muscular dystrophies - MD (especially Duchenne MD and Becker MD), myopathies, Friedreich ataxia, some neuro-muscular junction diseases (e.g. Myasthenia gravis), Charcot-Marie-Tooth disease, Myotonia congenita; Amyotrophic lateral sclerosis (ALS), Barre-Lieou syndrome, etc.

In NR of rare diseases, we change the therapeutic paradigm: we treat the concrete symptoms and syndromes, because the period of diagnostic sometimes can be too long.

The problems of the quality of care and quality of life of patients with rare diseases were popularized in relation with the famous British astrophysicist Stephen Hawking, author of the theory of black holes, suffering from ALS (Fig.2).

Fig. 2. Steven Hawking – a "victory" of NR.

1.5 Education, Based on Electronic Libraries

Briefly, the topic "Neurorehabilitation" is significant in everyday clinical practice and we decided to prepare scientific information - for the members of the multi-professional and multi-disciplinary NR team.
For this, we applied the existent knowledge on the topics: online education, electronic repositories and electronic archives, developed in other scientific domains (Arapi et al., 2016; Halkal et al., 2022; Paneva-Marinova & Pavlov, 2018).

2 Exposition of the Investigation

On the base of a systematic investigation of the scientific literature, we prepared educational materials on the topic "Neurorehabilitation" (Koleva, 2009; Koleva & Avramescu, 2017; Koleva, 2020; Koleva et al., 2018; Koleva et all., 2019; Koleva et al., 2023b). We included most frequent socially important neurological disorders, rare neurological diseases and some neurosurgical conditions. The emerging application of Information and communication technologies (ICT) in clinical rehabilitation practice imposed the addition of the topics "Robotic NR" and "NR with virtual reality devices" (Gimigliano et al., 2021; Krichmar & Hwu, 2022; Iosa et al., 2016; (Koleva et al., 2023a). At the beginning, our goal was to facilitate the process of education of all members of the NR-team.

2.1 Objective

The objective of current article is to assess the results of the introduction of an electronic archive on the topic "Neurorehabilitation" in the education of members of the

NR-team, and to evaluate qualitatively and quantitatively the efficacy of this e-archive for amelioration of professional competencies of medical specialists and health professionals.

2.2 Structure of the e-Archive

Our electronic archive was divided into several parts, presented in the next figures.

The general structure of the archive includes (Fig.3): socially important and rare diseases, diseases of the Central nervous system (CNS) and of the Peripheral nervous system (PNS), disorders in the childhood (Pediatric diseases). Different diseases are presented: stroke, Multiple sclerosis (MS), Parkinsonism, discal hernia with Cervico-brachial plexopathy (PCB) or Lumbo-sacral radiculopathy (RLS), Bell's palsy (peripheral paresis of the facial nerve), etc. Separately, we included a window for ICT-based NR with clinical case presentations (videos).

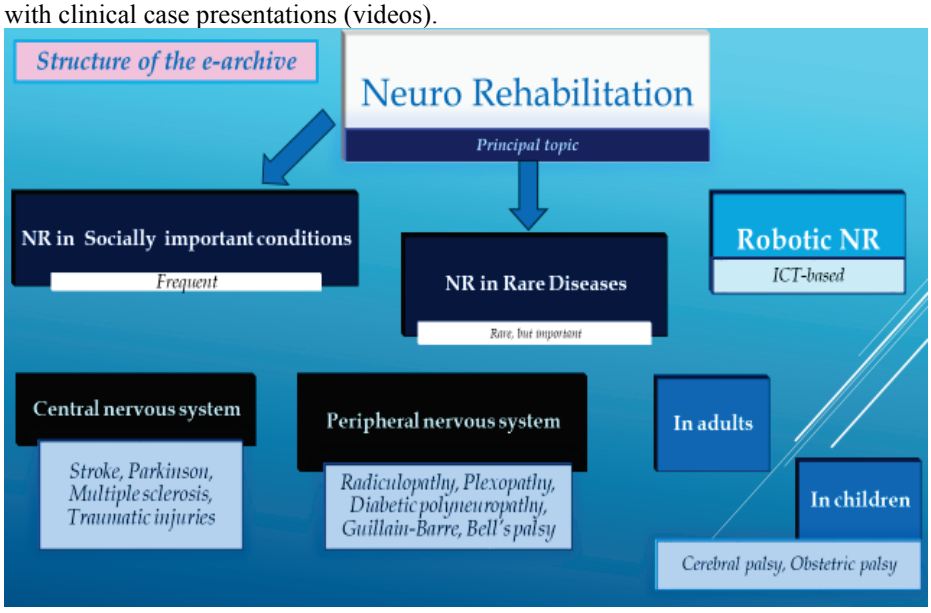


Fig. 3. General structure of the e-archive.

The structure of every window (chapter) with the name of a disorder includes (Fig.4): definition; clinical signs, symptoms and syndromes; schema for the functional assessment of the patient; and a general NR-algorithm. We incorporated methods of physiotherapy, functional electrical stimulations /FES/, SPA-techniques /hydro-, balneo-, thalasso-Th/, preformed modalities for pain relief /physical analgesia – laser, magnetic field /MF/, transcutaneous electro-neuro-stimulation /TENS/, and ICT-based methods /neuro-robots and virtual reality/.

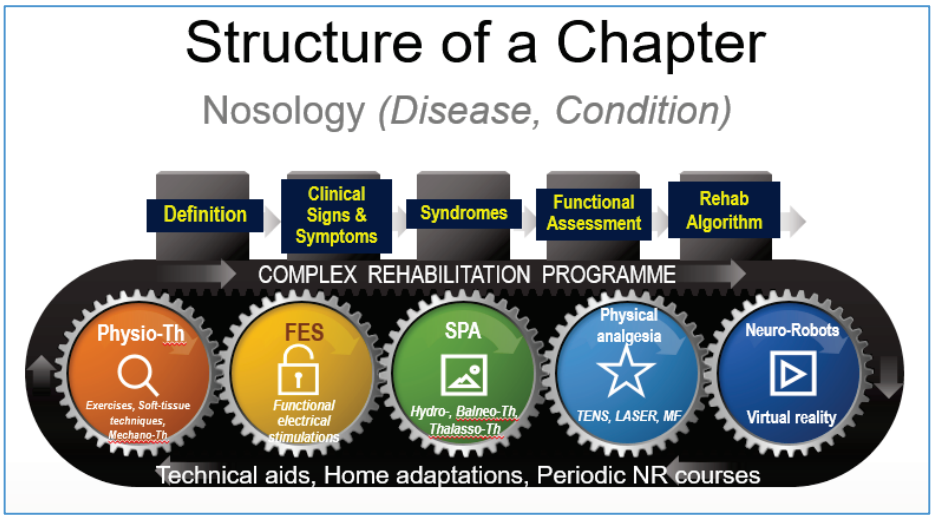


Fig. 4. Structure of a Chapter.

2.3 Design of the Study

From the beginning of the year 2021, we introduced the modules on NR - in the process of education of different types of learners: students (from the summer semester of the academic year 2021/2022 to the winter semester of 2023/2024), medical doctors and physiotherapists (during post-university specialized courses).

We used the electronic materials in the process of education of our students and trainees, and during long-life learning (LLL) of different members of the NR-team – medical doctors and health professionals. We used the classrooms of the electronic platform of the Medical University of Sofia and the platform of the Bulgarian association of health care professionals (for some of LLL-courses). The e-archive was applied in the process of training of our learners and we evaluated their professional competencies – by electronic tests and practical exams. We investigated the learners' opinions on the educational materials and the e-archive, using a Likert scale.

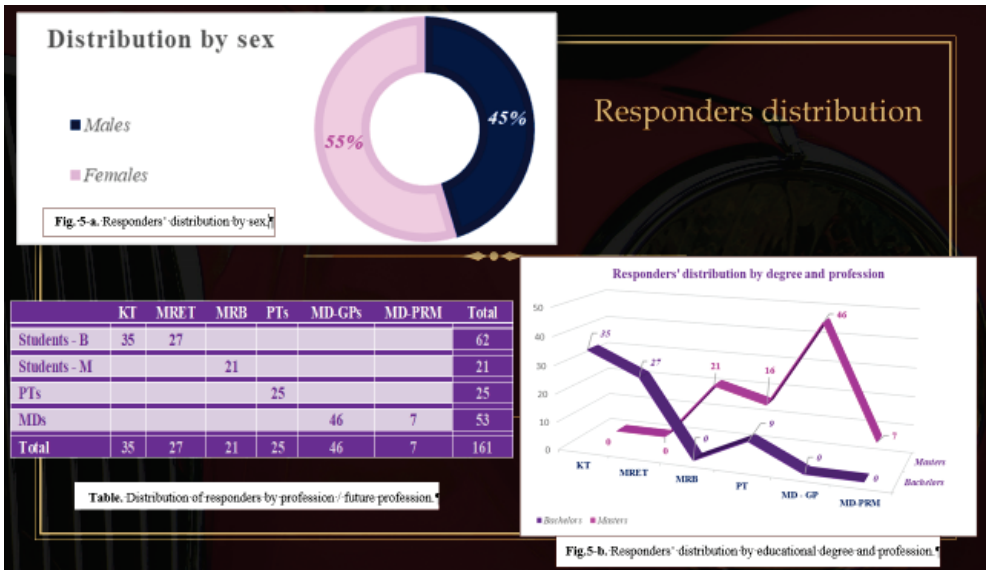
For statistical analysis of results, we used the statistical package SPSS.

2.4 Structure of the Responders

Our 161 learners were distributed into two principal groups (Fig.5):

- *83 students*, of them 62 in bachelor's /B/ degree (35 in Kinesitherapy /KT/ and 27 in Medical rehabilitation and Ergotherapy /MRET/); and 21 in Master's /M/ degree (Medical rehabilitation and Balneotherapy /MRB/),
- *78 participants* in long-life learning courses, of them 25 physiotherapists and 53 medical doctors /MDs/ (46 general practitioners /GPs/ and 7 trainees in "Physical and Rehabilitation medicine" /PRM/).

The structure of the responders is presented in the table of figure 5.



	KT	MRET	MRB	PTs	MD-GPs	MD-PRM	Total
Students - B	35	27					62
Students - M			21				21
PTs				25			25
MDs					46	7	53
Total	35	27	21	25	46	7	161

Table. Distribution of responders by profession / future profession

Fig. 5. Responders' distribution by sex; by educational degree and profession.

The distribution by sex is 88 females and 73 males (Fig.5-a). Figure 5-b presents the learners' distribution by degree (B, M) and by profession (students, PTs, MDs-GP, MDs-PRM).

3 Results

3.1 Evaluation of the Efficacy of the e-Archive in the Education

We calculated the difference in the level of professional competencies of our learners before and after the usage of the e-archive. The theoretical knowledge was assessed by questionnaire with open and closed questions (maximal level 100 points). We evaluated practical skills using the traditional for our country system (Notes: Excellent 6, Very good 5, Good 4, Satisfactory 3, Poor 2). The results are presented in the next figure 6.

Fig. 6. Efficacy of the e-archive on professional competencies of our learners.

3.2 Evaluation of the Learners' Opinion

For assessment of learners' opinion, we applied a Likert scale with five possible answers: Very satisfied, Satisfied, Indifferent, Unsatisfied, Very unsatisfied.

The questionnaires were proposed with a link in the classroom and the answers were anonymous. We received 137 fully filled questionnaires (85,09 % of learners). The distribution of the answers is presented in figure 7.

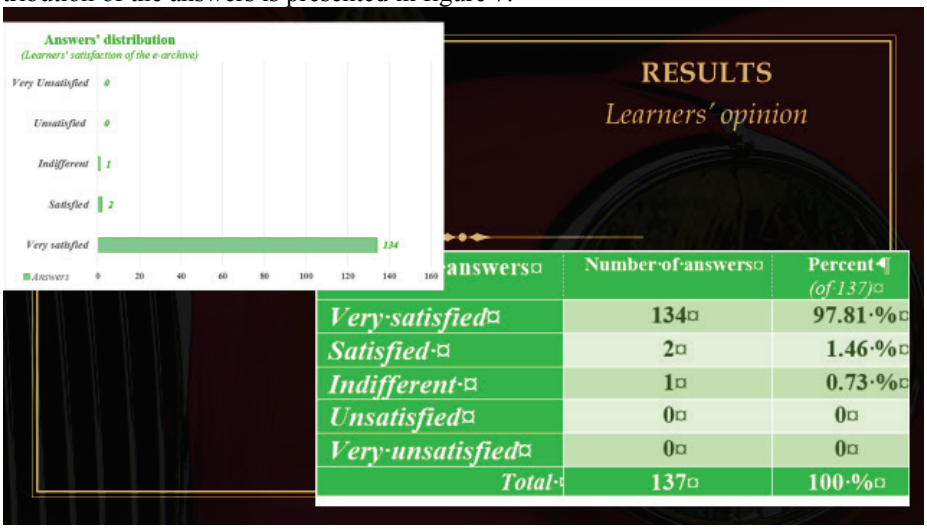


Fig. 7. Learners' satisfaction of the e-archive.

4 Discussion

The efficacy of the application of the electronic archive is shown by the obtained results during the evaluation of professional competencies of our students, trainees and participants in LLL-courses.

Our learners consider very important the topics “Neuro-Rehabilitation”, “NR in rare diseases” and “ICT-based NR”. Some medical doctors and physiotherapists, oriented in the clinical rehabilitation practice, require detailed information about the different alterations of the central and the peripheral nervous system, the high level of disability due to neurological diseases and conditions, and the significance of the systematic and well-structured rehabilitation algorithm for functional recovery and amelioration of the quality of life of patients.

The opinion of learners on the educational materials and the e-archive is positive. They consider useful our electronic archive.

5 Conclusion

The creation and the application of electronic archives in the field of NR is convenient and must be amplified.

We consider necessary the inclusion of more rare diseases in the e-archive.

It will be very useful for the clinical practice, if we add more case reports with history of the disease, videos, information about the NR-process and its efficacy.

Some patients need more information about the possibilities to use the social security system for technical aids and for adaptation of their homes and offices. Respectively, we can include this information in the learning process of the members of the multidisciplinary multi-professional rehabilitation staff.

Of course, our work has some limitations. For the moment, only our students and trainees (of the Medical University of Sofia) can use the e-repository. During this year, we were invited as lecturers of post-university courses, organized by the respective professional organizations, and in the future, we must amplify the access to these educational materials.

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No ethical issues. In clinical case presentations, we respect the principles of the Declaration of Helsinki (1964, 2001).

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