Social telerehabilitation opportunities

Możliwości telerehabilitacji społecznej

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Artykuł podsumowuje łotewski narodowy program naukowy VPP INOSOCTEREHI, który jest trzyletnim multidyscyplinarnym projektem nt. telerehabilitacji społecznej rozpoczętym w 2014 roku z zaangażowaniem czterech łotewskich uniwersytetów, ukierunkowanym na wykorzystanie technologii mobilnych w zakresie rehabilitacji społecznej.

Przedstawiono tu pierwszy rok działania projektu VPP INOSOCTEREHI, koncentrując się na koncepcji telerehabilitacji społecznej, podkreślając interdyscyplinarne umiejętności i wiedzę niezbędną do rozwoju usług telerehabilitacji społecznych (pedagogiki społecznej, edukacji specjalnej, informatyki, inżynierii, fizjoterapii).

W artykule nakreślono koncepcyjne ramy projektu, gdzie przyjęta metodologia utworzyła ogólne podstawy niezbędne do zapewnienia skutecznej współpracy między partnerami.

Słowa kluczowe: *rehabilitacja, telerehabilitacja społeczna, rehabilitacja społeczno-readaptacyjna, innowacja społeczna, zaburzenie równowagi*

This paper reports on the Latvian national science program VPP INOSOCTEREHI, a three-year multidisciplinary project on social telerehabilitation, started in 2014 and conducted by four Latvian Universities, which is aimed at the use of mobile technology in the field of social rehabilitation.

The activities of the first year of the VPP INOSOCTEREHI project are illustrated here; focusing on the concept of social telerehabilitation, and highlighting the multidisciplinary competences and expertise necessary for developing social telerehabilitation services (social pedagogy, special education, computer science, engineering, physiotherapy).

The conceptual framework of the project is outlined, and the methodology that has been adopted to create the common background necessary to ensure effective cooperation between partners is presented.

Key words: *rehabilitation, social telerehabilitation, social-re-adaptation, social innovation, balance disorder*

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Introduction

Telerehabilitation is a growing new multidisciplinary sector of investigation that is increasingly attracting the interest of researchers since it provides effective results for many rehabilitation purposes. A review of the literature, carried out some years ago, presented interesting outcomes about the effectiveness of telerehabilitation. The analysis of a sample of 66 papers extracted from the literature available on online databases showed that 71% of telerehabilitation applications were successful, whilst in 11% of cases the status was unclear, and in 18% were unsuccessful [1]. The authors of this study reported that outcomes in 51% of the applications appeared to be clinically significant.

Since then, much progress has been made, so, social telerehabilitation is now a new topical research field and represents a specific area within the telerehabilitation scope.

This is the result of a change in the rehabilitation concept. Over the last years, patients' rehabilitation has moved from a predominantly medical point of view towards a more complex concept in which psychological and sociocultural aspects are deemed equally important [2-4].

The notion of rehabilitation has extended from a medically driven process of physical medicine to a more comprehensive process, which includes socially driven forms of intervention [5].

Great emphasis has been placed on patients' activity and, today, the rehabilitation process also includes patients' social re-adaptation.

One of the most popular topics in social rehabilitation is the rehabilitation of workers. Significant advancements have been made in occupational rehabilitation. The aim of occupational rehabilitation is to assist injured workers in reaching the maximum physical and emotional level of functions demanded by their job or to assist them in effectively managing their disadvantaged behavioural level.

It is widely accepted that rehabilitation is a complex, multidisciplinary process [6-8], in which it is not easy to define the specific nature of interventions, since it is difficult to isolate the effects of interventions from other factors, especially those related to the social sphere.

There is a general consensus that rehabilitation involves multidisciplinary professional competences [9]. In fact, rehabilitation treatments are delivered by teams of professionals (physiotherapists, psychologists, social educators, etc.) who work together towards common goals. Their activity is directed to resolve the patient problems, following an iterative, active, educational, and problem-solving process that focuses on the patient's behaviour and adapts to it. The most common goals of the rehabilitation process are:

- Maximising the participation of the patient in his or her social setting;
- Minimising the pain and distress experienced by the patient;
- Minimising the distress of, and the stress on, the patient's family and caregivers.

Figure 2 shows the essential flow of the rehabilitation process. *Assessment* is the identification of either the nature and extent of patient's problems or relevant factors for their resolution. *Intervention setting* may include both treatments, which affect the process of restoring ability damages, and support, which maintains the patient's quality of life. *Evaluation* is the assessment of intervention effects.

Nowadays, new services have been designed to overcome and minimise people's limitations/impairments, both in a physical and social context. In designing these new rehabilitation services, patients' attitudes, beliefs, and expectations are increasing in importance.

In rehabilitation, an emerging crucial issue is to regain people's psychophysical functions and to improve their everyday quality of life through the use of ICT and mobile technologies.

This paper analyses the concept of social telerehabilitation, reporting on the first research year carried out within the Latvian national science program VPP INOSOCTEREHI.

```
(defparameter *eliza-rules*
 '((((?* ?x) hello (?* ?y))
    (How do you do.  Please state your problem.))
   (((?* ?x) computer (?* ?y))
    (Do computers worry you?) (What do you think about machines?)
    (Why do you mention computers?)
    (What do you think machines have to do with your problem?))
   (((?* ?x) name (?* ?y))
    (I am not interested in names))
   (((?* ?x) sorry (?* ?y))
    (Please don't apologize) (Apologies are not necessary)
    (What feelings do you have when you apologize))
   (((?* ?x) I remember (?* ?y))
    (Do you often think of ?y)
    (Does thinking of ?y bring anything else to mind?)
    (What else do you remember) (Why do you recall ?y right now?)
    (What in the present situation reminds you of ?y)
    (What is the connection between me and ?y))
   (((?* ?x) do you remember (?* ?y))
```

Fig. 1. An example of the Eliza chatting

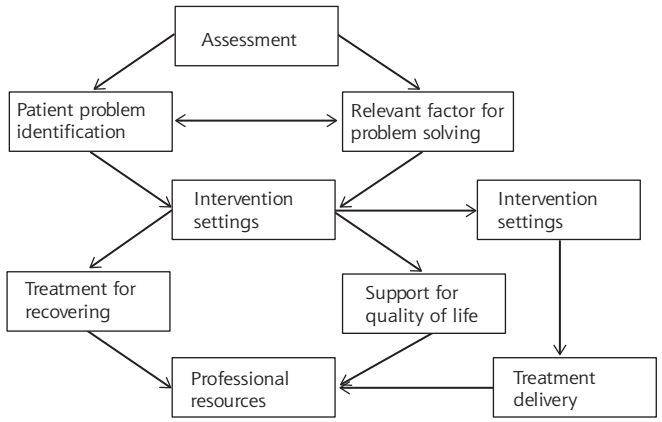

Fig. 2. The flow of the rehabilitation process

What is social telerehabilitation?

Until a few years ago, telerehabilitation was considered a specialisation within the wider field of telemedicine. Accordingly, even now, most telerehabilitation services fall into three main categories: clinical assessment (the patient's functional abilities in his or her environment), diagnosis, and clinical therapy.

Telerehabilitation (or *e-rehabilitation*) is defined as the delivery of rehabilitation services through telecommunication networks and the Internet. At the beginning, the primary aim of telerehabilitation was to provide equitable access to health care for individuals who were geographically remote, and for those who were physically and economically disadvantaged, although very quickly telerehabilitation demonstrated its capacity to improve, in many cases, the quality of rehabilitation services.

Recent advances in ICT, which allow contact with patients at home, have shown the possibility of extending the application of new technologies to the social rehabilitation scope. Accordingly, social telerehabilitation can be assumed to be the delivery of social rehabilitation services using ICT.

Many researchers and practitioners argue about the importance of social telerehabilitation services

for patients, caregivers, and public institutions, e.g. services for children suffering from physical handicaps and emotional disturbances [10, 11], for alcoholics [12, 13], and for patients with bipolar disorder [14].

Research has underlined the potential for social media, mobile phones, and the Internet in general, to improve mental health and physical health, treat addictions, and also to help individuals experiencing homelessness [15-17].

The scope of social telerehabilitation services is wide: it faces challenges that set it apart from the broader telemedicine and telehealth arenas. It has been observed that one such challenge is that rehabilitation is often provided across both acute medical and community settings, often with different funding structures and rehabilitation protocols in place [18].

Figure 3 shows the position of social telerehabilitation within the broad scope of rehabilitation.

Social telerehabilitation and social innovation

It is a commonly shared notion that social innovation is the creation of social value by solving social problems. Accordingly, social innovation can be deemed to be the production of new solutions to social problems in more effective, efficient, and sustainable ways.

Analysing the consequences of the current economic crisis and its impact on health care services, there are those who have advanced the idea that social innovation can constitute an effective strategy to counter-balance the retrenchment of public social provision [19]. From this perspective, telerehabilitation represents a very interesting area, since it aims to develop new ideas (products, services, and models) that meet social needs and that can simultaneously create social value.

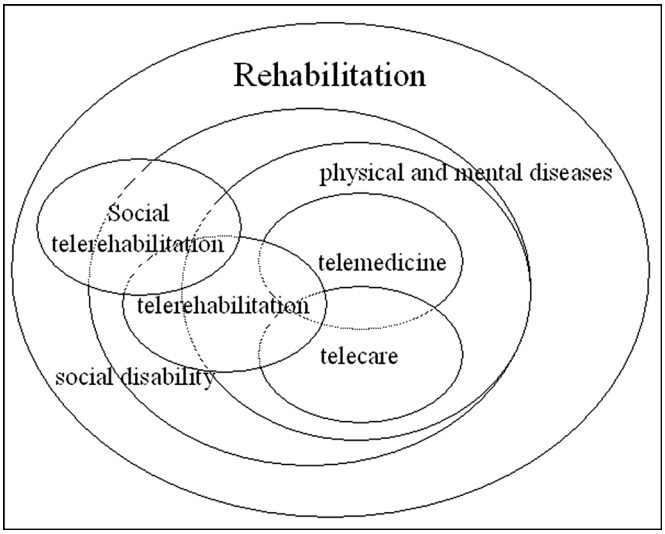

Fig 3. Interactions between telemedicine, telecare, and telerehabilitation

Online delivery of social rehabilitation services encourages the rethinking, reorganisation, optimisation, and extension of the current social rehabilitation services that fall under face-to-face treatments and protocols.

In fact, the use of computers to deliver traditional social rehabilitation services cannot be a sufficient condition for transforming them as effective social telerehabilitation services: to make these services really effective, it is often necessary both to rethink them in the light of the opportunities offered by the new technologies and, at the same time, to carefully analyse the impact that they have on the persons involved in the process. In many cases it is worthwhile to verify the impact on the organisation which delivers telerehabilitation, e.g. considering the requalification of caregivers, the reliability of the computing services, the costs, and so on.

Internet-based applications can be realised not only for follow-up communication between caregiver-doctor-patient after a therapy, which is the most common use of ICT in the rehabilitation process, but also for improving the quality of the traditional rehabilitation therapies or for realising services that are completely new. The aim of developing new types of services is shared by social innovation. Another common point between social innovation and telerehabilitation is that both entail cutting across organisational, sectoral, or disciplinary boundaries of expertise. Furthermore, social innovation looks towards technology as a means to create new social relationships between previously separate individuals and groups.

Social innovation and social economy are closely tied: both pursue the same goal of creating solutions that can generate a positive impact, not only on the economic, but also on the social development of people and their communities. The basis of social economy is the creation of services that focus on specific target groups who need to be sustained and assisted (e.g. services that complement core hospital staff, employment counselling, vocational training, education/rehabilitation for addict/misfit people, and so on), or that satisfy a general public need (e.g. nurseries, care services for the elderly, shelters for the homeless, integration for the disabled, and so on).

Social telerehabilitation can mainly be useful in the above-mentioned sectors, especially in the scope of vocational rehabilitation, which encompasses all the elements that can help someone with a health problem to stay at, return to, and remain in work. Vocational telerehabilitation needs to be underpinned by an integrated approach and a strong collaboration among different subjects: rehabilitation structures, employers, and workers. Education institutions play a crucial role

in the implementation of vocational telerehabilitation services, since the different subjects involved in them need to be educated. More generally, telerehabilitation and social innovation necessitates training and retraining activities for both the providers and users of services. For this reason, educational issues are part of the national science program VPP INOSOCTEREHI developed in Latvia for social telerehabilitation.

Findings from the first year VPP INOSOCTEREHI research activity

The national science program VPP INOSOCTEREHI (Innovative solutions for social telerehabilitation in the schools of Latvia in the context of inclusive education) is a new three-year multidisciplinary project on social telerehabilitation, conducted by four Latvian Universities (Rezekne University, Latvia University, Riga Technical University, Liepaja University), which investigates the use of mobile technology in the field of social rehabilitation (http://telerehabilitation.lv/). The research program is developed along two dimensions: horizontal and vertical.

The horizontal dimension concerns the definition of the social rehabilitation context in terms of services, actors, and regulations. The vertical dimension concerns the comparative analysis of the solutions of *balance disorder*, a complex disturbance that affects many people worldwide.

At the beginning, the research focused on the notion of social telerehabilitation. The goal was twofold: to limit the research area, and to share basic concepts between research participants. A shared concept of social telerehabilitation was a prerequisite for starting the project, as this was necessary for creating a synergistic collaborative framework and exploiting the partners' skills and experiences in the fields of physiotherapy, engineering, computer science, social pedagogy, and social anthropology.

The preliminary analysis provided both a definition of the social telerehabilitation scope and a preliminary operative description of the skills/expertise involved. Indeed, it was necessary to identify the specific areas of expertise within the various disciplinary fields. For example, in computer science there are many specific areas of expertise that could be involved in social telerehabilitation, e.g. communicative interaction, robotics, augmented reality, and so on. The same situation applies in social pedagogy whose scope is equally wide, extending from educational theories to socialisation and, recently, even to coaching.

To delineate the social telerehabilitation scope and the competence framework, the methodology adopted was to first perform an analysis of the current literature and official statistics in the field of rehabilitation, and then to undertake a series of visits to institutions that offer rehabilitation services and to higher institutions that provide courses in this field. These visits took place in both Latvia and Lithuania, given the similarities between the two countries and the possible synergies in service development, especially in the border region (Tables I and II). In order to acquire new knowledge and increase the scientific contact network, a visit was also organised in Australia.

During the visits, short informal interviews were conducted with key people, and qualitative and quantitative data were gathered through direct observation. This concerned:

1. Rehabilitative practices;
2. Equipment;
3. Professional level staff;
4. ICT solutions;
5. Specific needs reported by insiders (Table III).

The visits revealed that most rehabilitation services had been developed in the physical rehabilitation area, and the level of personnel involved was sufficiently high. Higher institutions demonstrated that they were very active in research on cognitive rehabilitation practices. Some of them used advanced computer-based special equipment.

Despite the fact that in Latvia and Lithuania the Internet is used by over the 72% of population, with

Table I. Type of visited institutions

Type of institution	Latvia	Lithuania
Higher institution	4	2
Rehabilitation center	1	–
Rehabilitation service	1	1
Special center	1	–
Total	7	3

Table II. Rehabilitation services

Type of institution	Physical rehabilitation	Cognitive rehabilitation	Special equipment
Higher institution	X	X	X
Rehabilitation center	X	X	X
Rehabilitation service	X	–	–
Special center	X	–	–

Table III. The principal need indicated by respondents (in order of priority)

Needs	Higher institutions	Rehabilitation centers	Rehabilitation services	Special centers
Specialized personnel	X	X	X	X
Equipment for treatments	–	X	X	X
Special equipment	X	–	–	X
Quality assessment	X	X	X	X
Professionalization	–	X	X	X
Treatments extension	X	X	X	X

uniformly available and fast connection everywhere, and that many systematic rehabilitation activities are performed by government in collaboration with higher education institutions, there is currently no provision of telerehabilitation services.

The same situation can be observed in private institutions and foundations engaged in the rehabilitation field. It must be kept in mind that, in Latvia, there are some non-governmental institutions which are very active in assistive technology. The most well-known is the Latvian Society for the Blind, which provides basic rehabilitation services for visually impaired persons through 12 structured units spread throughout the country.

Our analysis shows that much progress has been made in Latvia in the field of rehabilitation during the last few years, but only in the mainstream direction. Nevertheless, the current situation in the research field is encouraging: the number of Latvian researchers interested in assistive technology, telecare, e-health, and innovative rehabilitation practices and services is increasing [20-23]. This is an important development, since only a few years ago (2012), the lack of research activity in the field of "human functioning" and its limitations was indicated as a critical factor, along with a chronic lack of funding and a notable scarcity of medical professional knowledge and skills [1/].

An important element that emerged from our preliminary analysis is the diffusion of the Internet connection to all the rehabilitation structures, as well as the presence of television devices everywhere. Nevertheless, we didn't find any integration of Internet-television, or the utilisation of television for delivering programs targeted to specific need users. This is a pity, since the potential of these means is not being exploited, even though this would require significant investment and an innovative outlook.

Socio-technical challenges

Thanks to the investigations that have started in the last fifteen years on different forms and roles of affection in virtual agents and robots (*Scheutz*, 2011), some researchers are now considering the employment of robots in social rehabilitation services (*Tickle-Degnen, Scheutz & Arkin*, 2014). The new robots could provide moral functionalities that enable them to establish therapeutic human relationships, for example in the context of occupational therapy and Parkinson's disease. At the simplest level, a robot could ensure basic functional elements of interpersonal communication. On a more sophisticated level, they could act as "observers" that accurately detect and prioritise people, objectives, and context attributes relevant to reasoned and ethical therapeutic interaction (*Arkin, Scheutz & Tickle-Degnen*, 2014).

Almost 50 years have passed between the creation of the *Eliza Weizenbaum* program and the appearance of the new robots designed for rehabilitation services. The difference is that *Eliza* was one of the first experimental programs in the field of natural language processing, whilst the new robots utilise the achievements in natural language processing for communicating with patients. The focus is now on programming machines for empathy emulation and ethical therapeutic activities.

However, we are persuaded that much time will pass before the research findings can provide robotic caregivers for social rehabilitation purposes.

From our analysis of the literature we identified three principal areas of interest for the development of social telerehabilitation services:

1. the psycho-physical area;
2. the social-communication area;
3. the behavioural area (e.g. behavioural addictions).

Most telerehabilitation research falls into the psychophysical area, and concerns the physical issues. This is due to the fact that the number of people requiring social rehabilitation services following trauma, disease, or enduring chronic pathology is increasing (*Enders & Brandt*, 2007).

Data shows that, in Latvia, the current use of the new technologies in the health scope is rather limited. Although the implementation of an e-health system has been initiated since 2003, for a long time there was no progress in this area because of a lack of funding and a cultural reluctance to accept it [23].

A mobile solution for balance disorder

In Latvia, the priority in e-health research, and consequently also in the social telerehabilitation field, is the development of services, which use the new technologies to increase the number of users. Accordingly, the VPP INOSOCTEREHI project will develop a multidisciplinary research in the context of inclusive education targeted on students' balance disorders. It aims to experiment the possibility of implementing new prototypes and innovative methodologies (approaches, methods, and techniques) for the social telerehabilitation of students with balance disorders. In particular, it aims to ensure the transfer of innovation through the application of knowledge formerly acquired with BIOSWAY equipment [24], a portable balance system for testing and training patients. The choice of this specific field of application of telerehabilitation emanates from the fact that many people suffer from dizziness or imbalance during their lifetime.

[1/] Assistive technology public distribution system in Latvia. http://portale.siva.it/files/doc/library/a410_1_VETRA_aaate2012.pdf (4.16.2015)

The human balance system involves a complex set of sensorimotor-control systems, which includes sensory input from vision (sight), proprioception (touch), and the vestibular system (motion, equilibrium, spatial orientation). Problems with balance occur when there is a disruption in any of the vestibular, visual, or proprioceptive systems. The interlacing feedback mechanism which regulates the balance control can be disrupted by damage to one or more components through injury, disease, or the aging process [25]. A person can feel disoriented if his/her sensory input sources (eyes, muscles and joints) are in conflict with one another. This means that balance dysfunction may be caused by problems in any one or a combination of the contributing systems. Accordingly, most balance patients travel a long and frustrating road before finding help.

In the VPP INOSOCTEREHI project, we pursue the idea of using mobile technology to capture data about the patient's body movements through sensors connected via Bluetooth to a mobile device. A computer program has been designed for data storing in a cloud application, and algorithms have been selected for comparing and improving diagnostic analysis, exploiting the data previously acquired using BioSway equipment.

Our goal is the creation of a portable and inexpensive balance assessment system that has widespread availability. New wearing devices for balance disorder rehabilitation have already been experimented, e.g. that utilise inertial sensors and sensor fusion processing to measure body posture and provide real-time feedback to alert the wearer to remain in the region of stability [26].

We have designed a Smartphone container that can be easily worn (Fig. 4). It is equipped with a laser pointer connected to the Smartphone. The laser pointer is used by the patient to establish his/her right position, centering the target in a special wall poster. The patient's movements made to maintain the right position are calculated by sensors and analysed with specific algorithms.

We would like to investigate the possibility of using augmented reality with or instead of optical sensors, and the possibility of implementing a mobile app which emulates the movement sensors to calculate the changes from the patient's equilibrium position .

Interesting prototypes are available [27, 28]. Prototypes which use the three components: mobile, cloud, and web applications have already been implemented. The mobile detects balance instability using sensors from a Smartphone, interacts with the patient via audio feedback, and manages exercise information, whilst the cloud performs trend analysis from the stored users' profile and data [29].

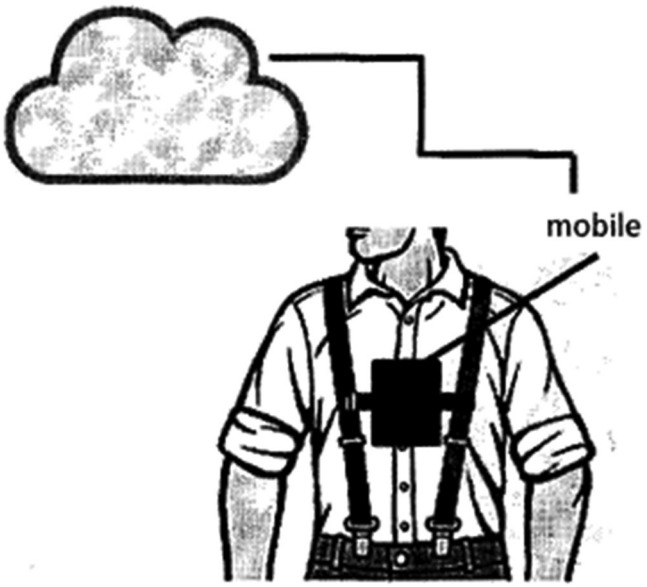

Fig. 4. A mobile used to calculating patient's movement

Studying and comparing the available prototypes, and designing effective large-scale cheap services using the basic mobile equipment (GPS, level apps, etc.) will be our aim.

Conclusions

It has been observed that advances in rehabilitation contrast dramatically with advances in all other medical areas [3]. This is due to the difficulty for rehabilitation services to maintain or increase their share of resources in the face of expensive but effective single treatment advances in other fields.

The use of new technologies can offer productive allocation of resources, and allow control and treatment from a distance. For example, the current rehabilitative treatment of balance disorder requires a long and intensive process. In this case, the possibility for a clinician to objectively assess standing balance using a portable, inexpensive, and valid system could provide numerous benefits in a wide range of patient populations.

In this paper, we presented the VPP INOSOCTEREHI project, a research program which aims to investigate the possibility of developing social telerehabilitation services. The project foresees the experimenting of mobile technology for implementing a low-cost service in the balance disorder scope (balance testing rehabilitation exercises, progress monitoring, etc.).

The first step of the VPP INOSOCTEREHI research was an analysis of the state of the art in social telerehabilitation. We found that, on a general organisational level, social telerehabilitation services share the basic model of rehabilitation services:

- Planning multidisciplinary interventions;
- Organising and managing a multidisciplinary team;

- Involving and educating the patient and their family;
- Treatment delivery;
- Assessing treatment results.

This warns us that the availability of technology is necessary but not yet sufficient for the realisation of effective social telerehabilitation services. One of the obstacles that needs to be overcome is the cultural divide which prevents the use of the new technologies. In fact, although Latvia is showing signs of embracing the practices and technologies (such as electronic information sharing, RFID, cloud services, and the use of social media), the take-up of these practices compared to other EU countries appears slow [2/]. Moreover, it is necessary to define models for evaluating the long-term advantages and cost-effectiveness of the new telerehabilitation services.

The next step of the VPP INOSOCTEREHI project will be to focus our research on these issues and design the appropriate solution strategy.

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[2/] See: The Digital Economy and Society Index (DESI). http://ec.europa.eu/digital-agenda/en/digital-agenda-scoreboard (07.04.2015)

Piśmiennictwo / References

1. Hailey D, Roine R, Ohinmaa A. Evidence on the ef fectiveness of telerehabilitation applications. Publication of Institute of Health Economics and Finnish Office for Health Technology As sessment. Dennett, 2010. https://www.yumpu.com/en/document/view/28671925/evidence-of-effectiveness-of-telerehabilitation-applications/3
2. Brown RI, Hughson EA. Behavioural and social rehabilitation and training. Captus Press, 1993.
3. Wade DT, de Jong BA. Recent advances: Recent advances in rehabilitation. BMJ 2000, 320(7246): 1385.
4. Altman IM, Swick S, Parrot D, Malec JF. Effectiveness of community-based rehabilitation after traumatic brain injury for 489 program completers compared with those precipitously discharged. Arch Phys Med Rehabil 2010, 91(11): 1697-1704.
5. Karkou V, Martinsone K, Nazarova N, Vaverniece I. Art therapy in the postmodern world: Findings from a comparative study across the UK, Russia and Latvia. Arts Psychother 2011, 38(2): 86-95.
6. Wressle E. Client Participation in the rehabilitation process. Linköping 2002. http://www.diva-portal.org/smash/get/diva2:23342/FULLTEXT01.pdf (6.12.2015).
7. Wressle E, Eeg-Olofsson AM, Marcusson J, Henriksson C. Improved client participation in the rehabilitation process using a client-centred goal formulation structure. J Rehabil Med 2002, 34(1): 5-11.
8. Rettke H, Geschwindner HM, Heuvel WJ. Assessment of Patient Participation in Physical Rehabilitation Activities: An Integrative Review. Rehabil Nurs 2015, 40(4): 209-23.
9. Neumann V, Gutenbrunner C, Fialka-Moser V, Christodoulou N, et al. Interdisciplinary team working in physical and rehabilitation medicine. J Rehabil Med 2010, 42(1): 4-8.
10. Nilsson AG, Nilsson TH. Towards a New Concept for Supporting Needy Children in Developing Countries – ICT Centres Integrated with Social Rehabilitation. [in] Information Systems Development. Song WW, Xu S, Wan C, et al (eds). Springer, New York 2011: 437-448.
11. Nilsson AG, Nilsson TH. Global Development and ICT for Building Civil Societies in Developing Countries. [in] Proceedings of IDIA 2011, the 5th International Development Informatics Conference on ICT for Development: People, Policy and Practice, 26-28 October, Lima, Peru. IDIA, Monash University 2011.
12. Simpson TL, Kivlahan DR, Bush KR, McFall ME. Telephone selfmonitoring among alcohol use disorder patients in early recovery: a randomized study of feasibility and measurement reactivity. Drug Alcohol Depend 2005, 79(2): 241- 250.
13. Rose GL, Skelly JM, Badger GJ, Naylor MR, Helzer JE. Interactive voice response for relapse prevention following cognitive-behavioral the rapy for alcohol use disorders: a pilot study. Psychol Serv 2012, 9(2): 174.
14. Osmani V, Maxhuni A, Grünerbl A, Lukowicz P, et al. Monitoring activity of patients with bipolar disorder using smart phones. [in] Proceedings of International Conference on Advances in Mobile Computing & Multimedia. ACM 2013: 85.
15. Freedman MJ, Lester KM, McNamara C, Milby JB, Schumacher JE. Cell phones for ecological momentary assessment with cocaine-addicted homeless patients in treatment. J Subst Abuse Treat 2006, 30(2): 105-111.
16. Luxton DD, McCann RA, Bush NE, Mishkind MC, Reger GM. Health for mental health: Integrating smartphone technology in behavioral healthcare. Prof Psychol Res Pr 2011, 42(6): 505.
17. Rice E, Kurzban S, Ray D. Homeless but connected: the role of heterogeneous social network ties and social networking technology in the mental health outcomes of street-living adolescents. Community Mental Health J 2012, 48(6): 692-698.
18. Hill AJ. Report on the potential application of telerehabilitation to adult rehabilitation services in Scotland. Scottish Government, Edinburgh 2010.
19. Grisolia F, Farragina E. Social Innovation on the Rise: yet another buzzword in a time of austerity? Salute e Società 2015.

20. Stumbris E. EHealth and Telemedicine development perspectives in Latvia and EU 2005-2015 (The Model of Riga Telemedicine centre). IST4Balt, Riga 2006, April 7.
21. Ardava E, Onzevs O, Viksne I, Namatevs I. Research of computerization and implementation of the e-prescription for individual pharmacies. Environment. Technology. Resources (Latvia) 2011.
22. Markovitch Z, Lauznis J, Balodis G, Katashev A, Markovitcha I. Development of New Mobile Telemedicine Screening Complex. [in] International Symposium on Biomedical Engineering and Medical Physics 2012, 10-12 October, Riga, Latvia. Springer, Berlin Heidelberg 2013: 31-34.
23. Butane L, Paulins N. E-health progress in Latvia. Applied Information and Communication Technologies (Latvia) 2013.
24. Baranauskienė I, Gerulaitis D, Lubkina V, Radzevičienė L, Usca S. Health Promotion and Professional rehabilitation Technologies for Participation in Labor Market. Rēzekne, Rēzeknes Augstskola 2013.
25. Shumway-Cook A, Woollacott MH. Motor control: theory and practical applications. Lippincott Williams Wilkins 1995.
26. Hsu Y, Payson E, Sapir I, Villacorta V. U.S. Patent No. 20,150,018,724. U.S. Patent and Trademark Office, Washington 2015.
27. Clark RA, Bryant AL, Pua Y, McCrory P, Bennell K, Hunt M. Validity and reliability of the Nintendo Wii Balance Board for assessment of standing balance. Gait Posture 2010, 31(3): 307-310.
28. Scaglioni-Solano P, Aragón-Vargas LF. Validity and reliability of the Nintendo Wii Balance Board to assess standing balance and sensory integration in highly functional older adults. Int J Rehabil Res 2014, 37(2): 138-143.
29. Wai AAP, Duc PD, Syin C, Haihong Z. (2014, August). iBEST: Intelligent balance assessment and stability training system using smartphone. [in] Engineering in Medicine and Biology Society (EMBC), 2014 36th Annual International Conference of the IEEE: 3683-3686.