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EDITOR'S PREFACE

It is with great pleasure that we present the 2nd 2017 issue of the MEFANET Journal (MJ). MJ is dedicated to provide readers around the world with high quality peer-reviewed articles on a wide variety of topics related to applications of computer science and technology-enhanced learning in medical education. Its mission is to become the premier vehicle for disseminating information about MEdical FAculties NETwork (www.mefanet.cz), which covers all Czech and Slovak medical faculties as well as schools or faculties of health care sciences.

This second issue encompasses three original articles and an editorial report. The first original paper by Kristinikova et al. demonstrates students' ability to perform Evidence Based Practice and to ask PICOT formatted research questions. The authors work with undergraduates studying in a rehabilitation study program and conclude that the students are able to determine which of the uncovered evidence is of the highest significance in particular patient cases. Obročníková et al. focus on the continuous training of nurses and midwives in the light of the global, epidemiological and social problems related to malignant breast tumors and the patients' quality of life. The third original research paper by Klempir et al. describes an interactive web-based application for processing and analysis of data in neuroscience. The authors exemplify the feasibility of performing explorative data analysis on-line, with the use of NeuroEDA web-based application developed on the grounds of Shiny framework. This framework has been created around the popular R studio and has been recently and repeatedly proven to be a very useful tool for reactive programming. The editorial report by Komenda et al. recalls the 10th anniversary of the MEFANET conference. This event celebrated the jubilee of creating the network, starting the conference series and initiating plethora of professional links. Blazkova et al. report on the launch of the SIMU project, which aims at revision of the curriculum of the General Medicine and Dentistry study programs at Masaryk University. The curriculum amendments will impact mostly the practical parts of teaching, which will employ a comprehensive range of medical simulation modalities, such as patient simulators, mannequins, standardized patients and virtual patients, in order to facilitate development of the 21st century skills, such as critical thinking, decision-making, clinical reasoning, crisis communication and teamwork.

I am sure that the readers will benefit from the information in the presented papers and it is my hope that this issue will stimulate further discussion and additional research. I would like to extend my sincere appreciation to the editorial members and reviewers, without whom this issue would not be possible. I would like to see the whole fifth volume of MJ as another valuable resource for the MEFANET community and a stimulus for further research into the area of medical education science. Readers are encouraged to submit both comments on these articles and their own relevant manuscripts.

September 2017

Daniel Schwarz
Editor-in-chief

EVIDENCE-BASED PRACTICE IN THE FIELD OF REHABILITATION

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ABSTRACT — Background: *At universities, the EBP course occurs within the master's degree or doctorate studies. To be able to make the right decision based on finding relevant evidence is one of basic skills of a university educated graduate of medical fields.*

Objectives: *The aim of this study was to determine the degree of awareness of physiotherapy and occupational therapy students about the principles of Evidence Based Practice (EBP), to inquire into their ability to use electronic information resources for searching strategies, and apply the results in practice.*

Methods: *Students in this study were tested by means of a questionnaire survey at the beginning and at the end of the training course Evidence Based Practice for rehabilitation disciplines.*

Results: *The results show that after completing EBP course, students were able to define the term, to search in electronic information resources, and to apply the results to practical tasks more efficiently.*

Conclusions: *In this pilot study, significant differences in the results have been found between the answers to the questions in the input and output surveys. The results confirm our hypothesis about the benefits of the EBP course, even in undergraduate studies. The students can apply acquired knowledge and skills in subsequent studies.*

INTRODUCTION

Evidence-based practice (EBP) is an interdisciplinary approach which appeared for the very first time in medicine as Evidence-Based Medicine and subsequently was transferred to other fields, e.g. psychology, nursing, education etc. First EBM principles occurred in clinical practice in the beginning of the 20th century in surgery. Later on more extensive studies were published, e.g. in the treatment of tuberculosis. However, the first one who applied statistic evaluation of therapeutic results, the French physician Charles-Alexandre Louis, proved blood-letting ineffective. The term EBM itself was probably used for the first time in the 1990s by MacMasters University employees as "systemic approach to the analysis of published research papers as the basis for clinical decision-making" [1].

Since 1995, the concept of evidence based practice has developed also in other health care branches, e.g. in nursing (Evidence Based Nursing), midwifery (Evidence Based Midwifery), in physiotherapy (Evidence Based Physiotherapy), occupational therapy (Evidence Based Occupational Therapy), in public health (Evidence Based Public Health), but also outside health service, e.g. in librarianship (Evidence Based Librarianship) and in law (Evidence Based Law). The World Confederation for Physical Therapy (European region) defined EBP as "a commitment to use the best available evidence to inform decision-making about the care of individuals that involves integrating physiotherapist practitioners and individual professional judgement with evidence gained through systematic research" [2].

The principle of EBP application is making decisions about further procedure for patients based

on research, where efficiency of procedures is compared and the best possible solution is searched out for the given case. EBP makes problem solution in clinical practice possible and ensures an effective approach to clinical decision making based on searching for the best and latest evidence, clinical experience, patients' evaluation and value preference connected with health care [3].

Evidence based practice is one of those approaches that enable future health care providers to manage an explosion of new technologies, findings, literature, and it will consequently lead to improvement of patient's results. Courses aimed at EBP in study programmes in rehabilitation field can be found at universities of medicine or health studies, either separately, or the EBP principles are implemented in other education courses, most frequently in research methodology. EBP has provided a great development especially in nursing [4,5].

In the field of rehabilitation, Evidence Based Practice (EBP) is a very frequently discussed term in practice. There are no uniform estimations of using EBP principles and both supporters and eager opponents of this approach can be found. Obviously, the clinical practice itself is not the most important argument to decide on the application of a specific therapeutic procedure for physical treatment. Economic, personal and technical aspects must be considered, too. Integrating EBP into the education is the most frequently used in nursing. Also, most studies dealing with the evaluation of the benefits of EBP by nurses. For students of physiotherapy, EBP principles are not applied in teaching standards. Physiotherapy students mostly learn basics of Evidence Based Practice during their Master study. This is a major reason why they are hardly able to apply the EBP fundamentals in practical therapy after graduation.

A piece of work from 2009 examined the awareness of EBP at Czech occupational therapy facilities by means of a question form [6]. Very low awareness about EBP among occupational therapists was concluded, although it was included in undergraduate university education in nursing simultaneously [6].

EVIDENCE-BASED PRACTICE IN STUDY PLANS OF REHABILITATION BRANCHES AT THE FACULTY OF MEDICINE, UNIVERSITY OF OSTRAVA

As mentioned above, nursing has the longest tradition of involving EBP in curricula where also the methods of project teaching are being used. Project education is based on theory and practice interconnection and improves the student's creativity. Using a project in teaching of the course Evidence based practice shows to be an effective way of how to acquire knowledge and use it to solve problems relevant to clinical practice [7].

Within a project focused on teaching innovation in paramedical study branches, a new course Evidence Based Practice in Rehabilitation Branches was created which was integrated into study plans of the branches physiotherapy and occupational therapy. To support the teaching, a resource text was elaborated and e-learning course within LMS Moodle was created [8–10].

Pilot courses

The course was involved in teaching for the very first time in the study programme Specialization in health service in the branches physiotherapy and occupational therapy in summer semester of the academic year 2011/2012. The course was offered to students of physiotherapy and occupational therapy within one common course because of a very useful cooperation of these professions in comprehensive patient's therapy in practice. There was also the intention to develop common topics for problem solution within multidisciplinary approach.

The teaching was led in a combined form with e-learning support and emphasis on the work itself. Students got a theoretical part that explained EBP history and principals, methods of how to formulate the clinical question (PICOT: P – stands for patient population, I – represent issue of concern or intervention, C – stands of comparison intervention, O – signifies outcome, T – stands for time duration) and how to evaluate the results found. The EBP application in the classes referred to searching in electronic information sources available at the university. In collaboration with a university librarian, the most suitable electronic databases for rehabilitation branches were searched out. Students were acquainted with principles of searching according to key words in Czech as well as in English languages and they practised searching for solution of real tasks in electronic databases. In the e-learning course, students elaborated five assignments. The tasks concerned both to work with electronic databases and search strategy but also to form clinical questions. As a course conclusion, each student compiled a case study related to a particular diagnosis in which he/she chose a treatment strategy related to the sought arguments [10].

Within practical skills, a portion of searching in electronic databases, available at the University of

Ostrava, was involved in the course. A university librarian, who participates in teaching, seeks out the up-to-date information databases especially suitable for physiotherapists and occupational therapists so that the students can search for and work with professionally directed pieces of information.

Implementation in standard teaching

In academic year 2014/2015, the course was implemented in the bachelor study of physiotherapy as obligatory-optional or optional course in the summer semester of the second year of study. From this time onwards, the course has been taught five times, and 68 students have completed the course.

The teaching is implemented, as mentioned above, with an e-learning support in LMS Moodle. The illustration of the setting is shown in Figure 1.

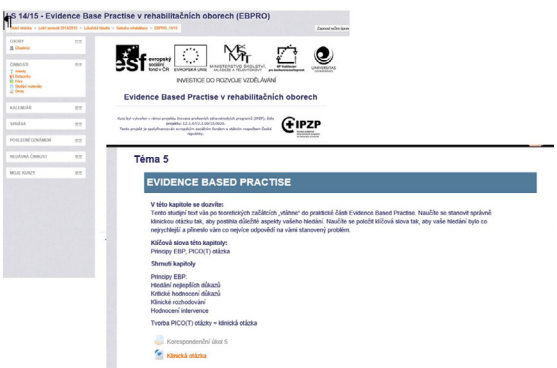


FIGURE 1. Setting of the e-learning course EBP in rehabilitation fields. In topic 5, students learn how to formulate the PICOT question in the right way so that the question expresses important aspects of search

Within the course, students compiled particular case studies in the form of correspondent tasks. Students picked up from 10 offered case studies – case studies concerning patient with autism, with apallic syndrome, cerebral palsy, urinary incontinence, multiple sclerosis, the issue of doing sports during pregnancy, falls in senior facilities, well-timed diagnosis of defective posture, amputations and signs of dementia are being solved. Figure 2 presents selected issues solved by EBP methods.

METHODS

In the pilot course in academic year 2011/2012, an interview took place in the first lesson where the students explained why they had enrolled the EBP course, and what their expectations were. Most students did not know what the term Evidence Based Practice means, they had no expectations and they enrolled the course due to its attractive credit rating. At the course end, an interview with students proceeded again. It aimed to evaluate the course, specify particular benefits for individual students and analyse deficiencies. It was observed that students missed basic orientation in research frequently. In searching in electronic information resources, students were successful under direct teacher's guidance only.

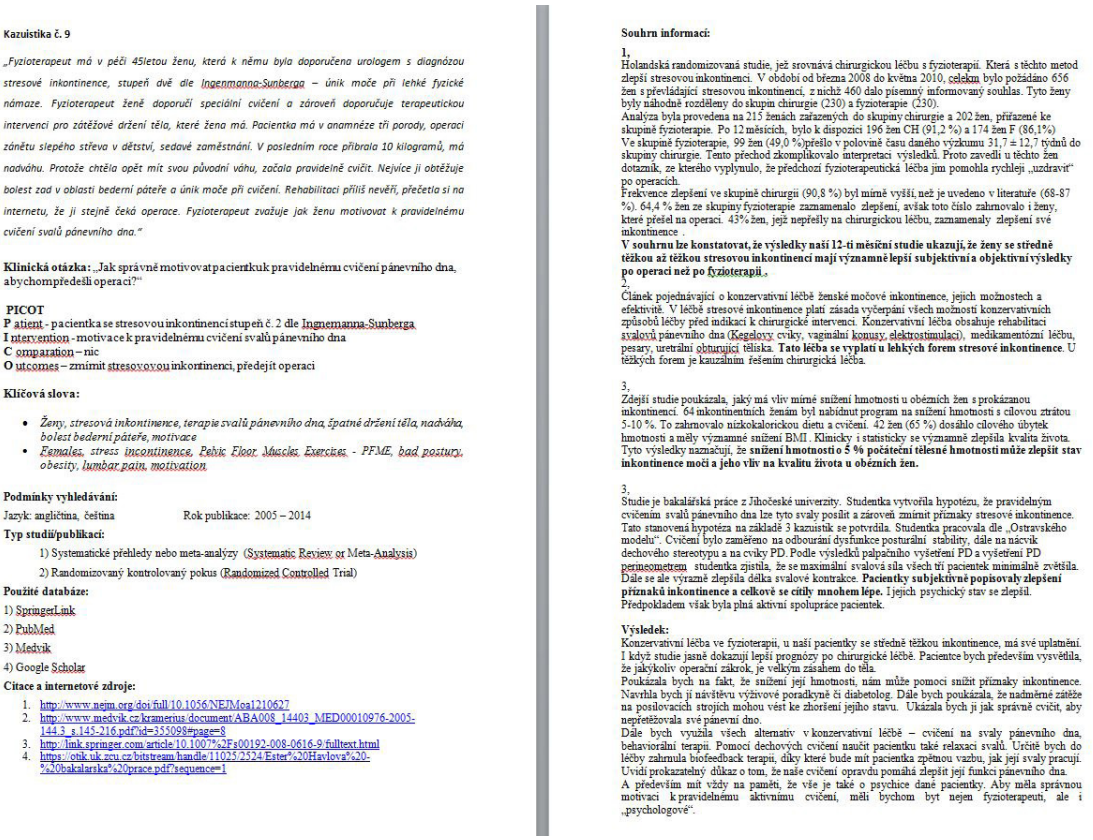
In academic years 2013/2014 and 2014/2015 students were offered to take part in initial and final course evaluation. The survey was conducted via a questionnaire. The questionnaire included both closed and open questions aimed to find out how students understand the concept of Evidence Based Practice, whether they can explain it. We also wanted to find out if they know the electronic information resources and focus on the search strategies (Figure 3). Students' answers were evaluated in percentages. The questionnaire was applied twice as entrance and exit survey and the results were compared.

RESULTS

Twenty-six students in two academic years participated in the study, all have filled in the input survey while the final one was completed by 20 students.

Only 7 students out of the total 26 involved in the initial survey knew the term EBP in advance, the other heard it for the very first time. Out of 7 students, who had heard the term before, only three answered that they knew what the results acquired by means of EBP could be used for and just one student out of these three characterized EBP correctly. There was a different situation after the end of the course. 20 students took part in the final survey and all of them answered positively the question whether they are able to define meaning of the term EBP. In addition, each answer contained proper example of EBP result practical application.

The orientation in electronic university databases was another part of teaching. In the initial survey, 15 students out of 26 stated they had already used any database. This low number shows that students were not used to search for needed pieces of information by means of EIS very much. Most of them (17 students) mentioned the Internet without any detailed specification as the most common source of information. Then, during oral questioning, they mentioned only general search engines as Google or Seznam.cz and the like. It took them too much time to find the needed information due to the lack of any searching strategy, and they did not know about existing special databases



Kazuistika č. 9

„Fyzioterapeut má v péči 45letou ženu, která k němu byla doporučena urologem s diagnózou stresové inkontinence, stupeň dvě dle Ingenmanna-Sunberga – únik moče při lehké fyzické námaze. Fyzioterapeut ženě doporučí speciální cvičení a zároveň doporučuje terapeutickou intervenci pro zátěžové držení těla, které žena má. Pacientka má v anamnéze tři porody, operaci zánětu slepého střeva v dětství, sedavé zaměstnání. V posledním roce přibrala 10 kilogramů, má nadváhu. Protože chtěla opět mít svou původní váhu, začala pravidelně cvičit. Nejvíce ji obtěžuje bolest zad v oblasti bederní páteře a únik moče při cvičení. Rehabilitaci příliš nevěří, přečetla si na internetu, že ji stejně čeká operace. Fyzioterapeut zvažuje jak ženu motivovat k pravidelnému cvičení svalů pánevního dna."

Klinická otázka: „Jak správně motivovat pacientku k pravidelnému cvičení pánevního dna, abychom předešli operaci?"

PICOT
P atient - pacientka se stresovou inkontinencí stupeň č. 2 dle Ingnemanna-Sunberga
I ntervention - motivace k pravidelnému cvičení svalů pánevního dna
C omparation – nic
O utcomes – zmírnit stresovou inkontinenci, předejít operaci

Klíčová slova:

- *Ženy, stresová inkontinence, terapie svalů pánevního dna, špatné držení těla, nadváha, bolest bederní páteře, motivace*
- *Females, stress incontinence, Pelvic Floor Muscles Exercises - PFME, bad postury, obesity, lumbar pain, motivation*

Podmínky vyhledávání:
Jazyk: angličtina, čeština Rok publikace: 2005 – 2014
Typ studií/publikací:
1) Systematické přehledy nebo meta-analýzy (Systematic Review or Meta-Analysis)
2) Randomizovaný kontrolovaný pokus (Randomized Controlled Trial)
Použité databáze:
1) SpringerLink
2) PubMed
3) Medvik
4) Google Scholar
Citace a internetové zdroje:
1. http://www.nejm.org/doi/full/10.1056/NEJMoa1210627
2. http://www.medvik.cz/kramerius/document/ABA008_14403_MED00010976-2005-144.3_s.145-216.pdf?id=355098#page=8
3. http://link.springer.com/article/10.1007%2Fs00192-008-0616-9/fulltext.html
4. https://otik.uk.zcu.cz/bitstream/handle/11025/2524/Ester%20Havlova%20-%20bakalarska%20prace.pdf?sequence=1

Souhrn informací:

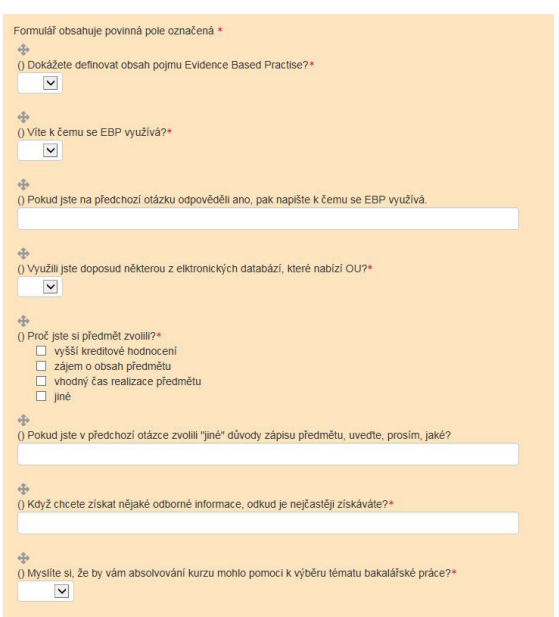
1,
Holandská randomizovaná studie, jež srovnává chirurgickou léčbu s fyzioterapií. Která s těchto metod zlepší stresovou inkontinenci. V období od března 2008 do května 2010, celekm bylo požádáno 656 žen s převládající stresovou inkontinencí, z nichž 460 dalo písemný informovaný souhlas. Tyto ženy byly náhodně rozděleny do skupin chirurgie (230) a fyzioterapie (230).
Analýza byla provedena na 215 ženách zařazených do skupiny chirurgie a 202 žen, přiřazené ke skupině fyzioterapie. Po 12 měsících, bylo k dispozici 196 žen CH (91,2 %) a 174 žen F (86,1%)
Ve skupině fyzioterapie, 99 žen (49,0 %)přešlo v polovině času daného výzkumu 31,7 ± 12,7 týdnů do skupiny chirurgie. Tento přechod zkomplikovalo interpretaci výsledků. Proto zavedli u těchto žen dotazník, ze kterého vyplynulo, že předchozí fyzioterapeutická léčba jim pomohla rychleji „uzdravit" po operacích.
Frekvence zlepšení ve skupině chirurgii (90,8 %) byl mírně vyšší, než je uvedeno v literatuře (68-87 %). 64,4 % žen ze skupiny fyzioterapie zaznamenalo zlepšení, avšak toto číslo zahrnovalo i ženy, které přešel na operaci. 43% žen, jejž nepřešly na chirurgickou léčbu, zaznamenaly zlepšení své inkontinence .
V souhrnu lze konstatovat, že výsledky naší 12-ti měsíční studie ukazují, že ženy se středně těžkou až těžkou stresovou inkontinencí mají významně lepší subjektivní a objektivní výsledky po operaci než po fyzioterapii .
2,
Článek pojednávající o konzervativní léčbě ženské močové inkontinence, jejich možnostech a efektivitě. V léčbě stresové inkontinence platí zásada vyčerpání všech možností konzervativních způsobů léčby před indikací k chirurgické intervenci. Konzervativní léčba obsahuje rehabilitaci svalovů pánevního dna (Kegelovy cviky, vaginální konusy, elektrostimulaci), medikamentózní léčbu, pesary, uretrální obturující tělíska. **Tato léčba se vyplatí u lehkých forem stresové inkontinence.** U těžkých forem je kauzálním řešením chirurgická léčba.

3,
Zdejší studie poukázala, jaký má vliv mírné snížení hmotnosti u obézních žen s prokázanou inkontinencí. 64 inkontinentních žen byl nabídnut program na snížení hmotnosti s cílovou ztrátou 5-10 %. To zahrnovalo nízkokalorickou dietu a cvičení. 42 žen (65 %) dosáhlo cílového úbytek hmotnosti a měly významné snížení BMI. Klinicky i statisticky se významně zlepšila kvalita života. Tyto výsledky naznačují, že **snížení hmotnosti o 5 % počáteční tělesné hmotnosti může zlepšit stav inkontinence moči a jeho vliv na kvalitu života u obézních žen.**

3,
Studie je bakalářská práce z Jihočeské univerzity. Studentka vytvořila hypotézu, že pravidelným cvičením svalů pánevního dna lze tyto svaly posílit a zároveň zmírnit příznaky stresové inkontinence. Tato stanovená hypotéza na základě 3 kazuistik se potvrdila. Studentka pracovala dle „Ostravského modelu". Cvičení bylo zaměřeno na odbourání dysfunkce posturální stability, dále na nácvik dechového stereotypu a na cviky PD. Podle výsledků palpačního vyšetření PD a vyšetření PD perineometrem studentka zjistila, že se maximální svalová síla všech tří pacientek minimálně zvětšila. Dále se ale výrazně zlepšila délka svalové kontrakce. **Pacientky subjektivně popisovaly zlepšení příznaků inkontinence a celkově se cítily mnohem lépe.** I jejich psychický stav se zlepšil. Předpokladem však byla plná aktivní spolupráce pacientek.

Výsledek:
Konzervativní léčba ve fyzioterapii, u naší pacientky se středně těžkou inkontinence, má své uplatnění. I když studie jasně dokazují lepší prognózy po chirurgické léčbě. Pacientce bych především vysvětlila, že jakýkoliv operační zákrok, je velkým zásahem do těla.
Poukázala bych na fakt, že snížení její hmotnosti, nám může pomoci snížit příznaky inkontinence. Navrhla bych jí návštěvu výživové poradkyně či diabetolog. Dále bych poukázala, že nadměrné zátěže na posilovacích strojích mohou vést ke zhoršení jejího stavu. Ukázala bych ji jak správně cvičit, aby nepřetěžovala své pánevní dno.
Dále bych využila všech alternativ v konzervativní léčbě – cvičení na svaly pánevního dna, behaviorální terapii. Pomocí dechových cvičení naučit pacientku také relaxaci svalů. Určitě bych do léčby zahrnula biofeedback terapii, díky které bude mít pacientka zpětnou vazbu, jak její svaly pracují. Uvidí prokazatelný důkaz o tom, že naše cvičení opravdu pomáhá zlepšit její funkci pánevního dna.
A především mít vždy na paměti, že vše je také o psychice dané pacientky. Aby měla správnou motivaci k pravidelnému aktivnímu cvičení, měli bychom být nejen fyzioterapeuti, ale i „psychologové".

FIGURE 2. Illustration of solving a case study of a patient with urinary incontinence. The student had to answer the question how to motivate the patient to exercise the pelvic floor muscles regularly in order to avoid surgery



Formulář obsahuje povinná pole označená *

() Dokážete definovat obsah pojmu Evidence Based Practise?*

() Víte k čemu se EBP využívá?*

() Pokud jste na předchozí otázku odpověděli ano, pak napište k čemu se EBP využívá.

() Využili jste doposud některou z elktronických databází, které nabízí OU?*

() Proč jste si předmět zvolili?*
- vyšší kreditové hodnocení
- zájem o obsah předmětu
- vhodný čas realizace předmětu
- jiné

() Pokud jste v předchozí otázce zvolili "jiné" důvody zápisu předmětu, uveďte, prosím, jaké?

() Když chcete získat nějaké odborné informace, odkud je nejčastěji získáváte?*

() Myslíte si, že by vám absolvování kurzu mohlo pomoci k výběru tématu bakalářské práce?*

FIGURE 3. Initial questionnaire in the beginning of teaching

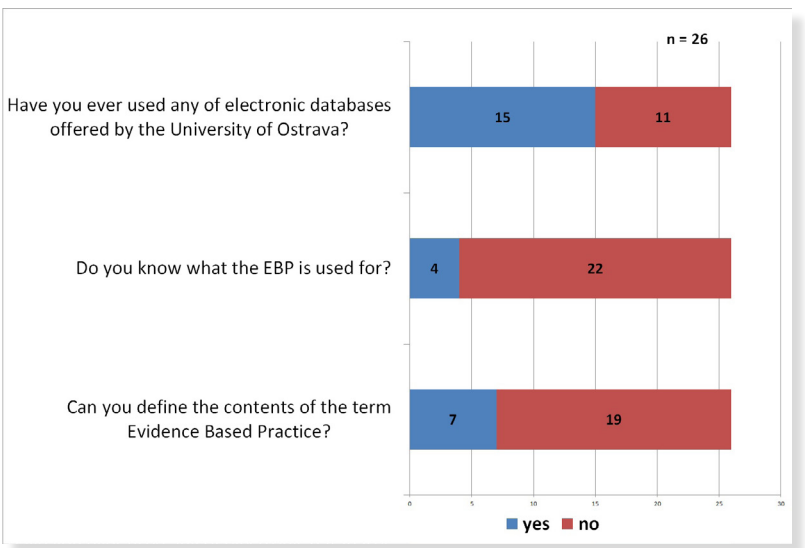


FIGURE 4. Illustration of outputs of the initial questionnaire

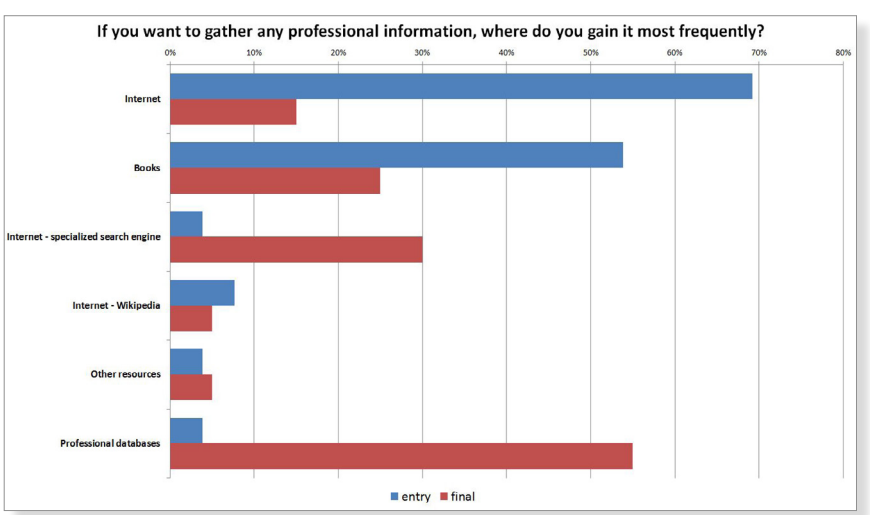


FIGURE 5. Reasons for not using VPs

for physical therapy or occupational therapy, either. Professional books or journals were given as the most frequent source of information. In the final survey, all 20 respondents replied they started using university EIS to a larger extent to search information for study. EBSCO, MEDLINE and Google Scholar (100%) were found most beneficial. Although the students got familiar with university EIS, searching strategy, defining the key words and their English equivalents seemed to be their permanent problems. These troubles were especially obvious when they should have worked without tutor's assistance.

DISCUSSION

Although this was just a pilot survey with a small number of participants, the results are interesting and inspiring. The introduction of EBP in physiotherapy and occupational therapy curricula at the undergraduate level is not quite standard, this is rather the domain of nursing. The research of the effectiveness of acquired knowledge and skills after the completion of such a course of study can be found mostly in nursing, too. Our results related to the understanding and definition of EBP and its contents correspond to the results of Martinez et al. [12], performed in university nursing students. Increased skills in using EBP tools after 15 weeks of education were discovered, which is almost identical to our time allocation of 14 weeks.

Nevertheless, it should be noted that at least some students of the bachelor study fields physiotherapy and occupational therapy knew the term but they cannot explain it correctly. The above mentioned results imply that students have learned both EBP principles and the application of EBP outputs in practice.

Other studies [15], however, describe the EBP principles to be difficult to understand and worse to apply in clinical practice, and the students are looking for a way how to keep the skills acquired at university in their working environment.

Olsen et al. [16] point to the fact that physiotherapy students who had EBP courses in their curricula, were able to form and ask questions and critically evaluate research results.

At the beginning of our research, students in the survey reported that they used mainly books, textbooks or journals to gather the necessary information. Few among them featured electronic sources as a source of information. If even used, general-purpose Internet resources such as Google or Seznam were used, despite the negligible scientific value of their information.

The study [17] reported similar results, and also pointed to the fact that students rather proceed from such resources, if adequate training and skills in work with electronic information sources were not provided to them. As a further option to gain professional experience for deciding on appropriate therapy, the respondents reported their personal experience and advice of senior colleagues.

Our students positively valued the fact that they were able to make a basic search related to their bachelor thesis. Eight students mentioned the EBP course helped them to choose or elaborate the topic of the bachelor thesis.

CONCLUSION

Our view to the accuracy of involvement of a course dealing with the solution of clinical questions based on the EBP principles in curricula even at the undergraduate level was also supported by the systematic review of MOTA DA SILVA et al. [13], in which the need to increase theoretical information and practical skills to enhance EBP skills of physiotherapists in deciding on therapy for the patient was demonstrated. As mentioned above, nursing disciplines have a long history in teaching the EBP principles, thereby the competence of nurses to apply this scientifically based knowledge into practice is increased [14].

When the efficiency of our course is evaluated, we can say the students positively value the use of information presented in the course for their further studies, and mainly for future practice. They learned how to specify a problem and find possible solutions with the aid of EIS. This was shown especially during assignments and mainly during elaborating a particular case history. Students were able to form the PICOT question and find possible therapy for a particular case. Considering they were also acquainted with essentials of research methodology, they were able to determine which of the found pieces of evidence was of highest significance, and they learned at least the principles of critical evidence analysis in this way [11].

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QUALITY OF LIFE IN WOMEN WITH BREAST CANCER

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ABSTRACT — **Objective:** *The aim of this cross-sectional study was to investigate the quality of life (QoL) in women with breast cancer, who are members of support groups – civil society.*
The second objective was to evaluate the possibility of supporting the education of nursing students at the undergraduate or postgraduate level in order to provide effective support to women with breast cancer and to identify the areas that need to be addressed in education.

Methods: *For purposes of assessing QoL of women with breast cancer, the standardized instrument WHOQOL-BREF was used. The sample was composed of 90 women with malignant breast disease. Results of study were compared to a population norm. Empirical data collection was performed in a period from January to March 2014.*

Results: *Results of the statistical analysis pointed to the lowest quality of life in all aspects of the physical dimensions (physical health) in comparison with the population norm. The worst were evaluated in items of dependence on medical care (2.30), pain and discomfort (2.90) in the domain of "psychological health," the item was negative feelings (2.74). In contrast to the above results, the highest quality of life in women have been reported in the domain of "social relations" and "environment" that were almost identical, in certain items QoL was better with the values of a population norm. Women evaluated QoL worse after radical mastectomy and without life partner (single, divorced, widows).*

Conclusions: *Breast cancer is a serious disease that reduces the quality of life, particularly in physical domain and in the emotional area. Oncological disease is becoming a disease for a lifetime. It connected with the constant fear of cancer recurrence and the consequences of treatment. Attention should be paid to each patient and for better compensation of the disease and maintenance the quality of life, also to support the development of psychosocial intervention in all forms.*

INTRODUCTION

Breast carcinoma is the most frequently malignant tumour among women. Malignant tumour of breast became global, epidemiological and social problem which is affecting women in medium age category. For last twenty years, a large number of breast cancers has been increasing by more than 30% in women aging between 25 and 40 years, whereas in the past, the disease was occurring mostly in women aging about 60 years. Positive aspect is that in the event the cancer is detected soon enough, the treatment efficacy achieves about 90–100%. Disease causes negative long-term changes in emotional, cognitive and social dimension [1]. Breast cancer is a very stressful event in women lives. They have permanent fear from disease recurrence which is connected with consequences of oncological treatment and psychosocial morbidity progress. This fear decreases the quality of life in the patients with the breast cancer [2]. Tumours require an intensive and complex treatment, which depends on the type, scope and location of the tumour focus. Woman-patient is confronted by notice diagnosis of various thoughts, feelings, physical changes

that result from a combination of therapies, such as surgery therapy in combination with chemotherapy, radiotherapy and hormonal therapy. Each modality brings with it a range of adverse effects through hematologic complications, regression of the immune system, hormonal changes, digestive problems (anorexia, nausea and vomit), alopecia, after local skin changes which are consequences of radiotherapy and persistent fatigue for months or years after treatment. Sadovská [3] states that the pain is often a complication and it affects approximately 80–90% of patients. Pain is characterized by burning feelings and contraction in thorax wall, arm-pit or back side of shoulder. However, the pain is usually also associated with lymphedema which is very often a complication after surgery intervention on breast and regional lymph system. It affects approximately 20–40% of women after the operation during six years [4]. The resulting lymphedema limits the mobility of the limb, furthermore is the source of pain and relapsing infections, and therefore greatly influences the quality of life of a woman. Symptoms of lymphedema will be able to retreat with long-term and intensive rehabilitation, compliance of treatment measures and skin care [3]. Mastectomy can cause unbalance and asymmetrical posture with tilting to healthy side of the body. These facts can induce pains in cervical spine and stiffness in the neck. Breast epithesis is an advisable tool for maintaining proper posture and it hides the empty space in the chest. With this prosthesis, women feel more confident (comfortable) and they can return to normal life without any visible changes in their body [4]. From the psychological aspect, the disease is a very challenging/ difficult life situation. It changes ordinary life rhythm, hobbies, and well-being and also threatens their feelings security [5]. Many investigation studies which were bearing to existence psycho-social problems, they documented the incidence of depression in 30% patients, adaptation problems and negative stress after they were diagnosed a cancer. Also, only 4% of patients with cancer accept that they suffer from a depression or anxiety [6]. Doubts on self-appreciation and difficulties in sexual relationships occur in addition to depression, fear, anxiety and emotional stress arising due to the disease in patients. Women feel low-rate, unattractive, abhorrent by the consequence of an amputation of their breast. In many cases, they have a fear that they are unattractive for their sexual partner. Very often, the first reaction after the removal of the breast in patients attempt to disguise scars and withdraw into seclusion. Some women do not put off their bra or they resist physical contact in chest area during sexual intercourse [7]. The rate of psychosocial burden and quality of life is a dynamic process, where problems in the mental, emotional and social areas persist several years after treatment of the disease [1]. In social dimension, life of every woman with breast cancer brings various changes in the arrangement of their family life, changes in social roles, in the field of work and changes in the financial position [7]. Ill women have the biggest fear from work disability, from decreasing life standards and the resulting loss of social prestige. Surrounding social environment of women is affected by the disease, along with her surviving treatment, the chance to cure and disappointment [8].

AIM

The aim of the research was to determine the quality of life in women with breast cancer by using a standardized questionnaire WHOQOL-BREF.

The second objective is to propose (evaluate) the possibilities of supporting the nursing education at pregradual level in the meaning of follow-up assistance and help to patients with breast cancer and to identify the areas where should be paid attention to the healthcare workers education.

METHODS

For measuring quality of life, we used a questionnaire Quality of Life by World Health Organization WHOQOL-BREF that is focusing to general quality of life, general satisfaction with health and the assessment of single domains and aspects of the quality of life. Questionnaire WHOQOL-BREF is a short version of the original questionnaire WHOQOL-100 which allows a detailed assessment of each individual facet relating to the quality of life. The instrument was developed by WHOQOL group (1998), based on an analysis of data from 20 research centres around the world. The questionnaire is used for self-assessing the quality of life that the respondent fills out alone. It is designed for assessing the quality of life of groups or populations and it enables regional or international comparison of groups with different socio-economic characteristics. The questionnaire was tested in 23 countries around the world such as Brazil, Spain, Russia, USA and the Czech Republic, where it was analysed by Dragomirecká and Bartoňová [9]. The questionnaire consists of 26 items: two independent items which are evaluating the overall quality of life and satisfaction with general health and 24 items associated into four domains (physical health, psychological health, social relationships and environment).

The results of questionnaire WHOQOL-BREF are expressed as:

- domain score which represents average raw score from items including the transformation to scale from 4 to 20 or from 0 to 100 (in %), the higher score means a better quality of life

- the values of answers of two independent items which evaluate general quality of life and overall health
- range of scale for individual items 1–5, which means 1 is the worst answer and 5 is the best answer [9].

The questionnaire was completed with other questions relating to the socio-demographic characteristics: age, marital status and questions are focused to the type of operation and the length of a diagnosed disease. Questionnaire was anonymous and its administration was voluntary. Data collection was conducted from January to March 2014 in Slovakia. Questionnaires were distributed after written agreement by female members of a self-group Venuša in Prešov, self-group Narcis in Vranov nad Topľou and self-group Viktorka in Banská Bystrica. We determined the specified criteria for the choice of respondents:

- age of cancer patients up to 65 years
- diagnosed breast carcinoma
- women willing to complete the questionnaire

Statistical analysis and evaluation of empirical data has been realized in Microsoft Office Excel 2007 programme and with the usage of descriptive statistics – absolute frequency (n), relative multiplicity (%), arithmetic average and standard deviation (SD). Results of our survey were compared with the results of research (population norm) by authors Dragomirecká and Bartoňová. Quality of life data was analysed and compared also in terms of operating performance and in terms of marital status of women. The gross scores of the domains and their transformation ware carried out according to the methodology Dragomirecká and Bartoňová [9]. Evaluation of the quality of life was analysed and compared from the family aspect.

RESULTS

The research sample consisted of 90 women with breast cancer. Predominant age group in the survey sample consisted of 73 women in the older adulthood (81%). Minimum number of women 5% was in age from 31 to 40 years and 2% in age to 30 years. From the perspective of marital status, it was 50 (56%) of married women, 24% widows and 13% divorced women in our survey. Single women accounted for 7%. More than half of respondents 49 (54%) reported the length of diagnosing the disease to six years or more. 21% of women reported 2–3 years and 18% of women reported the length of diagnosing 4–5 years. Minimum number of women 7% reported one year. From the whole research sample 49 (54%) of women underwent the breast-conserving surgery and 40 (45%) women the mastectomy. Only one woman has been without surgical intervention. The largest number of women 70 (78%) were located in remission period; the 5% of women were at the stage of remission. 17% of women was in the process of treatment.

Pleasing findings are that women have the greatest support among their closest, 34% in children and 25% in their sexual partners. 15% of women finds support in self-groups or civic associations, however, only 9% stated the support from the surrounding background (friends) and 7% from parents (Table 1).

Interpretation of items and domains for questionnaire WHOQOL-BREF

In global assessment of quality of life and satisfaction with health is possible to observe the differentiation in both population groups (Table 2). Respondents rated, in average, a poorer overall quality of life (3.55) than the population norm (3.82) and similarly they reported lower satisfaction with health (3.11) compared to population norm (3.68). Women with mammary carcinoma were the least satisfied in physical health (score 13.92). In the above domain they rated negative especially the option "dependence on medical care" and option "pain and uncomfortable feelings" (2.90). Mobility (3.45) was ranked also worse in comparison with the population norm. In other domains, patients ranked items such as population norm, except "negative feelings" in the domain of mental health (2.74) and "sex life" (3.04). Patients reported that they often suffered from negative feelings such as irritation, hopelessness, anxiety and depression. Domain – environment was rated better than the population norm, especially in items: personal safety, environment, financial situation, access to information, hobbies, environment around residence/ home, transport, the results are shown in Table 2.

From the perspective of marital status, we observed the most significant differences in the mental health domain in item negative feelings. Women without partner (2.40) were suffering with depressive mood unlike married women (3.02). In domain environment, women without a partner have limits in practical life associated with their financial situation (3.10) and possibilities of transferring from one place to another by transport (3.25). Despite of results, it is possible observe in other items lower levels which are correlating with less ranking quality of life (3.23) and satisfaction with health (3.20) in single items.

TABLE 1. Basic socio-demographic and clinical characteristics of patient group (n = 90)

Characteristics		N	%
Age	to 30 years	2	2%
	31 - 40 years	4	5%
	41 - 50 years	11	12%
	51 - 65 years	73	81%
Marital status	single	6	7%
	married	50	56%
	divorced	12	13%
	widow	22	24%
Duration of disease	1 year	6	7%
	2-3 years	19	21%
	4-5 of years	16	18%
	6 years and more	49	54%
Type of operation	complete removal of the breast	40	45%
	removal of part of the breast	49	54%
	without surgical intervention	1	1%
Period	in the treatment process	15	17%
	at the stage of remission	70	78%
	at the stage of relapse	5	50%
Social support	husband/partner	44	25%
	children	60	34%
	parents	12	7%
	friends	16	9%
	members of the association	27	15%
	physician	8	5%
	nurse	1	1%
	psychologist	6	3%
	priest	2	1%

N – absolute frequency, % – relative multiplicity

TABLE 2. Mean score of items and domains WHOQOL-BREF in patients with breast cancer (n = 90) and population norm

Domains and items	Patients with breast cancer		Population norm*	
	Mean	SD	Mean	SD
Single items				
Q1 – quality of life	3.55	0.90	3.82	0.72
Q2 – satisfaction with health	3.11	0.81	3.68	0.85
Domain 1 Physical health	**13.92**	**2.53**	**15.55**	**2.55**
Pain and uncomfortable feelings	2.90	0.87	4.3	1.5
Dependence on medical care	2.30	0.99	4.16	0.95
Energy and fatigue	3.28	1.5	3.62	0.93
Mobility	3.45	1.9	4.27	0.84
Sleep	3.26	01.8	3.61	0.99
Daily activities	3.35	0.94	3.76	0.78
Working performance	3.24	0.93	3.76	0.80
Domain 2 Psychological health	**14.53**	**2.37**	**14.78**	**2.43**
Enjoyment of life	3.84	0.80	3.83	0.90
Meaning of life	04.1	0.84	3.86	0.85
Concentration	3.47	0.87	3.55	0.88
Adopt its own appearance	3.72	1.9	3.90	0.82
Satisfaction with oneself	3.50	0.81	3.57	0.76
Negative feelings	2.74	1.00	3.47	0.95
Domain 3 Social relations	**14.34**	**2.2**	**14.98**	**2.89**
Personal relations	3.73	0.76	3.75	0.91
Sex life	3.4	0.92	3.64	1.7
Support of friends	3.98	0.65	3.85	0.80
Domain 4 Environment	**13.94**	**2.59**	**13.30**	**2.8**
Personal safety	3.33	0.82	3.24	0.79
Environment	3.36	0.99	2.85	0.92
Financial situation	3.14	1.6	2.87	1.8
Access to information	3.92	1.5	3.87	0.77
Hobbies	3.64	1.13	3.33	1.00
Environment around residence	3.61	0.76	3.54	0.86
Access to healthcare	3.39	0.85	3.70	0.79
Transport	3.49	0.82	3.19	1.7

* Dragomirecká, Bartoňová, 2006, p. 41
Mean – arithmetic average, SD – standard deviation

TABLE 2. Differences in domains 2–4 by marital status of patients

Domains and items	Marital status			
	Single, divorced, widow		Married patients	
	N	Mean	N	Mean
Domain 2 Psychological health				
Enjoyment of life	40	3.56	50	3.80
Meaning of life	40	3.68	50	4.8
Concentration	40	3.50	50	3.52
Adopt its own appearance	40	3.74	50	3.95
Satisfaction with oneself	40	3.30	50	3.70
Negative feelings	40	2.40	50	3.2
Domain 3 Social relations				
Personal relations	40	3.58	50	3.78
Sex life	40	2.93	50	3.14
Support of friends	40	3.88	50	4.6
Domain 4 Environment				
Personal safety	40	3.28	50	3.38
Environment	40	3.42	50	3.40
Financial situation	40	3.10	50	3.55
Access to information	40	3.93	50	3.92
Hobbies	40	3.56	50	3.54
Environment around residence	40	3.68	50	3.65
Access to healthcare	40	3.55	50	3.58
Transport	40	3.25	50	3.64
Single items				
Q1 – Quality of life	40	3.23	50	4.2
Q2 – Satisfaction with health	40	3.20	50	3.70

Mean – arithmetic average, SD – standard deviation

DISCUSSION

A fundamental change in the living situation with oncological disease significantly influences the subjective perception of the patient's condition and the related overall quality of life [10]. Women with breast carcinoma have to stand consequences of diagnosis and aggressive treatment such as pain, swelling of the upper extremities, lymphedema, limited mobility and discomfort, loss of or deformation of breast cancer which affects their life [2]. The values of a monitored group in comparison with the population norm show that oncological disease significantly affected all aspects of the physical dimension. The most frequent problems in cancer patients are pain in connection with discomfort, low mobility and an increased need for medical care.

Quality of life reflects more than just physical health. Sadovská [11] states that emotional, social and spiritual aspects that can be enhanced especially in situations where physical health is absent have a great influence to her evaluation of QoL. Analysis of the various aspects showed that the largest share in reduced quality of life has psychosocial distress. Patients suffer from a lot of negative feelings like a despair, irritation, anxiety or depression in comparison with the population norm. Mesárošová et al. [6] suggest that women with malignant breast cancer are highly experiencing symptoms of depression, anxiety and stress. Lehto et al. [12] in a large prospective clinical study investigated the effect of psychosocial factors on the quality of life and length of survival in patients treated by mastectomy and subsequent radiotherapy or chemotherapy. They state that consequence

of pressuring the psycho-social morbidity in patients is manifested in development of behavioural risk profile. It includes feelings as dangerous, anxiety, frustration, depression, stress and other negative emotions, which severely limits the length of survival of women with breast cancer. The good aspect is that women indicate despite frequent negative feelings, more sense and pleasure in their life than the population norm by Dragomirecká and Bartoňová [9]. This fact can be explained that the women are forced to seek sources of intense pleasure in life and more often think about its meaning.

Dančíková [1] describes the loss of the breast (symbol of femininity) brings feelings of disturbance of body integrity, defection of femininity and physical attraction which makes adecreased self-esteem and fear of establishing new contacts and relationships. The results of the data analysis conclude that the psychosocial consequences of the group influence in the negative sense to their sexual life. Similarly, dissatisfaction in the sexual life was confirmed by research Bencová, Bella and Švec [13]. The research findings by Kočišová [14] point to the disruption of social relations, not excluding sexual cohabitation between partners.

Maintaining a positive relationship with the partner is essential in the difficult period of a woman´s life. Open communication about disease, problem or anxiety is inevitable to a harmonic relationship. Only kind, tolerant and careful partner can help the woman and he can give her safety and make her stronger in the difficult time of her life [15, 16]. A positive finding is that patients, as well as the population norm, have a good personal relationships and adequate support from friends, what we attribute to the importance of active membership in the self-help groups. Žiaková, Maštenová [17] detected the differences in post-traumatic growth in women after surgical treatment of the breast cancer by using multiple methods (PTGI, PSSS, Brief COPE, SWLs). Participation in self-help groups allows women to be emotionally relaxed, dispel thoughts rationally to accept their situation and seek positive changes in their lives. In comparison to women who visit self-help group or not, they certify that women who visit self-help groups feel more positive changes in interpersonal relationships (reduction of social isolation). Participation in self-help groups allows women to be emotionally relaxed, dispel thoughts rationally to accept their situation and seek positive changes in their lives.

In comparison to the quality of life of married women and single women, widows or divorced women, we found out very interesting results. Women who are not married have analysed all dimensions of quality of their life worse than married women. They reported a lower satisfaction in personal relationships, sex life, family support, which greatly affected their satisfaction with life and the sense of life. They often feel negative feelings such as anxiety, despair or depressions or hopelessness. They have problems with financial situation and traffic. Arndt et al. [18] investigated consequences of treatment to the quality of life in women with breast during several years. Their study concluded that the physical problems subside within approximately one year after surgical treatment, mainly due to the family support and dispensary care by health professionals. At the same time, symptoms from emotional, psychological and social fields arise and persist years after the end of anticancer therapies. This topic is a challenge for continuing nursing care. Due to the current problems of women with breast cancer, it creates the space for nurses working in community care (nursing home care agency and others). Our educational institution reflects the current oncology issue and therefore it also incorporated the content of the nursing care of women with breast tumors within the portfolio of a specialized study programme nursing in community care.

Our research implies that psycho-social care will have to be an integral part of the comprehensive treatment regardless the course of the disease (treatment, remission, relapse, convalescence). The benefit of care is to help women overcome cognitive, emotional, and behavioural consequences of the disease and its treatment and to lead to the social reintegration (return to a normal family, work and social life), which has a positive impact on success of treatment, the average survival time and quality of life of cancer patients [2].

The results of study point to necessity of identifying the bio-psycho-social needs of these patients, which we detect with nursing students by model situations in education in artificial conditions. After completing the clinical training subjects, especially the subject Nursing in Oncology, students are able to perform physical assessment in these patients with the implementation of assessment tools (Test for functional assessment – instrumental activity daily living, Pain Assessment Scales, Depression, anxiety, stress scales and others) for specific clinical case. They also learn to use acquired theoretical knowledge in clinical practice through direct nursing interventions.

Our educational institution provides innovative training to future midwives in the form of an e-learning module. The project titled Multimedia technologies in midwifery preparation aims to create an e-learning environment in Faculty of Health Care of the University of Prešov. It is intended to complement and innovation the theoretical and practical training of midwifery students in accordance with the principles of adult learning and with support of distance learning.

Orientation of the content base of the project takes place through interaction and

active monitoring of information, problem-solving teaching, simulation of model situations, development of communication-information capabilities, demonstration procedures, case studies implementation, innovation of multimedia technologies.

Care for woman includes a bio-psycho-social model of perception of the disease and application of acquired knowledge in direct interaction with a female patient within clinical practice.

The training program is aimed at the bachelor's degree study programme of midwifery. Its content is to provide a composite picture of care for female and reproductive health. In the various modules, e-learning is focused on pathological processes of reproductive health during the life of a women. Part of the training modules are thematic units, focusing on the issue of cervical cancer and breast cancer.

For understanding and objectivizing the impact of the disease on the quality of life of women students implement the scales and assessment tools directly during practical training at clinical workplaces. Multidisciplinary care for a patient with breast cancer requires interventions from other professionals of non-medical study disciplines. In addition to midwives, the nursing profession has a dominant position in the care of a woman. Treatment of the disease involves a surgical and oncological approach, its effects cause a physical discomfort, emotional and social distress that is manifested by social isolation, disruption of family relationships and partnership, and disorder of self-image and self-conception. Therefore women with breast cancer expect a professional, erudite, empathic care, which involves highly professional training of graduates of the above-mentioned disciplines. Based on research results, it is necessary to develop communication skills in students of non-medical study disciplines in the context of psycho-social and emotional support.

Due to the high incidence of illness, nursing students take part in health education programmes (breast self-examination) in order to increase health awareness about the prevention, screening and pitfalls of the already diagnosed disease. Health educational programmes are focused at a target group of young women and girls for the positive modification of their attitudes towards own health.

CONCLUSION

Breast cancer significantly affects the quality of life of women. The results of our research investigation confirmed the reduced quality of life of patients in the domain of physical health. Oncological disease is becoming a disease for a lifetime and it is associated with the constant fear from relapse of disease and from the adverse effects of anticancer treatment.

Attention should be given to each patient and for a better compensation of the disease and maintenance of the quality of life we shall promote the development of psychosocial interventions in all forms [19].

This issue is the basis for continuous training of nurses and midwives and the measurement of quality of life by using cancer-specific instruments in long-term breast cancer survivors [20]. Current statistics of cancer becomes an incentive for the development of new education programmes of non-medical professions (Radiology technics, Laboratory diagnostics methods in healthcare). Oncological diseases should be part of many health education programmes in Slovakia. They should also stimulate the interest of transnational policies across the EU.

CONFLICT OF INTEREST STATEMENT

Neither author has any financial or personal relationship with people or organisations that could inappropriately influence their work.

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NEUROEDA – AN INTERACTIVE WEB TOOL FOR NEUROINFORMATICS DATA ANALYSIS AND TEACHING BIOMEDICAL STATISTICS

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ABSTRACT — ***Background:*** *INeuroinformatics is a rapidly developing interdisciplinary field which provides an enormous amount of data to be classified, evaluated and interpreted. Usage of exploratory data analysis (EDA) methods is essential in evaluating clinical data in medicine and this analysis remains a big challenge because each new system has specific requirements. Visualizations, models and illustrations of dependency can help in better understanding of measurements in diagnostics and in decision making. The number of available modern EDA packages for developers is increasing as well as the development in the Data Science field. The development of modern methods of data analysis must also be incorporated in university education.*

OBJECTIVE: *The aim of the study is to design and develop software, which implements current EDA packages and model making procedures for neurological data analyses which could be easily modified. The second objective is to evaluate the possibility of supporting the education of biomedical engineering students at the undergraduate level in order to provide effective support in biomedical data analysis.*

METHODS: *An application has been created under the reactive Shiny framework in the R language. Data in .csv or .tsv format are processed on the server side of the application.*

Results: *We have developed a new easy-to-use software named NeuroEDA for interactive web-based biomedical data assessment. This application covers basic descriptive statistics, exploratory graphs and cluster analysis, which is also suitable for big data examination. Furthermore, this application offers methods for robust and non-parametric analysis. These are particularly useful in neuroinformatics from our long-term experience. The application was practically deployed in the evaluation of clinical neurological data and in teaching the subject Biomedical Statistics.*

Conclusion: *We have introduced the possibility of creating biomedical software for clinical use and demonstration in teaching. Among the advantages of the application, is that it is easily expandability with new R packages and quick processing in web browsers. The interactive user interface allows one to work with R's functions without needing scripting/programming knowledge. Students can acquire practical experience in processing and transformation of heterogeneous medical data not only in biomedical engineering fields, but also at the medical faculties for Medical Informatics. This application is actively used for neuroinformatics data assessment and in discovering some potentially useable hypotheses.*

INTRODUCTION

Exploratory data analysis (EDA) has been systematically studied from the age of statistician John W. Tukey. In his book (1977), EDA was defined as a statistical method for finding interesting hypotheses and relations in data [1]. It was mainly about the graphical techniques of data representation: boxplots, histograms, scatter plots or manually calculated analysis of principal components etc. Deep analysis of data integrity and the variance of values, correlations and i.e. groups of discrimination in data, plays a key role in pre-processing and the subsequent creation of descriptive and predictive models. EDA is even more important in medicine, typically for small dataset counts or due to outlier observations.

Research and the application of EDA methods are constantly progressing and this progress reflects the rapid rise of the importance of areas related to computational data analysis and data science in general (Figure 1). The number of scientific papers from all data science fields grows every year in the Web of Science (WoS). Recent medical examples of EDA progress are, for instance, in application for electronic medical records [2], text mining in obstetrics [3] or methodology in neurosciences [4].

Despite the mathematical nature and recommended methods, modern EDA is a form of art and an expression of the author/analyst's creativity [5]. Creativity and the authors knowledge in the form of various packages, tools and libraries can easily be integrated into the work of biomedical software programmers. The creation of a precise, and compendious graph is in many cases more efficient than inductive analysis based on p-values. Current statistical studies point to an excessive or automated problem of statistical significance usage by p-values in medicine and psychology [6-9]. Visual analysis (visual mining) seems to be an appropriate alternative to inductive statistics [10].

This article introduces an interactive web application NeuroEDA, which implements current EDA packages and model making procedures for neurological data analyses (i.e. near infrared spectroscopy data (NIRS), transcranial magnetic stimulation data (TMS), camera systems or microelectrode recordings (MER)) in the form of a BioData product. The data product is the production of output from statistical analysis, which automates complex analysis tasks or uses technology to expand the utility of a data informed model, algorithm or inference. The study includes data from the Department of Biomedical Informatics, Faculty of Biomedical Engineering, Czech Technical University in Prague (DBI FBME CTU), which in the long-term cooperates with the Department of Neurology and Centre of Clinical Neuroscience, First Faculty of Medicine, Charles University in Prague.

METHODS

The application was developed because of the need for an integrating interface with new statistical methods for biomedical data analysis at DBI FBME CTU. It was programmed using the open source programming language R, which is a significant member in the statistical computing field. The app kernel is based on Shiny framework, standing on the reactive programming paradigm [11, 12]. Reactive programming was designed, above all, to simplify interactive user interface creations. The Shiny application is composed of two main parts, the user (ui.R) in the form of a webpage, and the server part (server.R). Within Shiny, reactivity is provided by reactive inputs and outputs. Typical input is the user's demand with a web interface. For example, picking one of several form choices, filling out the text field or clicking on a button. These actions set parameters, with which the application immediately reacts by rendering an output (graph display, table operation etc.). It can be executed on a local server and used within a web browser. The user controls the application within the user interface, and sends requests to the server, where computations are made and outputs are updated.

This application allows the user to import data in the .csv format. A file is chosen in the file system. It is possible to change a delimiter (comma/semicolon/tab) and turn the header on or off. Basic information is reactively displayed after uploading the dataset. The user can see basic attribute summaries or view datasets as a table, with paginating, sorting, filtering and searching options (Figure 2).

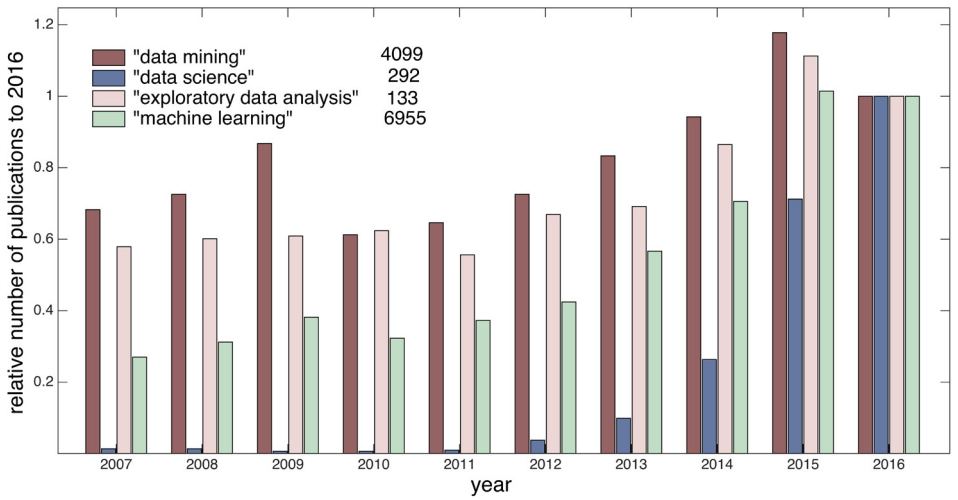

FIGURE 1. Annual progress of the count of key phrases in scientific papers in the Web of Science related to the Analysis and Data Processing field for the last 10 years (to the year 2016) (own arrangement according to WoS)

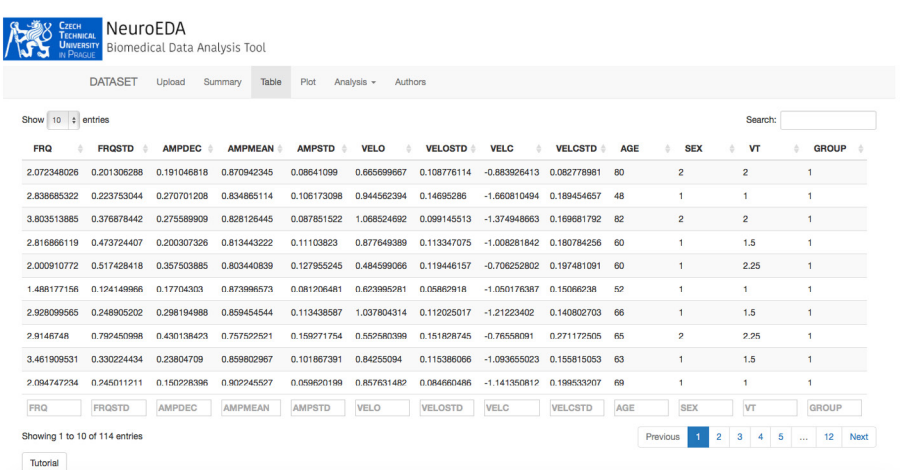

FIGURE 2. View on NeuroEDA application environment with imported data and table visualization

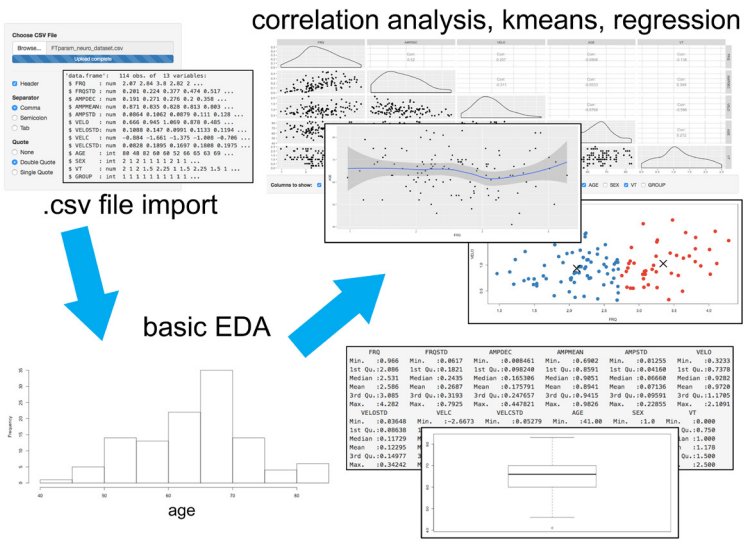

FIGURE 3. NeuroEDA Process map / Workflow

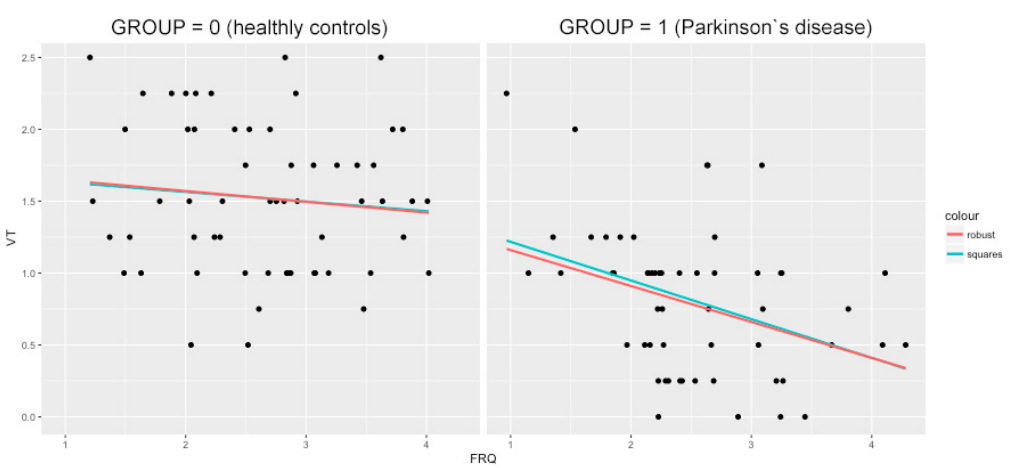

FIGURE 4. Example of visually discovered clinical hypothesis by NeuroEDA: the FRQ parameter has a greater impact on expert assessment in the patients group

RESULTS

The program is composed of five functional units: Upload, Summary, Table, Plotting and Analysis. It operates in graphical user interfaces (GUI).

Several methods were implemented for dataset exploratory analysis:

- graph visualizations, using the "ggplot2" package: e.g. boxplot, histogram, scatter plot,
- interactive correlation analysis + kernel density estimation using the "Ggally" package,
- k-means algorithm for finding compact clusters in data,
- imple regression analysis with an independent and dependent variable using least squares method,
- locally weighted regression (LOESS) using the "ggplot2" package – able to find nonlinear trends, suitable for detection of rapid dropdowns or other interventions,
- robust regression using the "robust" package – lower sensibility to outliers, represents linear models with smaller counts of observations better than the least squares regression method,
- the mclust - package provides models and methods to estimate the number of clusters in the multivariate dataset. The algorithm uses 10 models to calculate default 1 to 10 Gaussian Mixture Model (GMM) components (clusters) and Bayesian Information Criterion (BIC) to select final number of clusters.

The most beneficial clinical property of the NeuroEDA is the mclust package, which is practically used in our neuroinformatics research to automatically determine the number of clusters in the 2D data and for the subsequent classification, including the quantification of the uncertainty of the decision algorithm. In short, the number of detected clusters represent the number of neurons in the MER. Routine education of the whole analytical process enables evaluation of the data by bachelor students.

Case 1: clinical neurology dataset

The application was tested on several publicly accessible datasets of various extent (i.e. iris, mtcars of "datasets" package). Moreover, it was used for clinical neurological dataset exploratory data analysis of camera system measurements. Records represent parameters of periodic hand movements, or finger tapping (FT). FT stands for repetitive touching of a thumb and a forefinger following maximal expansion, as fast as possible. Measurements were taken in healthy controls (N = 59) and Parkinson disease patients (N = 55). An overview of the selected features is shown in the table (Table 1).

TABLE 1. Title and description of selected features from finger tapping measurements

Title	Description
GROUP	group membership: = 1 (disease)
SEX	sex: = 1 (female)
VT	expert rating (numeric)
FRQ	mean tapping frequency [Hz]
FRQSTD	FRQ standard deviation (std) [Hz]
AMPDEC	amplitude decrease of fingers distance [cm]
AMPMEAN	mean amplitude of fingers distance [cm]
AMPSTD	std amplitude of fingers distance [cm]
VELO	finger opening velocity [m/s]

Ways of working with the neurological dataset in NeuroEDA application are depicted in the process map (Figure 3). It is clearly visible, that based on FRQ and VELO parameters, it is possible to automatically distinguish between patients and healthy subjects, using k-means algorithm (two groups with an unsupervised separation).

The example of a visually found hypothesis by linear and robust regression methods has a practical importance. It was discovered that there is a difference between healthy vs. patient's groups considering this regression model (Figure 4):

dependent variable (y): VT
independent variable (x): FRQ

The tapping frequency parameter (FRQ) on how an expert evaluates a patient's condition has a significantly greater impact in the group of patients. Moreover, an expert is much more focused on finger tapping frequency than in a healthy group (in which case the expert is most likely considering some other parameter).

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Case 2: Biomedical Statistics course

The Biomedical Statistics lectures at the FBME CTU include a demonstration of the basic algorithms and methods for medical decision making (e.g. statistical inference, cluster analysis and regression). For better understanding, practical lessons should consist of exercises using this NeuroEDA application. Practical work with this system helps students to understand the Fundamentals of Statistics in medicine. Local versions of NeuroEDA were installed in the Laboratory of Information Technology in Biomedicine, which is supervised by the DBI FBME CTU. A pilot of 33 students in the 1st and 3rd year of a bachelor's degree in Biomedical informatics and Biomedical Technician were enrolled in the course. The faculty Moodle system materials are used for testing their learned skills.

Main scenario – the creation of a biomedical data analysis processing pipeline starting from loading of heterogeneous data files, to the interpretation of the achieved results. Within the main scenarios various tasks have been proposed depending on the complexity: e.g. management of dataset and preparation for inferential statistics, basic EDA, selection of optimal number of clusters by k-means, usage of robust regression in small sample etc. Each app functional unit included a bookmark with a brief, illustrative tutorial of use.

In a broader context, the exercises focus on the statistical fundamentals of preparing a simple BioData product that can be used to tell a story about data to a mass audience.

DISCUSSION AND CONCLUSION

NeuroEDA application is an easy to use software developed by biomedical engineers. Its outstanding feature, which makes it different from all existing statistical software, is its quick extendibility with new available statistical R packages on demand. The application provides immediate response, even in cases with bigger data files. Functionality was also successfully tested in commonly used web browsers (Google Chrome, Safari, Mozilla Firefox, Internet Explorer). The main advantage of the application is the availability of robust regression and the mclust package, that are not usually contained in available commercial statistical programmes and are crucial for statistical evaluation of our biomedical data. The usage of the interactive interface allows for working with R functions without any scripting knowledge, therefore it offers usage by non-technical clinic staff.

FUTURE WORK AND INTENSIONS

The application is still in an alpha version and is continuously tested and extended with new functions. We are considering direct connection to the database which stores data from various neurophysiological examinations, which is likewise developed at DBI FBME CTU.

An example of one of the already deployed clinical services is REDCap MRIviewer [13]. The MRIViewer can display MRI images that are stored on a SSH-accessible data storage on REDCap [14]. Due to the file sizes and complexity of the project, images must be stored in a large data warehouse which allows for easy viewing and downloading by researchers and physicians. The images are stored on the CESNET network storage and are displayed in a web environment using the modified DICOM Web Viewer. It offers the analytical potential of NeuroEDA (not only EDA, but e.g. image registration and pattern recognition) using packages for highdimensional data - such as MRI or fMRI, directly in DICOM or NIfTI format. In our opinion, the desktop version of Shiny NeuroEDA is capable of absorbing the high dimensional data and to analysing it efficiently. We anticipate problems with uploading from outside the internal system through the online Shiny UI, mainly due to the size of the uploaded files. To our best knowledge, the processing of biomedical images in the Shiny framework is currently unique and its integration into Shiny is possible [15, 16], but slow depending on the system.

Besides table data analysis modules, we also work on the module for analysing time series, according to new measured signals and hypotheses specified by medical doctors. An extended version can be used advantageously in teaching other subjects, namely Time Series Analysis. The application can be deployed in our internal server, and made accessible by a web browser. This allows the user to work with the responsive application not only in the computer lab, but also on tablets or mobile devices without the necessity of installing it on to the local station and can also operate remotely outside of the laboratory in the case of permitted security policies. A substantial amount of the content of this paper has been orally presented in Czech at the MEDSOFT 2017 Conference in Roztoky, Czech Republic. Based on conference discussion and positive feedback, we plan to provide the application for teaching at another biomedical department in the Czech Republic.

CONCLUSIONS

In this work, we have introduced the possibility of creating biomedical software for clinical use and demonstration in teaching. A web application, which implements various methods for exploratory data analysis was created. The benefits of using this practical demonstration tools for teaching health professionals were previously shown and not only within the MEFANET. Advantageously, it can be used in the classroom not only in biomedical engineering fields, but also at the medical faculties for Medical Informatics. Students will acquire practical experience in the processing and transformation of heterogeneous medical data. NeuroEDA can be executed without the need of programming knowledge. The application is actively used for neurological data assessment and discovering of potentially useable hypotheses.

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AVAILABILITY AND IMPLEMENTATION

NeuroEDA Shiny app is available at https://neuroeda.shinyapps.io/neuroeda/ and released under the MIT License <https://www.r-project.org/Licenses/MIT>. Source codes are available on request.

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MEFANET, THE CZECH-SLOVAK NETWORK OF MEDICAL FACULTIES, CELEBRATED A JUBILEE

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ABSTRACT — ***Background:*** *The pace of development and the tide of events are very relative terms. From the point of view of our planet or the life on Earth, ten years represent only a tiny fraction in a very long timeline. However, for the organism called MEFANET (MEdical FAculties NETwork), ten years proved to be a true evolution period, during which it became an important member of the European community dealing with medical education. Moreover, if we take into account that modern information and communication technologies play a key role in MEFANET activities, it is obvious that the days of MEFANET origin might seem as long ago as the century of steam, at least for our youngest colleagues.*

By an annual tradition, teachers from medical faculties, experts in information technologies and other involved people arrived to Brno at the end of November, this time to Hotel Continental, to celebrate the MEFANET's jubilee. A standalone ceremony was dedicated to the 10th anniversary of the beginnings of joint activities; however, memories of various stages of network development since its unofficial start up to these days – as well as future prospects – ran through the entire conference programme. For many speakers, especially those who had "got in on the ground flood", this meant that their talks were not just matter-of-fact and work-related, but rather personal.

"Ten years ago, we realised together with our colleagues that modern information technologies can substantially help us in medical education. But we found out very soon that the development of electronic teaching tools is not only demanding in terms of professional expertise, but is also time-consuming and expensive; a single faculty of medicine could not possibly cover the entire curriculum, and mutual cooperation seemed to be a very advantageous option. We have therefore started to share these teaching tools via our educational portals", explained Prof. Stanislav Stipek from the First Faculty of Medicine at Charles University (1st FM CU). This cooperation in cyberspace ultimately led to a spontaneous development of a community of teachers at medical faculties and IT enthusiasts – a community which was compact but nevertheless open to new members, branches of study, and ideas. "For me, the jubilee marks ten years since getting to know many colleagues from Czech and Slovak medical faculties. Many of these professional links have grown into true friendships over time", said Assoc. Prof. Daniel Schwarz from the Faculty of Medicine at Masaryk University (FM MU), who is currently Chair of the Coordinating Council of the MEFANET project. MEFANET's reputation has gradually spread beyond the borders of the former Czechoslovakia, and the network nowadays plays an important role in many research projects and activities across Europe and Asia. "During the 10 years of its activities, MEFANET has developed into an astonishing, internationally recognised body. MEFANET made it possible for teachers to create, to publish and to become accepted on an international level. Thanks to MEFANET, Czech and Slovak medical students now have access to attractive teaching materials from other faculties. I consider MEFANET to be more than just a Czech-Slovak institution; it is something that brings new and high-quality solutions to our future work", concluded Assoc. Prof. Jaroslav Majerník from the Faculty of Medicine at Pavol Jozef Safarik University in Kosice – an impression which many other conference participants certainly shared with him.

FIGURE 1. MEDCIN workshop

FIGURE 2. Celebration of the MEFANET conference 10th anniversary

But let us return from looking back to the conference programme itself, because even celebrations of the 10th anniversary certainly were not a reason why participants should not share their news from the area of information technologies in relation to education of future doctors and healthcare professionals. Conference organisers maintained the programme scheme innovated in the last year, starting with two technical workshops on the first conference day. The first workshop – led by a team from the 1st FM CU, Academy of Science of the Czech Republic, and the FM MU – was focused on the development and assessment of tests. Workshop participants could get the feel of putting together a high-quality test and its individual items in a way which would objectively assess the students' knowledge, and which would also distinguish between better and worse students. Practical examples were then discussed as to whether specific test questions (including their respective answers) seem to be well phrased or not, how difficult they are, and whether any modifications to those questions should be made. The second workshop, dedicated to the international project MEDCIN, was prepared by FM MU representatives together with their foreign partners from the Karolinska Institutet, Aristotle University, and St George's, University of London. The MEDCIN project deals with

FIGURE 3. Celebration of the MEFANET conference 10th anniversary

FIGURE 5. Luke Woodham

FIGURE 4. Andrzej Konowicz

the parametrisation of medical education and with the standardisation of medical curricula, and the respective workshop highlighted several of its important issues. Workshop participants could identify themselves with members of management of a new virtual faculty of medicine. Foreign partners as project co-investigators also got the floor: they introduced the structure of education of general medicine at their institutions in Sweden, Greece, and the UK.

The second conference day was dedicated to lectures and thus had a more traditional character. The day's programme started with a symposium focusing on the education of nurses, particularly on its practical part in clinical settings. The speakers presented outcomes of several studies which took place at several faculties of health sciences in the Czech Republic and Slovakia, and which assessed the students' attitudes and experience with practical education and training in hospitals.

In the keynote lecture session, which followed the above-mentioned ceremony, the floor was given to two foreign guests. The name of Andrzej Kononowicz from the Jagiellonian University Medical College (Kraków, Poland) is well known to anyone interested in virtual patients. It is therefore obvious that the first keynote lecture was dedicated to this issue. Dr Kononowicz pointed out that the concept of virtual patients and simulations is not new at all: they have been mentioned in the literature since 1960s. Paradoxically, the most dynamic changes and development in this area over the last 50 years have not occurred due to technology, but thanks to the introduction of virtual patients and simulations into the education process. Many studies have been published since then, undoubtedly supporting the use of this form of education, but also debunking numerous myths and expectations which often come along with new technology. The second speaker, Luke Woodham from St George's, University of London, focused on another current pedagogical phenomenon: the so-called Massive Open Online Courses (MOOCs). These interactive online courses enable hundreds to thousands of users to learn a specific topic simultaneously, which surely makes sense in quite a few disciplines and topics. On the other hand, medical education often requires more formal and detailed assessment of students as well as personal interaction, and this is where MOOCs encounter certain obstacles. However, one must always keep in mind that any technology only provides tools, and that the manner and effectiveness of using them are up to the user.

The topical session was dedicated to technology and e-learning in radiology, and was held under the auspices of the Czech Radiological Society. Despite the fact that a number of modern branches of medicine are based on imaging techniques, which thus play an essential role, education in radiology is inadequate: in the curriculum of general medicine, the duration of courses dealing with radiology is very short, if there are any courses at all. To give just a few examples, the speakers pointed out a poor education in the area of indication of correct techniques, and warned about relatively strict legislative requirements, which restrict the practical part of training. Although CT, MRI or ultrasound images are frequently found in teaching materials of other clinical disciplines, it will be quite a long way for radiology itself to adopt modern teaching approaches.

The conference was concluded by a session dedicated to short communications, presenting specific news, methods and tools that have been developed and are currently available at individual faculties of medicine and faculties of health sciences. It is surely worth mentioning that each author presented either an interesting software tool or an elaborate analysis of a large dataset – all of these contributing to the support of medical education based on modern technologies.

More details on the conference, including a photo gallery and presentations for download, are available at http://www.mefanet.cz/index-en.php?pg=conference.

THE SIMULATION CENTRE OF EUROPEAN SIGNIFICANCE WILL BE BUILT IN BRNO

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ABSTRACT — *The Ministry of Education Youth and Sports approved a unique project of Masaryk University to build a simulation centre for future physicians. The concept of the project was introduced on 8 June 2017 at a faculty conference which focused on the topic of reorganization of education and the Simulation Complex of Masaryk University.*

The planned concept will fundamentally affect both present and future medical programmes. The Simulation Centre is unique by its complex view on medical curricula by incorporating the state-of-the-art elements of simulation medicine into ordinary teaching. Each room, simulator or learning aid will have a firm place in the learning process.

The Simulation Centre (SIMU) project aims to upgrade the teaching of MU medical programmes through the implementation of advanced features of simulation medicine into ordinary teaching.

During the project implementation (4/2017 – 9/2022), the curriculum will be revised with focus on the General Medicine and Dentistry study programmes. The planned revisions will overlap into the curricula of other non-medical programmes in future. Revisions will mostly impact the practical part of teaching, which will be expanded to include a comprehensive range of simulation teaching methods, using patient's simulators, mannequins and virtual and standardized patients. Emphasis will also be placed on the development of soft skills, highlighting 21st century skills such as communication and decision-making skills, critical thinking, clinical reasoning, crisis communication and teamwork.

Introduction of these new teaching methods will place high demands on infrastructure equipment such as specialized lecture rooms, simulation of the hospital environment, high-fidelity simulators, etc. Consequently, a new buidling for the Simulation Centre will be constructed as part of the project in order to meet the above-mentioned spatial and material requirements.

SIMU is unique in:

- the scope and approach in the introduction of simulation methods into teaching,
- the standardization of teaching and its continuous assessment,
- the introduction of Objective Structured Clinical Examination (OSCE),
- the wide spectrum of simulation methods,
- increasing efficiency in practical training,
- the centralization of simulation methods into one location (simulation of hospital environment),
- the simulation of authentic hospital and prehospital environment,
- specialized equipment covering a wide range of pedagogical and simulation methods.

FIGURE 1. Simulation Centre visualization

SIMULATION – NEW TREND IN EDUCATION

Continuous development and innovation in modern medicine have steadily increased the volume of knowledge and the number of procedures with which the medical students must be acquainted. This compels lecturers to enrich and to expand the syllabus with new information and methods, thus greatly increasing the volume of teaching material. Although students are theoretically impeccably prepared, they often have difficulties in using the acquired knowledge in practice. At the same time, changes in the structure of healthcare mean that part of the inpatient care is transferred to the outpatient sphere and consequently, the time that students can spend in contact with patients has been increasingly limited. Students are merely in the role of observers, not being able to independently carry out tasks that they only know theoretically. Another problem is that the practical training of medical students takes place in faculty hospitals. Patients coming to medical facilities of this type usually have very specific and complex diagnoses, which are not suitable for teaching purposes. As a result, students lack training in basic skills, and their practical training may not be fully consistent with the theory currently being studied.

The SIMU project addresses these issues, focusing particularly on innovation, development and improvement of practical teaching.

Students who will complete the modified study process will have better practical skills, more experiences and a better ability of independent decision-making. They will be able to get involved in the working process more quickly and easily and their teamwork ability will improve.

PEDAGOGICAL METHODS PLANNED IN SIMU

We will not change what to teach but how to teach.

Problem-based learning / team-based learning

Problem-based learning represents a teaching style designed for a student who learns by developing his/her own solution(s) to a given problem. Compared to the traditional teaching method, its main advantages involve an effective solution of the problem and teamwork training. Working in groups, students discover what they really know, what they should know, and how and where to acquire more information that

will help them solve the given problem. The lecturer's role is not teaching but guiding the group towards the solution.

During the tutorial, students will be divided into small groups of 2–4 students. In these groups, they will examine a virtual patient (e.g. AKUTNĚ.CZ, Sepsis-Q.cz, or branched virtual patients authored in Open Labyrinth) node by node, and they will jointly discuss and select a suitable procedure, which will be subsequently presented and defended before the whole group. The lecturer will act as a discussion facilitator, guaranteeing the accuracy and completeness of the pathophysiological mechanisms and supplementing the outcomes with clinical context.

Virtual patient

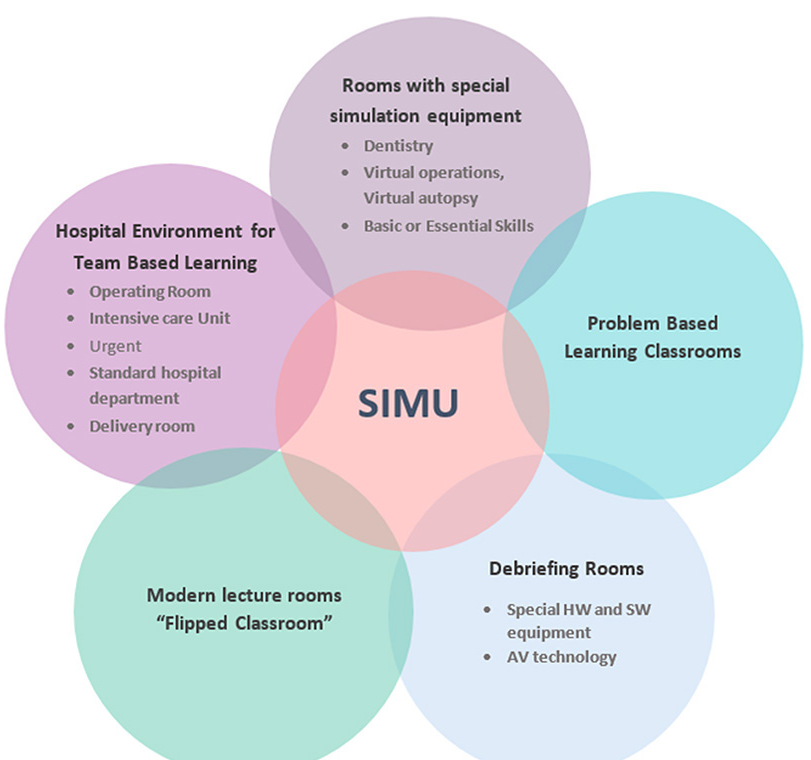
Virtual patient is an interactive computer simulation of a real clinical situation or a case created for medical and health education purposes. It supports the acquisition and training of skills such as clinical decision-making, clinical reasoning and critical thinking. Virtual patients facilitate self-directed learning and enable students to prepare for lectures or other teaching/learning sessions. Any incorrect options taken during the management of a virtual patient leads to an explanation; the student always receives an immediate feedback.

Simulation

Simulation is one of the most progressive forms of teaching because it has clearly definable and measurable objectives. Simulation makes it possible to practise repeatedly. It also provides the option of making mistakes without any consequences, which, in real life, could be fatal. In a simulation, mistake is considered as an opportunity to learn.

As part of the feedback (debriefing), the student's approach is discussed and its strengths and weaknesses are assessed. A detailed analysis of different key situations arising during the simulation is an important part of debriefing; audio-visual recording is edited in real time and tagged using key marks. The lecturer's personality is an important factor. Lecturers must be fully competent in solving the given clinical situations and must be familiar with strengths and limitations of any simulation media that will be used in teaching.

FIGURE 2. Simulation Centre building



VISION OF THE SIMULATION CENTRE

Through the involvement of advanced elements of simulation medicine in education, the Simulation Centre aims to become the leading workplace in the field of medical education in the Czech Republic.

"We knew what the student went through ...
... now we will know how the student has gone through."

ACKNOWLEDGMENTS

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