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ORIGINAL PAPER

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USE AND KNOWLEDGE ON THE INFORMATION TECHNOLOGIES IN MEDICAL EDUCATION -BOSNIAN AND HERZEGOVINIAN EXPERIENCE

Izet Masic¹, Edin Begic², and Nedim Begic¹¹Faculty of Medicine, University of Sarajevo, Sarajevo, Bosnia and Herzegovina²Medical and Biological Engineering Society of BiH, Sarajevo, Bosnia and HerzegovinaCorresponding author: Prof. Izet Masic, MD, PhD. Faculty of medicine, University of Sarajevo, Bosnia and Herzegovina. ORCID ID. <http://orcid.org/0000-0002-9080-5456>. E-mail: imasic@lol.ba; izetmasic@gmail.com.**ABSTRACT**

Introduction: Information technologies (IT) are becoming a tool without which further education of both medical students and doctors would not be possible. **Aim:** The aim of this paper was to analyze the use of IT in the prism of two systems, the old system and the Bologna system. **Material and methods:** Answers from questionnaires from total of 459 students (2012/13–2015/16 generation) were analyzed. **Results:** The presence of large number of female students, in both systems is significant ($p < 0.05$). About 92% of students of the old system and 98% of students of the Bologna system use computer in everyday work (only 36% of old system and 47% of the Bologna system are using “faculties” computers). The computer is used for entertainment, education, information (via Internet) and for communication (e-mail, chat, social networks) (68.5% of the old system and 84% of students of the Bologna system have chosen all 4 offered answers). MS Word and MS Power Point are significantly more used compared to the use of MS Excel in both systems ($p < 0.05$). The knowledge necessary to use their computers student of both systems have acquired through individual work. Students feel that they need to improve knowledge of the treatment of sub-base (76% of students of the old system and 62% of students of the Bologna system). Having analyzed the generation of 2015/16, 84.5% of students of the Bologna system and 75% of students of the old system used smartphones or tablets. The purpose of using a smartphone is, in most cases for accessing the social networks. 77.4% of smartphone users of the Bologna system, or 73.3% of the users of the old system have installed an application from the medical field. We analyzed the opinions of the availability of online course content and the degree of computerization of the study process and the possibility of electronic access to the literature - the results are not at the appropriate level. **Conclusion:** Education in software solutions that are connected to databases processing, must be imperative in reform of the teaching process. IT can only improve the teaching process, the organization of the education system in most eminent universities is undeniably linked to information technologies. **Key words:** IT, medical education.

1. INTRODUCTION

According to “Office of Technology Assessment”, 1976 the medical technology is “the gathering of the techniques, drugs, equipment, means and the procedures which are used by the healthcare staff in the offering of the healthcare protection to the individuals, and systems in which such technology is used” (1). The healthcare technology is wider notion, which includes all the procedures, means and the techniques with the goal to advance and protect the health of people, and allow more efficient treatment and rehabilitation of some population. Medical technology refers to the diagnostic or therapeutic application of science and technology to improve the management of health conditions. The information technologies (IT), techniques and methods in

the medicine and healthcare can be divided according to the different criteria. In Table 1, the distribution of these technologies is given according to Gjuro Dezelic (2), which is partly modified by Izet Masic and Zoran Ridjanovic (1).

Information is the lifeblood of modern medicine (3). Health information technology (HIT) is destined to be its circulatory system (3). HIT has the potential to improve the health of individuals and the performance of providers, yielding improved quality, cost savings, and greater engagement by patients in their own health care (3). Modern information technologies (IT) have enabled faster, more reliable and comprehensive data collection (4). Even though IT have great potential, still they did not found maximum application in B&H healthcare, although each year the scope

of their application is increasing. Since we live in the “Computer era”, we can safely say that their application in the future will be bigger and bigger, and that healthcare system in essence will have the use of information technologies.

IT can be used in the teaching process through several directions: interactive classroom, distance learning, interactive distance learning, web based learning and virtual classroom - through new methods, information technology, it is attempted, that accumulated material becomes closer in easier and approachable way to new, computerized generations (5). IT can only improve the teaching process, the organization of the education system in most eminent universities is undeniably linked to information technologies. By introduction of information technology, information have become within easy reach to students (it’s hard to explain to a student of the 21st century meaning of writing a term paper thirty years ago).

HEALTH PROTECTION
* diagnostic
• processing and analysis of biophysical signal and integration of more signal processing systems to monitor and analyze image processing and clinical - laboratory measurements
* Establishment of diagnosis
• Diagnosis systems to support decision - making, expert systems
* therapy
• radiological therapeutic systems
• therapeutic ultrasound systems
• laser system
• therapy by blood components monitoring of drugs
*rehabilitation
• devices to control physiological functions (stimulators)
• orthopedic appliances and aids
*evaluation
• Structure analysis
• Quality control
ORGANIZATION OF HEALTHCARE SERVICES
• Identification of patients and services (bar code and other technologies)
• appointment of patients' visits in the outpatient clinic
• patient admission into hospital
• medical records of the work
• administrative - financial business of healthcare
• planning of menus and distribution of meals in the hospitals
• problems of drug storing
• evidence of medical equipment
MEDICAL RESEARCH
• Data analysis
• Computer system for searching and data retrieval
• literature
MEDICAL EDUCATION
CAI

Table 1. IT in medicine (1)

In Medical informatics very important place is given to medical documentation and records, or storing medical records (the goal is that it is available to a doctor at any time). In primary health care, it is a very important segment and part of the daily activities of health care personnel. In medical practice two main areas of documentation differ - documentation of medical records and documentation

of the medical literature. Medical documentation is only a small part of medical informatics and mainly deals with the problems of the content of medical documents, methods of classification of terms and standardization of medical terminology. Database management in primary health care institutions is the responsibility of every young doctor, and for this already existing knowledge is essential, because the primary health care institution, is a place where the highest number of young doctors start their careers. IT are getting closer to the doctors and students in the form of mobile applications (cheaper hardware contributed to increasing convergence of software to health workers - with the aim of maximizing the availability) (6). Mobile applications have become an everyday occurrence to medical workers. Studies report that over 85% of health professionals use a smartphone, and 30–50% use medical applications in clinical care (7, 8, 9). Applications have huge potential to improve patient practice, system efficiency and communication by providing a quick reference tool accessible at the point of care (10). The advances in mobile health technology and the adoption of smart phones means that medical applications will be of vital importance and an integral part of daily medical practice in the near future (11). Medical applications constitute one of medicine’s most dynamic contemporary fields, with considerable potential to change the way healthcare is delivered in the future (11). IT are around us, the young generations from early childhood, became familiar with information technologies. Today’s students are familiar with the work on their computers, and better yet with mobile device management, but regardless of this, the question arises, do they have the knowledge to work on their computers, if you take into account that the computer is not just a web browser and social networks. IT will certainly continue to influence the development of medicine - without IT development there is no progress in medicine. The fact is that biomedical engineering is based on information technology, and medicine in modern times is going into new challenges- manipulating of genetic material, immunological knowledge that will enable treatment of many autoimmune diseases, 3D printing, artificial intelligence, brain computer interfaces, as well as diverse diagnostic instruments who will be able to diagnose primary cancer in the early stages of its creation. The fact is, that the young doctor, in addition to medical knowledge, need to expand his knowledge and keep up with modern technology. In countries in transition, including B&H, evidence based medicine will become an everyday occurrence, like in countries of the West. Application of evidence-based medicine ensures optimum clinical outcomes and increased quality of life. EBM application means relating individual clinical signs, individual clinical experience with the best scientific evidences obtained by the clinical research (12). The revised and improved definition of evidence-based medicine is a systematic approach to clinical problem solving which allows the integration of the best available research evidence with clinical expertise and patient values (1). Under the individual clinical noticing we thought of the ability, skill that doctors acquired during years of clinical practice, and clinical experience is necessary and indispensable part that makes a good doctor. The best scientific evidence is

considered to be a randomized controlled clinical study conducted on the amount of respondents that can prove the effectiveness of many drugs, as well as the harm and the inefficacy of others in comparison with the best existing therapy (13). In order to practice this some conditions are necessary to enable clinicians to efficiently search the literature, then knowledge of the basic rules that would be used for evaluating the reference literature, as well as ongoing education of clinicians on all important issues related to clinical diagnosis, treatment of many diseases, prevention programs and prognostic factors.

2. AIM

The aim of this paper was to analyze the use of information technologies at the Faculty of Medicine, University of Sarajevo, and analysis of skills in working with computers of students, in the prism of two systems, the old system and the Bologna system (Bologna process began to be used in Faculty of Medicine, University of Sarajevo, from the school year 2007/08 and from that moment, two school systems are taking place, the pre-Bologna (old) system and the Bologna system).

3. MATERIAL AND METHODS

Answers from questionnaires from total of 459 students (2012/13 - 2015/16 generation) were analyzed (197 who had studied under the old system and 262 who studied under the Bologna system).

4. RESULTS

On the basis of the fact whether the student studied during the old system or Bologna process, two groups were made (students of old system are older than students of the Bologna process ($p < 0.05$)). The presence of large number of female students, in both systems is significant ($p < 0.05$) (Figure 1).

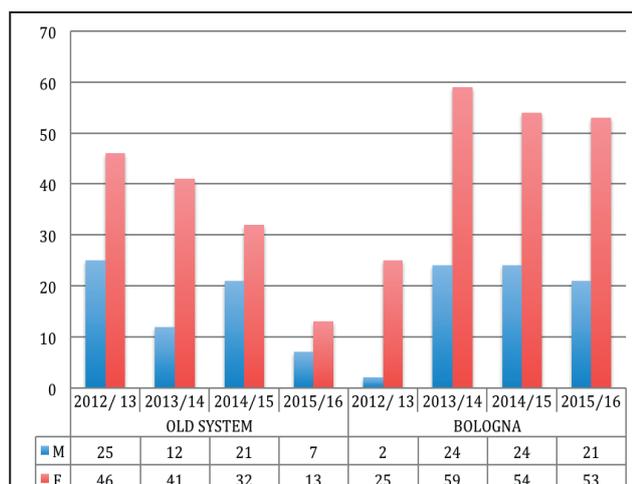


Figure 1. Gender distribution of examinees in our sample

By analyzing answers to the question “Do you use a computer in your everyday work”, 92% of students of the old system and 98% of students of the Bologna system said yes. All respondents have a computer available for their use, either at home either at college. In the last six academic years, computers are available at the Faculty of Medicine, Sarajevo (at the library), but only 36% of old system and 47% of the

Bologna system are using them. The computer is used for entertainment, education, information (via Internet) and for communication (e-mail, chat, social networks) (68.5% of the old system and 84% of students of the Bologna system have chosen all 4 offered answers. MS Word and MS Power Point are significantly more used compared to the use of MS Excel in both systems ($p < 0.05$). Internet connection is used by all subjects in order to check e-mail, social networks (communication through social networks), information search and download files or programs. The knowledge necessary to use their computers student of both systems have acquired through individual work (79.5% vs 86%) (Figure 2).

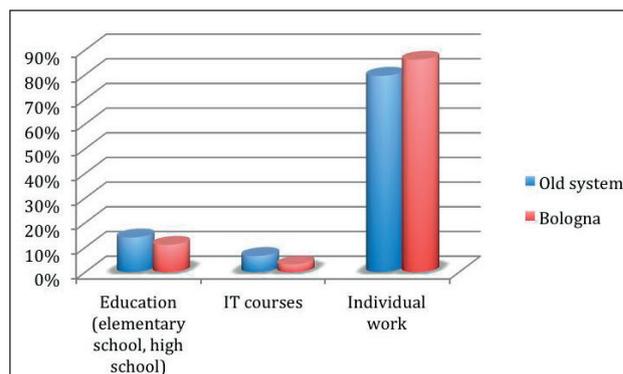


Figure 2. The knowledge necessary for computer using

In essence, the students of both systems (results vary from system to the degree of knowledge) know about hardware components of computers, they use MS Word and MS Power Point, know basic computer terminology and use the Internet. 16% of students of the old system and 18% of students of the Bologna system are familiar with the use of MS Excel, in terms of familiarity with the software (Figure 3, Figure 4).

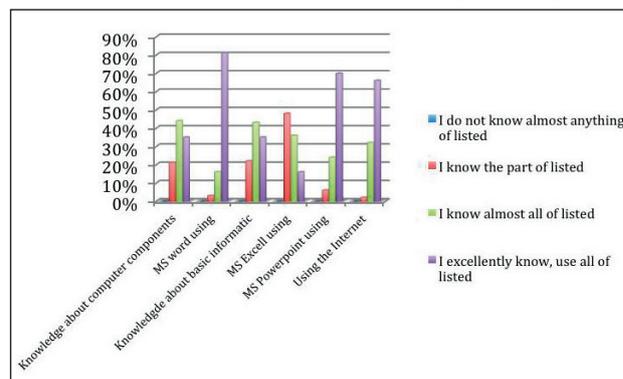


Figure 3. Existing knowledge – old system

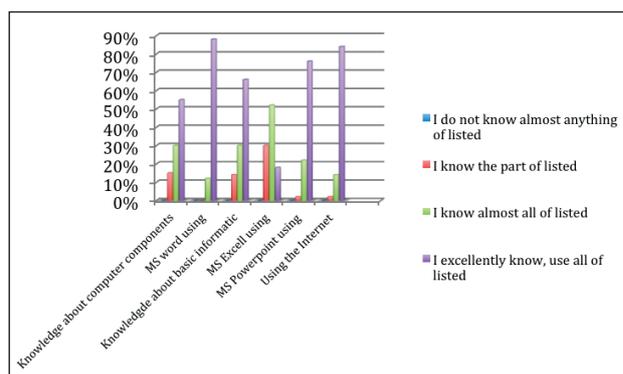


Figure 4. Existing knowledge – Bologna system

Students of both systems consider that it is necessary to work more on their computers through education and that distance learning should be commenced in education. Students feel that they need to improve knowledge of the treatment of sub-base (76% of students of the old system and 62% of students of the Bologna system).

Having analyzed the generation of 2015/16, 84.5% of students of the Bologna system and 75% of students of the old system used smartphones or tablets. The purpose of using a smartphone is, in most cases for accessing the social networks. 77.4% of smartphone users of the Bologna system, or 73.3% of the users of the old system have installed an application from the medical field. As the students of the old system, as a part of their education studied Medical Informatics, they graded all of these classes as follows: 6% said that teaching is bad, 16% said that the teaching is "satisfactory", 66% evaluated it as "good" and 12% as "excellent" (Medical Informatics is a subject studied only by students of the old

system in the sixth year of studies. With the introduction of the Bologna system, this subject has lost its place in the classroom - with the new reform of the original curriculum of the Bologna system, Medical informatics reappeared in the teaching process, as an optional subject in the second year). The faculty has currently only one subject performed through the distance learning method (optional subject in the second year), while the Department of Biochemistry already several years ago introduced an electronic examination (the only department which introduced this way of examination).

We analyzed the opinions of the availability of online course content and the degree of computerization of the study process and the possibility of electronic access to the literature (Figure 5, Figure 6, Figure 7) (Likert scale for assessment: grade 1 - I am completely dissatisfied; grade 2 - I'm not satisfied; grade 3 - I'm partly satisfied; grade 4 - I'm basically satisfied; grade 5 - I'm fully satisfied) - the results are not at the appropriate level, average scores do not exceed grade three, these are the last generation average score decreased compared to the last generation).

The last question was a question regarding suggestions of the students about what to add to the teaching in the field of IT, and thus improve the system of teaching. Students have suggested:

- Reorganization of the current website of the faculty - Faculty website should become a place where students could reach the necessary literature for learning;
- Introduce the subject of Medical Informatics, at the start of schooling - where students would study databases (with practical independent student work), and their manipulation, along with an introduction to science and research work through software such as MS Excel, SPSS;
- Provide students new learning methods - interactive classroom, distance learning.

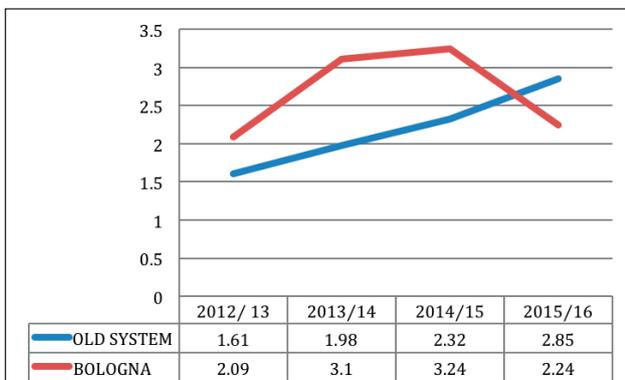


Figure 5. The availability of online course content

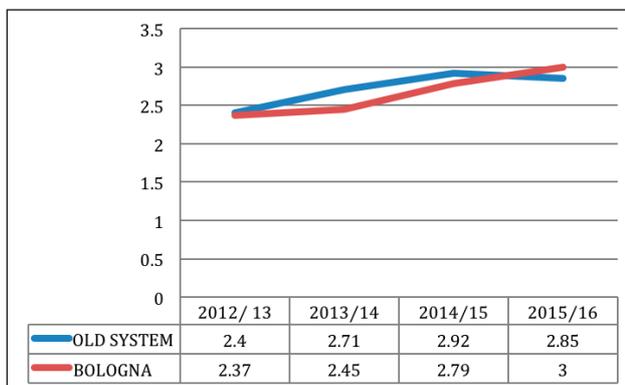


Figure 6. The degree of computerization of the study process

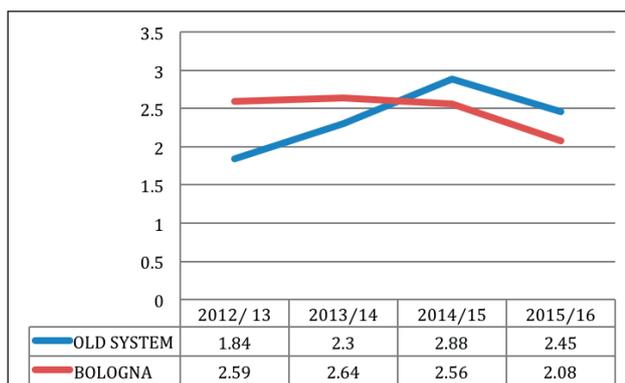


Figure 7. The possibility of electronic access to the literature

5. DISCUSSION

IT in education is defined as a combination of the processes and tools involved in addressing the educational needs and problems by using computers and other related electronic resources and technologies (14). Applications of information technology in education is commonly referred as educational technologies (15). IT in education includes wireless connectivity, using online learning management systems, internet technologies, merged technologies, high speed communication infrastructures, emerging technologies for visual presentation, accessing course materials through internet resources and artificial intelligence (14). IT in education can be classified into three categories: instructional, productivity and administrative (14). The number one benefit of IT is that it empowers people to do what they want to do, it lets people be creative, it lets people be productive, it lets people learn things they didn't think they could learn before, and so in a sense it is all about potential (Steve Ballmer). Today most of the academics are utilizing the applications of Information Technologies for their teaching purposes such as tutorials, researching, simulations and other forms of instructions (16). Computers are used by students of both systems at the Faculty of Medicine in Sarajevo.

They are used in their daily work, but mostly at home, so that even there are computers at the university, they are not used (only 36% of old and 47% of the Bologna system are using them). The computer is used for entertainment, education, information (via the Internet) and for communication (e-mail, chat, social networks). MS Word and MS Power Point is significantly more used in relation to MS Excel in both systems, which is probably a consequence of the system of schooling. The main commitments of students are writing seminar papers and making presentations of the same (MS Power Point). MS Excel as a software solution offers a number of possibilities for data manipulation; this means that a student should be more familiar with its capabilities. Sureya in his study, however, showed much higher scores of students knowledge of Excel. The knowledge necessary to work on their computers, students of both directions acquired through individual work without regular education through the teaching process, which has certainly left quite a gap in the knowledge of students. The use of MS Excel, in terms of familiarity with the software understands 16% of students of the old system and 18% of students of the Bologna system. All students generally know basic computer terminology, which is understandable given that we live in the 21st century. Students of both systems consider it necessary to work more on their computers through education and to initiate the distance learning method in education. Students feel that they need to improve knowledge of working with databases (76% of students of the old system and 62% of students Bologna system). It should be known that the manipulation of data is the thing that awaits young doctors in family practice. At the faculty, only one subject implemented the distance learning method, while the Department of Biochemistry, several years ago introduced an electronic exam. This is still a small number so the imperative should be the introduction of the system of information technology in everyday practice. In spite of fact that Bosnia and Herzegovina is last or second before last country in Europe in use of Internet technologies, there was a group of enthusiastic people (accompanying by Izet Masic, MD, PhD, at Medical Faculty and University of Sarajevo) who have been making significant effort to improve poor digital literacy in the University and among medical professionals (1). It was the first attempt to introduce distance learning and e-assessment at the Faculty of Medicine in Sarajevo. In October 2003, University of Sarajevo began with Distance learning education, opening University Distance Learning Centre. Opening the University Distance Learning Centre, as coordination body and leader in all activities in connection to Distance learning, has provided opportunity for development and growth of this kind of lifelong education (17, 18). In correlation with above project conducted by the University Teleinformation Centre (UTIC) and as continuation of two-year project Possibilities of introduction of Distance learning in Medical curriculum, the Cantonal Ministry approved and supported a new project "Introduction and implementation of Distance learning in medicine". On UTIC web site, several students enrolled from Medical faculty, for the subject Medical Informatics were able to learn from the distance location. Distance learning enables permanent learning (lifelong learning), students can improve

themselves professionally and independently, at their own tempo, at place and time that they choose by themselves, they can choose great deal of subjects which offer different institutions, teachers-individuals; students go through materials for learning by speed of their own and as many times as they want. The place can be chosen – it depends on media which is used for learning material (they can learn at work or from home). Themes access which are not offered by studies in that field – students find and attend the programs which they are interested in, although they are not offered by educational or business institutions in place where they live in or work. Taking part in top-quality and most prestigious programs – student can "attend" at least some studies at the top-quality institutions or studies held by lecturers that are very famous experts without changing their place of living. Choosing this way of learning – active or passive learning, different kinds of interaction: "Classical" written material and writing down their own lecture notes, interactive simulations, discussion with other students (e-mail, Teleconferences). Some of the main advantages of distance learning are: the economical factor; a student has 24 hour access to needed information; he/she is given the opportunity to learn the subject in his/hers own time and speed; he/she can access learning materials independently of a place or time; he/she is given the opportunity to learn how to work independently; using e-mail or chat rooms he/she is able to contact a professor or his/hers assistant if there are any questions or confusions regarding lectures; etc (1). Fundamental advantages of flexible education in terms of classical education are (1):

- More efficiency;
- Increased capacities of educational institutions;
- Education can be easily adopted;
- Costs of educational process are smaller;
- It is possible to distribute the education uniformly, thus the new educational programs are available for fields outside of educational and economic centers;
- It enables the possibility of access to the foreign educational resources;
- Superior quality of the gained knowledge.

Virtual patient and human patient simulator, as forms of use of information technology, would certainly be the ideal thing in education, and would primarily raise interest and the desire of students for certain topics. In many aspects, Bosnia and Herzegovina shows that, in collaboration with the regional countries (which are the European Union) and with proper training and support of faculty management, can come closer to the most developed Western countries. The traditional static concept of medical education should be changed into the dynamic concept. A passive doctor who is compelled to education, becomes a creative doctor focused on a problem he/she wants to solve in practice (self-directed) (1). Continuous Medical Education (CME) should be the base of their own education, starting from college days. In many countries, continuous education is structured and compulsory, but it stimulates free selection of problems and activities and specialization as a new cultural model (19, 20). Besides of using social networks (most popular among students) that can be used in the education purpose, telemedicine is a term for distance medical proce-

ture, including both diagnostic and therapeutic procedure and support from distance in making decisions. Moreover, today a doctor and his/her patient can communicate through a network, which shall probably be more used in the future, and systems for distant patient monitoring (e.g. at home) (1). All this should improve the quality of doctor's work. Technical possibilities for faster telemedicine development already exist, and organizational and infrastructure solutions are yet to be developed, where one of the major obstacles is insufficient IT literacy, especially of older generations of doctors, caused by a low level of computer use. One of rare published researches indicates that, even recently, only 10% of family doctors were using the computer, and only 5% were using Internet, mostly for e-mail and information source searching (1). Distance learning (E-learning) as a part of tele-education has gained popularity in the past decade; however, its use is highly variable among medical schools and appears to be more common in basic medical science courses than in clinical education.

Special attention should be focused to the use of applications on smartphones and tablets, which is great potential in education. In more accessible way, professors can reach to students, and thus increase the level of their knowledge. However, there is a need to be careful with the use of applications on tablets and mobile phones, especially applications that are used directly in medical practice, as well as the systems for the diagnosis and treatment decisions. Most medical applications lack authenticity details; authors, manufacturers and distributors which are not listed and often, references are unavailable or out-of-date (11). Eighty-six percent of 111-reviewed pain-management applications were found to have no medical professional involvement (21), which is a problem, because it is necessary to have symbiosis between medical workers and IT professionals (developers). Only this kind of symbiosis can lead to a quality product.

The content of all medical applications should be evidence based, externally peer reviewed by medical professionals and should provide up-to-date clinical information (11). The fact is that every application in the field of applications that work directly with patients, has to go to test phase or clinical research, before it is approved by the competent institutions. Medical application-developers should be encouraged to register their application in international registry and to submit a pre market notification to accrediting bodies and medical experts in order to assess the effectiveness and safety of the proposed application (11).

Today, IT are becoming a tool without which further education of both medical students and doctors would not be possible, since the quantity of information and the need for their fast search, can be satisfied only by using these technologies. Today, it can be freely claimed that a bad doctor is the one who does not use information technologies, because he/she does not operate with new facts which might mean a lot to his/her patients at the time (1). Healthcare is becoming part of information technology (Bill Maris).

The fact is that IT have great potential in medical education, which in Bosnia and Herzegovina has not (yet) been sufficiently exploited, and that IT can be a powerful tool in the approaching to European streams. IT, however, must be included in the official teaching process, and with the help

of primarily faculty management, with not so big financial requirements, can become everyday occurrence on Faculty of Medicine in Sarajevo.

6. CONCLUSION

Knowledge of basic computer terms, as well as work in basic software packages, are well-known to students of the Faculty of Medicine, Sarajevo. Education in software solutions that are connected to databases processing, must be imperative in reform of the teaching process. The involving of IT in learning process (interactive classroom, distance learning, interactive distance learning, web based learning and virtual classroom) can raise the quality of teaching, and certainly increase faculty rating (does not require large financial resources, only support of faculty management, with the involvement of experts who are familiar with IT in the educational process). Computer, portable computer, smartphone or other hardware variation, is not just a device that provides access to social networks, but really strong tool in education, and has to be a part of teaching process.

- **Author's statement:** all authors were included in all phases of preparing and drafting of the paper. Variables were defined and created by Izet Masic. Nedim Begic collected data. Edin Begic made processing and statistical analysis of results. Final proof reading was made by Izet Masic.
- **Conflict of interest:** none declared.

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Every article has to have a title page with a title of no more than 10 words: name(s), last and first of the author(s), name of the institution the author(s) belongs to, abstract with maximum of 45 letters (including space), footnote(s) with acknowledgments, name of the first author or another person with whom correspondence will be maintained.

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Authentic papers contain these parts: introduction, goal, methods, results, discussion and conclusion. Introduction is brief and clear review of the problem. Methods are shown, so that interested reader is able to repeat described research. Known

methods don't need to be identified, they are cited (referenced). If drugs are listed, their generic name is used, (brand name can be written in brackets). Results need to be shown clearly and logically, and their significance must be proven by statistical analysis. In discussion, results are interpreted and compared to the existing and previously published findings in the same field. Conclusions have to give an answer to author's goals.

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Use of abbreviations have to be reduced to a minimum. Conventional units can be used without their definitions. Supplement. If paper contains

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