
MODERN APPROACH TO THE STUDY OF TELEMEDICINE TECHNOLOGIES IN THE MEDICAL INSTITUTE

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Abstract

Telemedicine is being actively introduced into medical practice, however, in order for it to become an effective tool in their hands, a basic knowledge of the possibilities and limitations of modern telemedicine technologies is needed, as well as practical skills in the preparation and conduct of videoconferencing. This led to the need to include a course on the basics of telemedicine technology in the training of medical personnel. The Department of Medical Informatics created the educational module "Telemedicine", which is implemented by the Telemedicine Centre of the Medical Institute of the Peoples' Friendship University of Russia. After theoretical lectures, students receive practical skills through business games and conducting videoconferencing. Classes are conducted in accordance with world trends and standards. During the classes we demonstrate to students the technologies of remote interactive learning, in particular television lectures and master classes from the leading clinics of Russia, countries of Europe, India, Brazil and Canada. This practice allows our graduates to maintain contact with their teachers through telemedicine opportunities and participate in videoconferenced postgraduate education with PFUR professors, and international conferences held at PFUR sites. The experience of teaching the senior students of the PFUR Medical Institute is presented.

Keywords: telemedicine; videoconferencing; interactive education

Introduction

Telemedicine is being actively introduced into medical practice. The use of any technology requires training. The installation of equipment for videoconferencing in the clinic and the provision of extensive documentation to clinicians is not enough to support its use for telemedicine. A high level of user competence is achieved only if the training is not only theoretical, but also supported by weekly practice. Staff should be trained not only in how to switch on equipment, but also how to effectively use it for consultation, education and administrative purposes.

Researchers from the University of Geneva, collaborated with UNESCO and the WHO in coordinating the development of the e-Health Network in Africa (RAFT, Réseau en Afrique Francophone pour la Télémédecine). They noted that the key element in the quality and effectiveness of eHealth is continuing education, including its use for the exchange of medical information, remote consultations with their colleagues, the provision of continuing education courses and access to medical information of electronic libraries.¹

Studies show that after graduation, students plan to use mHealth mobile applications to improve the quality of medical services provided, although they did not receive any additional formal education in that area.² It is also noted in the literature that it is necessary to train medical students in the use of telecommunication and mobile technologies for the development of skills (competence) and to improve the quality of care provided to the patient.^{3,4}

But, despite the increasing presence of telemedicine in health care, this subject is not included in the training programs of medical students. This is partly due to the fact that the curricula are overloaded, preventing the inclusion of Telemedicine.⁵ Because People's Freedom University of Russia (PFUR) teaches students from different countries, we must prepare them in accordance

with international standards and requirements. To eliminate the discrepancy between the curriculum and real life, a course on the basics of telemedicine technologies was included to the training of medical students at the PFUR.

The aim of this report is to describe the development content and provision of the telemedicine course.

Methods

For several years we held discussions and conducted surveys within the framework of the school about the need to include a telemedicine module in the medical students' curriculum. We also investigated what the content, both theoretical and practical, should be. We concluded that the aim of the training should be to provide theoretical and practical knowledge in the field of telemedicine (preparation of teleconferences and distance learning, master classes and home telemedicine) and to give an idea of international experience and trends in the development of telemedicine. The evaluation of the acquired knowledge and course evaluation should include the preparation of teleconferences by students, their participation in masterclasses, questionnaires, and oral conversations.^{6,7}

Analysis of regulations, including the Federal Law on Education in the Russian Federation, the Russian Federal State Educational Standard, the act on an autonomous educational institution, was undertaken to ensure compliance. In addition, scientific articles and materials of conferences on telemedicine were reviewed and the international experience of using telemedicine technologies in medical institutions were studied.

Results

A curriculum for the module "Telemedicine" was developed. It is designed for 36 academic hours, 1 ECTS credit (European Credit Transfer and Accumulation System), 17 hours of which are for practical work, and the rest is reserved for students' self-education and self-preparation. Over two years we have taught the module to 1,200 students from specialties such as "Medicine" (893) and "Stomatology" (307). The majority of students were from Russia (899). The module was also completed by students from Asia (135), Africa (123), America (21) and Europe (22). The

detailed list of trainees by country of origin is presented in Appendix A.

Aim of the program

The aim of the programs is to teach students to use technology for the provision of healthcare at a distance, including:

- emergency and planned teleconsulting and medical care for patients who are at a considerable distance from the doctor-consultant
- tele-education and professional development of medical personnel (See Figure 2.)
- consulting pregnant women and patients with chronic diseases
- monitoring patients who are treated at home
- overseeing mobile patients using personal life support equipment.

Competences

On completion of the telemedicine module, students should be able to analyse and be ready to act in non-standard situations and to be socially and ethically responsible for the decisions made. The main professional competences that are formed are the ability to:

- manage groups of employees;
- develop a corporate strategy;
- use modern management methods to solve medical diagnostic problems.

They should be able to develop local regulations on the maintenance of information and documentation support for videoconferencing. In addition they will know the basics of the legislation concerning the use of telemedicine technologies, their current status in Russia and the world, the advantages and disadvantages of their use. Also, students will gain knowledge about the hardware and software of the telemedicine consulting centre and the methods for calculating the costs of its maintenance.

Students should be able to competently formulate a valid request for teleconsultation. During the teleconsultation they should present the patient to the expert consultant and give exhaustive answers to his questions; take part in developing a treatment plan; organize the registration of the results of teleconsultation; and assist colleagues in mastering the teleconsultations technology.

They should be able to master the methods of preparing an electronic extract from a medical-history and its transfer to a specialist-consultant and methods of organizing the interaction between the attending

physician and the consultant in the teleconsultation process.

Plan

The Telemedicine module includes five main topics, the fundamentals of telemedicine and the world trends in its development, technology equipment of telemedicine events, hardware and software of telemedicine, economic and legal aspects of telemedicine, and scenarios of telemedicine activities. The key topic content is listed in Table 1.

Technical support of the discipline

The telemedicine centre of the MI PFUR is used for familiarization with the discipline. It is equipped for videoconferencing sessions with Russian and foreign

telemedicine centres, and or demonstrations of video and presentations. (Figures 1 and 2)

Discussion

After lectures students are invited to participate in a business-game where they prepare and conduct a real remote videoconference session. The group is divided into subgroups, each of which prepares the patient and conducts a videoconference from the telemedicine studio. The theme of the videoconferencing and the roles of the participants (patient, young attending physician, experienced professor from the leading clinic, relatives, lawyer, etc.) are chosen by the students.

Table1. Telemedicine module topic content.

The fundamentals of telemedicine, and the world trends in its development
Goals and objectives of modern telemedicine
History of telemedicine
Development of telemedicine in Russia and abroad
Telemedical projects - successes and failures and their causes
The basic forms of work in telemedicine (consultation, lecture, seminar, master class, scientific and practical conference, patronage, monitoring, supervision)
Organizational structures of telemedicine system
Technological equipment of telemedicine events
Internet portal as an environment for organizing telemedicine events
Technical means of mobile telemedicine
Videoconferencing as the technological basis of telemedicine
Standards for encoding/decoding information, image and sound quality
Standards of storing and transferring graphic information about patients
Principles of building of Picture Archiving and Communication System (PACS)
Telepathology: spheres of application, technological equipment
Hardware and software of telemedicine
Electronic signature
Features of remote access to a medical information system during remote consultations and in personal telemedicine
Protection of copyright at remote interactive training
Development of leading manufacturers for telemedicine.
Economic and legal aspects of telemedicine
Legal and economic relations of subjects in telemedicine
Economics and marketing of modern telemedicine
Problems of Russian telemedicine and ways to solve them
Protection of personal data during telemedicine events
Scenarios of telemedicine activities
"Home telemedicine (monitoring and patient-doctor interaction)"
"Preparation, implementation and documentation of remote videoconferencing (including cross-border)"
"Organization of a remote master class on the basis of videoconferencing"
"Organization of remote mentoring during operations or diagnostic procedures"
"Organization of participation in international telesymposiums"
"Organization of a remote interactive lectures from PFUR to the country of graduates"

Preparation, management and documentation of the videoconferencing are conducted in accordance with the regulations, which includes the filing of an application, the preparation of a detailed description of the studies performed, the coordination of the timetable for the work of telemedicine centres.

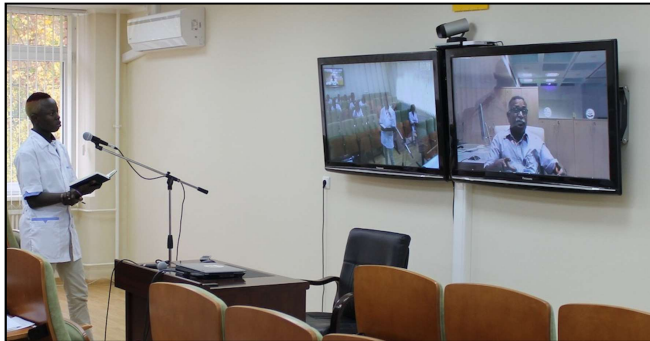


Figure 1. Interactive lecture on telemedicine for students, carried out from India.



Figure 2. The author V.S. leading lectures about organizing master-class on ophthalmology.



Figure 3. Business-game: students conduct a remote consultation for patient and his doctor.

Process

Stage 1. The young regional physician coordinates with his authority the necessity of videoconference of the patient with the leading medical centre and prepares the application for a videoconference. (Figure 3)

The application specifies: the purpose of the videoconference, the list of questions to the consultant, date and time, taking into account the time zone difference, what specialties of consultants are necessary, whether the patient or his relatives will attend. Depending on the chosen model of the consultant's behaviour, students prepare a list of questions for him. The amount of preparatory work depends on the type of model. It can be the control of the completeness of the examination and the absence of concomitant diseases in the selection of a patient for surgical intervention, advice on the provision of medical assistance on site, and or communication with colleagues on previously operated patients in case of complications. If a patient participates in the videoconference informed consent should be received from him and his personal data forwarded to the consulting clinic.

Stage 2. Students in the role of the physician prepare a detailed description of the case with their diagnosis, a description of the performed studies and when they were carried out with the necessary research from his point of view (ECG, X-ray, ultrasound, etc.) and notes - which studies will be additionally shown in during a videoconference (usually, it is video materials).

Students in the role of a consultant determine the adequacy and relevance of the information provided about the patient and in the case of dissatisfaction, request additional information. During the training it is possible to conduct a diagnostic procedure under the control of the consultant (modern videoconferencing systems allow the consultant to see 2 images simultaneously - for example, a picture from an ultrasound monitor and a sensor position).

Stage 3. The application is sent to the consulting clinic via the portal of telemedicine services, which protects the patient's personal data from unauthorized access or through secure communication channels.

At this stage students consolidate the knowledge gained on the lecture about personal data and about needs to use certified crypto protection tools (programs or file encryption devices) and anonymization (deleting names, medical history numbers, etc.-that is, everything related to personal data) .

Stage 4. Students in the role of employees of telemedicine centres make a work schedule, and additionally notify to all participants (especially the attending physician and consultants).

After the consent for the videoconference is reached with the consultants and the date and time coordinated, the videoconference is included in the schedules of the telemedicine centres. Special preparation is required for a videoconference with the participation of several clinics located in different time zones.

Stage 5. Conducting a remote videoconferencing with mandatory video recording on both sides.

During the videoconferencing, students decide both the medical, organizational and financial issues of assign treatment to the patient, indicating the date of hospitalization, the need to meet the patient at the airport with a special ambulance car. (Figure 4)

A special consideration is the question of the patient's presence at the videoconference. At the first stage students discuss the results (as well as possible shortcomings) of diagnosis and treatment, in the

absence of the patient. Only after agreeing on a common position, the participant acting as the patient is invited to participate. The consultant asks additional questions, and the patient has the opportunity to obtain information of interest to him about the methods and prospects of treatment, the conditions of stay in the clinic. After the videoconference, the following materials remain: a full set of documents on the patient, conclusions on the results of the videoconferencing, video recording.

Stage 6. Preparation and signing by consultants of an agreed conclusion on the results of a videoconference, which is scanned and forwarded through the portal of telemedicine services to a consulted clinic. The original findings are stored in the telemedicine centre of the consulting clinic.

Based on the results of the videoconferencing, students should competently prepare a document that indicates: the diagnosis, the purpose of the videoconference, the participants on both sides, the decision of the consultants, the set of necessary analyses



Figure 4. Students of PFUR conduct remote interactive videoconferencing.

for hospitalization, the recommendations for the preparation for hospitalization (treatment of comorbidities), recommendations for transportation of the patient (including for the accompanying physician or relative), and contact information of the consulting clinic.

Stage 7. The attending physician prints out the final conclusion based on the results of the videoconference and puts it in the patient's medical history.

Students should understand that advice of consultants is advisory in nature. The responsibility for the patient under the current legislation is borne by the attending physician, therefore his participation in the videoconferencing is obligatory.

Conclusion

Having completed the module, students should know the basics of legislation regarding the use of telemedicine, its current status in the world, and the advantages and disadvantages of its use. Also, students will have gained knowledge about the hardware and software equipment of the PFUR telemedicine consulting centre and the method for calculating the costs for its maintenance. They should be able to competently compose a qualified application for teleconsultation, and during the teleconsultation present the patient to the expert consultant, give exhaustive answers to his questions, take part in drawing up conclusions for the specified treatment plan and organize the process of registering and recording the results of teleconsultation. In addition they should know how to organize and conduct a course on mastering the technology of teleconsultations for colleagues, know the methods of preparing an electronic extract from the medical history and its transfer to a specialist-consultant, and methods of organizing the interaction of the attending physician and a consultant in the teleconsultation process.

The described content of the basics of telemedicine allows students to obtain theoretical knowledge and practical skills of videoconferencing and distance education methods, to be familiar with international experience and trends in the development of telemedicine technologies, and to provide an opportunity for graduates to maintain regular contacts with leading professors of PFUR and other universities and clinics. Thus, Telemedicine Centre of PFUR provides continuous training for medical specialists of all levels from students to qualified practitioner doctors.

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Conflict of Interest. The authors declare no conflicts of interest.

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Appendix A

Distribution of students by countries

COUNTRY	Total	Medicine		Stomotology	
		2016	2017	2016	2017
ASIA	135	53	50	13	19
AFGHANISTAN	4	1	1		2
BANGLADESH	5	3	1	1	
INDIA	6	5	1		
IRAQ	1	1			
ISRAEL	1	1			
JORDAN	1	1			
LEBANON	2	1			1
MONGOLIA	4	4			
NEPAL	7	1	6		
PALESTINE-JORDAN	3		2		1
REPUBLIC OF ARMENIA	6	2	4		
REPUBLIC OF SOUTH OSSETIA	3	1			2
SRI LANKA	3		3		
SYRIA-JORDAN	6	2	3		1
THE KYRGYZ REPUBLIC	5	3	2		
THE REPUBLIC OF ABKHAZIA	5		3	1	1
THE REPUBLIC OF AZERBAIJAN	12	6	2	2	2
THE REPUBLIC OF KAZAKHSTAN	15	8	3	3	1
THE REPUBLIC OF TAJKISTAN	18	6	6	1	5
THE REPUBLIC OF UZBEKISTAN	19	5	8	4	2
TURKMENISTAN	7	2	5		
VIETNAM	2			1	1
EUROPE	22	8	9	4	1
FINLAND	3	1	2		
GREECE	1			1	
MACEDONIA	1				1
REPUBLIC OF BELARUS	2		1	1	
SWEDEN	1			1	
THE REPUBLIC OF MOLDOVA	6	2	3	1	
UKRAINE	6	4	2		
UNITED KINGDOM	2	1	1		
AFRICA	123	42	79	0	2
ALGERIA	1	1			
BOTSWANA	1	1			
COTE D'IVOIRE	1	1			
ETHIOPIA	1		1		
GHANA	7	5	2		
GUINEA	1		1		
GUINEA-BISSAU	1		1		
JIBOUTI	1		1		
KENYA	3	1	1		1
MALAWI	1		1		
MAURITANIA	1	1			
MAURITIUS	1		1		
MOROCCO	1		1		
MOZAMBIQUE	2	1	1		
NAMIBIA	79	19	60		
NIGERIA	13	6	7		

SIERRA LEONE	1	1			
TOGO	1		1		
TUNISIA	3	2			1
UGANDA	1	1			
ZAMBIA	2	2			
AMERICA	21	9	9	1	2
COLOMBIA	4	1	3		
COSTA RICA	1	1			
ECUADOR	2	1	1		
JAMAICA	13	5	5	1	2
SAINT VINCENT AND GRENADINES	1	1			
RUSSIA	899	386	248	138	127
TOTAL	1200	498	395	156	151