# Telemedicine as a Part of Physicians Education

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## Abstract

Medical education is inconceivable without access to the experience and knowledge of leading practitioners - diagnosticians and surgeons. 3D movies and smart simulators are a nowadays tool for training of the medical beginners, butthey will not replace the clinical analysis of experienced doctors and communication with colleagues. The videoconferencing helps young doctors learn new diagnostic methods and operations, be aware of the most topical health and medical science problems.

**Keywords:** *telemedicine, distance education, videoconference, tele-lectures, tele-mentoring, Medical informatics*

## 1. Introduction

We started our experience of medicine distance interactive education with low-cost desk-top system Intel and V-CON, office system Picture Tel and digital telephony channel ISDN [1]. In those days the cost of telecommunication was much less than the cost of the lecturer's trip to remote regions. In addition to financial costs, the lectures trip was not always possible as the practitioner frequently unable leave his workplace. Telemedicine has become an important instrument to solve a number of problems of distance education. The telemedicine project «Moscow- remote Russian regions» in the late 90s showed economic efficiency of telemedicine using as well as active interest of remote regions in joint distance work.[2]

Further digital telecommunication improving and development of video technologies contributed to the new formats of tele-education. Those formats of tele-education have brought the training of medical students and medical officers to the next level. Medics got the opportunity:

- to take knowledge from tele-lectures cycle as part of distance postgraduate medical education;
- to organize and participate in interactive workshops that includes operations and diagnostics procedures by online broadcast from best Russian and foreign hospitals;
- to apply telemedicine for tele-mentoring of medical beginners by experienced specialists.

## 2. The distancetele-lectures

The distance tele-lecture is multipoint videoconference with studio quality sound and video for interactive communication of the lecturer with doctors [2]. Clinical discussions, analysis of diagnoses, analysis of data of electrograms and radiographs, demonstration of educational films and presentations can use in modern tele-lectures.

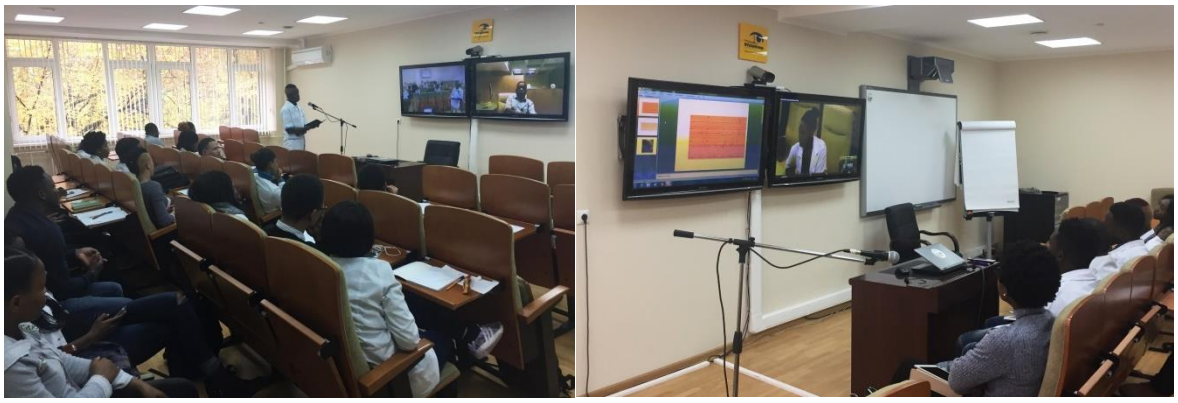

**Figure 1.Distance learning using videoconference**

## 3. Interactive workshops

Interactive workshops give doctors the opportunity to communicate with the surgeon during operation or to monitor the progress of the operation with the help of several cameras in the operating room. Camerascould be control remotely, for example move the zoom to the desired area or switch from camera to camera. The listeners could thereby study the work of each member of the surgical team [3].

**Figure 2.The workshop for medical students using video conferencing**

To date two or more video streams could transfer to remote point. This gives clear indication of what is happening during many operations (endoscopic operations, x-ray surgical operations, etc.) and diagnostic procedures. As an example, it is possible to study the manipulations of the endovascular surgeon and the X-ray image of the stent installation, the position of the ultrasound sensor and the image from the monitor at the same time, in so doing, interactively communicate with the surgeon.

## 4. Tele-mentoring

Tele-mentoring is interactive workshop in which from intern performs an operation (or diagnostic) in operating room under the remote control of an experienced colleague-medic that is in another room [4]. The videoconferencing allows a young specialist to quickly use the advice and experience of a teacher in difficult situations, as well as demonstrate acquired skills.

**Figure 3. Ultrasound the abdomen with remote support of mentor**

A modern development that helps in solving the problem of tele-mentoring is stereoscopic technologies. Stereo allow solve the problem of insufficient visibility of the subject of discussion during classes and seminars. Moreover, the technology help with spatial thinking developing and provide an opportunity to present a detailed model of any object. The implementation of stereoscopic complex aimed at solving a narrow range of problems. One of such complex was present by Scientific Clinical Centre of JSC "Russian Railways".

**Figure 4.Work of stereoscopic complex**

## 5. Discussion

What new do we see and expect in distance education of doctors? The use of miniature digital or analog cameras on the surgeon's helmet gave a huge impetus to solving the problems of master classes and tele-mentoring. This gives young medics the opportunity to see the progress of operations or diagnostic procedures. The opportunity allowed young medics to see the progress of operations or diagnostic procedures manipulations with the eyes of the operating surgeon or diagnostician from his position. This moment is important because in a number of operations the surgical field is block by the surgeon's head from the eyes of assistants, which complicates the training of specialists according to the traditional scheme - from assisting to independent work.The result of this was numerous educational films on the technique of operations. However, films show “perfect” operations, since errors and “overlays” are removed during the rough cut of the video, while the analysis of errors and the demonstration of to emerge an experienced surgeon from the deadlock could become the basis of the experience of a young specialist.

The solution was found in “on-line” broadcasts using modern video conferencing systems with the transfer of two video streams and full interactive communication of the operating surgeon with a remote colleague (young specialist or mentor).A serious problem is the explanation or recommendation of actions at a specific point in the surgical field - incision, separation of a vessel, etc. For this purpose, our partners at MIRCOD have developed a laser grid projection system that helps to visualize and indicate the exact location in the surgical field. These systems simplify and accelerate the exchange of information between the tandem of doctors, allowing you to avoid mistakes and make full use of the experience of senior colleagues. Depending on the willingness of tandem members, laser projection is scales and transforms the surface of a wound or surgical field that the surgeon looks at in an interactive map with coordinates. Thus, doctors have the opportunity to mark the area they are interested in visually both from the side of the surgeon and from the teacher.


**Figure5. Laser grid projector system developed by MICORD.**

A tiny device integrates into existing surgical helmets and projects an interactive laser grid (red, green, blue or violet lasers) on the work surface at the time of surgery or by a remote signal. This technology increases the efficiency of the development of new operations and manipulations, but has a significant reduction: we have a flat picture of the surgical field obtained by a video camera on the surgeon's forehead or in the operating lamp. The problem is not solved by mathematical algorithms that create a pseudo-stereoscopic image according to the principle how our brain completes a three-dimensional image with one eye closed, or 3D reconstruction based on a variety of solutions. The only solution is to receive and transmit a binocular stereoscopic image of the surgical field using a stereo pair of cameras (according to the principle of our two eyes).Designed unit with two digital cameras for the surgeon’s helmet was used by us in neurosurgery, oncology, maxillofacial surgery, etc. However, the practical use of this technology has posed new scientific and technical objectives: calculations based on a spatial picture, creating a convenient 3D laser grid and using a virtual reality helmet for tele-mentoring.

The problem of quantifying the quality of stereoscopic images is no less interesting. In the course of numerous meetings with the developers of video-conferencing systems and other technical specialists, we try to explain that for a complete remote diagnostics and

interactive training of doctors, we are concerned not so much with the number of pixels in the image, but a new quality, namely:

(a) receiving, transmitting and processing binocular stereoscopic images of the surgical field with the possibility of full interactive communication with the operating surgeon using augmented reality technologies;

(b) remote transmission of tactile sensations (interesting work in this area is carried out by specialists of Lomonosov Moscow State University);

(c) remote transmission of smell.

Separate successful solutions in these areas have long existed in technical applications, and our task is to try to integrate them into the medical field.

## 6. Conclusion

The telemedicine is a contemporary instrument to improve practical and theoretical skills of young medics. Modern communication technologies allow videoconference based remote training, online transmissions from the operating rooms, as well as interactive master classes with communication between the remote audience and the operating surgeon and monitoring the progress of the operation using a number of video cameras in the operating room. The videoconferencing using ensure high quality CME and postgraduate training and allows physicians to study at their workplace.

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