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Teaching Medical Students Pediatric Cardiovascular Examination by Telemedicine

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Abstract

The aim of this feasibility study was to assess whether medical students can be taught the pediatric examination of the cardiovascular system facilitated by telemedicine equipment. The views of the students regarding this new technology were sought in a subsequent questionnaire survey. Seventy-seven (n = 77) medical students attended eight telemedicine sessions that consisted of a lecture, case discussion, and physical examination of a child using an electronic stethoscope. The acceptance of this novel teaching method was generally good, but a minority of students (10%) preferred face-to-face encounters with the lecturer. Technical problems were common and may have influenced the outcome of the sessions. Teaching by telemedicine is a viable alternative to conventional teaching and should be applied when clinicians cannot meet the students in person.

Key words: telemedicine, medical students, electronic stethoscope, medical education, pediatrics

Introduction

The related terms "telehealth" and "telemedicine" are used to describe the provision of healthcare through telecommunication. They cover a wide range of activities from patient consultation to medical education and patient education. Pediatric telemedicine is a relatively new branch of telemedicine that utilizes modern communication technology for the benefit of sick children.^{1,2} Telemedicine instruments are becoming increasingly

sophisticated and include ophthalmoscopes, otoscopes, and stethoscopes.³ In a parallel development, medical students are more and more exposed to e-learning, for instance, through Web-based courses and interactive videoconferencing (VC).⁴⁻⁶

For this pilot project, we combined the aspects of physical examination and teaching via telemedicine. Our aim was to test whether medical students could be taught the cardiovascular examination of a child with the help of teleconferencing facilities and digital stethoscopes. We were also interested in the attitudes of the students toward this new technique and therefore conducted simultaneously a questionnaire survey.

Material and Methods

PARTICIPANTS

Telemedicine teaching sessions on the cardiovascular system were arranged for medical students as part of their pediatric training at this district general hospital. Depending on the group size, which varied from 4 to 14, students either had the opportunity to examine a child by themselves or they were allocated into pairs, with one of them performing the examination and the other one completing a marking sheet. For each session, 2 healthy children between the ages of 8 and 10 years were available to be examined in the company of their parent/guardian. The team facilitating the seminar consisted of a pediatrician, a teaching assistant, and an information technology (IT) expert who, after an initial staff training phase, remained on standby. Written consent was obtained from all participants.

TELEPEDIATRIC WORKSHOP

Each 2-hour workshop included a presentation on cardiovascular physiology, history and examination, a discussion of two pediatric cardiology-themed cases from a handout, and an examination of a child volunteer by the students using an electronic stethoscope. The complete workshop and the heart sounds of the healthy children were transmitted real-time via a video teleconferencing link between two different classrooms within the same hospital. The teaching assistant

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provided support to the medical students, whereas the pediatrician was situated in the distant classroom. At the end of the seminar, the students completed a 1-page questionnaire containing seven questions. The project was registered with the Trust R&D Department. Ethics approval was deemed not necessary. No video material was stored.

EQUIPMENT

AU1

Experimental equipment include the following NEC 50XM5G Plasma Screen (); Smart PX350 Interactive Overlay (); Quad Q4 Speakers (); Panasonic NVVP33EBS DVD Player/VCR Combo (); Sony TAFE370 Amplifier (); Sony DCR-HC94E Camcorder (); AMX EXP-7531 Kit (); Optical Switch; Tandberg 3000 MXP CODEC (); Tandberg Intern MXP (); AMD 3350 Smartsteth (); and Dell Latitude D520 Notebook ().

Smartsteth was connected to a laptop, which was linked to the Trust network. Through this all communications travelled via Microsoft Net Meeting (Microsoft, Redmond, WA) protocols. Net Meeting was installed but not running. SmartSteth was used on one hospital site only through the local network. As this network extends to all sites within the Trust, the digital stethoscopes could have also been used across sites. The only change would have been the IP address of the laptop. To help with this, a small program was included that displays the IP address of the laptop once connected to the network on a specific site. The VC part of the classes was a separate entity to the SmartSteth setup but again could have been connected across sites. The equipment was not monitored for bandwidth use, but there were no reports of network disruption when the sessions were in operation. The main consideration when setting up a session was network availability. Per room, one live network port was required for the SmartSteth laptop and another live port for the VC equipment (Figs. 1–3).

F1-3

Results

During the 8-month period, eight telemedicine teaching sessions were held for 77 medical students. The group size of 26 fifth-year students ranged from 4 to 8 (mean 6.5) and 51 third-year students ranged from 11 to 14 (mean 12.8).

All fifth-year medical students had a positive or neutral attitude toward the telemedicine teaching sessions as far as the outcome was concerned, but 50% rated the content of the session as too easy for their level of experience. The objectives as stated at the beginning



Fig. 1. Room of lecturer with telemedicine equipment.



Fig. 2. Classroom with telemedicine equipment and examination couch.

of each session were not achieved for 10% of the third-year medical students. The pitch of the session was judged as too easy by 31% and as too difficult by 10% of the third-year students (Table 1).

The students were asked to list three positive aspects of telemedicine. Both groups expressed interest in this novel technology and realized the advantage of the digital stethoscope, which allows student and teacher to listen to a patient's heart sounds simultaneously

T1

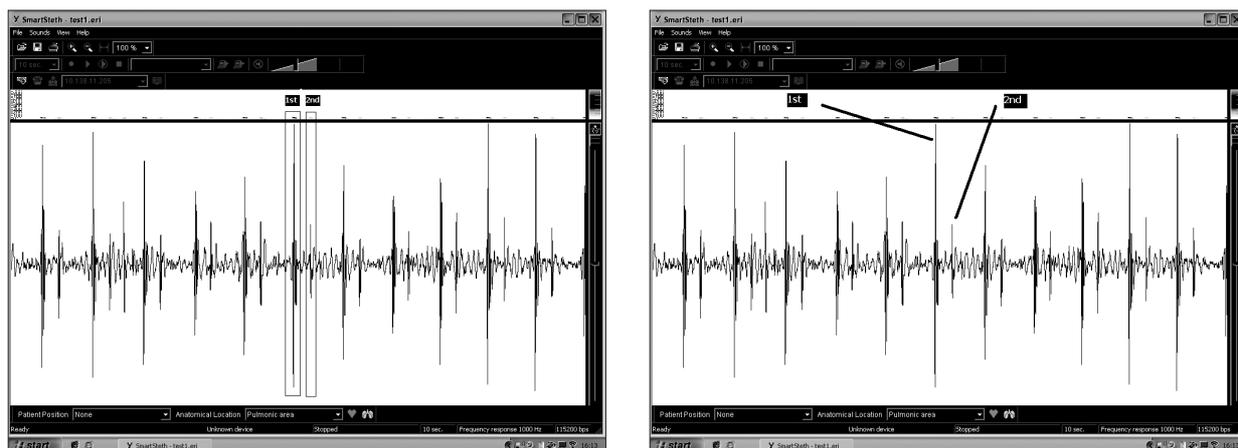


Fig. 3. Tele-Phonocardiogram depicting first and second heart sounds of a healthy volunteer.

over a distance. They felt that this method of teaching away from the hospital wards was more relaxed and less intrusive for students and child volunteers. The students found it helpful to practice the cardiovascular system examination under observation, but some of the third-year students preferred the conventional face-to-face sessions.

When asked about the disadvantages of teaching by telemedicine, the students stated that it was less personal and interactive. They felt the pediatrician could not demonstrate the correct examination technique on the patient and might also miss finer details, depending on the view of the camera.

Technical difficulties, albeit transient, were a common problem: for instance, delays in the transmission of images and reduced quality of the digital heart sounds due to background noise. Observing each other performing the examination was considered repetitive by some students.

Both groups made several suggestions on how to improve the quality of the seminars: The lecturer should be in control of the Powerpoint slides; the transmitted cardiac sounds should be audible by the whole class rather than just by one student at a time; children with abnormal clinical findings should be included to enhance the learning experience; a handheld examination camera to recognize finger clubbing and splinter hemorrhages would be helpful. They commented on the importance of a smooth running of the classes without technical faults and asked for detailed background information prior to the session, which should take into account the specific needs of the students.

Table 1. Answers of Medical Students to Three Questions about Telemedicine Teaching Session

GENERALLY SPEAKING, WERE THE STATED AIMS AND OUTCOMES OF THE SESSION ACHIEVED FOR YOU?			
Fifth-year students	Yes 23/26 (89%)	Neutral 3/26 (11%)	No 0/26
Third-year students	Yes 32/51 (63%)	Neutral 14/51 (27%)	No 5/51 (10%)
DID YOU GET WHAT YOU WANTED OUT OF THIS SESSION?			
Fifth-year students	Yes 14/26 (54%)	Neutral 12/26 (46%)	No 0/26
Third-year students	Yes 26/51 (51%)	Neutral 20/51 (39%)	No 5/51 (10%)
WAS THE SESSION PITCHED AT A LEVEL APPROPRIATE TO YOUR NEEDS?			
Fifth-year students	Just right 13/26 (50%)	Easy 13/26 (50%)	Difficult 0/26
Third-year students	Just right 30/51 (59%)	Easy 16/51 (31%)	Difficult 5/51 (10%)

All students recognized the wide potential of teaching by telemedicine, particularly if performed by an expert in a specific field who was unable to attend in person. The additional topics identified that could be taught this way included history taking, communication skills, examination of other organ systems, basic and advanced life support, and surgical procedures. Again, the more junior students felt

that basic examination skills should be demonstrated with a clinician present in the same room.

Discussion

With this feasibility study, we have been able to demonstrate that medical students can learn how to examine a child under the supervision of a health professional based at a remote location. The lecturer was connected to the students via state-of-the-art interactive presentation facilities and an electronic stethoscope that allowed him to simultaneously assess the clinical findings.⁷ This project was part of a wider initiative to develop new methods of information sharing for educational purposes within the regional health services.

For a majority of students (71%), the objectives of the session were achieved, and 22% adopted a neutral position. However, only 56% of students felt that the workshop was tailored to their needs, whereas 38% considered it as too easy. As this was a pilot study and for reasons of comparability, the content of the teaching seminars was not significantly modified between the two groups of third- and fifth-year medical students. We also did not include children with cardiac disease, but this would be an option in future teaching studies.

Despite careful preparation and IT support, technical difficulties hampering the transmission of images and sounds were common. They interrupted the flow of the session and occasionally caused the lecturer to attend the classroom in person to address the problem. This would not be possible in a scenario where teacher and students were based at different hospital sites. In a recent literature review, Broens et al. studied the factors that influenced the implementation of new telemedicine projects. They identified five categories: acceptance, technology, organization, funding, and legislation. Among those, acceptance and technology were the main determinants for a successful implementation.⁸

A limitation of this study is that outcomes were limited to student satisfaction, and no attempt was made to formally measure changes in clinical skills or knowledge, although the supervisor gave verbal feedback to the students on their performance.

Literature regarding the use of telemedicine in medical education is relatively scarce. Stain and colleagues compared two groups of third-year surgical students who received either conventional teaching in a university hospital or VC lectures at a remote army hospital. Both groups were tested with a quiz, and their results were 71.4% and 70.5%, respectively.⁹ Bertsch et al. studied a group of medical students who attended half of their lectures in person and the other half by VC. At the end of each subset of lectures, written exams were held that did not show a significant difference in the scores achieved by these students.¹⁰ At the University of Texas Medical Branch, a

telemedicine teaching program for physician assistance has been in place since 2003. This program involves indirectly supervised visits of students to elderly volunteers in their care homes during which they can practice a geriatric examination using telemedicine equipment. In a subsequent evaluation, 86% of students felt comfortable with this method and 62% rated telemedicine as equal to a face-to-face encounter with their mentor. However, only half of the students preferred telemedicine over direct supervision and considered the technology reliable.¹¹ These results are similar to the findings in our study. Recently, a research team from Boston conducted a survey among third-year medical students who, during their surgical clerkship, observed different operations from a teleconference center. In these sessions, students and doctors were more likely to ask questions, and more teaching topics were covered than with the students present in the operating theater.¹²

In summary, we have shown that telemedicine is a useful instrument in the repertory of medical education, and that its acceptance among medical students is satisfactory. This novel method of teaching should complement rather than replace traditional clinical teaching. Continuing IT support is a prerequisite for the successful implementation of a telemedicine seminar.

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Disclosure Statement

No competing financial interests exist.

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