

C A Kavamoto *et al.* Brazilian model of distance education

ambulance entered an area with adequate signal strength. As a back-up, the telemetry unit was also capable of connecting by landline from the patient's home, although this was never necessary during the study.

Other communication problems were due to equipment failure. Most of the recorded episodes were at the beginning of the project and these were rapidly rectified with the help of the manufacturer. Complete communication failure was encountered on only four occasions. After the initial problems were solved, the equipment proved robust in the field. Delays encountered in ECG acquisition and transmission undoubtedly added to the call-to-needle time in some cases. Despite this, a call-to-thrombolysis saving of 72 min was demonstrated for patients treated pre-hospital, compared with controls, in similar geographical locations.<sup>7</sup>

Pre-hospital thrombolysis results in greater access and equity of care for patients living in remote and rural areas. For these patients, pre-hospital treatment may represent the only way of achieving the National Service Framework thrombolysis target. Telemetry offers essential back-up to paramedics who are acting in a challenging and extended role. Strategies can be developed to deal with signal strength and equipment failure.

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# ▶ A Brazilian model of distance education in physical medicine and rehabilitation based on videoconferencing and Internet learning

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## Summary

We have developed an integrated educational model in rehabilitation mediated by technology. Three teams of professionals worked to implement the interactive model based on videoconferencing, use of the Internet and three-dimensional (3-D) animated models. Two courses were created: amputee rehabilitation and back pain. Each course was divided into four phases: (1) a first videoconference; (2) Internet-based learning; (3) a second videoconference (workshop); (4) an Internet discussion list. The Internet-based learning modules were divided into topics by multiple-choice questions. Multisite videoconferences were used to connect the remote sites. Eleven animated 3-D models were created to help the teaching process. Each course had 11 modules, and each module required up to 2 h to be completed. There were 136 participants on the two courses. None of the participants, including the teachers, had had any previous experience with Internet-based learning and videoconferencing. The integrated educational model has great potential in a country the size of Brazil, where there may be difficulties in travel for patients with disabilities and for health-care professionals.

## Introduction

The Brazilian census of 2000 showed that the country had approximately one million people with physical

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disabilities.<sup>1</sup> This is an important social issue and telemedicine has the potential to make health-related information and services more accessible to vulnerable populations, such as people with disabilities.<sup>2</sup> One way to improve the health care of these patients is by providing adequate training for rehabilitation professionals and facilitating access to high-quality education. The feasibility of Internet-based teaching has already been established.<sup>3</sup>

Learning depends on motivational, cultural and social aspects that will determine the kind of approach. In the superficial approach, the student will grasp only the meaning of the object. In the profound approach, the student gains a comprehensive understanding and will build his knowledge according to his own specific needs.<sup>4</sup> It is important to create new tools to improve the medical teaching process in physical medicine and rehabilitation. One of the goals in physical medicine and rehabilitation is to care for people with disabilities and help them to achieve the highest possible function and quality of life. The aim of the present work was to develop an integrated educational model in rehabilitation mediated by technology.

## Methods

Three teams of professionals from different expertises worked together:

- (1) Telemedicine specialists, physiotherapists and computer science professionals constructed an e-learning environment based on an interactive educational model (videoconferencing, Internet learning and a Website).
- (2) Physical medicine and rehabilitation specialists, social workers, psychologists, physical therapists, occupational therapists, nurses, nutritionists and physical educators prepared the learning material (text, images and multiple-choice questions), presentations and participated in the discussion list.
- (3) Physical medicine and rehabilitation specialists, telemedicine specialists and digital designers created three-dimensional (3-D) video clips.

Two themes were chosen: rehabilitation of the amputee patient and back pain. The rehabilitation team was instructed in how to prepare the material and use the discussion list. They were also trained in performing videoconference presentations.

## Courses

Each course had four phases.

- (1) The first videoconference was about the learning strategies and objectives of the course, and included

an explanation and demonstration of the teaching tools to be used during the course (aspects of videoconference interactivity, access to the material on the Internet and the discussion list).

- (2) The second phase was an Internet-based learning period during which the participants could access the material organized into modules. The modules contained a sequence of topics with multiple-choice questions, which guided the learning process. Answering the questions concerning a topic was obligatory before the student could proceed with the next one. The text contained various links in order to stimulate further study. Participants received an individual performance report.
- (3) The second videoconference was a practical workshop with short presentations followed by a question and discussion period oriented by the mediators. Teachers had previously received the performance reports and used the feedback to prepare the workshop.
- (4) In the final phase, an Internet discussion list was used as a complementary educational tool.

The courses lasted for six weeks, with a two-week period between the videoconferences and four weeks of using the discussion list. There were two structured evaluations: during phase 2 and at the end of phase 4. Participants were encouraged to learn how to think critically and could ask questions at any time during the videoconferences or during the discussion list phase.

## 3-D animated models

The 3-D animated models were constructed following research of the relevant scientific material by a physical medicine and rehabilitation specialist. A prototype model was then constructed. It was revised after evaluation of the model by the rehabilitation team.

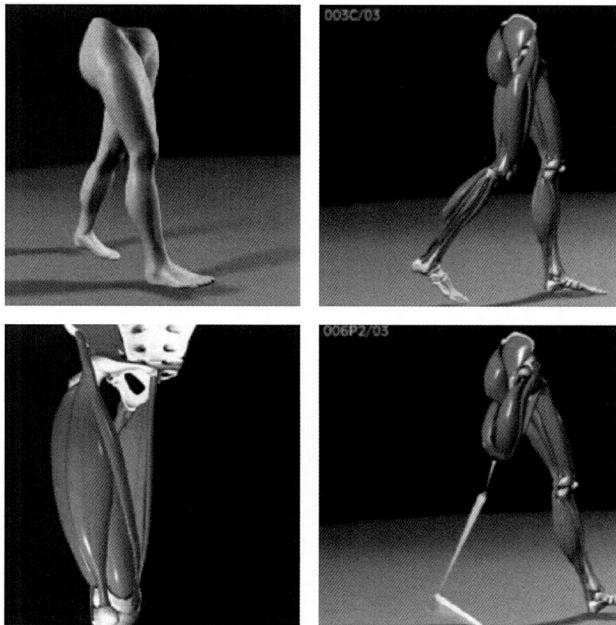
## Videoconference infrastructure

The central videoconference equipment (model 6000, Tandberg) was located in the Faculty of Medicine at the University of São Paulo. There was a 2 Mbit/s ISDN connection, which was able to connect three different sites simultaneously. The remote-site equipment (Viewstation, Polycom) was connected by three ISDN lines at 384 kbit/s. There was a technical professional and a local mediator at each of the remote sites.

## Results

The contents of the two courses were:

- (1) *Rehabilitation of the amputee*: lower- and upper-limb amputation aetiology, surgical aspects of amputation



**Figure 1** Examples of the 3-D models on normal gait and transfemoral amputee gait

and rehabilitation, upper-limb amputation and prosthesis, lower-limb amputation and prosthesis, pre- and post-prosthetic rehabilitation, phantom pain treatment, normal gait, gait evaluation, amputee gait, work rehabilitation and health system.

- (2) *Back pain*: global treatment of patients with low back pain, back pain school, exercise and health, self-knowledge and self-perception, posture, daily-life activities and ergonomics, habits for health, nutritional aspects, social participation, posture pattern (theory and basic exercise programme).

Each course had 11 modules, and each module required up to 2 h to be completed. Eleven 3-D animated models showing normal gait, lower-limb amputation and postural biomechanical alterations were created (Figure 1).

There were 136 participants on the two courses. None of the participants, including the teachers, had had any previous experience with Internet-based learning and videoconferencing. Three remote sites needed help to implement videoconferencing (e.g. to install ISDN lines, to hire equipment and with technical support). Four multisite videoconferences were performed between São Paulo and the remote sites: Londrina (528 km), Maceió (2453 km), Porto Alegre (1109 km), Recife (2660 km) and Sorocaba (87 km).

## Discussion

The success or failure of technology-mediated teaching may depend on the ability to communicate meaningful information and the nurturing of social networks.<sup>6</sup> As the Internet modules might seem to be static, different ways of interacting with the material were devised: learning guided by user-friendly questions, a discussion list and email. The discussion list was adopted due to its flexibility in providing a quick, easy and inexpensive communications channel between teachers and participants.<sup>5</sup> Teachers received individual and global performance reports. This feedback was useful to prepare the workshop according to the identified difficulties of the participants and to improve the quality of the material available on the Internet. Our experience shows that in dealing with multisite videoconferencing and Internet learning resources, coordinated multidisciplinary team work is fundamental for success.

There were difficulties concerning the costs of equipment, ISDN line installation, professional support and lack of familiarity with the new teaching tools. However, these difficulties were outweighed by the benefits of connecting distant sites to share regional experiences and reduce the loss of work hours and costs related to the transportation of the educators (up to 10 different professionals). This kind of educational model brings new perspectives for education, assistance and interactive training in rehabilitation. It has great potential in a country the size of Brazil, where the distance between rehabilitation centres and travel for patients with disabilities and for health-care professionals may be problematic.

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