

# Technology Mediated Learning in Healthcare: When a Picture Paints a Thousand Words

**Leo Donnan<sup>1,2</sup>, Andrew Beischer<sup>2</sup>, Andrei Cornoiu<sup>2</sup>, Richard De Steiger<sup>1,3</sup>,  
Stephen Graves<sup>4</sup>, Martin Richardson<sup>4</sup>**

*<sup>1</sup>Department of Orthopaedics, Royal Children's Hospital, Melbourne, Australia*

*<sup>2</sup>Department of Orthopaedics, Royal Melbourne Hospital, Melbourne, Australia*

*<sup>3</sup>Department of Orthopaedic Training and Research, Epworth Healthcare, Victoria*

*<sup>4</sup>Department of Surgery, University of Melbourne, Australia*

## **Introduction:**

The advent of the information age has presented healthcare providers with opportunities as well as challenges. (1) The internet has opened up access to an expanse of medical information that varies greatly in terms of quality and validity (2). At its best, the internet has the potential to empower the individual and at its worst, to mislead and confuse. This in turn has placed new demands on the healthcare educator and healthcare organisations to address system design issues and ensure that high quality information is accessible to all participants. (1,3)

In establishing a process to develop health education material it is essential that the developer understand the underlying educational requirements of the target audience. These requirements and objectives are not exclusively concerned with transfer and retention of knowledge but may also extend to skills competency and behavioral modification. A patient receiving information as part of an informed consent process for arthroscopic surgery has very different educational requirements to that of a health professional learning how to examine an infant's hip

Technology mediated learning refers to the presentation of material or information that is mediated through information technology (4). The use of multimedia, a medium that combines animation, voice and text is one form of technology that has been identified as an alternative to the standard methods of information delivery in healthcare (1,5)

Multimedia offers the educator a range of presentation styles that vary in detail and complexity in which this material can be developed, packaged and delivered. It does however carry an inherent risk that the media itself becomes the focus rather than the quality of the underlying material and how well this information impacts on the subject.

## **Objective:**

To develop a process of continual improvement in the production and delivery of technology mediated learning modules in healthcare utilising modern education theory principles and a program evaluation approach to validate effectiveness.

## **Background:**

For many years clinicians have recognised that the informed consent process for surgery was inadequate and that patients consistently complained of unmet expectations in the post-operative period. A multitude of studies indicated that patients often did not understand the basics of the surgery they were about to undergo and not able recall, after the procedure, the risks that had been discussed at pre-operative consultation (6,7). In an attempt to improve this situation a number of "learning" tools were introduced into clinical practice including the use of models, information sheets, video presentations and education sessions.

Modern learning theory indicated that there are many factors that need to be considered when developing material for adult education. Education levels, literacy, cultural background, trust in the information, emotional state and environment all impact on the learner's ability to absorb and retain knowledge both in the short and long term. The transference of knowledge is directly related to both the challenge given to the individual and the skills that they possess, that is, learning can be adversely affected by both anxiety and boredom (8).

The use of multimedia allows the educator to directly address the variety of learning styles (visual, auditory, written) and by the interactive possibilities produce a kinesthetic environment. The production of education modules utilising these principles has been central to a sequential exploration of knowledge transfer and behavior modification that these three studies exemplify beyond what had been the original intention of improving the informed consent process.

## **Methods:**

(a) A prospective randomised control trial was conducted comparing standardised verbal, printed and multimedia information delivery as an adjunct to the informed consent process for knee arthroscopy. A questionnaire based on educational objectives was used to evaluate patient's knowledge immediately after information delivery at the initial surgical consultation, at the pre-operative assessment and at six weeks after surgery. This questionnaire was supplemented by measures of mental state, anxiety level and satisfaction with information delivered, in order to understand the impact of each method of knowledge transference.

(b) A randomised controlled single blind trial was conducted comparing printed and multimedia patient instructions for a home based exercise program for paediatric patients. A Delphi consensus process was used with a large group of practicing physiotherapists to establish which components of a calf and quadriceps stretch were required for effectiveness. These components were used to develop an animated education module that explained the anatomy of the underlying muscles to be stretched and demonstrated the actual stretch. Children were instructed by the physiotherapist in the stretch and then randomized to receive either pamphlet or DVD as adjunct material. At review six weeks later they were surveyed both with qualitative and quantitative themes as to the use of the material.

(c) Early detection of hip instability and dislocation relies on an accurate clinical examination of the infants and child's hips by a practitioner who understands the underlying pathology and the implications of the clinical examination. An education module was developed out of a focus group process with midwives, maternal and child health care nurses, general practitioners and paediatricians combined with an evidence based review of the literature. The key educational objectives were in three areas; knowledge, change of practice and consistency of approach. A pre/post module questionnaire was utilized to assess the practitioner's knowledge, clinical practice and self-confidence with a three month follow-up of changes to clinical practice, referral method and self confidence. Long-term clinical outcomes are being tracked prospectively through the Victorian Perinatal Data Collection Unit.

## **Results:**

(a) In the assessment of informed consent for arthroscopic surgery twenty patients receiving the multimedia module had a significant improvement in knowledge retention at the early, mid and long term when compared to either the verbal ( $p < 0.025$ ) or pamphlet ( $p < 0.002$ ) methods of information delivery in similar patient groups (figure 1). There was a trend towards reduced anxiety levels at all time points and a significant improvement in satisfaction with the quality of the information received when compared with pamphlet in those subjects who received the module.

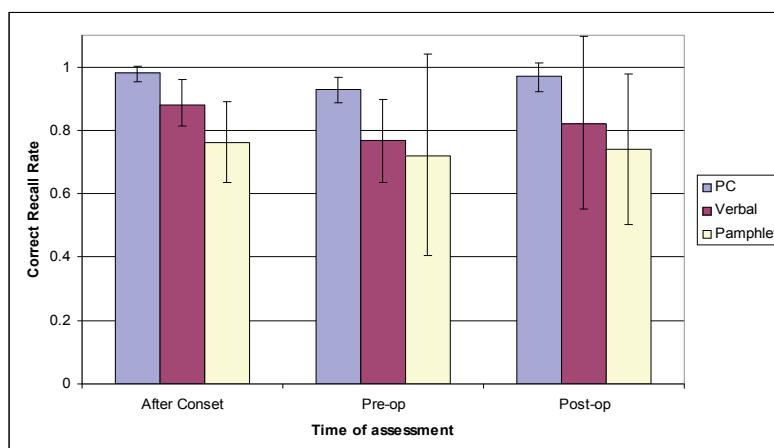


Figure 1. Comparison of knowledge retention between different media at different time points

(b) In this preliminary study of physiotherapy exercises a number of qualitative themes were explored indicating a clear preference for the multimedia (figure 2) over pamphlet material (control 76% preference, intervention 87% preference). Qualitative themes can be summarized as clarity of instruction, engagement of child, minimization of language barriers and spontaneous interest.



Figure 2. Screen shot from calf stretch module

(c) Two hundred and three maternal and child health care nurses participated in the infant hip trial. The pre-post knowledge questionnaire showed a significant improvement in short term knowledge retention ( $p < 0.001$ ) and almost universal acknowledgement that the module was relevant to the nurses' practice and met their educational needs. The three-month change to clinical practice survey indicated that for the majority of items the nurses' practice had changed positively and similarly the confidence in the examination of the infant improved significantly (table 2)

|                                                                                                                 | Prior to module<br>% agree | At 3 months<br>% agree | p-value |
|-----------------------------------------------------------------------------------------------------------------|----------------------------|------------------------|---------|
| 1. I feel very confident in my ability to accurately explain DDH to a parent                                    | 70%                        | 96%                    | <0.0001 |
| 2. I feel very confident applying the observations and tests for each stage of development in screening for DDH | 61%                        | 92%                    | <0.0001 |
| 3. I feel very confident performing the physical maneuvers to detect hip instability                            | 68%                        | 91%                    | <0.0001 |
| 4. I feel very confident with my interpretation of the clinical findings                                        | 62%                        | 93%                    | <0.0001 |
| 5. I feel very confident that I can make appropriate DDH referrals to GPs or paediatricians                     | 79%                        | 97%                    | <0.0001 |

Table 2. Self-confidence in the detection and management of developmental dysplasia of the hip (DDH)

## Discussion:

This paper presents the evaluation of three different technology mediated health education modules that build on modern education principles of learning and that can be delivered in accordance to the individuals or groups preference.

The improved performance of multimedia over verbal and paper based informed consent process was the basis for the production of a range of consent modules that explored different themes. Each module has shown a significant improvement in patient knowledge about their procedure but has also indicated ease in decision-making, confidence in choice and in a number of cases was preferred to the surgeon's explanation. The modules have not been designed to replace the interaction between clinician and patient but rather to enhance the experience, ensure that consistent high quality information is given and that all patients have the ability to ask questions of their physicians from an informed prospective.

One of the challenges of treating children and adolescents who require exercise programs is to engage them in such a way that they are compliant and competently perform the prescribed exercises. We have observed that multimedia provides a vehicle by which the paediatric patient can be educated in a stimulating way out of the hospital environment whereby the whole family can have an understanding of what has been prescribed and encourage performance. The responses of families recruited into this qualitative study have been so positive that the resource is being studied more extensively with respect to technical proficiency in exercise performance, clinical outcomes and methods of delivery.

From a public health prospective the early detection of hip instability or dislocation is imperative to avoid the considerable morbidity of late diagnosis, which requires complex surgical correction and rarely results in a normal joint. High quality community clinical examination is the most expedient and cost effective way in which this can be achieved. Maternal and Child Health Care nurses are charged with screening the infants and child's hip but have been hampered by lack of hands on experience, no uniform method of examination, inconsistent terminology and unclear referral mechanisms. This education module focused on knowledge transference but from the outset had an outcome goal of change to clinical practice and an improvement in the nurses' self-confidence. The module was designed and evaluated with these principles and has demonstrated

that the information and format of delivery is valid both at the short and medium time points and has produced interval improvement in almost all facets of learning.

## **Conclusion:**

By maintaining a focus on quality information and outcome evaluation we have been able to develop a process of continuous improvement in the development of health education modules, utilizing multimedia and modern delivery systems.

## **Acknowledgements:**

Medical Research Foundation for Women and Babies  
Prue Weigall – Physiotherapist, Orthopaedic Department  
Royal Children's Hospital, Melbourne

Sharon Vladusic – Physiotherapist, Orthopaedic Department  
Royal Children's Hospital, Melbourne

Michelle Vu – Program Manager Paediatric Orthopaedics,  
Royal Children's Hospital, Melbourne

## **References:**

1. Woolf SH, Chan EC, Harris M, Sheridan SL, Braddock CH. Promoting informed choice: transforming health care to dispense knowledge for decision making. *Ann Intern Med* 2005;143:293-300.
2. Carlile S, Sefton A. Healthcare and the information age: implications for medical education. *Med J Aust* 1998;168:340-43.
3. Weinstein JN, Clay K, Morgan TS. Informed Patient Choice: Patient Centred Valuing of Surgical Risks and Benefits. *Health Aff* 2007;26(3):726-730.
4. Wan Z, Fang Y, Neufeld DJ. The Role of Information Technology-Mediated Learning: A Review of the Past for the Future. *Journal of Information Systems Education* 2007;18(2):183-192.
5. Lewis D. Computer-based approaches to patient education: a review of the literature. *J Am Med Inform Assoc* 1996;6:272-82.
6. Byrne DJ, Napier A, Cuschieri A. How informed is signed consent? *BMJ*. 1988; 296(6625): 839–840.
7. Hutson MM, Blaha JD. Patients' recall of preoperative instruction for informed consent for an operation. *JBJS* Vol 73, Issue 2 160-162
8. Chen H, Wigand RT, Nilan MS. Optimal experience of Web activities. *Computers in Human Behavior*, 1999,15, 585-608.