Creation of a Cyber-Medical Campus: A Personal Perspective*

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ABSTRACT

The cyber-medical campus is a vision of the Outram campus for the delivery of the Graduate Medical Programme (GMP). It will use the latest in information technology to create a virtual or borderless environment to enable telemedicine to be practised. This will be both in the delivery of healthcare services via tele-consultation and diagnostics and also through e-learning. Singapore Health Services has embarked on an e-learning pilot project which comprises three facets — the creation of the e-learning infrastructure and "smart" classroom; the development of content for delivery on the web; and the implementation of the Learning Management System to systematically monitor the progress of learning. This e-learning pilot will lay the groundwork for the delivery of the virtual e-learning environment for the Graduate Medical School.

Keywords: cyber-medical education, e-learning, telemedicine, virtual medical school

INTRODUCTION

The goal of the cyber-medical campus is to provide a state-of-the-art online virtual healthcare education system. It creates a borderless environment for teaching and learning, the exchange of ideas and the application of expertise. This is the way forward to the future.

This virtual environment will facilitate telemedicine — the convening of the best medical expertise live, via video conferencing — as well as the mobility of medical records, and information access by the attending medical officer via portable devices. Its methodology will be centred on three areas: didactic teaching delivered via web-based programmes; interactive learning via "smart" classrooms; and archival resources via e-libraries or repositories.

This paper presents the evolution of the Singapore Health Services' (SingHealth) cyber-medical campus from vision to reality. It also shares the notable implementation of virtual medical hubs, the effects of technology on healthcare costs, the need for the use of technology in medical education, and the competitive edge that it brings.

SINGHEALTH'S CYBER-MEDICAL CAMPUS: FROM VISION TO REALITY

We want to provide training for all medical and non-medical staff in a healthcare environment anywhere, anytime, with the enablement of state-of-art technologies. The idea is to stretch virtual education and training beyond the classroom to mobile learning via personal data assistants, electronic broadcasting of medical events, live operations, conferences and seminars, and remote diagnosis to tap the vast experience available worldwide.

The creation of a vibrant cyber-medical campus will position Singapore as not only a leader in medical services, but also as a medical education and training hub. E-learning has brought training out of the classroom and onto desktops. Mobile e-learning will take e-learning off our desktops and into our pockets. This is the vision of Education and Training for the 21st century.

* Based on the presentation "The Era of Cyber-Medical Education" delivered at the SGH 13th Annual Scientific Meeting on 26-27 April 2002.

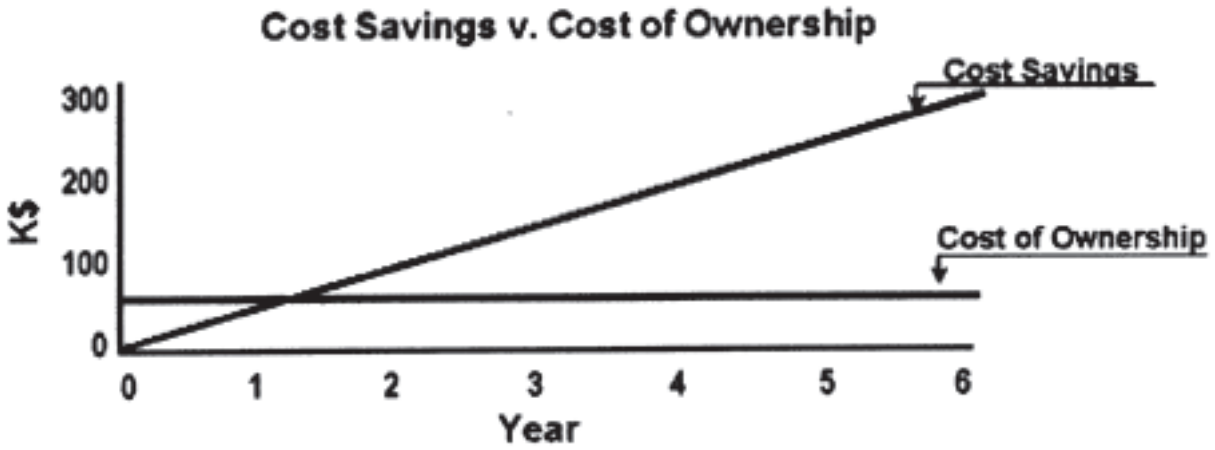


Fig. 1. For a 150-bedded hospital, the Digital Film Viewer has a break-even period of 1.1 years, and generates significant cost savings over its life cycle. For larger departments, the cost savings will be proportionately higher.

The siting of the Graduate Medical School (GMS) on Outram campus, another milestone, is a justification for a strong need for technology to be used to change the way medical education is delivered. Prof Shih Choon Fong, President of the National University of Singapore in the MOU Signing ceremony, remarked,"…I envisage that the collaboration between GMS at Outram and Duke in North Carolina will be conducted through global classrooms and distance learning carried on high speed telecommunications…we have a unique opportunity to forge an intelligent organisation for medical education building…."

The building of content was the foremost challenge in our journey to building a cyber-medical campus. This was closely followed by network and training infrastructure. In *content development*, we explored the availability of experts who could translate their teaching expertise into reusable content that is designed pedagogically and delivered using state-of-the-art technology. Clinician expertise is confined to transferable knowledge that is being crystallised into teaching content. Didactic teaching content is now replaced by online electronic instruction. Clinical expertise is supplemented with world-wide clinician expertise, brought to the classroom via video conferencing teaching sessions that are captured and transmitted two hours after editing via the web, for access anywhere, anytime.

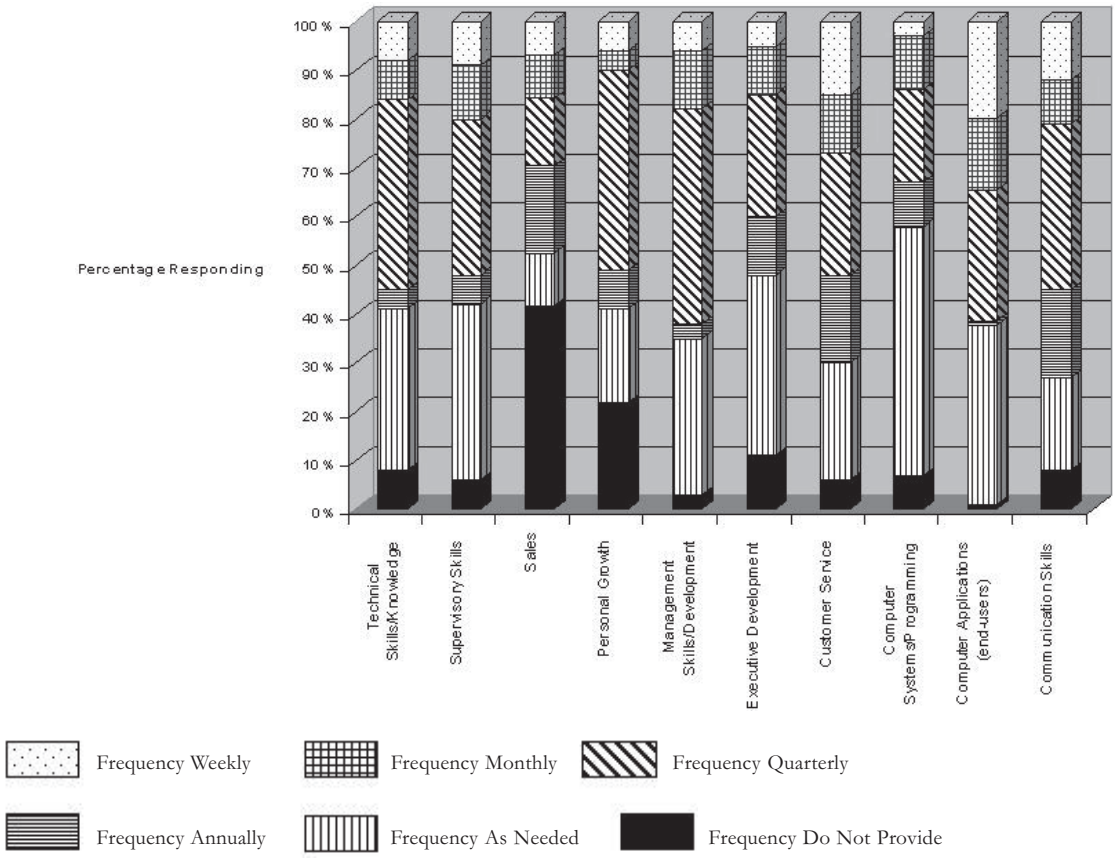
In *infrastructure*, we have built a smart classroom that has the capability of capturing, transmitting, archiving and web-casting teaching sessions, including video conferencing teaching sessions. A learning management system ensured web-based user-friendly interface to access courseware, register for face-to-face teaching sessions, seminars, conferences, catalogue and a range of training management administrative features. The learning management system will also enable the generation of reports that will show improvements in learning and teaching.

EFFECT OF TECHNOLOGY USE ON HEALTHCARE COST

Information technology (IT) has transformed the cost drivers of healthcare provision. The cost of healthcare has been seen to be progressively rising as the patient moves from primary to secondary and then tertiary medical care. This is due to the high cost of medical intervention and hidden costs accrued through the process of seeking expert opinion.

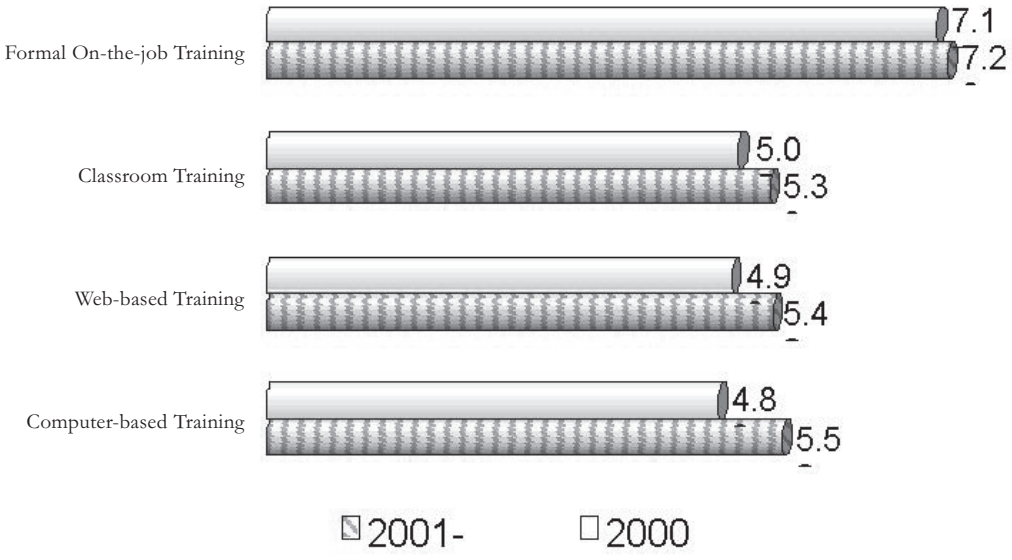
IT enablement has armed the patient with critical information: closing the gap between the healthcare provider and the recipient, and transforming the relationship from one of total dependence to one of shared responsibility and decision making. This can dramatically lower the cost of healthcare, as demonstrated by The Digital Film Viewer (DFV).[1] The DFV is a personal workstation for the radiologist, designed to enhance diagnostic quality and boost productivity by revealing all the details on the film and completely eliminating visual fatigue. The DFV is a low cost means of upgrading the imaging chain. By improving diagnostic quality and productivity, the DFV can achieve cost savings with a net present value exceeding USD200 000 for a 150-bedded hospital (Fig.1).

IT enablement also creates the impetus for the physician to pursue continuing learning using the most efficient means possible, to stay several steps ahead of the patient.



Source: Training Magazine, Oct 2001[4]

Fig. 2. Health/medical services.



Ratio is indicated out of a scale of 10.

Source: Infocomm Development Authority, 2001

Fig. 3. Utilisation levels of training methods.

E-learning and IT availability now allow patients to seek specialist care and opinions in a teleconference mode, thereby reducing the cost of transporting the patient from one place to another. They also allow multiple opinions to be available through interactive video conferencing, hence reducing the critical time

frame incurred between the first consultation to treatment initiation. This gap reduction becomes more important for complex disease processes where multiple specialists are involved in the care of a patient. In the process of intermingling between specialist and primary physician, learning enablement is effected.

NEED FOR THE USE OF TECHNOLOGY IN MEDICAL EDUCATION

The International Advisory Panel Report on Medical Education noted that Singapore seeks to have a world class system of medical education to become the hub for the bio-medical industries of the region.[2] IT development and electronic learning is a significant and critical enabler in this process. Without radically and rapidly developing this, Singapore will be left behind.

The impact of e-enabling SingHealth has far reaching significance and will touch the lives of many Singaporeans who form the patient base of the institution.

The panel further noted that a critical need within the teaching hospitals of Singapore is the development of lecture rooms and laboratories with excellent IT links. It recommended that all the teaching hospitals in Singapore should have ultra-high bandwidth fibre optic link that allow some joint teaching with real-time interactions from remote sites. The panel noted that this is the current practice in the UK and elsewhere.

Figure 2 shows the frequency in which the following types of training are offered for Health/Medical Services. The greatest number responded (44%) on the need for management skills/development on a quarterly basis. There is also a trend (51%) for the need of computer systems and programming training, possibility indicating the use of more computers in training and learning.

Figure 3 shows utilisation levels of training methods. According to the Infocomm Development Authority of Singapore (IDA), there has been an increase in computer and web-based training to supplement formal on-the-job training as well as classroom training. Traditional methods of training, commonly classroom training, can never be completely replaced by electronic learning. Technology is not yet capable of converting "the expert" such that it can replace classroom training completely. Formal on-the-job training still constitutes a large ratio of training methods used, with the use of web-based and computer-based learning increasing from year to year.

However having said that, it has been proven that an integrated approach to learning and teaching has significant impact on the learner. Later, we will look at the key benefits of e-learning.

THE COMPETITIVE EDGE OF A CYBER-MEDICAL CAMPUS

Through the use of multimedia technology, e-learning will supplement and enhance the traditional methods of delivering medical education such as tutorials, lectures, etc. Cyber-medical education confers the following advantages:

1. It enables a self-determined and individualised learning pace i.e. self-paced learning. E-learning transcends physical constraints and limitations of time, space and schedules.

2. It allows tracking, monitoring and assessment of knowledge and skills acquisition, as well as performance abilities in an objective manner.

3. It provides a system of archiving information on knowledge and skills acquisition, and performance abilities. This can be retrieved for self-paced learning and revision.

4. It allows distribution and immediate content delivery through video conferencing, web-casting and web-based collaborative learning, enabling synchronous communication and collaboration.

5. E-learning improves training effectiveness. Studies on corporate usage have shown that with e-learning:

   i) Learner comprehension is 16 times greater;

   ii) Training time is significantly reduced;

   iii) Content retention is increased (by 25% to 60% on average);

   iv) Consistency is improved by 50% to 60%;

   v) Performance by e-learning students is 20% better compared to students taught by traditional methods.[3]

6. The learning management system that supports e-learning also provides the framework of effective training administration

7. E-learning reaches larger audiences inexpensively compared to traditional modes.

8. E-learning significantly reduces overall training cost - corporations reduce training cost by 50 to 70% when they replace instructor-led training with electronic delivery of training.

FUTURE IMPLICATIONS AND POTENTIAL INVESTMENT RETURNS — TANGIBLE AND INTANGIBLE BENEFITS

The tangible benefits are:

1. The development of the Cyber Medical Campus constitutes pioneering work in medical e-learning for the region. It has the long term potential to be a novel development for healthcare institutions in the region and perhaps even further.

2. Development of study modules for medical staff at various stages of their careers, from students/undergraduates to established specialists, with the potential for patenting such learning systems.

3. A wider international audience can be reached for the various courses in which content is developed in Singapore, and marketed through the Internet.

The intangible benefits are:

1. Singapore will play a strategic role in healthcare e-learning in the region.

2. The use of e-learning in the development of the proposed graduate medical program in the conjoint model where a foreign university partner has to deliver significant curriculum content and teaching to the students is of strategic importance. Cost avoidance through the use of distance-learning modalities for didactic teaching would lower the cost of teaching — fewer lecturers need to be flown into Singapore. Singapore would also enjoy increased brand recognition as initiators of a novel virtual medical institute in the region.

3. Enhanced international collaborations that are made through increased connectivity. New collaborative learning and academic programs can be instituted if the e-learning platform is instituted, for example the Harvard Master of Public Health programme.

4. Cost savings are derived from the conversion of conventional didactic teaching to e-learning. Revenues can be generated when physician time, which is freed up, is converted to service provision.

5. Enabling of a uniform mode of assessment and appraisal for training of various grades and types of professional staff within SingHealth.

CYBER-EDUCATION IN HEALTHCARE TODAY

There are numerous web-sites today that provide a variety of healthcare information and education. Cyber University claims to be the one-stop shop for doctor education, providing a portal of comprehensive medical education for the physician and other healthcare professionals. It offers preparatory examinations for undergraduate, graduate and postgraduate medical education, as well as preparation for specialty board certification and medical licensing. It also offers a wide range of Continuing Medical Education (CME) courses as well as education for physician practice management and medical research.

Medvarsity, India's first virtual medical university established in April 2000, was developed by Apollo Hospitals Group and NIIT Limited. Its mission is to deliver quality education to the healthcare providers at a distance, applying information technology tools, to uplift the standards of medical practice, facilitate cutting edge medical research and thus ensure widespread availability of quality healthcare resources. Medvarsity's long term plan is to be a content, learning solution and integrator/platform provider.

Other virtual education portals include The Virtual Lecture Hall, which positions itself as the web's premier location for online continuing medical education, having awarded 42,766 hours of CME credits to physicians and other health professionals since 1998. HealthStream Inc. provides web-based solutions and services to meet the training and education needs of the healthcare industry, as well as customers throughout the USA, focusing primarily on healthcare, pharmaceutical and medical device companies. Its focus is on expanding installed and Internet-based application service provider (ASP) e-learning solutions to hospitals, long-term care facilities and outpatient facilities. CEU4U, Learnwell OnLine and Swank Healthcare Services are some of the portals providing continuing education courses for nurses and other healthcare professionals.

Finally, CMEWeb is the global continuing medical education resource that promotes itself as a one-stop resource for physicians to earn CME credits via the Internet. It provides over 1,400 credit hours of training in 21 specialty areas ranging from alternative medicine, cardiology, oncology, emergency planning healthcare, surgery to travel medicine, and over 30 topic areas for as low as USD5 per hour.

CYBER-EDUCATION IN SINGAPORE

On the local scene, NUS has implemented a smart classroom concept for lectures with Massachusetts Institute of Technology (MIT). The Singapore-MIT Alliance (SMA) is an innovative engineering education and research initiative involving NUS, Nanyang

Technological University and MIT. Founded in November 1998 to promote global engineering education and research, SMA brings together the resources of three academic institutions, while providing students with unlimited access to exceptional faculty expertise and superior research facilities.

A primary goal of SMA is the creation of a world-class centre for graduate education and research in engineering, featuring the most technologically advanced distance learning facilities available. The centre will provide opportunities for private sector organisations to share in SMA's research, collaborate with its students, and recruit potential employees.

SMA combines a focus on creativity and entrepreneurship with an intense, hands-on approach to research. Graduates will comprise some of the industry's best-educated professionals, both in the growing economy of Singapore and in industrial centres across the globe.

The Nanyang Polytechnic (NYP) has embarked on another phase of e-learning with the launch of two initiatives — wireless network access and the Course Management System (CMS). Access points for wireless network access are now available outside the classrooms and laboratories, enabling students to plug into access points located in the canteen and library for their e-studies. They need not be desk-bound to access their email account, the Intranet, the Internet or even their course modules. Notebooks and network interface cards are available for loan to students keen to use this service. For those who have their own notebooks, an installation guide will be made available to aid their use of this wireless system. About 300 modules offered by the School of Engineering are now delivered online. Students congregate at the E-Learning Plaza instead of the lecture theatre for their lessons. The 500-seater Plaza supports more than one lecture group at any one time. Different groups of students can have their lectures held concurrently at the same venue, without distracting each other. The CMS complements the School's instructor-led classes and encourages students to access online review questions and practice assignments to help them prepare for their examinations.

CONCLUSION

A cyber-medical campus aims to create a virtual education hub for all medical and non-medical healthcare workers. It will foster an e-learning environment for education to occur anywhere, anytime with the enablement of the latest in IT. The idea is to stretch virtual education and training beyond the classroom to mobile distance learning via PDAs, e-portals for CME, live surgery broadcasts and teleconferences. The creation of such a vibrant cyber medical campus will position Singapore as a leader not only in healthcare services, but also as a medical education and training hub.

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