

**A. Jai Mohan,  
A.B. Suleiman**

Malaysian Health Informatics  
Association  
Kuala Lumpur  
Malaysia

## Review

# *E-Health Strategies for Developing Nations*

### Introduction

Developing nations are facing significant challenges in improving the health status of their populations while at the same time addressing the social and political challenges of the new millennium. Implementing e-health solutions can be particularly difficult in a developing nation but the end results can be worth taking on the challenges: greater patient safety, improved population health and an integrated healthcare system that addresses the issues of equity, seamless quality health care and cost-effectiveness. An e-health solution is in the process of being implemented in Malaysia. The initiative will be described in some detail and the experience of this developing nation may be of some value to

other developing nations that are implementing or considering the implementation of similar e-health solutions.

Malaysia consists of two geographical divisions, peninsular Malaysia and the northern one-third of the island of Borneo separated by the South China Sea. Peninsular Malaysia shares borders with Thailand in the north and Singapore in the south while Indonesia (Kalimantan) and Brunei Darussalam are immediate neighbours on Borneo island. The total land area is 330 252 square kilometers. The estimated population of the country in 2004 (third quarter) was 25.72 million [1,2].

**Healthcare Challenges:** The government has been the main provider of public health services through a na-

tional network of hospitals, clinics and other services. At the end of 2002, there were 123 government main and district hospitals [3] throughout the country which were supporting 854 community polyclinics, 94 maternal and child health clinics, 168 mobile clinics and 1934 rural community health clinics [4]. The Second National Health and Morbidity Survey (NHMS2) reported that 88.5% of the population lived within 5 km of a static health facility in 1996 [5]. A strong public health approach has resulted in a very low incidence of communicable diseases. Mortality rates are quite remarkable for a developing nation (see Table 1 below). Life expectancy at birth is now 70.7 years for males and 75.3 years for females. Organisations such as the World Health Organisation

Table 1. Selected health indicators.

	Under-5 mortality rate, 2003*	Infant mortality rate, 2003*	Life expectancy at birth, 2003†
China	37	30	71
Germany	5	4	78
India	87	63	64
Japan	4	3	82
Malaysia	7	7	73
United Kingdom	6	5	78
United States	8	7	77

\* Source: UNICEF, United Nations Population Division and United Nations Statistics Division [9]

† Source: United Nations Population Division [10]

and the World Bank have acknowledged that the public health system in Malaysia is “equity-promoting and becoming more so over time” [6,7,8].

All this has been achieved by spending only about 3.5% of the gross domestic product (GDP) on healthcare. However it is inevitable that healthcare spending will have to rise as the pattern of disease has changed from one largely of infectious diseases and under-nutrition to one of chronic diseases and lifestyle which often require long-term drug therapy with relatively expensive drugs and/or surgical interventions (Table 2 [11] and Table 3 [12]).

As stated by a former Minister of Health [13] “In Malaysia, about a third of all medically certified deaths are due to cardiovascular disease (CVD). Two-thirds of these CVD deaths are due to heart disease and the rest due to stroke. The number of admissions in government hospitals for cardiovascular disease had increased 14% from 96,000 in 1995 to 110,000 in 2000; with a mortality rate of just above 7% among these admissions. The incidence of cancer in Malaysia, on the other hand, is estimated to be around 150 per 100,000 population, meaning that there are about 35,000 new cancer cases each year. In the year 2000, there were 40,244 admissions for cancer in government hospitals, up 8% from 1996. The largest group of admissions was for cancer of the blood (leukaemia) accounting for 13.6%, followed by cancer of the breast (10%), cancer of the lung (9.3%), cancer of the cervix (6.6%) and cancer of the mouth and throat (6.5%).

With all these alarming figures and facts, preventive measures have and must remain the focus to combat these diseases. More than 50 percent of deaths and disabilities from heart disease and stroke can be cut by a com-

bination of simple, cost-effective national efforts and individual actions to reduce major risk factors such as high blood pressure, high blood cholesterol, obesity and smoking. Even in the case of cancer, scientific studies and successful control activities have indicated that one third of all cancer cases are preventable, and a further one-third are potentially curable if diagnosed sufficiently early. If these diseases are prevented or detected and treated early, less government resources will be spent on expensive treatment and rehabilitation and more resources can be channeled to preventive healthcare. This will translate into a more healthy Malaysian population.”

It is no longer possible to address population health issues by improvements in sanitation, safe water, adequate food supplies, immunisation, good maternal and child health services, and curative care in hospital settings which have been the backbone of the progress made in the last half decade. The role of the individual in adopting and maintaining a healthy lifestyle and using healthcare professionals as partners in achieving lifetime health has become the key to an optimal health status of the Malaysian population.

This is recognized in the vision of health of the Ministry of Health Malaysia which states: Malaysia is to be a nation of healthy individuals, families and communities through a health sys-

tem that is equitable, affordable, efficient, technologically appropriate, environmentally adaptable and consumer friendly, with emphasis on quality, innovation, health promotion and respect for human dignity and which promotes individual responsibility and community participation towards an enhanced quality of life.

The mission statement states: The Ministry of Health Malaysia is dedicated to build partnerships for health to facilitate and support the people to attain fully their potential in health, motivate them to appreciate health as a valuable asset and take positive action to improve further and sustain their health status to enjoy a better quality of life.

In working towards achieving Malaysia’s health vision, eight health service goals were identified in the Telehealth Blueprint “Leading Healthcare into the Information Age” released by the Ministry of Health in 1997 [14]:

1. Wellness focus: services must be provided to promote individual wellness throughout life.
2. Person focus: services must be focused on individuals and must be available when and where required.
3. Informed persons: all individuals must be developed to become informed persons, and services will be developed so that accurate and timely information and knowledge will be available to

Table 2. The five leading causes of mortality in Ministry of Health hospitals (2002).

<b>Mortality (2002) (rate per 100 000 population)</b>	
Septicaemia	22.60
Heart diseases and diseases of pulmonary circulation	21.24
Malignant neoplasms	13.51
Cerebrovascular diseases	11.97
Accidents	9.25

Table 3. Number of deaths for selected conditions in government hospitals (1999).

Organ System	Disease	Number of deaths in government hospitals	Rate per 100,000 population
<b>Cardiovascular</b>	Ischaemic Heart Disease (I 20-I 25)	2,088	9.19
	Acute but ill-Defined Cerebro-Vascular Disease (I64)	1,716	7.56
<b>Malignancies</b>	Cancer of Trachea, Bronchus and Lungs (C33-C34)	564	2.48
	Cancer of Female Breast (C50)	185	0.81
	Leukaemia (C91 – C95)	209	0.92
	Cancer of Stomach (C16)	166	0.73
	Cancer of Cervix Uteri (C 53)	91	0.40
<b>Endocrine</b>	Diabetes Mellitus (E10-E14)	366	1.61
<b>Infections</b>	Measles (B05)	10	0.34
	AIDS (B20-24)	875	3.85
	Tuberculosis (A15-A19)	933	4.11
	Malaria (B50-54)	21	0.09

enable well-informed decisions on health to be made.

4. Self-help: all individuals will be able to participate in self-help practices; health services will facilitate knowledge and skills transfer that will empower and enable individuals and families to manage their health and to be more involved in their own care.
5. Care at home or close to home: wherever possible, care will be provided at home or close to home or in the community
6. Seamless, continuous care: care provided will be coordinated, continuous and seamless; services will be developed to manage and integrate care across episodes and settings throughout life.
7. Services tailored as much as possible: services that are provided will be tailored to meet individual or group needs and special circumstances.
8. Effective, efficient and affordable services: the services provided

must be effective, efficient and affordable; there must be greater equity, greater access, greater integration of healthcare services and more timely delivery of high quality services at affordable costs.

**Role of E-Health:** It is clear that an episodic relationship between health consumer and health care professional is no longer sufficient to achieve lifetime health for the population. It is necessary to empower the individual with knowledge and training to enable him to maintain the highest possible state of health. Periodic risk assessment should enable early detection of risk factors or disease early in its lifecycle so that appropriate interventions can be implemented that would prevent disease, cure disease or at least prevent or delay onset of morbidity and mortality. This is where information and communication technology can play a significant role in building a health infrastructure which would

enable a continuous health promoting relationship between individuals, health professionals, support groups, health facilities, payers and academic centres in a way to enhance the health of the individual and the community.

The Ministry of Health has recognised the potential of information and communication technology (ICT) and e-health in particular as important enablers for realising the above health service goals. In fact, e-health today presents opportunities to enhance health services in ways that were almost impossible a decade ago (Table 4).

Taking the above into consideration, the e-health system infrastructure within the Ministry of Health was developed in phases.

#### *Phase 1: 1991-1994*

In the first phase, personal computers were supplied throughout the Min-

Table 4. The Role of E-Health in Achieving Health Service Goals [15].

Goals of Health Services	Role of E-Health
Wellness Focus	Promote wellness throughout life through network based services and health management tools
Person Focus	Provide user-friendly virtual services when and where required
Informed Person	Provide accurate and timely information and promote knowledge through personalised information and education services delivered via multimedia networks
Self-help	Increase the ability of individuals to manage health through knowledge transfer and interactive network-based health management tools
Care Provided at Home or Close to Home	Provide distributed multimedia network to deliver virtual services into rural and metropolitan homes, health settings and community centres
Seamless, Continuous Care	Integrate personal health and medical information across episodes of care throughout life through computerised health plans and records
Services Tailored as Much as Possible	Customise and integrate services and information for individual and group needs
Effective, Efficient and Affordable Services	Provide enhanced access, integration and timely delivery of high quality services at reasonable cost.

istry of Health. The computers were essentially used to run applications for administrative tasks, drug inventory management, finance and health management information reporting.

#### *Phase 2: 1995-1998*

The second phase commenced with the formulation of the Information System Strategic Plan (ISSP) in 1995 which laid the ground work for a more comprehensive information system implementation for the whole Ministry. In the attempt to translate the health goals into actual health service deliverables it became clear that the health infostructure had to be more than a mere conduit for collecting and transmitting health management information. It was recognised that information technology had to be exploited to create an e-health infostructure that can directly serve the core business of managing and delivering actual healthcare services to the people. It would also have to effectively support health promotion programmes and disease surveillance and control activities.

Several localised network based systems were initiated based on the master plan. An in-house developed standard Patient Management Information System was introduced in 14 State hospitals. As part of a computer acculturation process, personal computer-based applications and office automation tools were introduced to as many personnel as possible.

In 1996 a wide area network infrastructure was implemented to provide dial-up communication between all programme and activity head offices in the federal capital Kuala Lumpur to their counterparts in the state health departments and district health centres. Electronic mail, home pages and internet access services were deployed on the network. The stand-alone personal computers that ran the Health Management Reporting System in hospitals, clinics, and health centres were connected to the network to transmit the reports online from the ground to various levels of management.

The second phase also saw the introduction of automation in the drug

approval and licensing work processes at the National Drug Control Bureau. This helped to reduce the turnaround time for approving and issuing of licences. The pharmaceutical electronic ordering system introduced in 1997 resulted in quantum improvements in productivity for all Government hospital pharmacies. The just-in-time inventory management features of the system contributed significantly to reductions in drug wastage and improved availability.

In 1998, a point-to-point real-time video conferencing pilot teleconsultation system was initiated in seven hospitals to support remote renal care management by specialists from two tertiary hospitals. This was a high-end system utilising 384 Kb/s ISDN connections. The same infrastructure was also shared by the psychiatry and oncology disciplines. Most of the teleconsultations were carried out on scheduled basis with pre-fetched patient data and diagnostic images. There was satisfaction with clinical outcomes and patient satisfaction with this approach. However, it is still early to

determine its success in terms of operational efficiency. Real-time continuing medical education case conferencing was also conducted via the system with varying degrees of success.

At the same time, a team of medical professionals in the state of Sarawak on the island of Borneo embarked on a tele-imaging (teleradiology and teledermatology) trial project. This project was born out of sheer need, as there were only two radiologists and one dermatologist to serve the whole state. Travel statewide was largely by air or more commonly by river. The road links were relatively limited. Using e-mail with multimedia attachments, digital scanners and digital cameras, store and forward teleconsultation was practiced. The results were encouraging from their point of view. Without this system, it would take about 30 days for routine radiology reporting from the radiologist in the tertiary referral hospital to be received back at isolated district hospitals in the interior. Now it only took one to 3 days. Of the 300 odd images received monthly, the radiologist is able to diagnose more than 80% of the cases with confidence. The rest of the images were sent by courier service. The low-end technology was only capable of lossy compression and did not give sufficient

definition for diagnosis of all radiology cases. Higher end videoconferencing systems are being deployed in the state to address these limitations.

*Phase 3: 1999-2001*

The national e-health infrastructure was further enhanced in 2000 with the upgrading of the wide area network to a Virtual Private Network. This is a managed network and runs on a 64Kb/s to 2.5 Mb/s frame relay ISDN backbone. As a starter three State-wide online pilot applications were initiated in 3 states. These were the Mother and Child Care Information System, the Communicable and Vector Borne (Malaria and Dengue) Disease Surveillance and Control System and the Food Quality Control System. These applications will be rolled out to other states after integrating with clinical information systems in hospitals and clinics. The network is designed to be modularly upgraded in tandem with increasing bandwidth demand and service level requirements.

**Total Hospital Information Systems:** A major milestone in health information systems was achieved in 1999 with the launching of the region's first fully electronic or paperless and filmless hospital in Selayang [16].

Being the first project of its kind for us, it took almost 3 years to develop and operationalise the Total Hospital Information System (THIS). A similar system was introduced for the Putrajaya health clinic in 2000. The paperless and filmless Putrajaya hospital [17] was opened later the same year. The lessons learnt in these implementations have provided the confidence to embark on similar systems for all future new hospitals. Currently there are 14 such new hospitals in the pipeline. The project scope for information technology implementation includes six basic hospital information systems, two intermediate hospital information systems and six total hospital information systems (see Figure 1). Two of these new hospitals are fully operational and two more will be operational within the next 6-8 months with the others expected to be ready within two years. The systems being implemented are modular and scaleable, and basic and intermediate hospitals if needed can be upgraded to total hospital information systems.

As for the existing hospitals it is not as easy to introduce total information technology solutions in one go. However the core functions directly relevant in patient care and patient management will be given priority. It has

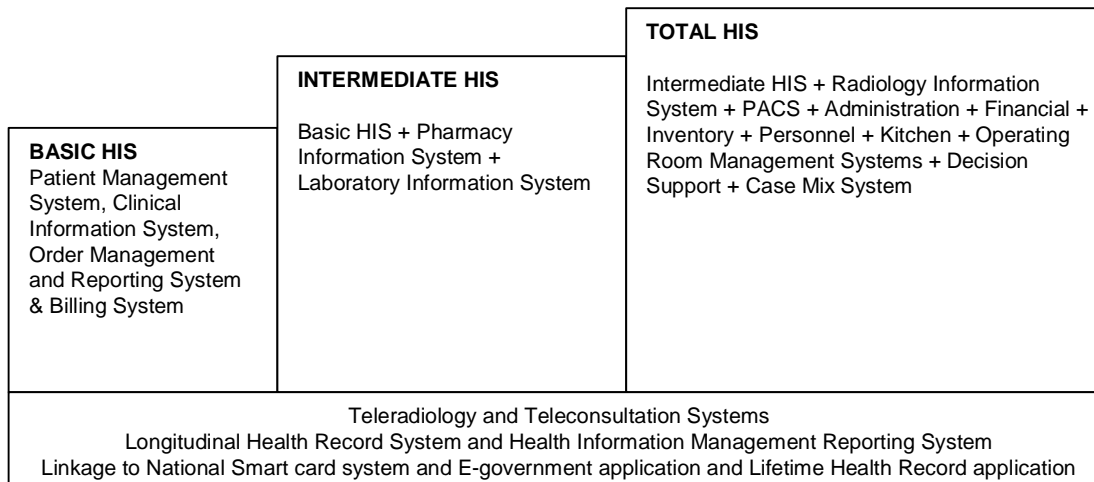


Fig. 1. Scope of Basic, Intermediate and Total Hospital Information Systems (HIS).



been made a policy that all healthcare information systems will be implemented based on the same work processes, clinical practice guidelines and critical pathways, health informatics and technical standards. This is to ensure easier integration and seamless access to patient information.

The systems now being implemented are web-enabled and extension from the hospitals to the regional community polyclinics, maternal and child health centres, community pharmacies and other health facilities including those in the private sector, and to various levels of programme management can be established without much difficulty. The concept of “hospitals without walls” will come about once these links are fully established. A longitudinal health record function operates within each hospital information system to permit linkage to the national electronic lifetime health record project so that encounter summaries from all health facilities can be retrieved at future visits. Aggregated data can be used for case mix analyses and health audit and to support healthcare planning and financing. Early warning systems will be designed and support for disease registries are being incorporated. While operational and financial efficiencies have been the initial driving force for implementing information systems, improving health outcomes through reduction of adverse drug events and improving compliance with evidence-based management are becoming the new drivers, necessitating incorporation of pharmacy and clinical decision support systems.

#### **Telehealth Flagship Application:**

The Multimedia Supercorridor [18] is a major infrastructure and services project initiated by the Malaysian government. It is located in a geographic corridor, 15 kilometres wide and 50 kilometres long, that starts from the Kuala Lumpur City Centre, itself an

intelligent precinct, which houses the world’s (until 2004) tallest buildings - down south to the site of the region’s largest international airport, the Kuala Lumpur International Airport. Two Smart Cities have been developed in the Corridor: Putrajaya [19], the new seat of government and administrative capital of Malaysia where the concept of electronic government will be introduced; and Cyberjaya, an intelligent city with multimedia industries, R&D centres, a Multimedia University [20] and operational headquarters for multinationals wishing to direct their worldwide manufacturing and trading activities using multimedia technology.

The launching of the Multimedia Supercorridor (MSC) offered an opportunity to review and expand the scope of telehealth in Malaysia. Telehealth was identified as one of the seven flagship applications to be developed by the Government of Malaysia, the others being Smart Schools, Electronic Government, Multipurpose or Smart Cards, R & D Clusters, WWW Manufacturing and Borderless Marketing or e-Commerce. The lead agency for managing Telehealth would be the Ministry of Health Malaysia.

On the basis of their high potential to impact positively on health care needs, four telehealth applications were selected as priorities for implementation in Malaysia – the national consumer health portal, the lifetime health plan project, the continuing medical education portal and the teleconsultation network [21]. Their implementation will complete the integration of the national health infrastructure and ensure seamless continuous care across all health facilities and across episodes of care to support lifetime health care (Figure 2).

To build “a nation of health individuals, families and communities ... through a health system that promotes

individual responsibility and community participation” a **national consumer health (Mass Customised and Personalised Health Information and Education, MCPHIE) portal** was launched in November 2000. This will be used to improve health information and education outreach nationwide and maximise the use of information and education services to enhance health awareness in a way that motivates individuals to lead a healthy life.

Features like online health risk assessment, personalised health links based on risk assessment, personalised health information pushed through e-mail, discussion or support groups, the facility to consult an expert or make an health appointment will create, it was hoped, an online community which utilizes knowledge and peer and professional support to enhance their health status.

The key component of the MSC Telehealth Project is the **Lifetime Health Plan** Project. Individuals can generate their own lifetime health plans either by themselves or with the help of a primary care practitioner. It is the intention that individuals, through lifetime health plans, in print or electronic format, be aware of the health risks attendant in each age category and be aware of the screening and interventions available that would considerably reduce such risks. Scheduled periodic health examinations supported by these lifetime health plans, offered through employers, insurers and directly to individuals, will ensure that health information will not only be received but also acted upon.

Through these electronic lifetime health records (which contain detailed wellness information and summary illness information from electronic or traditional medical records at health outlets) and lifetime health plans, seam-

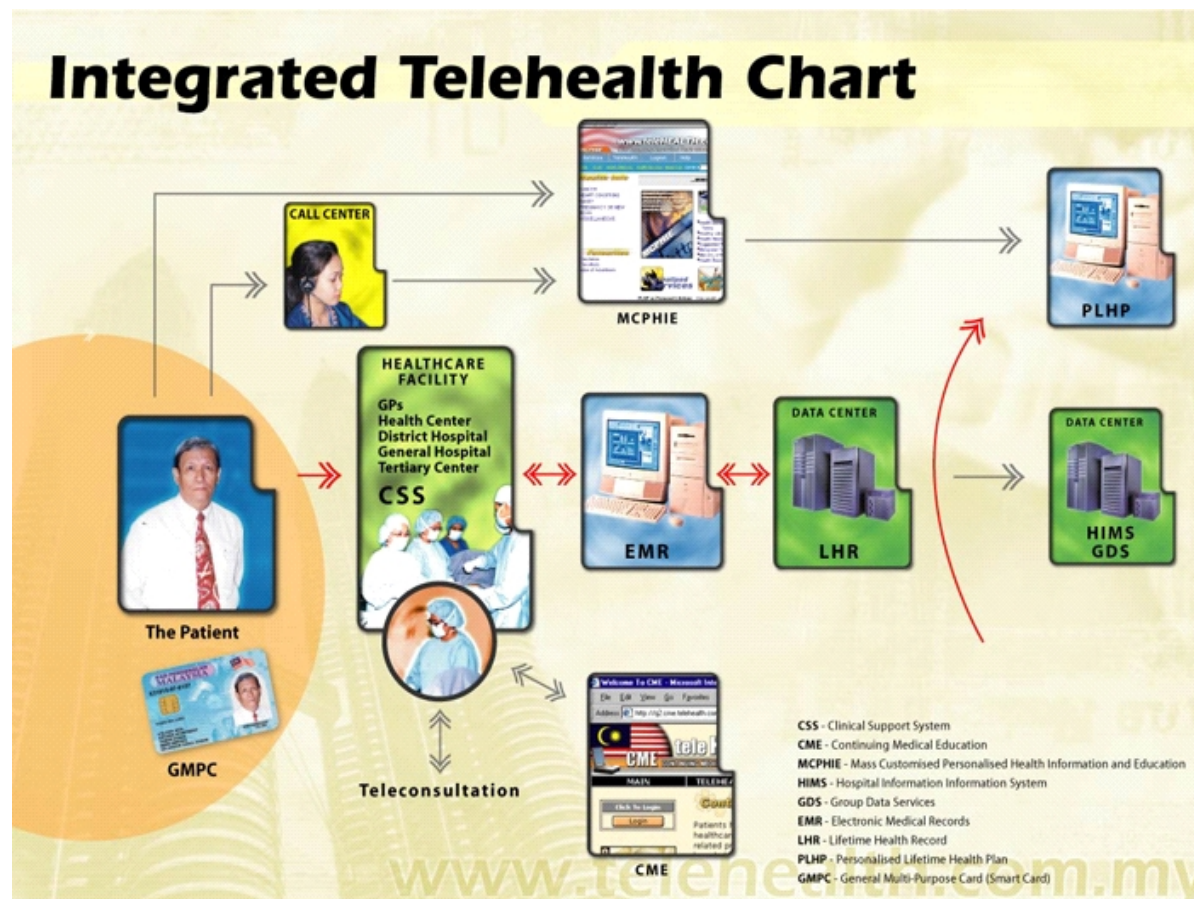


Fig. 2. National Health Infostructure showing linkage between components of the Telehealth Flagship Application and the Total Hospital Information System Project.

less medical care based on best practice guidelines and personalised to individual requirements by doctors would come about. Consumers will have access to these lifetime health plans and will be able to update information in it, including health risk assessments and observations, and will permit appropriate health care providers access to the information. Information required for national planning would be available from these Lifetime Health Records through Group Data Services while consumer privacy is protected by removal of personal identifiers before analysis.

A stepwise approach will be utilised to ensure the success of this project. Individuals will first be exposed to the concept of lifelong wellness and be taught to use online assessment tools to assess their own health or utilise

primary care centres (and general practitioners) to have their health assessed. They will be informed of the risks relevant to their specific age categories and offered screening and/or interventions based on risk assessment. If they have internet access they will receive customised information by push technology or by personalised sets of health hyperlinks.

The results of screening and interventions will be available in a seamless manner to permitted caregivers to allow lifelong management of health in a proactive manner by the individual and his caregivers.

The **Continuing Medical Education** component of the Telehealth Flagship provides free access to a virtual library (Medline, the Cochrane database, and full text articles from 58

premier medical journals) to all staff in the Ministry of Health countrywide. The staff can receive these materials at work as well as at home through the Internet. Within the next couple of years, post-basic courses for allied health personnel and postgraduate diplomas and degrees for doctors will be made available through the same channels. A system of recording continuing professional development activities (CPD Diary) online is being developed and will be used to support credentialing activities.

As part of the MSC project, forty-two **teleconsultation** stations have been set up countrywide. Under a teleprimary care project, additional stations will be added to this network. The teleconsultation project will provide primary care centres access to consultative and related services using

multimedia over a geographic distance, including consultancy, diagnostic support, treatment, tele-monitoring, management of chronic illness and rehabilitation.

Unlike traditional point-to-point applications, this project is designed from the start to be multipoint-to-multipoint, and structured to encourage and support primary care practitioners to provide as many services as possible at their level, and minimise referral to tertiary centres. The teleconsultation project will also support interactive and multimedia medical education. Agreed common work processes and protocols contribute to the use of teleconsultation in a effective manner.

For those without access to the Internet, a national Health Call Centre (to be set up) will provide access to similar services through telephony. The National Call Centre will work closely with Care Centres distributed nationwide. These will be utilised to provide wellness screening, promote lifetime health plans and records, enroll individuals into lifetime health plans, enter data on behalf of other health outlets without online access into these health records, be training centres on use of lifetime health plans and records for individuals and caretakers, monitor quality and evaluate success of implementation and outcomes. They would act as centres for teleprimary care and offer support for disease management.

## Results

A substantial part of the project has been completed. There have been delays especially associated with the development of standards and re-engineered workflows and code sets which have taken longer than anticipated. A major vendor has run into financial difficulties before completing parts of the project. As a result, the consumer

health portal and the continuing medical education portal are temporarily unavailable. New vendors are being appointed to reactivate the project.

## Conclusions

Much has been learned about management of national health infrastructure projects and especially of the need to keep to the long-term health vision in the face of inevitable short-term setbacks and delays. It is important to recognize from experience in other industries that in the short-term, information technology projects do not achieve their projected objectives within the timelines and budgets set but in the long-term they tend to exceed their anticipated outcomes. Much preparatory work in the form of development of policies [22] and re-engineered workflows and standards and code sets is required. In this instance, a Telemedicine Act had to be enacted and is already in need of revision due to the widened scope of telehealth as implemented subsequently. A Data Protection Act has also been prepared. Developing consensus will be harder than anticipated. Change management issues will remain a continuing challenge all through the project development and implementation.

When these linkages are being completed, work is proceeding on developing the other flagship applications [23] of the Multimedia Supercorridor and they are expected to have considerable synergy with the Telehealth project. For example, the Electronic Smart Card (which incorporates the national ID card, driving licence and passport) will be used to provide secure audited access to Lifetime Health Records. An electronic purse built into the card will allow e-payments when needed. The Electronic Government project will result in the setting up of many electronic kiosks countrywide

and consumer access to health information and online services will be facilitated. It will also provide the human resource management information system as well as the electronic procurement system to support e-commerce. The Smart School project will provide additional access nationwide to the Internet and the health portal.

Healthcare is all about knowledge management. Good healthcare requires the right knowledge being available at the right time in the right place; and this will contribute to the right outcomes. The applications being piloted now are a major step in the right direction as they provide consumers equitable and appropriate access to healthcare and will bring the lifelong medical record, consumer health information and professional resources to the point of care.

Malaysia's goals are the development of a system of healthcare which is focused on individuals and lifetime health management. E-health provides the means of bringing about this transformation of the healthcare system. It is hoped that successful implementation of these projects will result in Malaysia becoming a centre of excellence for e-health as well as a model of good healthcare delivery as a whole.

The Malaysian Telemedicine Blueprint (with its supporting documents on Standards, and Concept Request for Proposals for Lifetime Health Plans, Mass Customised and Personalised Health Information and Education, Teleconsultation and Continuing Medical Education) [24] is one of the earliest national blueprints created to describe the development of a national healthcare system utilising knowledge management and the tools of the information era.

While it is too early to draw conclusions on the success of e-health solutions in national health systems, the



initial feedback from consumers and healthcare providers is largely positive. Progress is being made though at a slower rate than expected. Technology is less the problem than people are, especially healthcare providers, not all of whom are comfortable with the rate and nature of change. Adequate funding and time must be found for training and change management to ensure participation and buy-in of all involved.

As emphasized in the concept of health by the World Health Organisation, health will not be about just absence of disease. Success will be measured, NOT by how many patients are treated, but by how many persons do not need to be treated. This is the standard against which e-health solutions must be measured.

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Address of corresponding author:

Dato Dr A. Jai Mohan  
 Director  
 Healthcare Informatics  
 Solutions Protocol  
 5th Floor, Menara SPK  
 22 Jalan Sultan Ismail  
 50250 Kuala Lumpur  
 Malaysia  
 E-mail: [jmohan@streamyx.com](mailto:jmohan@streamyx.com)