

Summary

Singapore is an island economy with a population of about 4.2 million. HIT is a priority for the government, and hospital administrators and clinicians alike recognize the importance of continuing to integrate IT into Singapore's health system. From the early stages of HIT adoption, the government adopted a pragmatic approach focused on implementing immediate goals rather than a holistic one that encompassed all foreseeable needs and concerns.

HIT Adoption

In 1999 acute care hospitals, specialty centers, and primary care polyclinics in Singapore were restructured into two vertically integrated clusters: the National Healthcare Group (NHG) and Singapore Health Services (SingHealth). Both are owned by the government and partially funded through subsidies. By 2003 both clusters had already implemented clinical IT systems extensively. For example, Singhealth has a single-instance EMR system that covers the entire cluster. This means that a clinician in any Singhealth institution has access to EMRs generated from any other Singhealth institution. Singhealth has also implemented e-prescriptions and successfully achieved 100% adoption by clinicians. Although NHG institutions have different EMR systems, they were linked through a Cluster Patient Record Sharing system. The clusters were, however, unable to share information.

To address problems of interoperability between clusters, the Singapore government implemented an EMR Exchange (EMRX) system to enable secure health information exchange between clinicians in the public sector. In reaction to sensitivity expressed by the public, data on HIV and STD status are not shared through this exchange. Both SingHealth and the NHG are also working on deploying Computerized Clinical Order Entries (CCOE) across their hospitals and polyclinics as an important step toward improving patient safety with the help of clinical decision support systems.

IT in Polyclinics

Singapore has also been leveraging technology in healthcare through offshore outsourcing of teleradiology in polyclinics. As a result, patients save time as return trips for results are no longer necessary. Increased competition has resulted in cheaper X-rays and improved turnaround times from local radiologists, benefiting almost 60,000 patients per year. The country is also moving beyond simple X-rays to CT scans and MRIs.

IT in Primary Care Clinics

In 2006 Singapore's Infocomm Development Authority initiated a program to encourage HIT adoption among private primary care clinics through commercial vendors that provide integrated clinic management systems through a software-as-a-service model. Adoption was facilitated by the fact that both systems had integrated functions for claims submission from the Ministry of Health under its Chronic Disease Management Programme.

Progress: From Paper to Electronic Documents

Date	Document Type
April 1, 2004	Hospital inpatient discharge summaries
July 1, 2004	Medical alerts and allergies
October 1, 2004	Laboratory and radiology reports
December 16, 2004	Medication (prescriptions or dispensed medication)
October 14, 2005	Immunization records from Health Promotion Board
January 17, 2006	<p>Critical Medical Information System (CMIS), which replaces the existing medical alert and allergies system. Features include:</p> <ul style="list-style-type: none"> • direct reporting by doctors instead of medical records offices • new drug codes for 4,553 brands with 1,428 active ingredients • routing of adverse drug reaction reports to Pharmacovigilance unit • integration to e-prescription systems for automated alerts • routing of adverse drug reaction reports to Pharmacovigilance unit • integration to e-prescription systems for automated alerts
March 31, 2006	School health system records from Health Promotion Board
October 1, 2006	Launch of Chronic Disease Management and Clinic Management System Programmes
October 6, 2006	Operating theatre and endoscopy reports
March, 2007	Cardiac and ED Reports

Government Policy

In 2003 Singapore's incoming Minister for Health, Khaw Boon Wan, identified as one of his priorities "Exploit IT Maximally," with the aim of "One Singaporean, One EMR." The Exploit IT Maximally Workgroup (ITWG), chaired by Deputy Secretary of Health Goh Aik Guan, convened in September 2003 to drive the initiative. The ITWG began as a small group with several sub-groups to tackle specific issues such as law and ethics, culture and change management, publicity, and IT architecture standards.

ITWG Operating Principles

- Key criteria for consideration would be the **improvement of patient care outcomes**. **Data collection for research**, though important, was a secondary concern.

- Focus would be on areas where market outcome is suboptimal and **central coordination adds highest value**. The ITWG would not intervene with institutions' internal systems unnecessarily.
- The ITWG chose to **live with diversity** and was careful to **implement initiatives with the lightest touch** possible. Recognizing the significant achievements of HIT implementation within the health system clusters described above, ITWG consciously steered away from proposals that required massive rebuilding of existing systems. **ITWG standardized only when the business case is strong**.
- ITWG adopted the Pareto principle by beginning with the NHG and SingHealth clusters, as they account for 80% of Singapore's acute-care markets.

Who Drives HIT?

Public sector hospitals lie at the forefront of HIT implementation in Singapore. Visionary clinician champions willing to commit the time and energy to drive implementation and encourage change among their peers have been the primary leaders of adoption. At the national level, the Ministry of Health drives country-wide HIT efforts such as EMRX. The Infocomm Development Authority (IDA), in collaboration with the Ministry of Health, has set the broad direction for HIT with the development of its iN2015 plan for the healthcare and biomedical sectors.¹ IDA also catalyzes HIT development by matching vendors with potential early adopters, as well as through the provision of seed funding for innovative pilot projects.

Who Pays For HIT?

HIT implementation is primarily funded by individual institutions themselves, driven by their own assessment of the benefits of HIT adoption. Even in the charity sector, some institutions have been able to raise funds from philanthropic organizations targeted at specific HIT projects. However, the government funds a large part of national HIT systems, such as EMRX.

Challenges

The ITWG engaged various stakeholders in open consultation, including hospital CEOs and senior clinicians, who openly debated issues that might impede implementation. Issues and actions taken to address them include the following:

Privacy

Challenges	Solutions
<ul style="list-style-type: none"> • Legal implications of providing EMRs beyond cluster boundaries were considerable. • Obtaining consent from individual patients would have been cumbersome and impeded widespread availability of EMRs. 	<ul style="list-style-type: none"> • The Attorney General clarified that in seeking treatment patients implicitly consented to attending clinicians' accessing of relevant records, regardless of source. • The ITWG embarked on a public EMR education campaign through printed brochures for patients and through media coverage. An opt-out scheme was set up for patients with more specific concerns.

¹ Intelligent Nation 2015 (iN2015) is Singapore's ten-year master plan for realizing the potential of infocomm over the next decade. Led by the Infocomm Development Authority of Singapore (IDA), iN2015 is a multi-agency effort that is the result of private-, public-, and people-sector co-creation. For more information, see <http://www.in2015.sg>.

Data Standardization

Challenges	Solutions
<ul style="list-style-type: none"> As both clusters had implemented their EMR systems independently, data exchange could not be easily achieved in spite of HL7 v2.3 adoption by both, because the standard was open to variations that impeded direct interoperability. Modification of systems to enable data interoperability would have been costly, without direct benefits to the clusters. 	<ul style="list-style-type: none"> For treatment, clinicians required only information that was “as good as paper records.” Thus, the ITWG determined that clinician-readable documents were sufficient for standard goals and that machine-readable EMR data was unnecessary at this stage. The ITWG acknowledged that standardization would probably be needed at a later stage, but deferred this expensive exercise until there is consensus on the need to do so.

Ownership of EMRs

Challenges	Solutions
<ul style="list-style-type: none"> EMRs shared with other institutions could become outdated, resulting in the source institution being liable if such outdated EMR became a contributing cause of medical errors. 	<ul style="list-style-type: none"> EMRX adopted a pull-on-demand— rather than pre-delivery—model. The ITWG determined that EMRs will only be pulled at the request of clinicians and discarded after use. Storage is prohibited.

Current Exemplars

SMS health systems	<ul style="list-style-type: none"> Tan Tock Seng Hospital developed an SMS system to transmit information to its doctors. SingHealth and the NHG have deployed SMS for patients at Specialist Outpatient Clinics through appointment reminders and queue management.
National Heart Center and Singapore General Hospital home telecare solution	This solution integrates the Internet, SMS, web portal, and mobile phones to monitor patients’ vital signs at home. The system sends SMS alerts to both doctors and the patients whenever vital signs are beyond set thresholds.
National University Hospital computerized patient support system (CPSS)	CPSS at National University Hospital enables an integrated view of patient data from multiple source systems such as X-rays, laboratory results, surgical operating notes, discharge summaries, clinical results, and reports.
SingHealth motorized mobile triple LCD X-ray light box	SingHealth designed the wireless light box to allow doctors to bring digital images and EMRs to patients’ bedsides for more effective, personal consultations.
Changi General Hospital interactive patient guide (IPG)	Changi’s IPG allows patients to obtain information on treatments, surgical procedures, and aftercare of 25 common medical conditions through online video and printable text.

Future Direction

Now that EMRX has been fully implemented in the public sector, the next logical step is to extend it to the private and charity sectors. However, as these sectors are more diverse, Singapore needs to take more deliberate steps in close consultation with the community. In particular, the obstacles that the country had previously overcome—regarding privacy, data standardization, and data ownership—will need revised solutions in a broader landscape amidst rising clinician expectations for HIT.

Healthcare Landscape

Expenditure

The government subsidizes public health services, and provides free basic emergency care. Patients pay for a portion of their treatment, and the amount depends on the level of service they demand. The remaining funds come from government subsidies.

- In 2005 total expenditure on health was 3.6% of GDP, with 34.7% coming from the general government and the private sector spending 65.3%.
- The government expenditure on health was 6.3% of general government expenditures.²

Coverage

- **Medisave.** A national medical savings scheme which helps individuals put aside part of their income into their Medisave Accounts to meet their future personal or immediate family's hospitalization, day surgery, and certain outpatient expenses. Introduced in 1984, Singaporeans contribute 6 to 8% of their income to Medisave.
- **Medishield.** A low-cost catastrophic insurance scheme designed to help patients meet the medical expenses their Medisave balance would not be sufficient to cover. Medishield was introduced in 1990.
- **Medifund.** An endowment fund set up by the government in April 1993 to help needy Singaporeans who are unable to pay for their medical expenses. This fund acts as a safety net for those who cannot afford medical care even with Medisave and MediShield coverage.
- **ElderShield.** An affordable severe disability insurance scheme, introduced in 2002, designed to help Singaporeans meet expenses associated with severe disability. ElderShield premiums can be paid using funds from the individual's Medisave accounts.

Infrastructure

- Private practitioners provide 80% of primary healthcare services while government polyclinics provide the remaining 20%. Public hospitals provide 80% of the more costly hospital care, however, with the remaining 20% provided by private hospitals.
- The public healthcare delivery system is comprised of seven acute care hospitals, nine specialty centers, and 17 primary care polyclinics. In 1999 these institutions were restructured into two vertically integrated clusters: National Healthcare Group (NHG) and Singapore Health Services (SingHealth). Both are owned by the government and partially funded through subsidies.

² See <http://www.who.int/nha/country/SGP.pdf>.

- The private healthcare sector comprises 16 private hospitals and approx 1600 primary care clinics. A vibrant charity sector includes four community hospitals that provide intermediate care as well as five “Chronic Sick” hospitals and 56 nursing homes that provide long-term care.