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DISCUSSION PAPER 3/23 | 27 DECEMBER 2023

# Case Studies of Hospital Digitalisation:
## Lessons for Electronic Health Records in Malaysia

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Khazanah Research Institute

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This discussion paper was prepared by Ilyana Mukhriz and Rachel Gong from the Khazanah Research Institute (KRI) and Lim Su Lin, an independent researcher. The authors are grateful for the valuable comments from Tan Sri Abu Bakar Suleiman, Dr Fazilah Shaik Allaudin, Dr Jason Tee, Dr Jun-E Tan and Norsheila Abdullah. The authors would also like to thank the experts interviewed for this paper for their insights and contributions.

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# Case Studies of Hospital Digitalisation:
## Lessons for Electronic Health Records

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## Summary


- In the past three decades, the Malaysian government has made significant efforts to digitalise its public healthcare system towards improving the quality and efficiency of its healthcare services while enhancing patient care.
- Since the publication of the 1997 Telemedicine Blueprint, there has been a vision for the nation to have digitalised patient records that are able to follow a patient across their lifespan. The backbone of this vision is a network of integrated healthcare facilities that allow health records to be shared between different healthcare providers and facilities, specifically an electronic health records (EHR) system.
- This paper has examined MOH's efforts to digitalise public hospitals using three case studies:
    1. **Total Hospital Information System (THIS)**, a comprehensive hospital information system purchased off-the-shelf from vendors
    2. ***Sistem Pengurusan Pesakit (*SPP)**, a customised system built to MOH specifications by external vendors, and
    3. **i-Pesakit**, an in-house system developed at a teaching hospital.
- Our analysis shows that similar challenges exist across the case studies, such as procurement processes, supporting infrastructure, system design, system adoption, change management, interoperability and standardisation, and data governance.
- Drawing on lessons learned from these case studies, we propose the following seven policy recommendations for the implementation of a comprehensive national EHR system:
    1. **Increase investment in foundational healthcare digitalisation** including total life cycle costs and infrastructure readiness
    2. **Improve internet connectivity and upgrade existing healthcare facility infrastructure** to ensure systems can be adopted and patient information can be shared
    3. **Prioritise user-friendly and care-centric system design** to enhance healthcare provider workflows and encourage user acceptance
    4. **Conduct sufficient training of end-users**
    5. **Continue with iterative stakeholder engagements beyond deployment** to ensure systems are properly maintained and upgraded to be fit for purpose
    6. **Enforce minimum data standards across the healthcare landscape** to allow for interoperability across healthcare facilities
    7. **Establish clear public messaging around data access and data privacy**

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# 1. Introduction

In 1997, Malaysia set out an ambitious agenda to reform healthcare in Malaysia from being curative to preventive, using IT as an enabler for integrated healthcare delivery and patient empowerment[1]. This goal was reiterated in the 2023 Health White Paper (HWP), illustrating the government's commitment towards digitalising its healthcare services[2].

Healthcare digitalisation initiatives spanning almost three decades have met with varying levels of success, facing challenges related to data governance and change management, as well as concerns surrounding patient privacy and information security. Sustaining long-term use of such technologies also became an issue as initial investments may not have taken into account ongoing technical maintenance and operation services[3].

One of the long-standing goals of healthcare digitalisation in Malaysia has been the establishment of digitalised medical records[4]. The Ministry of Health (MOH) has frequently referred to this as an electronic medical record (EMR). In 2019, then Health Minister, Datuk Seri Dr Dzulkefly Ahmad, had claimed that with an EMR system, "[p]atient records can now be easily shared between private clinics and hospitals, and even to post-care practitioners"[5]. In June 2023, Deputy Health Minister Lukanisman Awang Sauni reiterated the ministry's efforts to launch an "EMR pilot project" in Negeri Sembilan, in line with a larger target for the nationwide rollout of the EMR system by 2026[6].

However, the idea of a shareable digital record of patient health across different healthcare facilities is technically closer to the concept of an electronic health record (EHR). EHRs have been widely touted as a foundation for the modernisation of healthcare with the creation of a record of lifelong health information for patients enabling better service coordination throughout the care continuum[7]. Box 1 summarises the differences between EMRs and EHRs as well as another commonly used term, personal health records (PHR)[8].

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[1] MOH (1997)
[2] MOH (2023)
[3] Ilyana Mukhriz (2021b)
[4] MOH (1997); (2023)
[5] The Malaysian Reserve (2019)
[6] The Star Online (2023)
[7] The benefits of EHRs have previously been discussed in a prior KRI publication Digitalised Health Records: Does Malaysia Need It?
[8] This paper will not include further discussion on PHRs and instead will focus on EMRs and EHRs in relation to Malaysia.

**Box 1: Dissecting the differences between EMRs, EHRs and PHRs**

Digitalisation of health records has been gaining momentum worldwide through various approaches, resulting in different types of health records. The terms electronic medical records, electronic health records and personal health records are commonly used, sometimes even interchangeably despite there being significant differences between them. In brief:

- **Electronic Medical Records (EMR)** are a digital version of a clinician's chart, meant to be used within a single practice and are limited to use within a single facility. An EMR can longitudinally follow a patient's healthcare journey as long as he or she continues receiving care at the same healthcare provider[9].
- **Electronic Health Records (EHR)** are a digital record of patient health that can follow an individual throughout their entire journey across the healthcare landscape through the enablement of seamless information sharing between healthcare providers and facilities. An EHR system is more comprehensive than an EMR as it is cross-institutional and provides a complete overview of a patient's medical history regardless of location of treatment[10].
- **Personal Health Records (PHR)** are a collection of a patient's medical history that is maintained and managed by the patient themselves or an authorised caregiver. As a more patient-centric extension of EHRs, PHRs can include data that are sourced from a healthcare provider's EHR, e.g. laboratory results and diagnosis, in addition to self-generated data, e.g. symptoms and at-home monitoring results[11].

A summary of differences are shown in Table 1. While both EMRs and EHRs are owned and maintained by healthcare providers, PHRs tend to have patient-specific functions and are fully controlled by the patient. Between EMRs and EHRs, EHRs appear to be a more comprehensive solution for the modernisation of healthcare since they track patient needs over time and across facilities, ensuring thorough health services at all levels of care intensity[12].

PHRs reside with the patient, and this means that patients are able to present their full medical data to multiple healthcare providers regardless of whether these providers have an EHR system in place or if their system is able to communicate with the patient's previous provider. Although PHRs promote continuity of care for the patient and empower patients to track their health at home through their personal devices, the setup of EHR systems remains crucial. Outsourcing the responsibility of data collection to patients could potentially pose problems in terms of inclusivity and data accuracy.

[9] Heart, Ben-Assuli, and Shabtai (2017); Garrett and Seidman (2011)
[10] Heart, Ben-Assuli, and Shabtai (2017); Garrett and Seidman (2011)
[11] Bouayad, Ialynytchev, and Padmanabhan (2017); Heart, Ben-Assuli, and Shabtai (2017)
[12] Ilyana Mukhriz (2021a)

**Table 1: Summary of terms involved in the digitalisation of health records**

| Term | EMR | EHR | PHR |
|---|---|---|---|
| **Contributors** | Healthcare provider | Healthcare provider | Healthcare provider and patient |
| **Shared across facilities** | ✗ | ✓ | ✓ |
| **Access by patient** | ✗ | Varies | ✓ |
| **Follows patient over lifetime** | ✗ | ✓ | ✓ |

Malaysia has historically referred to its efforts of digitalising patient records using the term EMR. However, EMR may be a misnomer since the system's description of "ensuring seamless flow of information among healthcare facilities" points towards it being more of an EHR venture[13]. Malaysia's 1997 Telemedicine Blueprint has also previously proposed a system that would ensure "access to an integrated set of medical records independent of time and location", indicating an EHR-like system[14].

The term health information exchange (HIE) has also been used by the government. This usually refers to a platform that is designed to electronically transmit patient information between hospitals and clinics[15]. Thus, HIE would fall under the umbrella of an EHR system since it allows cross-institutional data exchange.

Although the vision described by the government for Malaysia is for an EHR system, much of the developments in hospital digitalisation within the country have so far been facility-based. This means that established EMR systems are limited to use only within the facility where they were installed.

This paper examines the implementation of such digital systems within Malaysian public hospitals, and some of the challenges associated with implementation. Three case studies of

[13] Ilyana Mukhriz (2021a)
[14] MOH (1997)
[15] Salleh, Abdullah, and Zakaria (2021); Nurul Ismail and Nor Hazana Abdullah (2017)

digitalisation in government and university teaching hospitals[16] were conducted using a combination of literature review and key informant interviews. Based on key takeaways from these case studies, we offer practical policy recommendations for healthcare digitalisation, including the impending rollout of a national digital health records system (See Box 2).

**Box 2: The Negeri Sembilan pilot programme[17]**

As at 2023, plans for the implementation of a digital health records system involve the rollout of the National EMR Initiative (NEI) that was planned pre-pandemic in 2019. The NEI set out a goal of equipping all healthcare facilities in Negeri Sembilan with a system that would allow sharing of patient records across the healthcare landscape by 2023. Following this, the integration of all public hospitals nationwide was envisioned to be achieved by 2026. This initiative received an allocation of RM140 million under Malaysia's Fourth Rolling Plan (RP4)[18].

The NEI would involve a HIE platform. Considered an EHR system, the HIE platform would enable cross-institutional access to patient health records. HIE is planned to be used in conjunction with three user portals catering to healthcare providers, patients and facility administrators. Through these portals, doctors can create, transmit and manage records whereas patients can access their records at any time[19].

The introduction of a web-based platform through HIE represents a shift in the government's approach towards digitalising public healthcare facilities in Malaysia and promoting sharing of patient information between providers. Also, the patient portal provided by HIE enhances patient empowerment, adding to previous systems that focused on care delivery.

In this paper, we use the term "digital system" as an umbrella term to refer to past digitalisation efforts within Malaysia's public healthcare facilities and the term "EMR" as a component of these larger digital systems[20]. On the other hand, when discussing future systems that should be put in place, we use the term "EHR" as a more accurate description of a shareable patient record.

[16] Government hospitals fall under the purview of MOH whereas university teaching hospitals are under the governance of the Ministry of Higher Education (MOHE).

[17] Further discussion on the HIE platform described in this Box can be found in KRI's discussion paper, Putting Patients First: Principles for Electronic Health Records in Malaysia

[18] Internal MOH documents (2022)

[19] Internal MOH documents (2022)

[20] Exceptions are made where EMR is used as part of the project name such as in the Negeri Sembilan EMR pilot project or if the term is used specifically in direct source quotes.

## 2. Background

Malaysia's digitalisation efforts can be traced back to the late 1980s under the Fifth Malaysia Plan (5MP) (1985–1990), when computerisation was introduced in order to create a more efficient billing system at selected government hospitals[21]. Subsequently, under the Sixth Malaysia Plan (6MP) (1991–1995), this computerisation was expanded to include health management information systems for non-medical programmes. This included patient administration and quality assurance budget performance monitoring[22].

By and large, the systems that were rolled out to healthcare facilities between 1985–1996 focused on mainly administrative purposes, such as document preparation and billing, while most work processes, such as patient discharge summaries and laboratory orders, were still paper-based[23].

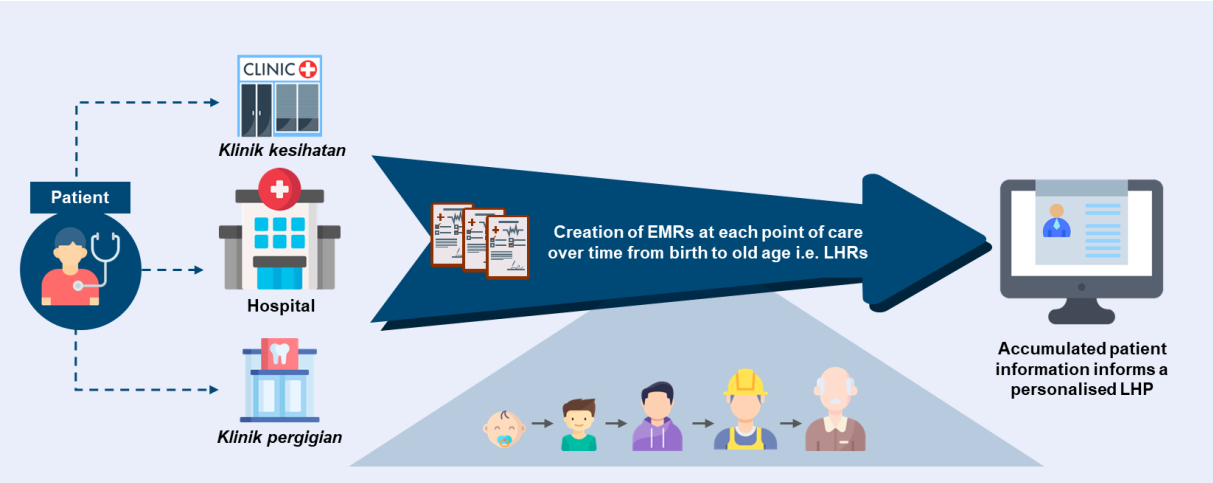
In 1997, the pace of information technology (IT) adoption picked up with the government's launching of the Multimedia Super Corridor (MSC) project and Telehealth Flagship project. Together, these represented a turning point and driving force for the nation to embrace technology in various sectors of the economy, including healthcare services. On top of this, the establishment of the Telemedicine Blueprint provided a foundation for a comprehensive transformation of healthcare services via the planning and implementation of IT initiatives[24,25].

Four pilot projects were mooted, namely: (1) Customised/Personalised Health Information and Education, (2) Continuing Medical Information (CME), (3) Teleconsultation and (4) Lifetime Health Plan (LHP)[26].

Of these four projects, the LHP aimed to establish a set of "network-based lifelong personal health management tools" that could facilitate the recording of detailed patient information. This would collectively contribute to building longitudinal health records for patients, termed a Lifetime Health Record (LHR) by the Malaysian government[27], implying an EHR system. An illustration of how patient encounters create EMRs which in turn feed into the LHR-LHP system is shown in Figure 1.

[21] EPU (1991)
[22] EPU (1996)
[23] Bulgiba (2004)
[24] Zainatul Shima Abdullah (2013)
[25] Interviewee 2 (I2). Interviewees are referenced according to the interview table in Appendix A.
[26] MOH (1997)
[27] MOH (1997)

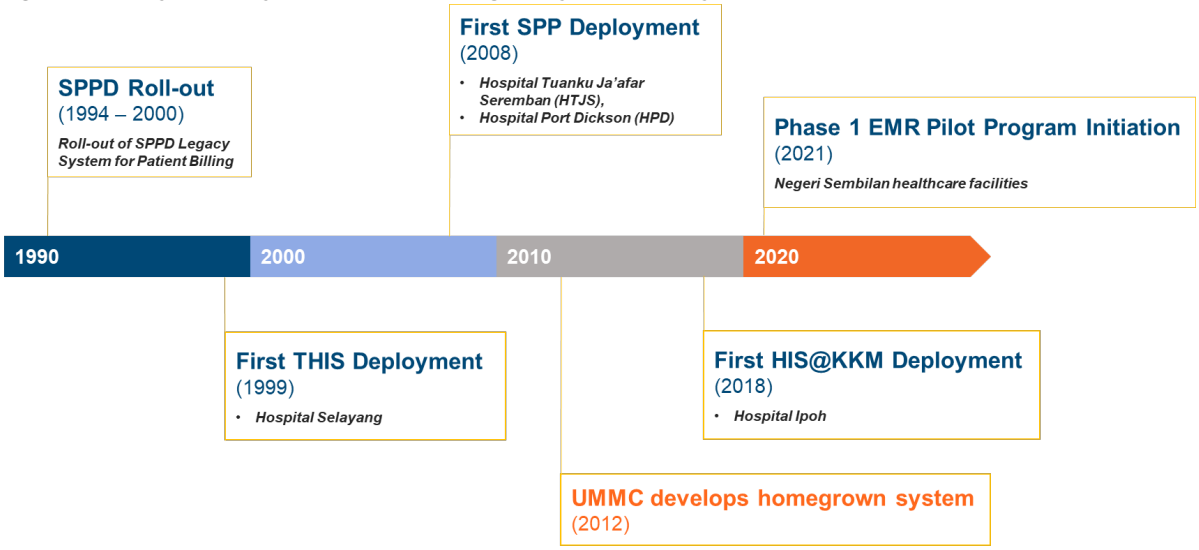
**Figure 1: Information flow through the EMR-LHR-LHP system**




Source: Authors' visualisation based on MOH (1997)
Translation: *Klinik kesihatan* (primary care clinic); *klinik pergigian* (dental clinic)

# 3. Overview of Digitalisation in Malaysia's Public Hospitals

**Figure 2: Malaysia's Key Public Hospital Digital System Deployments, 1994–2021**




Source: Adapted from Nor Bizura Abdul Hamid (2016) and internal MOH documents (2022)
Abbreviations: Hospital Information System @ *Kementerian Kesihatan Malaysia* (HIS@KKM), *Sistem Pengurusan Pesakit Dalam* (SPPD), *Sistem Pengurusan Pesakit* (SPP), Total Hospital Information System (THIS), Universiti Malaya Medical Centre (UMMC)

As illustrated in Figure 2, multiple digital systems have been deployed in public hospitals in Malaysia over the years. This section describes three different digital systems used in Malaysia's public hospitals.

The first system is a Total Hospital Information System (THIS). MOH procured ready-made components of THIS from vendors. The second system is *Sistem Pengurusan Pesakit* (SPP) or Patient Management System. MOH appointed external developers to build SPP according to MOH specifications. In both cases, MOH acted as the main implementation authority and driver of top-down change. The third system is the homegrown i-Pesakit (or i-Patient) system used in a teaching hospital under MOHE where the hospital developed and implemented its own in-house system.

All three digital systems include an EMR component but are not technically EHR systems since they do not allow sharing of patient information with other facilities. Some later systems in Figure 2 are upgrades of earlier versions (e.g. HIS@KKM is an upgrade of SPP) while others differ in terms of level of complexity (e.g. THIS has more features than i-Pesakit). Efforts to implement these digital systems have typically been limited by development budget allocations[28], making large scale rollouts difficult.

[28] Interviewee 4 (I4)

## 3.1. THIS: Procurement of systems from vendors

A comprehensive Total Hospital Information System (THIS) integrates clinical (including imaging and critical care), finance, administrative, laboratory, imaging and support services systems. This comprehensive digital system, the subject of the first case study, put Hospital Selayang on the world map in 1999 as "the first integrated paperless and filmless hospital"[29].

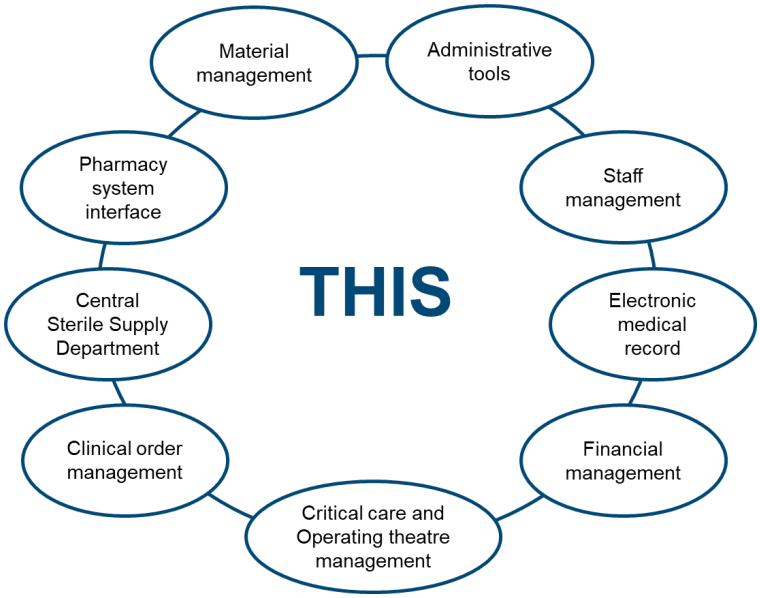
Building such a facility from scratch was an ambitious project. MOH formed a core team of clinical specialists, radiologists, pathologists, pharmacists, senior nurses and IT officers tasked with preparing Hospital Selayang to start its operations using THIS[30].

Prior to the project initiation, this core team worked on planning the overall structure of the system. The team outlined key processes such as the implementation methodology, hospital policies, functional requirements, work process, operating procedures and decision-making processes[31]. They also embarked on a series of meetings, discussions and visits to hospitals abroad[32,33] to observe how new technologies were being leveraged in healthcare. However, it was soon discovered that such a comprehensive and highly integrated system did not exist at that time[34].

Eventually, the strategy adopted by MOH was to acquire a range of off-the-shelf software systems that had been functioning at successful sites, and to integrate these systems by working closely with their vendors.

A summary of THIS functions is shown in Figure 3. The Cerner Millennium platform provided many of the clinical applications in Hospital Selayang. These clinical applications were supplemented by a Picture Archiving and Communication System (PACS); patient accounting, human resources and payroll software; financial

**Figure 3: Summary of THIS functions**




Source: Adapted from Rosnah Hadis, Mohamad Azrin Zubir and Y. Nor Akma (2004)

[29] Chor (1999)
[30] BebasNews (2021)
[31] Rosnah Hadis, Mohamad Azrin Zubir, and Y. Nor Akma (2004)
[32] Rosnah Hadis, Mohamad Azrin Zubir, and Y. Nor Akma (2004)
[33] Interviewee 1 (I1) and I2
[34] Rosnah Hadis, Mohamad Azrin Zubir, and Y. Nor Akma (2004)

and materials management software; critical care and operating theater applications and the Central Sterile Supply Department (CSSD) application, all provided by different vendors[35].

Combining these systems into an integrated suite of applications was challenging. Given the scale and complexity of what MOH had set out to achieve with Hospital Selayang, it represented a landmark digital adoption project in Malaysia's public health system.

Although the hospital's digital system faces challenges[36], important lessons can be drawn from its implementation. These include the importance of having a clear understanding of the project's objectives and intended outcomes, as well as having sufficient skill and knowledge to maneuver technicalities related to project management and system development[37].

Under the Seventh Malaysia Plan (7MP) (1996–2000), policy initiatives were laid out for the government to continue implementing more digital systems in general and district hospitals[38]. Plans for the expansion of THIS, using the same approach as Hospital Selayang, were made for several other hospitals including Hospital Putrajaya and Hospital Shah Alam[39].

Several obstacles were encountered during the digitalisation process. Broadly, these included the constraints of procurement requirements and operational or technical difficulties, as well as issues with change management[40]. These challenges were compounded when contracted vendors ran into financial difficulty and were unable to fulfil their deliverables[41].

## 3.2. SSP: Appointment of an external developer to create a customised system

The second case study follows the implementation of a digital system known as SPP, which was rolled out in several hospitals throughout Malaysia beginning in 2008. SPP represents MOH's pivot from purchasing off-the-shelf systems to building its own system as a likely result of the challenges of dealing with multiple vendors.

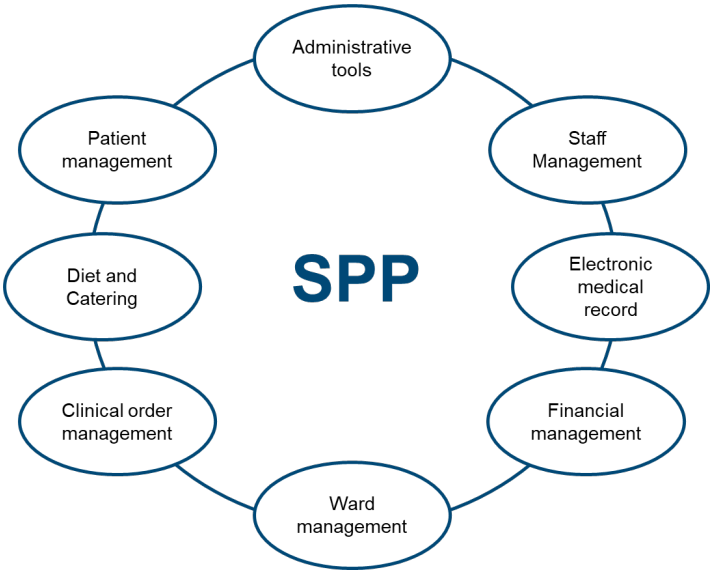
In 2007, an external consultant was appointed to assist MOH in developing SPP, envisioned to be the backbone for the future development of hospital information systems for MOH hospitals[42]. Significantly, MOH would be the sole owner of intellectual property rights to the SPP system. Moreover, all system modules were developed according to established guidelines, policies and systematic work processes[43] indicating that, unlike off-the-shelf products, the SPP had been

[35] Rosnah Hadis, Mohamad Azrin Zubir, and Y. Nor Akma (2004)
[36] The Star (2023)
[37] Nuraidah binti Mohd Marzuki (2018)
[38] EPU (1996)
[39] EPU (2001)
[40] I1, I2 and I4
[41] Nuraidah binti Mohd Marzuki (2018)
[42] MOH (2017b)
[43] MOH (2017b)

designed and manufactured based on specific parameters identified by MOH.

The functions of SPP were intended to be comparable to those found in off-the-shelf digital systems. SPP should integrate data and work processes related to patient management, ward management, order management, diet and catering management, billing and payment management, and medical records management (Figure 4)[44].

**Figure 4: Summary of SPP functions**




Source: Adapted from MOH (2017)

Development and implementation of SPP was conducted in phases under the Ninth Malaysia Plan (RMK9)[45]. This resulted in different hospitals having different versions of SPP, meaning some hospitals have fewer modules than others.

The first version of SPP (V2.1) was deployed in Hospital Port Dickson and Hospital Tuanku Ja'afar Seremban. Following this, from 2009 to 2010, a second version (V2.6) was implemented in the outpatient wards of Hospital Kuala Lumpur, Hospital Tengku Ampuan Rahimah Klang and Hospital Kajang, followed by V3.0 that was deployed in Hospital Permaisuri Bainun (also known as Hospital Ipoh) in 2011. Later, between 2014–2015, Hospital Bentong, Hospital Port Dickson and Hospital Tuanku Ja'afar Seremban were upgraded with V3.1[46].

MOH reported that during the early stages of implementation hospital staff were reluctant to use the system and user acceptance became a major barrier to system adoption. This required change management efforts spanning the years of implementation to ensure that staff were ready to use the system[47].

Following several version upgrades, SPP was rebranded as HIS@KKM[48]. As at 2023, plans for the expansion of digital systems within public hospitals will involve HIS@KKM. HIS@KKM still carries the vision of bringing to life an LHR that follows a patient along his or her healthcare journey.

[44] MOH (2017b)
[45] MOH (2017b)
[46] MOH (2017b)
[47] MOH (2017b)
[48] Internal MOH documents (2022)

The pilot implementation of HIS@KKM was carried out in Hospital Ipoh in 2019 and subsequently expanded to Hospital Port Dickson, Hospital Rembau, Hospital Bera, Hospital Cyberjaya and Hospital Melaka. In addition to supporting similar work processes as SPP, HIS@KKM also featured additional integration with supporting systems in the MOH ecosystem, namely the Radiology Information System (RIS@KKM) and Pharmacy Information System (PhIS).

HIS@KKM will also be integrated with a sharing platform that enables sharing of patient records between facilities. Thus, although SPP began with only EMR capabilities that keep patient records in a facility, MOH's evolved approach with HIS@KKM will enable an EHR system with shareable patient records across healthcare facilities.

## 3.3. i-Pesakit: In-house development and implementation of a homegrown system

The third case study is a digital system called i-Pesakit (or i-Patient), developed and implemented in-house at a teaching hospital. Teaching hospitals[49] are a category of government hospitals under the jurisdiction of MOHE, which are managed and governed by their respective universities. This case study examines the homegrown digital system used at Universiti Malaya Medical Centre (UMMC). UMMC was built in 1967 in Kuala Lumpur as a paper-based teaching hospital.

The implementation of UMMC's digital system was a gradual evolution. Prior to 2000, UMMC had procured basic computerised systems from various vendors, which covered various aspects of hospital services ranging from patient care to support services[50]. These systems mainly served to electronically store laboratory results, imaging and pathology reports, whereas clinical notes were still manually written[51].

At its peak, UMMC had engaged 23 vendors to supply systems, which posed issues. As each software was unique, different systems would sometimes be incompatible. On top of this, given that the hospital did not own proprietary rights to the software, it faced challenges in customising these systems to incorporate new features with vendors frequently reluctant to adjust their systems[52].

Amid rising demand for medical services and steady population growth in the locality, the university hospital formed an IT task force to upgrade its existing computerised systems. It was then that exploring the transformation of its paper-based medical notes to EMRs took place. After forming several committees to discuss and evaluate the availability and cost of medical software,

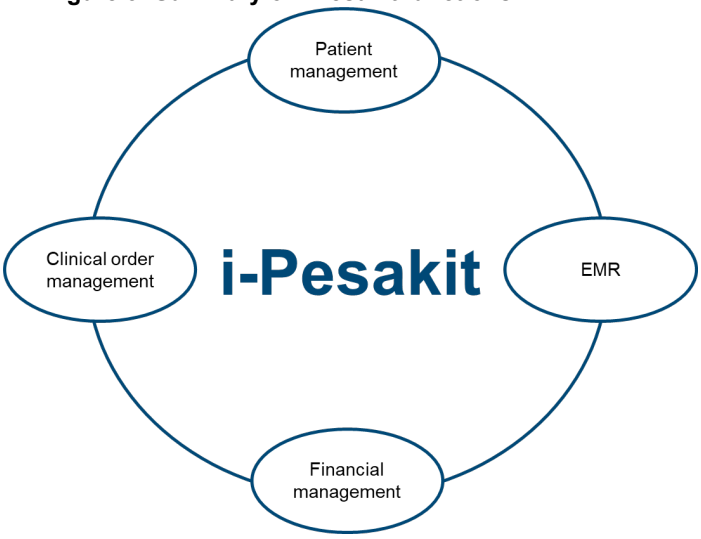
[49] In Malaysia's public healthcare system as at 2023, there are five teaching hospitals: Universiti Malaya Medical Centre (UMMC), Hospital Canselor Tuanku Muhriz, also known as Hospital Universiti Kebangsaan Malaysia (HUKM), Hospital Universiti Sains Malaysia (HUSM), International Islamic University Malaysia Medical Centre (IIUMMC) and University Teknologi Mara Teaching Hospital.
[50] Bulgiba (2004)
[51] Interviewee 3 (I3)
[52] I3

a decision was made to move forward with designing and developing a homegrown system[53].

In 2012, the hospital's IT Department started to develop an in-house system called i-Pesakit that included an EMR function. In 2013, i-Pesakit was expanded to include clinical documents, orders and results. Figure 5 summarises the functions in the i-Pesakit system.

i-Pesakit was implemented as a pilot study in the staff health clinic a year later, and gradually extended to other departments. As at 2019, the EMR component is used in 99% of UMMC clinical areas[54]. Various iterative improvements have been made to enable the system to work as required by clinicians.

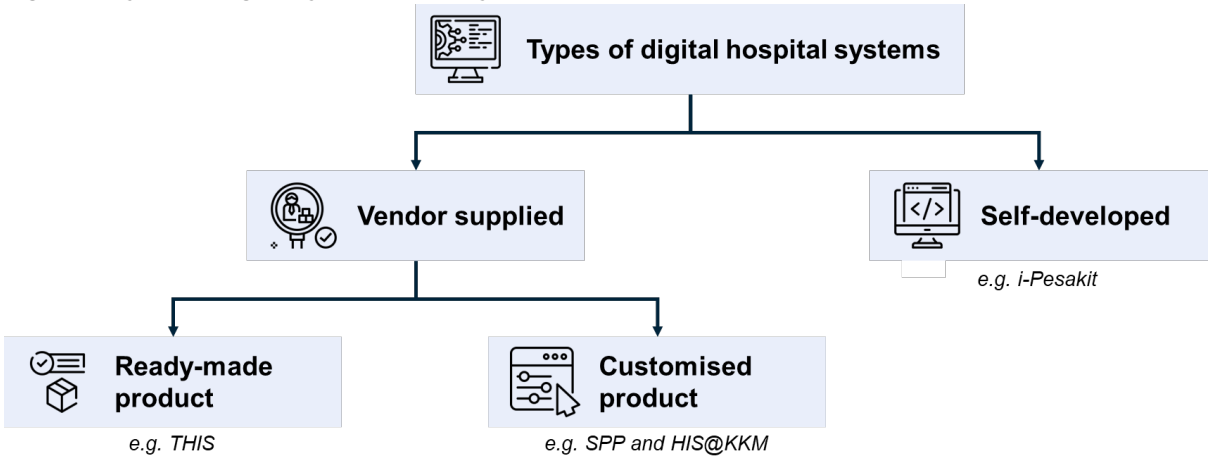
**Figure 5: Summary of i-Pesakit functions**




Source: Nurul Aqilah et al. (2019) and interviews
Note: Patient management includes modules such as patient registration for outpatient, inpatient and emergency medical visits.

Figure 6 below provides a summary of the different digital systems that have been discussed in this section. Historically, public hospitals have bought ready-made off-the-shelf systems, worked with vendors to build customised systems and developed their own in-house systems.

**Figure 6: Types of digital systems in Malaysian public hospitals**




Source: Authors' visualisation

[53] Chew, Pang, and Hana Salwani Mohd Zaini (2019)
[54] Nurul Aqilah Mohd Nor et al. (2019)

# 4. Discussion

Analysis of the case studies described in Section 3 highlight lessons learned that could ease the process of implementing digital systems in Malaysia going forward. Section 4 discusses the procurement process, supporting infrastructure, system design, system adoption, change management, interoperability and standardisation, and data governance.

## 4.1. Build, Buy or Integrate

**One dilemma faced in the digital transformation of a healthcare facility is deciding between building a custom product for the facility and buying a ready-made product off-the-shelf.** As the terms suggest, "build" generally refers to writing a system independently from scratch, whereas "buy" refers to acquiring a complete and finished product in the market.

In Malaysia, the build versus buy debate emerged in the mid-to late 1990s, when planning first began for Hospital Selayang's digital system. MOH had wanted to build its own comprehensive system for Hospital Selayang, but this proved untenable given the challenges of insufficient capital and talent resources. Instead, the ministry purchased an off-the-shelf system from a vendor called Cerner Corporation, with the requirement that it should be customisable[55].

As the hospital's main vendor, Cerner provided an application called PowerChart, a clinical system solution that allowed management of patient records, laboratory results and charts. Besides Cerner, other software developers were brought in to supply additional subsystems for human resource management and financial functions[56].

If a hospital chooses to acquire different software systems from different vendors, these systems will need to be integrated to ensure a seamless flow of information within the facility[57]. A challenge in customising off-the-shelf systems is that the pace and control of the process largely depends on the vendors, who own the proprietary rights to the product.

The case of THIS in Hospital Selayang showed that when purchasing and customising an off-the-shelf system, healthcare providers had to expend significant time and resources working with the vendor and be deeply involved in the implementation process to achieve desired results. Customisation for this one facility proved to be a painstaking process that might not be feasible on a nationwide scale[58,59].

When implementing SPP, MOH sometimes recruited hospital clinicians to provide input to vendors regarding system module modifications. These exercises, while administratively proper, required clinicians "to go through each module and give the vendors feedback in order to tailor

[55] I1
[56] Chor (1999)
[57] Norsyaliza Abdul Razak, Norafida Ithnin, and Mohd Zamri Osman (2020)
[58] Chor (1999)
[59] I1

the system"[60]. Customisation preferred by one set of clinicians may not have necessarily aligned with the workflow of others and the time clinicians spent doing this was likely not factored in the cost of implementing the system[61].

Technical expertise and familiarity with clinical workflows are crucial in steering the development, planning, testing and implementation of the software to ensure usability. These activities could consume MOH's limited resources and divert it from its core roles and responsibilities. Ideally, the ministry's primary roles should be to oversee policy and carry out regulatory and monitoring work, rather than to build solutions[62,63].

Eventually, the solution adopted by MOH was a hybrid of "buy off-the-shelf" and "build-from-scratch". Instead of buying and customising a ready-made system from a vendor or creating their own in-house system, MOH commissioned developers to build systems according to guidelines and policy[64]. This approach produced SPP and HIS@KKM.

**At the end of the day, outsourcing the building of a system according to MOH specifications to a vendor may be the most practical solution for the ministry.** It allows for greater flexibility in customising the system without requiring in-house technical expertise[65]. Any such system would also **need to be upgraded over time** to ensure it does not grow obsolete in the face of rapid technological advancement. **These maintenance and upgrade costs also need to be factored into the overall budget for the system.**

## 4.2. Internet and Supporting Infrastructure

Reliable IT infrastructure and strong network connectivity ensures optimal system functionality in storing patient records and enables coordination of care delivery across different devices and departments in a healthcare facility.

**Despite improvements over the years, inadequate IT infrastructure and weak internet connectivity continue to pose major challenges.** Older hospitals operate on legacy client/server digital systems which are less dependent on constant internet access. These facilities may lack sufficient broadband capabilities to support a web-based, or cloud-based, system that enables real-time sharing of health information across facilities.

The physical infrastructure of these hospitals poses another challenge. Limited and obsolete infrastructure and hardware are obstacles to digital transformation. Newer hospital building

[60] Interviewee 6 (I6)
[61] I4 and I6
[62] I2
[63] MOH (2023)
[64] MOH (2017b)
[65] I4

projects under the Twelfth Malaysia Plan (12MP) include IT infrastructure and hardware[66], but older hospitals are less well-equipped.

> *"[When] we go to legacy hospitals like Hospital Tuanku Ampuan Najihah [...] They do not have enough power points in the room, they do not have network ports, because they were not built as digital hospital[s] [...] electric overload, no power points, [the infrastructure is] basic."*[67]

In addition to IT and physical infrastructure, location can be another limiting factor. **Compared to urban hospitals, hospitals located in rural or remote locations are more likely to have slow and unreliable internet connections.** Slow data transfer speeds and internet blind spots in certain areas of the hospital vicinity are known to occur[68].

Without good internet connectivity and reliable IT infrastructure, the performance of EHR systems can lag greatly, often to the point of being detrimental to healthcare providers' workflow efficiency. Clinicians we spoke to reported feeling frustrated at having to wait for long periods to call up patients' health records on the system[69].

**High costs can hinder efforts to upgrade IT infrastructure and install new hardware**. Efforts to scale up hospital systems were often set back by insufficient budget allocations and slow procurement processes[70]. Chronic underinvestment in the nation's public healthcare system has knock-on effects on how funds are distributed within the ministry itself. Financial allocations for digital systems implementation have had to compete with other funding demands within the public healthcare system[71,72].

## 4.3. System Design

A well-designed digital hospital system should facilitate the workflow of its users while retaining usability. In practice, however, this may not be the case.

Past implementations of digital systems had form-based designs[73]. In other words, design was focused on creating digital forms rather than on ensuring a smooth workflow. This sometimes resulted in healthcare providers spending time filling up forms instead of attending to patients, thus reducing quality of care. Other reported usability issues include information overload where

[66] EPU (2021)
[67] Interviewee 7 (I7)
[68] I7
[69] I6
[70] I4
[71] I4
[72] KRI (2021)
[73] I1, I2 and I6

too much information is presented on densely populated screens, unintuitive layout design, and process inefficiency where users face an increased number of steps to accomplish simple tasks[74].

Introducing an EHR system into a hospital setting may yield many benefits, but it may also bring about unintended problems if the system is not efficiently designed for ease of use and to meet the needs of its users. Research on EHR design and use factors in other countries has shown that inefficient system design increases workload and cognitive burden on clinicians, leading to eventual stress and burnout[75].

One way to benchmark usability is to evaluate user interface factors. This refers to the quality of interaction between users and the system, for example, their perception of how coherently data is displayed on the screen, their ability to navigate the system quickly and whether the terminology used in the system is something that can be easily grasped[76].

**Ultimately, it is important to design these systems for efficient clinical practice[77], not privileging administrative and documentation purposes.** Earlier versions were "not made for medical practice. It's made for administrative purposes. That's why doctors have spent hours [and] hours after work on the electronic health record"[78].

In the United States, the practice of employing medical scribes to meet the growing data entry challenge has rapidly expanded with the push towards EHRs[79]. However, in Malaysia, it is largely clinicians and nurses who perform the work of documenting patient encounters in real time, prompting them to focus more on the screen than the patient. This might reduce their work efficiency and the quality of patient care.

To improve the usefulness of the system, experts have suggested adding features such as automatically converting data collected into a narrative format or consolidating narrative summaries of information relevant for clinicians in their work process[80]. In care delivery, it is important that are "no gaps in clinical data available to doctors, or difficulties in accessing data due to poor design or other such factors, that lead to errors in clinical decision making"[81].

## 4.4. System Adoption

**Successful implementation of EHR systems depends not just on the success of converting paper-based health data to electronic records, but also on user acceptance and healthcare personnel embracing new ways of working.** User acceptance is defined as the willingness

[74] I6
[75] Kroth et al. (2019)
[76] Haslina Mohd and Sharifah Mastura Syed Mohamad (2005)
[77] Kroth et al. (2019)
[78] I2
[79] Kroth et al. (2019)
[80] I1 and I6
[81] Interviewee 5 (I5)

within a user group to adopt the technology designed to improve their workflow productivity and increase efficiency[82].

Researchers have pointed out that such efforts require proper strategies which consider social factors such as the age and level of digital literacy of users. Other usability factors that should be considered include whether users find it easy to use the system[83].

In the case of Hospital Selayang, user acceptance was addressed by handpicking a core team of staff, based on their passion and interest to work in a computerised hospital[84]. These core personnel were then tasked with passing on their knowledge to fellow staff members and influencing them to be committed to a computerised way of doing work. In UMMC, besides peer-to-peer learning, a variety of training approaches is used, ranging from short training courses for batches of medical officers to e-learning via video tutorials for specialists and clinicians[85].

The implementation of THIS in Hospital Selayang was a unique case, as Hospital Selayang had been built to be paperless from the start. In the case of SPP where hospitals had previously operated manually, staff were used to a paper-based workflow. This meant that a lot of support was needed to cope with digitalisation.

> *"If you [the hospital] are 100% manual, you cannot expect digital transition to happen easily. It is about the mindset. Users must change to think digitally, and you have to help them through. Only after that will you see an effect"[86].*

MOH is prioritising such support. For example, in the ongoing pilot programme in Negeri Sembilan, the appointed vendor offers live training sessions to selected staff as part of a "train the trainer" approach. Trained staff will then be tasked with training their peers to transition to a computerised system[87].

The "train the trainer" approach is combined with a short period of on-site facility training, where direct support is provided to the main users of the system to enable them to use the system with ease[88].

**One challenge of the on-site training approach lies in finding adequate human resources for training.** While it may still be feasible for a pilot programme, this could be harder to achieve on a larger scale. In preparation for future nationwide rollout of systems, toolkits have been

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[82] Haslina Mohd and Sharifah Mastura Syed Mohamad (2005)
[83] Haslina Mohd and Sharifah Mastura Syed Mohamad (2005)
[84] I1
[85] I3
[86] I7
[87] In the case of smaller facilities, such as health clinics, short video tutorials will also be provided for staff to have access to quick guides.
[88] I7

developed for health centres and district health offices with the intention that staff from these facilities will play a role in the training process[89].

**Wherever possible, it is also useful to engage with the user community on how the system would best cater to all aspects of their work processes.** For example, UMMC's IT team had invited a range of stakeholders, including specialists, allied healthcare professionals, and staff from the pathology and biochemical departments, to contribute feedback on needs analysis and system requirements:

> *"We, as end-users, will provide feedback on what kind of system we need moving forward [...] we also provide input on what kind of features we want, and what kind of tools are available for us to use."*[90]

After developing a prototype system based on feedback from this consultation, the team also conducted a pilot study on a small group of users to test the platform's usability. A ground up approach may not always be feasible in cases where the system is purchased off-the-shelf from external vendors. However, where possible, engaging in dialogue and discussion with users may help to encourage greater acceptance, while fostering a sense of ownership and satisfaction with the product.

**Another factor impacting user acceptance is their perception of how well the system improves their workflow.** For example, a former doctor felt that using digital systems had cost her time with patients during clinical sessions. "It's really slow [...] the work process. A doctor who can see 20 patients in the outpatient clinic sessions, can only see 10 with the system. [...] My patients may be queueing outside for two to three hours to see me. But when they walk in, I'm busy looking at the computer"[91].

It should be noted that this experience occurred at a time when the technology was still nascent and may not be reflect experiences with more updated tools. Nonetheless, functional and user-friendly system design is still important for system adoption.

## 4.5. Change Management

Hospitals are complex organisations with overlapping clinical, financial and administrative functions. As such, there is a need for appropriate and effective strategies to help clinical, operations and management staff adapt to inevitable changes in workflows associated with the shift from paper-based records to digital systems.

In the case of Hospital Selayang, a core team and IT committee had been appointed during the pre-operations phase to develop detailed operational policies for embracing digitalisation. This business process reengineering (BPR) involved several meetings to review the functions of the hospital organisation and redraw existing SOPs and procedures to meet the needs of digital

[89] I7
[90] I3
[91] I6

transformation. These efforts culminated in the production of a General Operational Policy document[92].

A top-down approach is being taken with MOH's Negeri Sembilan pilot programme using a prototype BPR document with generic instructions on how to use the system. This document includes guidance on adjusting staff's former manual routines, workflows and procedures in the paper-based system. After a month, the vendor returns to the hospital to conduct a situational assessment. During this visit, they speak to selected staff to identify their unique problems and needs and make adjustments accordingly[93].

This may be challenging to scale at a national level in terms of costs and human resources. Nonetheless, **this iterative practice of ongoing ground-level monitoring and evaluation of workflows by the vendor allows for adjustment of SOPs to ensure a system that is fit for purpose**, in accordance with the hospital's needs.

**Another important element of change management includes providing technical support on how to navigate the system.** An in-house IT taskforce with the requisite expertise to oversee the establishment of the system and provide technology-related support to users would be useful. For example, a team of software engineers at UMMC supported IT-related services from development to deployment of i-Pesakit[94]. This may not be the case at hospitals where IT support may be scarce, with a high turnover rate[95].

## 4.6. Interoperability and Standardisation

In its efforts to digitalise hospitals between the late 1990s to the mid-2000s, MOH had employed an open tender approach for multiple vendors to service public hospitals by supplying off-the-shelf systems applications. **These systems, by virtue of being developed by different vendors, possessed different system architecture on top of being built using different codes and formats.** This posed a problem of integrating data between hospitals as disparate systems were not able to communicate between each other. Moreover, each hospital maintained its patient data in its own database[96].

Figure 7 provides a non-exhaustive summary of system types that have been deployed by MOH in the public healthcare landscape between 1996–2020. Significantly, each time a new system was introduced, older hospitals continued to run on their existing systems. Other facilities which had independently developed their own systems were also allowed to continue using them.

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[92] I1

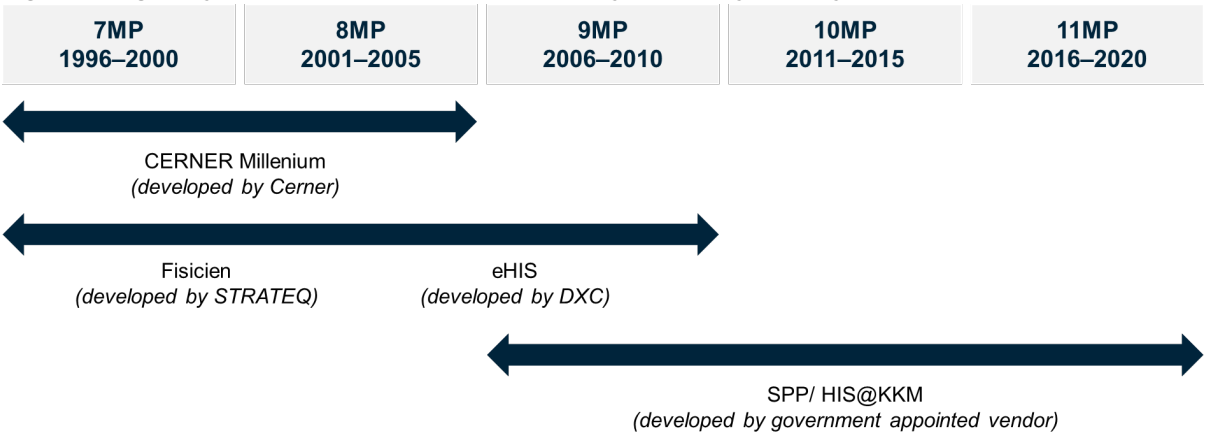
[93] I7

[94] I3

[95] I1, I4 and I6

[96] A discussion of the government's effort to introduce a system for sharing health records, i.e. MyHix, and its implementation in Malaysia has been previously published in Electronic Health Records: Planning the Foundation for Digital Healthcare in Malaysia

**Figure 7: Digital system adoption in MOH hospitals, by product type and year, 1996-2020**




Source: Internal MOH documents (2022)

> *"[MOH] had our own system but at the same time all the new hospitals also had customised off-the shelf-systems… [A] lot of our hospitals and clinics… [a]re also using [their own] systems. For example, some states have already created their own systems especially for registrations, billing, to improve operations. That also didn't stop […] all of this was ad-hoc."*[97]

Over time, this increases the likelihood of hospitals using different data codes or structures in their digital systems, creating an obstacle for MOH to integrate health data across its various healthcare facilities[98].

Ultimately, even if all hospitals are fully digitalised and equipped with digital systems, a lack of interoperability and standardisation between these systems means that patient data will still be fragmented and dispersed across different databases.

**Standardisation needs to occur at two levels.** First, standardisation is needed from a technical standpoint. Standardisation of database architecture and data format ensures that any software system can read the data from the source system. MOH has used Clinical Document Architecture (CDA) to standardise information.

Second, standardisation is needed from a medical standpoint. Coding of health data such as diagnoses and treatments needs to be standardised so any healthcare provider can understand the patient's condition. In Malaysia, the health informatic standards that are used include the International Classification of Disease (ICD), Malaysia Health Reference Data Model (MyHRDM), Malaysian Health Data Dictionary (MyHDD), Logical Observation Identifiers Names and Codes (LOINC) and SNOMED CT[99]. For example, an existing MOH Standard Operating Procedure

[97] I4
[98] Ilyana Mukhriz (2021a)
[99] KRI (2021)

encourages but does not require the use of ICD-10[100] coding of diagnosis before submitting data[101].

In June 2023, MOH announced its plans to implement the integrated expansion of systems nationwide through cloud deployment in 2026[102]. The ministry has also engaged in talks with private sector cloud providers to use external cloud-based computing platforms[103].

**Systems interoperability also needs to take into account private sector provision of healthcare.** There are data sharing restrictions between public and private healthcare providers. MOH has laid down strict rules[104] that any health data collected and stored in its healthcare facilities cannot be shared with private providers or third-party providers[105]. At the time of writing, it is unclear how this data sharing issue will be resolved.

## 4.7. Data Governance

We have discussed elsewhere[106] the importance of considering different types of data and the entire data value chain when considering data governance.

The health data value chain can be visualised as a series of processes (Figure 8), beginning with data generation and data collection at the point of the patient-provider encounter, followed by data storage, data access and data use by patients and providers, and ending with data deletion. While there are many factors to consider, we limit our discussion to concerns of data security and privacy and patient access to their data.

**Figure 8: Stages of the data value chain**


Source: Adapted from Gong (2022)

Patients may be concerned with the security and privacy of their personal data being digitally collected and stored. However, as health management and healthcare become more data-centric, patients may want more access to their data as well. Data access will also be of concern to doctors whose patients may cross medical departments or facilities.

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[100] ICD-10 is the 10th revision of the International Statistical Classification of Diseases and Related Health Problems (ICD), a medical classification list by the World Health Organization (WHO). It contains codes for diseases, signs and symptoms, abnormal findings, complaints, social circumstances, and external causes of injury or diseases.

[101] MOH (2017a)

[102] The Star Online (2023)

[103] I4

[104] MOH (2010)

[105] I7

[106] Gong (2022)

Simply put, **this is a matter of building trust in the system**: clinicians and patients alike want to know that their data is safe, and that they can get it when they need it.

## Data security and data privacy

**Health data, like all personal data, needs to be carefully secured.** Significant risks of abuse and misuse may arise if health records systems, or the pipeline between them, are badly managed or unsecured[107]. To cite an example of how data security safeguards can be vulnerable to cyberattacks, the Singapore government's SingHealth integrated health information system suffered a massive cyberattack in July 2018, leading to the personal data breach of 1.5 million patients, including Prime Minister Lee Hsien Loong[108].

MOH complies with "guidelines by lead agencies such as the Malaysian Administrative Modernisation and Management Planning Unit (MAMPU), National Cyber Security Agency (NACSA) and Chief Government Security Office (CGSO)"[109]. The ministry also requires hospitals to maintain and provide their own Information Security Policy and to "comply with governing laws and regulations regarding disclosure of patient's information and accessibility of data"[110]. Regular training refreshers, inspections and audits may be needed to ensure that systems and users are adhering to cybersecurity protocols when handling patient data.

**Another aspect of health data governance relates to digital rights, such as data privacy, patient confidentiality and anti-discrimination.** Data privacy broadly refers to the protection of personal information and ensuring that it is used in a way that respects individual rights. As medical records contain private and personal information, they are categorised as confidential documents. Management of these documents must comply with the government's Security Orders[111].

As part of its regulatory function, MOH has developed a User Access Control Policy and Guidelines. These guidelines set out clear principles for the scope and context of user-specific access control, including appropriate types of information and reasons for access[112].

**SOPs and procedures are useful, but specific laws and regulations around health data governance are needed.** At the time of writing, Malaysia does not have a law that explicitly governs health data privacy. The Personal Data Protection Act only applies to personal data related to commercial transactions, while the protection of personal data collected for non-commercial purposes, such as health records, is subject to interpretation. Moreover, as Federal Government and State governments are exempt from the act, MOH-owned

[107] Tan and Ilyana Mukhriz (2023)
[108] HealthITSecurity (2019)
[109] Malay Mail Online (2019)
[110] MOH (2017a)
[111] MOH (2016)
[112] MOH (2011)

hospitals, clinics and other public healthcare providers technically do not come under the Act's purview.

Healthcare-related laws such as the Medical Act 1971 do not explicitly address digital data concerns[113] and largely focus on matters related to medical practitioners' registration and practice in their approach to safeguarding patient privacy and confidentiality. For example, the Malaysian Medical Council's Confidentiality Codes 2011 apply mainly to doctors' practice rather than patients' right to privacy[114].

To be sure, MOH has taken measures to protect patient confidentiality and privacy. Digital systems themselves are likely to have built-in security features, such as profile-specific access protocols, audit trails, password protection and data encryption, to safeguard data privacy[115]. However, there is space for health data privacy laws and regulations that could help build patient confidence and public trust in the use of digital health records.

### Patient access to data

Official government and professional medical guidelines suggest that ownership of medical records lies with the hospital or healthcare facility, with the caveat that actual patient health and treatment information contained in the record belongs to the patient[116].

As a matter of practice, digital health records have resided on computers and servers housed within healthcare facilities in much the same way that paper records are filed and stored on-site. **However, as MOH transitions towards cloud-based systems that support health information exchange, questions around data storage and data access arise, data ownership notwithstanding.**

A patient's ownership of their personal health information that is generated and stored is undisputed[117]. But the medical record itself, as a form of data, is owned by healthcare providers under the custody of the Medical Records Department (see Appendix B: Data Ownership). Patients are not given immediate access to view their actual medical records in the system. Instead, healthcare providers act as the gatekeepers to health data information, and only release certain data to patients upon request.

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[113] I4

[114] Nazura Abdul Manap, Mohamad Rizal Abdul Rahman, and Siti Nur Farah Atiqah Salleh (2022)

[115] I5

[116] Nazura Abdul Manap, Mohamad Rizal Abdul Rahman, and Siti Nur Farah Atiqah Salleh (2022); MOH (2016); Malaysian Medical Council (MMC) (2006)

[117] Malaysian Medical Council (MMC) (2006)

The doctors we spoke with generally agreed that these limitations were reasonable and appropriate:

> *"There are many things we [as clinicians] discuss and do which is beyond the understanding of most patients. There are things that we document for accuracy, which patients may misunderstand."*[118]

> *"When you [as a doctor] document [a patient's health information], there are certain things you record that you don't want patients to know. For instance, if there are any particularly sensitive issues, like whether they have any psychiatric disorders, any depression. It wouldn't be nice for a patient to read that [and think] "Oh, you think I have some psychiatric illness?""*[119]

While these concerns are valid, in the context of individual patient empowerment, this approach seems contrary to the original spirit of the 1997 Telemedicine Blueprint, i.e., to create lifetime health records to equip patients with greater knowledge and to empower them to exercise greater agency over their personal health[120].

**Although the experts we spoke to did not support full disclosure of records to patients, they did support giving patients some degree of empowerment and ownership over their health data and medical history.** Some suggested allowing patients to access only pertinent and selected data, such as a summary of diagnoses, laboratory results or medication doses, instead of the complete medical record[121].

On a related note, it appears that patients have little control over how their medical data are subsequently managed. There are no formal mechanisms that empower them to give consent or approval to transfer data[122], or to decide how this data is used outside healthcare institutions, even when it is for their own benefit.

As at 2023, practice for enrolment into digital health records in public healthcare facilities involves implied consent, where patients who register for treatment are assumed to know and agree with the data management terms of the facility. Patients may only exercise the choice not to have their data recorded in the system under an opt-out policy. It is important that patient rights be taken into consideration when developing health-data specific regulations.

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[118] I5
[119] I3
[120] MOH (1997)
[121] I1, I2, I3, I4, I5
[122] MOH (2011)

# 5. Policy Considerations

Drawing on the lessons learned from the case studies of hospital digitalisation, we put forth seven policy recommendations. These can be incorporated into existing and future plans for healthcare digitalisation, including a national EHR system.

## 5.1. Increase investment in foundational healthcare digitalisation

Regardless of whether MOH retains its hybrid procurement process or adopts a new model, efforts to realise nationwide implementation of EHR systems will require substantial investments[123]. Setting up systems in healthcare facilities and ensuring technology and infrastructure readiness to support such services is a long-term endeavour. Unfortunately, chronic underfunding for public healthcare[124] and even lower resource allocations for healthcare digitalisation have historically been a significant barrier towards putting in place an EHR system in Malaysia[125,126]. Approximately 75% of MOH hospitals still operate on manual systems[127].

**Moving forward, MOH should strive to provide greater budget allocations for foundational healthcare digitalisation across its facilities**, in line with the HWP and the call to increase public healthcare investments to 5% of Malaysia's GDP in stages[128]. This should come together with practical digitalisation targets to ensure that there is no wastage of funds.

**Total life cycle costs, including technical support, system maintenance and upgrades, should be taken into account, as opposed to solely focusing on the cost of system installation.** For example, a minimum budget for hospital digitalisation should ideally factor in expenses to build buildings with basic technology, fees for regular technical support, system maintenance and upgrades. For existing hospitals, funds should be allocated for maintenance activities such as enhancing internet connectivity and upgrading essential hardware such as computers, printers and servers.

## 5.2. Improve internet connectivity and upgrade existing healthcare facility infrastructure

Access to secure, fast and reliable internet connectivity is crucial for a web-based shareable patient clinical information system across healthcare facilities. However, hospitals that were originally designed without IT infrastructure may not be properly equipped to support a digital system. For example, there may not be enough power points within easy reach of computers or the building design may require extensive cables to be installed to provide connectivity.

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[123] NST Online (2023)
[124] KRI (2021)
[125] I2 and I4
[126] Nurul Izzatty Ismail et al. (2013)
[127] MOH (2020)
[128] MOH (2023)

**Such facilities may need to be refurbished, including upgrading building facilities to be more conducive to digital systems.** Wherever possible, MOH should invest in high-quality equipment for its healthcare facilities. Though this may be costly in the short-term, it would offset the potential future costs of having to constantly replace and upgrade outmoded technology. As this process may disrupt patient care, it must be carefully planned to ensure continuity of care.

Additionally, healthcare facilities may be located in areas where internet connectivity is limited. Concerted efforts to close the digital divide in rural and remote areas can be expanded beyond households and schools to healthcare facilities as well.

The 12MP indicates the government's commitment to improving healthcare facilities. This includes the emphasis on design of new healthcare facilities to meet post-pandemic requirements and focusing on the repair, replacement and restoration of aged facilities, particularly those above 50 years old[129]. Budget 2024 has allocated RM300 million for the repair of 400 dilapidated clinics and RM150 million to maintain MOH's IT systems[130].

**We recommend all new healthcare facilities under MOH be equipped with a minimum level of broadband connectivity and IT infrastructure that can support the adoption of computerised systems.** For all new building projects, infrastructure, IT hardware and systems should be included in the initial budget plans and costs.

## 5.3. Prioritise user-friendly and care-centric system design

Usability issues represent a major hurdle in EHR adoption, since end users who experience difficulties in using the system are more likely to be dissatisfied and unwilling to integrate the new technology into their work processes. Moreover, as highlighted in Section 4.3, poor system design can lead to undesired consequences. For example, clinicians who need to expend additional time and energy to figure out how to navigate the system may experience diminished work productivity and burnout[131]. There may also be increased risk of data entry errors that can harm patient safety.

It is important that EHR systems add value to patient care. **They should complement existing healthcare practitioner workflows while not being difficult to use.** Usability and productivity can be enhanced by including features such as basic data entry checks, an auto-save of drafts, auto-generated care summaries and flagging of allergies in clinical documentation.

**Once developed, prototype testing should be conducted** with a range of different healthcare facilities to give healthcare staff a chance to use the system and check usability given the location's infrastructure and internet access. Developers can then take user feedback to make iterative improvements. These steps will not only create space for ideation, but also empower end-users

[129] EPU (2021)
[130] Ministry of Finance of Malaysia (2023)
[131] Kroth et al. (2019)

by giving them a stake in customising a system that they themselves are confident of operating with minimal effort.

## 5.4. Conduct sufficient training of end-users

**Training policies and strategies play an important role in successful technology adoption and ongoing use of digital systems within healthcare facilities.** As part of the Negeri Sembilan pilot programme, MOH has adopted the "train the trainer" concept of recruiting and training hospital staff to lead change management activities within their own facilities[132]. As personnel may be relocated or reassigned, additional follow-up training may be needed to ensure knowledge is retained. As at 2023, MOH sends teams of dedicated trainers to conduct a short period of on-site facility training.

**These on-boarding and follow-up trainings should be scaled according to MOH's nationwide rollout, particularly for healthcare facilities in rural areas.** As much as possible, efforts should be made to ensure that all users are truly familiar and comfortable with adopting the new technology into their existing workflows and processes.

## 5.5. Continue with iterative stakeholder engagements beyond deployment

Given that technology needs evolve over time and digital systems are vulnerable to malfunction and obsolescence **it is important for MOH to maintain engagements with hospitals that have adopted such systems.**

In the long term, an optimisation strategy could be developed by encouraging users to provide continuous feedback on quality improvement through rigorous data collection methods. Periodic evaluation exercises could be carried out to assess system performance, and an empirical set of indicators could be developed to measure the clinical impact and cost-effectiveness of implementation.

This process would allow MOH administrators and policymakers to make resource-related decisions based on scientific evidence, and to pinpoint actionable strategies to help hospitals achieve more meaningful use of systems while improving patient outcomes.

## 5.6. Enforce minimum data standards across the healthcare landscape

Data collected through EHRs are valuable not only for clinical care, but also for a range of other purposes. These include measuring the performance of healthcare services to increase quality assurance and carrying out population health analytics research to plan for preventive care. During the Covid-19 pandemic, countries with advanced uses of EHR data such as the Netherlands and the United Kingdom had leveraged EHRs as a data source "for measuring the spread of community infection and its impact on population health and health services"[133].

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[132] I4

[133] Barbazza et al. (2021)

**In order to maximise the full potential of EHRs and ensure shareability of patient records, data standards should be used consistently across facilities**. Moving forward, a framework that prescribes a minimum set of data standards should be established to ensure all healthcare facilities nationwide use the same approach to sharing, storing and interpreting data. Regular checks on healthcare facilities may be needed to enforce, monitor and oversee compliance with these standards.

**There will also be a need to review and update these data standards regularly to match current international versions.** Where possible, this process should be automated. For example, the current system being rolled out in Negeri Sembilan includes automatic updates of ICD standards. This is a useful mechanism which ideally should be universally implemented to ensure an integrated system of healthcare and service delivery.

## 5.7. Establish clear public messaging around data access and data privacy

Data governance is an important consideration in any process of digital transformation, especially when personal data are involved. Data security and data privacy are paramount.

MOH does have guidelines and policies around information security. However, guidelines are not binding. As at 2023, there is no law or regulation specific to health data that governs digital data collection, storage, access, use and deletion. Given MOH's goal to establish lifelong patient health records, **it is important to have clear rules on how health data are to be managed and for patients to have means of recourse should their data be mismanaged**.

The development of laws and regulations have little impact without regular training updates and audits to reinforce protocols and appropriate use of data. It is important for healthcare practitioners to be informed and to inform their patients regarding their rights and responsibilities regarding their health data. For example, data security protocols could be added to continuing medical education requirements.

Increasingly, it may not be enough that protocols are followed and healthcare practitioners held responsible for data management. **Public education and public communication are also important for public sector digital transformation.** It is important to clearly communicate data safeguards to patients and the public to reassure them that their data are being properly protected.

**Regulations that improve transparency, such as requiring healthcare facilities to inform patients in the event of a data breach, could improve public trust in digital health systems and increase public digital literacy in general.** Although very little can be done to re-secure the data, transparency measures can make affected patients aware of increased risk and serve as an indicator regarding healthcare provider trustworthiness.

In addition to handing out documentation and putting up banners and notices at healthcare facilities**,** information on data security, privacy and access could also be provided in easy-to-access and easy-to-understand forms on MOH's website. This would enable interested members of the public to learn how MOH is employing digital health systems in hospitals and how their data are being governed.

## 6. Conclusion

In the past three decades, the Malaysian government has made significant efforts to digitalise its public healthcare system towards improving the quality and efficiency of its healthcare services while enhancing patient care. Since the publication of the 1997 Telemedicine Blueprint, there has been a vision for the nation to have digitalised patient records that are able to follow a patient across their lifespan. The backbone of this vision is a network of integrated healthcare facilities that allow health records to be shared between different healthcare providers and facilities.

This paper has examined MOH's efforts to digitalise public hospitals using three case studies: (1) THIS, a comprehensive hospital information system purchased off-the-shelf from vendors, (2) SPP, a customised system built to MOH specifications by external vendors, and (3) i-Pesakit, an in-house system developed at a teaching hospital.

Our analysis shows that similar challenges exist across the case studies. Challenges highlighted in this paper include deployment issues such as the high financial costs of procuring and implementing systems and the need for regular hardware maintenance and system upgrades; usability issues such as designing a functional and user-friendly system (in the case of customised or homegrown systems); business process issues such as preparing the personnel of healthcare facilities to transition to digital systems; and, finally, from a systems perspective, issues of interoperability and data governance.

Drawing on lessons learned from these case studies, we propose the following seven policy recommendations:

1. Increase investment in foundational healthcare digitalisation
2. Improve internet connectivity and upgrade existing healthcare facility infrastructure
3. Prioritise user-friendly and care-centric system design
4. Conduct sufficient training of end-users
5. Continue with iterative stakeholder engagements beyond deployment
6. Enforce minimum data standards across the healthcare landscape
7. Establish clear public messaging around data access and data privacy

Implementing digital systems in the healthcare landscape is a complex process which requires careful planning, preparation and execution. Nevertheless, these efforts hold the potential for a variety of benefits, including facilitating person-centric care, ensuring continuity of care and enhancing the quality of healthcare services.

This aligns with the government's commitment under the 12MP and HWP to leverage technology to improve the healthcare sector and, more specifically, address the issue of fragmented health information systems. As Malaysia aspires to become a digital-first nation, implementing a comprehensive national EHR system is timely and crucial.

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# Appendices

## A. Research Methodology

The primary aims of this study are to understand the broader landscape of the adoption of information systems within public hospitals in Malaysia and to identify key problems or issues associated with implementing these digital systems. In carrying out our research, we drew upon both primary and secondary sources for data. The stages and methods that were applied in our research process are laid out below.

In the first stage of our research, we conducted a desktop review to achieve a broad understanding of the background and evolution of digital systems within public healthcare facilities. This involved an online search for secondary information sources such as reports, news articles and academic research papers that contained relevant data and were publicly accessible on the internet. Once data collection was complete, we parsed the material and extracted data that were relevant and useful to our research objectives. We then consolidated this information for future reference. Alongside this, we also reviewed policy documents and press statements from MOH to help increase our understanding of the government's position and policy direction in its efforts to establish a shareable digital patient record in public healthcare facilities and how this had evolved over the years.

In the next stage, we reviewed the consolidated information from our desktop review, and identified specific points of inquiry to be addressed during our interviews with respondents. These included issues such as the deployment of systems, user experience, data management and back-up systems, interoperability, data governance, infrastructure, human resources, cost and financial allocations.

The objective of these interviews was to gain deeper insight into the process of operationalising EHR systems in public hospitals and the factors influencing effective adoption of these systems. We sought to clarify whether end-users considered the introduction of digital systems helpful in easing their workflow process. We wanted to obtain information on what they felt would be necessary conditions for them to work more effectively with these systems.

We developed a set of open-ended interview questions, targeting policy makers, system implementers and end-users. Then, we conducted a search for potential interview candidates via online research and snowball sampling. The main selection criteria for our interview candidates was for each individual to possess at least one of the following:

1. Experience in the development and formulation of MOH digitalisation policy & strategy;
2. Experience in the implementation or deployment of information systems within public hospitals;
3. First-hand user experience with information systems within public hospitals.

After shortlisting potential candidates, we arranged interview sessions with candidates ranging from current and former MOH senior government officials, system vendor/implementors and healthcare providers working in government hospitals. The interviews were carried out face-to-face or via video conferencing. Prior to each session, all candidates were given the opportunity to ask any questions related to the study before signing an informed consent form allowing for the interview to be recorded, and, if preferred, for attribution to be accorded to them in the final report.

One limitation of this research may be the modest number of interviewees. The names of government officials with domain experience in the development and implementation of EMR systems are generally not publicly available, which made it challenging to identify potential interviewees.

Furthermore, a few candidates who had accepted our invitation and given tentative confirmation were unable to make the interview date at the final hour, further reducing our sample. Despite the modest size, the final sample is adequate given the high level of knowledge of our interview respondents, including MOH officials who had been directly involved in policy processes and were able to offer high-level insights into the intricacies of the EHR implementation process. The final sample reached saturation[134] with similar themes repeating.

Moreover, the variation within our sample enabled us to capture core views and experiences not only from the perspectives of policymakers, but also system vendor-implementers as well as end-users.

A detailed profile of the interview respondents (given aliases I1 to I9) is presented in Table 2, along with details of the interview session and a brief overview of each individual's relevant experience.

[134] Saunders et al. (2018)

**Table 2: Profile of interview respondents**

| Interviewee Code | Interviewee Biodata |
|---|---|
| I1 | Retired surgeon, former Clinical Advisory Committee chairman and clinical IT coordinator at a public hospital. |
| I2 | Former Director-General of Health and advisor for Malaysia's telehealth initiative. |
| I3 | Faculty of Medicine member at a public university, senior consultant physician at a public hospital. |
| I4 | State health director, former Senior Deputy Director of MOH Planning Division. |
| I5 | Senior consultant surgeon, head of a surgical division in a public hospital. |
| I6 | Retired state health director, former hospital director. |
| I7 | System vendor consultant involved in MOH digitalisation efforts. |
| I8 | Doctor at a public hospital. |
| I9 | Doctor at a public hospital. |

Data collected from these interviews represent both current and retrospective accounts of respondents' experiences of the policy processes involved in hospital digitalisation, and what it takes for these systems to be implemented well in MOH hospitals.

After conducting the interviews, we transcribed the taped recordings in order to extract information relevant to our research. In the final stage, we reviewed and synthesised the knowledge acquired from all stages of data collection to inform the drafting and final editing of our findings and policy considerations.

## B. Data Ownership

Official government and professional medical guidelines suggest that ownership of medical records lies with the hospital or healthcare facility, with the caveat that actual patient health and treatment information contained in the record belongs to the patient[135]. This view is echoed by the ministry in its MyHealth portal, which states that "physically, medical records are properties of the Hospital, even though the contents belong to patients"[136]. The Malaysian Medical Council (MMC) in its 2006 Guideline on Medical Records and Medical Reports, provides an even more unequivocal interpretation on health data property rights:

> *"A patient's medical record is the property of the medical practitioner and the healthcare facility and services, who hold all rights associated with ownership. It is important to appreciate the confidential nature of the Medical Records and though the practitioner and the healthcare facilities and services have rights of ownership, they should still obtain consent from the patient or next of kin before any release of information from the medical records to any third person.*
>
> *Medical records are also the intellectual property of the medical practitioner who has written them, and also belong morally and ethically to the practitioner and the patient.*
>
> *The personal information (name, address, identification data, etc.) that the medical practitioner has recorded belongs to the patient. This is based on the premise that the notes are made in the first place because the patient has voluntarily sought the consultation.*
>
> *The results of investigations (blood tests, tests on secretions, imaging and scans) belong to the patient, and these may be released to him/her when requested. Information obtained by the practitioner from a third party (relative mainly) about the patient is not part of the patient's information, as such information may have been revealed on strict instructions of confidentiality. Such information may be crucial in the care of the patient. The practitioner may be obliged to reveal such information in providing a Medical Report to the patient. The practitioner, however, should not reveal the source of the information in view of the instructions of confidentiality by the third-party informant .*"[137]

The MMC's guidelines were adopted in 2006 and, to the best of the authors' knowledge, are still adhered to by practitioners. Reading its contents, together with the 2010 government circular and MyHealth article, one may reasonably surmise that, while a patient's personal health information that is generated and stored in an EHR system is acknowledged to belong to him or her, the medical record itself, as a form of data, is owned by healthcare providers.

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[135] Nazura Abdul Manap, Mohamad Rizal Abdul Rahman, and Siti Nur Farah Atiqah Salleh (2022)
[136] MOH (2016)
[137] Malaysian Medical Council (MMC) (2006)