

# INSIGHTS

HIMSS PUBLICATION

DECEMBER 2023

## *One Taiwanese hospital's journey to becoming a smart hospital*

With three HIMSS validations under its belt, read how China Medical University Hospital is integrating data and AI to achieve improved patient outcomes and cost savings

pg 19



## DIGITAL EXCELLENCE IN HEALTHCARE: APAC CASE STUDIES VOLUME 5

# INSIGHTS

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# An optimistic future for digital health in APAC



**SIMON LIN**

Vice President, HIMSS  
Managing Director, APAC

Our final issue of the *Digital Excellence in Healthcare: APAC Case Studies* (DEHC) series signals an exciting future for digital health in the Asia-Pacific (APAC).

In developed nations, we are seeing the fruits of digital transformation journeys that have been ongoing for years – with the pandemic giving them the nudge they needed to ramp up their digital investments to meet the demands of an increasingly complex and challenging healthcare landscape. Among these countries is Taiwan, which has over the years been making a name itself as a hub for digital innovation in the region.

A growing number of Taiwanese hospitals have been undergoing the HIMSS Maturity Model assessments to gain an objective measure of their digital transformation while complying with international standards, in the process achieving significant digital health milestones. Incidentally, the country's National Health Insurance Administration has recently [signed an agreement with HIMSS](#) to develop a digital health ecosystem based on the HIMSS digital capacity and maturity frameworks.

A front-runner in digital maturity among Taiwanese hospitals is China Medical University Hospital (CMUH). Off the heels of its global third placement in the 2022 Digital Health Indicator ranking, CMUH has achieved three HIMSS validations this year – Stage 7 for the Infrastructure Adoption Model (INFRAM), Stage 7 for the Electronic Medical Record Adoption Model (EMRAM), and Stage 6 for the Analytics Maturity Adoption Model (AMAM). Read how CMUH is becoming a model smart hospital [here](#).

Fellow Taiwanese hospital Kaohsiung Medical University Chung-Ho Memorial Hospital (KMUH) joins CMUH this issue with a Stage 6 achievement for the EMRAM. Per Taiwan's regulations, medical staff are required to indicate the owner of the EMR within 24 hours of signing their record. In the past, EMR signing at KMUH was accessed and done on a web-based EMR signing system using the physical ID of the medical staff. However, this process was outdated and ineffective. KMUH developed applications that would enable the convenience and timeliness of uploading EMR signatures through mobile devices, resulting them in saving more than 15,000 minutes per week from signing badges. [Find out](#) how else the hospital is leveraging digital technology.

Another country that has seen its share of digital health wins over the past few years is South Korea. The nation's most prolific achiever is Samsung Medical Center (SMC), which adds Stage 6 AMAM – a first for APAC – to its list of accolades. During the validation, SMC was commended for a robust analytics infrastructure and foundation, backed by cloud technologies which allow its staff to extract and analyse data for clinical activities and research in multiple ways. [Learn how](#) SMC is leveraging analytics to markedly improve its operations.

While hospitals from advanced economies like Taiwan and South Korea are serving as exemplars for digital transformation in the region and around the world, we have also been witnessing hospitals from developing nations in the region taking the first step in their journeys. In Indonesia, the home of our HIMSS APAC conference over the past two years, the tide of digital transformation has swept over the country's healthcare sector. A number of key digital health initiatives – such as the development of a [national integrated health data platform](#) (SatuSehat) and health facilities being mandated to [implement an EMR by the end of 2023](#) have spurred hospitals to make digital technology a crucial part of their operations.

One such health facility is An-Nisa Hospital, which since 2022 has fully implemented its self-developed EMR and hospital information system across its outpatient, inpatient, and emergency departments. The EMR has also been integrated with the National Insurance Information System while work is underway to connect it with SatuSehat. Since implementing the integrated EMR and HIS, there is no longer a wait time for processing medical records while the hospital has also been able to reduce administrative staffing by 60%. Read more about An-Nisa Hospital's journey [here](#).

The future of digital health is optimistic in APAC. Health facilities in the region will no doubt continue on their path of digital excellence in the coming years. While this might be the final issue of DEHC, HIMSS will continue to showcase our partners' achievements through our various events and media platforms. On that note, should you be interested to learn how you can leverage our advisory services, write to us [here](#).

Wishing you happy holidays and a great 2024!

A handwritten signature in black ink, appearing to read "Simon", written in a cursive style.



# ***Kaohsiung Medical University Chung-Ho Memorial Hospital: Powering a patient-centric smart hospital with mobile technologies***



*Credit: Kaohsiung Medical University Chung-Ho Memorial Hospital*

## **WHO THEY ARE**

Started as a teaching hospital for the Kaohsiung Medical University in 1957, the Kaohsiung Medical University Chung-Ho Memorial Hospital (KMUH) provides clinical training and general medical services in Sanmin District, Kaohsiung, Taiwan. The 1,720-bed hospital also offers specialised treatment and facilitates medical research. In 2010, it was designated as a Cancer Therapy Center by the Taiwanese government.

Through its Information Office, KMUH has developed several systems – from the outpatient to administration and decision support – that enable flexibility to respond to ever-changing health insurance reporting and related regulatory requirements of the government. Its outsourcing system includes the Picture Archiving and Communication System, Radiology Information System, Knowledge Management System, Digital Learning System, Clinical Information System, pathology imaging, and equipment such as automatic test standby.

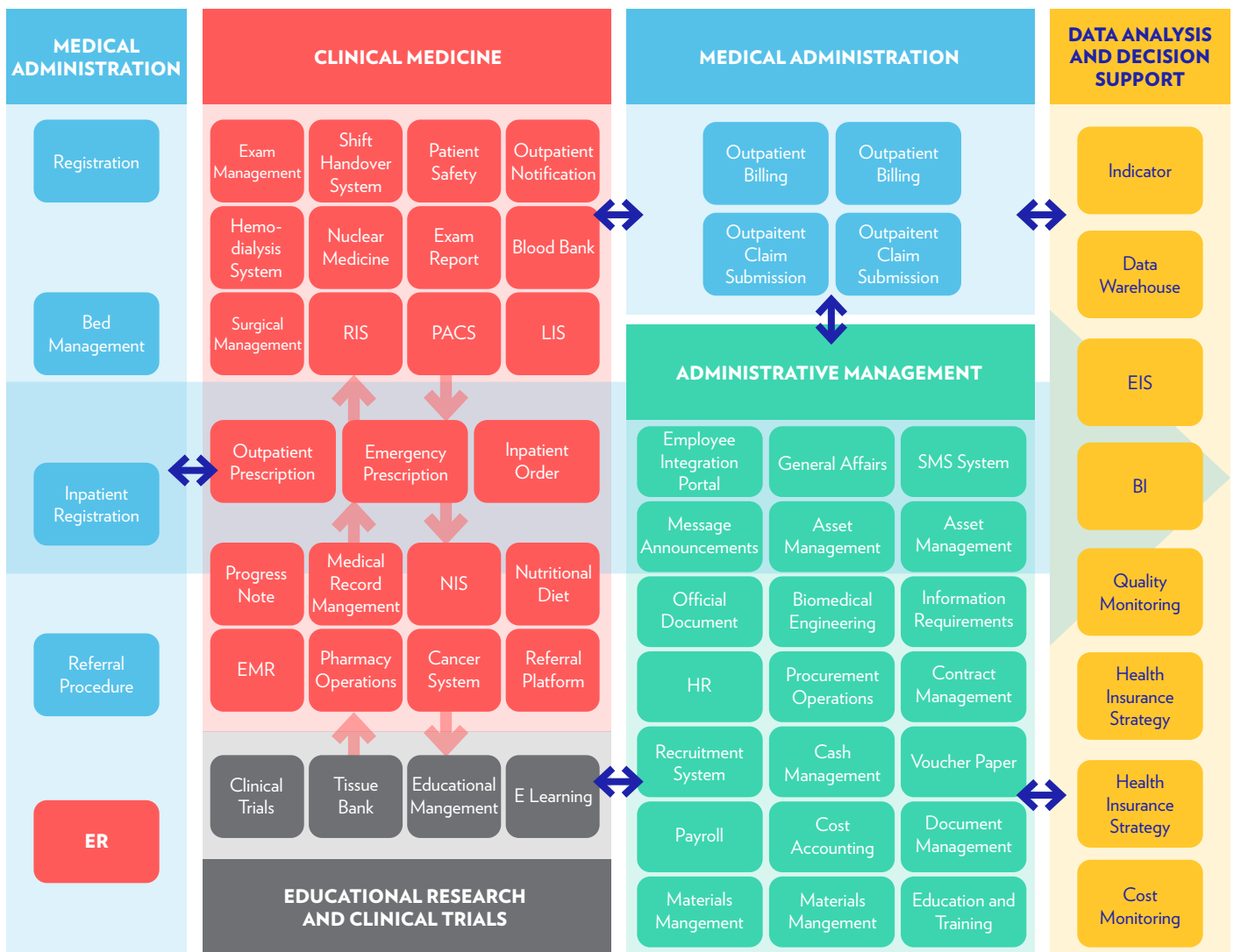


Figure 1. Overview of KMUH's main IT systems

## THE OBJECTIVE

With a commitment to meet the demands of an ageing society, expand internationally, and develop novel medical treatments, KMUH as a medical centre is focused on technological innovation and smart healthcare.

As a university hospital, it is also becoming more research-oriented and active in establishing industry-academy partnerships, as well as cultivating talent.

In pursuing these missions, KMUH adheres to three strategies:

- **Provide holistic care:** develop excellence in specialties of medical treatment and enhance regional medical standards;
- **Cultivate outstanding talents:** develop excellence in teaching and reward research published with both quality and quantity; and
- **Become the most trusted medical centre for the public:** enhance patient safety and quality of medical treatment and improve operational efficiency and effectiveness.

Given this context, KMUH sought an objective measure of its digital transformation while complying with international standards. Recently, it underwent the validation for Stage 6 of the HIMSS [Electronic Medical Record Adoption Model \(EMRAM\)](#). This maturity model gauges an organisation’s clinical outcomes, patient engagement and clinician use of EMR technology.

## FINDINGS

KMUH has joined the growing roster of hospitals in Taiwan that have demonstrated maturity in their use of the EMR, achieving Stage 6 for the EMRAM. Hospitals at this level have enabled the integration of their medical devices; facilitated data sharing through health information exchange; allowed patients to submit self-reported outcomes data, access educational content and a subset of clinical data like discharge status, and update their health status data online and report progress with care pathways or therapies; measured patient satisfaction using automated digital tools; set up analytics governance that actively assesses outcomes data for needed changes; and formed a Clinical Governance Committee that is working closely with Data Governance to optimise the capture of clinical outcomes.

In KMUH’s case, it has demonstrated a high level of structured clinical documentation. HIMSS noted its impressive organisation of the EMR, in terms of standardisation, efficiency, quality checks, and use of data, all of which contribute to the creation of a structured clinical record.

The hospital has also showcased an advanced clinical decision support system, which consists of different types of alerts and warnings that assist clinicians in decision-making. Unique alerts, such as for medications that may not be powdered or halved, integration of pharmacogenetic testing results, infusion speed checks and paediatric dosing tips, were also observed.



### ANDREW PEARCE

Vice President Analytics  
and Global Advisory Lead

**“The use of technology to support patient engagement for both in-patients as well as outpatients with several apps covering various functions to support self-management was truly exceptional in supporting patients with timely information and communication.”**

## NOTABLE PROJECT

### Healthcare Certification Authority (HCA)

Per Taiwan's Electronic Medical Record Production and Management Regulations, medical staff are required to indicate the owner of the EMR within 24 hours of signing their record. At KMUH, EMR signing is accessed and done on a web-based EMR signing system using the physical ID of the medical staff. However, this process is already outdated and ineffective.

Following the release of the Regulations for the Management of HCA Medical Staff Credentials for Mobile Devices of the HCA Medical Credentials Management Center in 2019, KMUH began setting up an application platform for the management of mobile credentials. It also started developing a mobile credentials app and an EMR signature app. These applications would enable the convenience and timeliness of uploading EMR signatures through mobile devices.

A year later in February-March 2020, KMUH physicians and nurses started using the new mobile EMR signing system. Currently **used by more than 7,500 staff**, the system has an **average signing rate within 24 hours of over 94%**. The mobile process has also allowed them to **save more than 15,000 minutes per week from signing badges**.

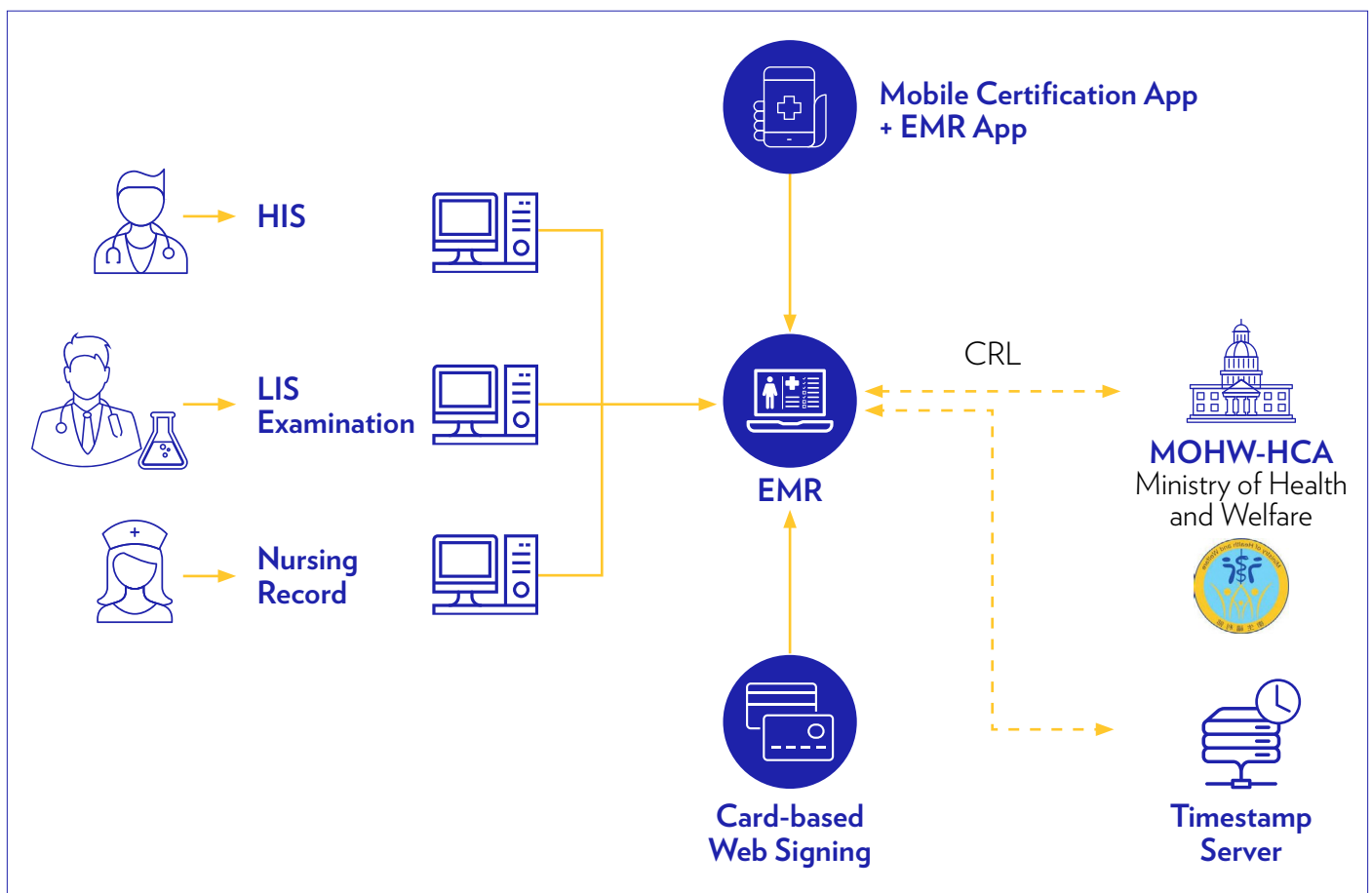


Figure 2. KMUH's EMR architecture



In preparation for its Stage 7 validation, KMUH is now making some improvements to its EMR system following HIMSS’ recommendations.

Recently, the hospital completed the development of its mobile personalised health app called KMUHOME. This allows patients under remote care to enter their vital measurements, such as blood pressure, heart rate, blood glucose, insulin, body temperature, blood oxygen, weight, body fat, and water intake, as well as photographic records of their wounds and the like. The app is also connected to Google Fit, which also collects exercise data. Patients can then send their health data to their hospital-based care team, who will provide personalised advice on managing their conditions.

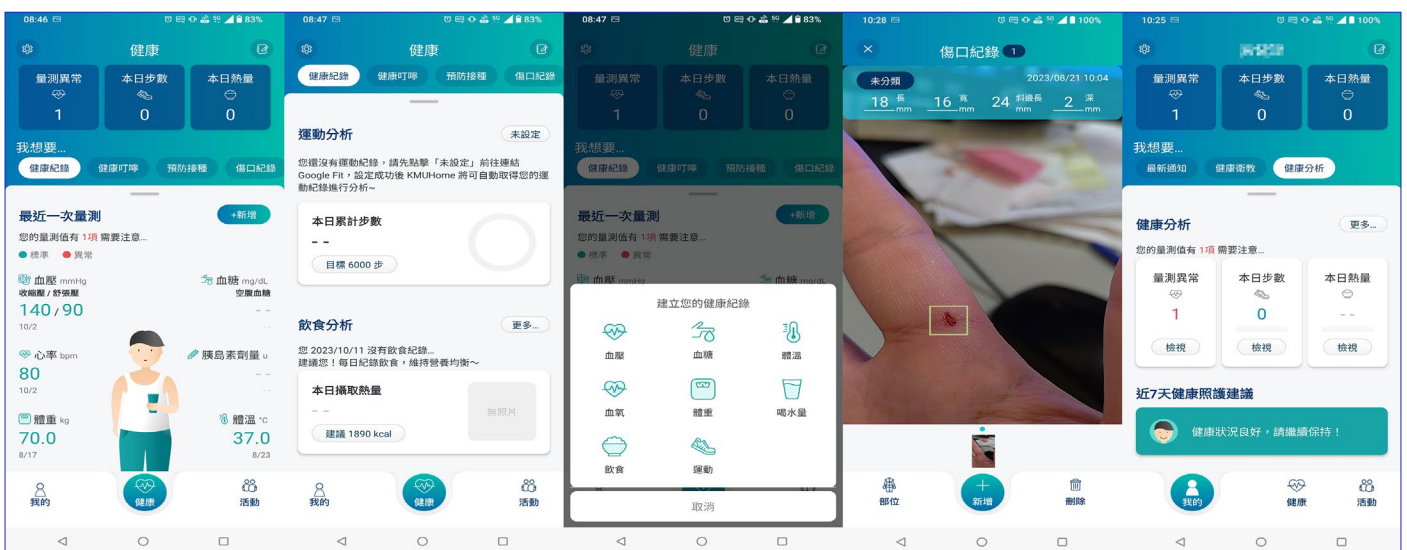


Figure 3. Interface of the KMUHOME mobile app.

“The personal care manager of patients with chronic kidney disease, for example, can carry out personalised health care education, push messages, and respond to emergencies through the KMUHOME platform,” said Dr Jaw-Yuan Wang, professor and superintendent, KMUH.



Figure 4. KMUHOME dashboard for the hospital care teams

The app is currently being integrated with the KMUH registration system and the Health Insurance Department’s health passbook to synchronise the health insurance cloud medical record information with the hospital’s health app. The integration is expected to be completed by 2024.

The hospital is also in talks with the Pharmacy Department to introduce an automated alert functionality as part of the prescribing process.

“Now that we have successfully obtained Stage 6 validation, we aim to replicate this success throughout all departments and relevant healthcare digital processes in the hospital. We are now preparing to invest in the necessary software and hardware facilities, hoping to achieve validation as soon as possible in the near future,” Dr Jaw said.



## ON THE RECORD



**DR JAW-YUAN WANG**

Professor and Superintendent

“We are delighted that HIMSS has recognised KMUH’s efforts in achieving EMRAM Stage 6. Throughout the certification preparation process, we have thoroughly reviewed various healthcare digital processes, leading to the discovery of innovative ideas and procedural improvements. Obtaining EMRAM certification enables KMUH to continue introducing advanced technologies, expanding industry linkages, and exploring the application of AI in the medical field as we continue to drive healthcare digital transformation. Our goal is to provide patients with higher quality medical services.”

“HIMSS provides unique depth and breadth of expertise in health innovation, public policy, workforce development, research, and digital health transformation. KMUH is both a medical centre and a university-affiliated hospital, and it looks forward to obtaining [the next stage of EMRAM] to facilitate objective measurements in its digital transformation journey and strive to meet international standards.”

# *Samsung Medical Center: Leading the healthcare analytics revolution in Asia-Pacific*



Credit: Samsung Medical Center

## WHO THEY ARE

Seoul-based Samsung Medical Center (SMC) is one of South Korea's leading hospitals. Established in 1994, the 2,000-bed hospital offers a wide range of diagnostic and treatment services through the Samsung Comprehensive Cancer Center, Proton Therapy Center, and Heart Vascular and Stroke Institute. Its services are backed by advanced medical infrastructures, including proton therapy, gamma knife surgery, robotic surgery, tomotherapy, high-intensity focused ultrasound, an emergency medical helicopter, a smart ER, a Clinical Pathology Automation System, a Logistics Automation System, and a hospital information system.

SMC's IT infrastructure covers two key areas. The operational side supports all aspects of patient care. It features an EMR system based on the Samsung SDS platform that provides end-to-end data security for both patients and clinicians who access services via a mobile patient app and a suite of mobile solutions for healthcare professionals. The system is also connected to PACS and a multi-channel call centre.

Its IT infrastructure for analysis, on the other hand, uses a hybrid private cloud in public zone technology, which includes a data research registry, a common data model, and a clinical data warehouse, to meet the information needs of the hospital's researchers and data analysts. The integrated network combines wired and wireless technologies to enable the secure integration of medical and monitoring devices, automated guided vehicles, and a full range of facilities management tools and services.

It has always been SMC's mission to provide high-quality care while being at the forefront of medical research. It aims to be a leader in personalised healthcare, equipped with state-of-the-art and continuously evolving medical technologies.

## THE OBJECTIVE

To realise its mission and vision, SMC is building data-driven systems that promote healthcare innovation. It does this by following what it calls the Learning Healthcare System (LHS) strategy, which is to integrate existing best practices and introduce a new knowledge framework.

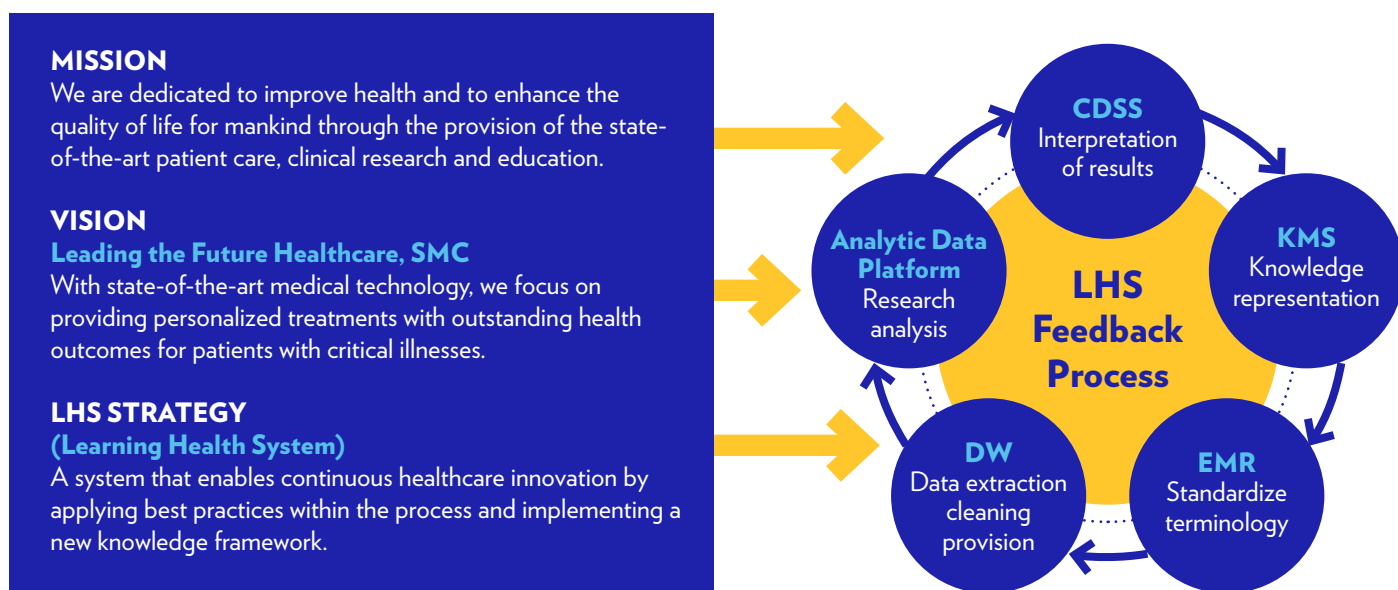


Figure 1. Data Strategy integrated with SMC's Mission and Vision

The hospital is collecting tracks of data from various sources – external, operational, managerial, clinical and research. To unlock the potential of these data, it is making consistent improvements in organisational frameworks, member protocols, and operational policies, alongside standardisation, integration, sharing, and efficacious utilisation of data. These efforts have allowed SMC to use data to inform organisational decisions and pursue strategies under the LHS, ultimately raising the competitiveness, operational efficiency, and collaborative initiatives of their researchers.





**PROF JONG-SOO CHOI**  
Information Technology Lead

“We are confident that our strategic approach considerably aids in fostering a data utilisation ecosystem that can be seamlessly accessed and refined to elevate patient safety and the overall quality of care.”

Its data utilisation ecosystem is further sustained by implementing four pivotal aspects of data governance: ongoing data quality management, stringent data protection, secure utilisation, and a robust support framework for data usage environments. The Digital Innovation Promotion Team, in an effort to make data governance consistent across the organisation, provides overarching support to the hospital’s operational, clinical, research, and managerial units, in collaboration with different committees, such as the Information Management Committee, the Data Management Committee, the Medical Records Committee, and the Data Review Committee.

Over the years, SMC has demonstrated the strength of its infrastructure. After achieving triple Stage 7 HIMSS Digital Maturity Model validations within 12 months, the hospital readily took on its fourth assessment for the [Adoption Model for Analytics Maturity \(AMAM\)](#). This model gauges the analytics capabilities of a healthcare organisation and its advances based on its strategy and competency.

For some time, SMC has been utilising data to gain predictive capabilities that are being applied in both its clinical and operational processes. It has sought objective validation of its efforts to establish a cyclical process of generating data analysis and translating it into clinical and operational workflows.

Eventually, SMC achieved Stage 6 of the AMAM, in the process becoming the first hospital in Asia-Pacific to do so. Below are some noteworthy findings from its recent AMAM evaluation.

## FINDINGS

SMC was commended by HIMSS for having a robust analytics infrastructure and foundation. This infrastructure is backed by cloud technologies which allow its staff to extract and analyse data for clinical activities and research in multiple ways. Having both clinical and enterprise data warehouses demonstrates the strength of its analytics infrastructure.

More evidence of its robust analytics capabilities are some remarkable AI integrations into the hospital’s clinical workflows. One such example is its Data-based Operation and Communication Center (DOCC) personal area network (PAN) system.

## DOCC PAN



### THE PROBLEM

Over the past decade, SMC has seen an increase in outpatient visits. Prescriptions for CT and MRI testing have doubled, alongside the number of critically ill inpatients. While demand for service grew, the hospital's infrastructural capacity remained static.

“This staticity has resulted in discrepancies in the allocation of medical resources, encompassing equipment, personnel, and spatial considerations. This incongruity has placed a considerable strain on our staff,” Prof Choi noted.

To plug this gap in demand and capacity, SMC needed to optimise its medical resources by taking an integrative data-driven approach. This is where the DOCC PAN system comes in.

The system was first conceptualised in 2018. A year later, PANs were created to serve as instruments for relaying data. These were categorised into four departments: Outpatient, Inpatient, Surgery, and Examination. SMC recently completed the first phase of implementation of the DOCC PAN system with 22 PANs. It is now entering its second phase of implementation.

HIMSS first noted SMC's [groundbreaking](#) use of predictive modelling through the DOCC PAN system to optimise the allocation of medical resources and personnel during the evaluation of the Stage 7 [Digital Imaging Adoption Model](#) and the [Electronic Medical Record Adoption Model](#) earlier this year.



### OUTCOMES

In terms of success measures, SMC identified two criteria for its analytical system for non-scheduled tests: the average number of patients and a reduction in the median waiting time. For scheduled tests, the waiting period for an appointment is set as the benchmark.

Meanwhile, for AI implementation, indicators are individually managed for each algorithm. “For instance, in the fall prediction program, the criteria for life cycle management include sensitivity, specificity, accuracy, and the rate of high-risk assessments. Quality is overseen by monitoring any deviations from a predetermined standard during operation. Should it surpass the defined quality threshold, the system undergoes retraining to ensure it retains or exceeds a specified level of performance,” explained Ok Soon Jeong, SMC's Data Service Platform manager.

In SMC's busy and crowded Blood Collecting room, a PAN implementation has resulted in a notable reduction in patient wait times. By using PAN, staff can furnish operational data at 30-minute intervals. This has provided them with the ability to predict patient influx, thereby, being able to decide on reallocating staff during anticipated peak periods.



**OK SOON JEONG**

Manager, Data Service Platform

“From this endeavour, it became evident that synergistic outcomes are achievable when field-specific data is judiciously combined with experiential insights. Even though patient numbers surged at the beginning, **the median waiting time eventually plummeted dramatically, from a range of nine to 10 minutes to a mere four minutes.** Despite initial hiccups during the early stages of PAN integration, the substantial reduction in wait time variability post-PAN stood out as a noteworthy transformation.”

Meanwhile, developing a PAN to automate processes in the CT Scan room has enabled SMC to accommodate a substantial number of additional patients.

Demand for CT scans at the hospital used to surpass its provision capacity. SMC came up with a PAN to automate operations at the CT Scan room to harness slots that clear up following cancellations. “Consequently, this allowed us to **extend CT scan services to an additional 1,750 patients annually,**” Prof Choi noted.

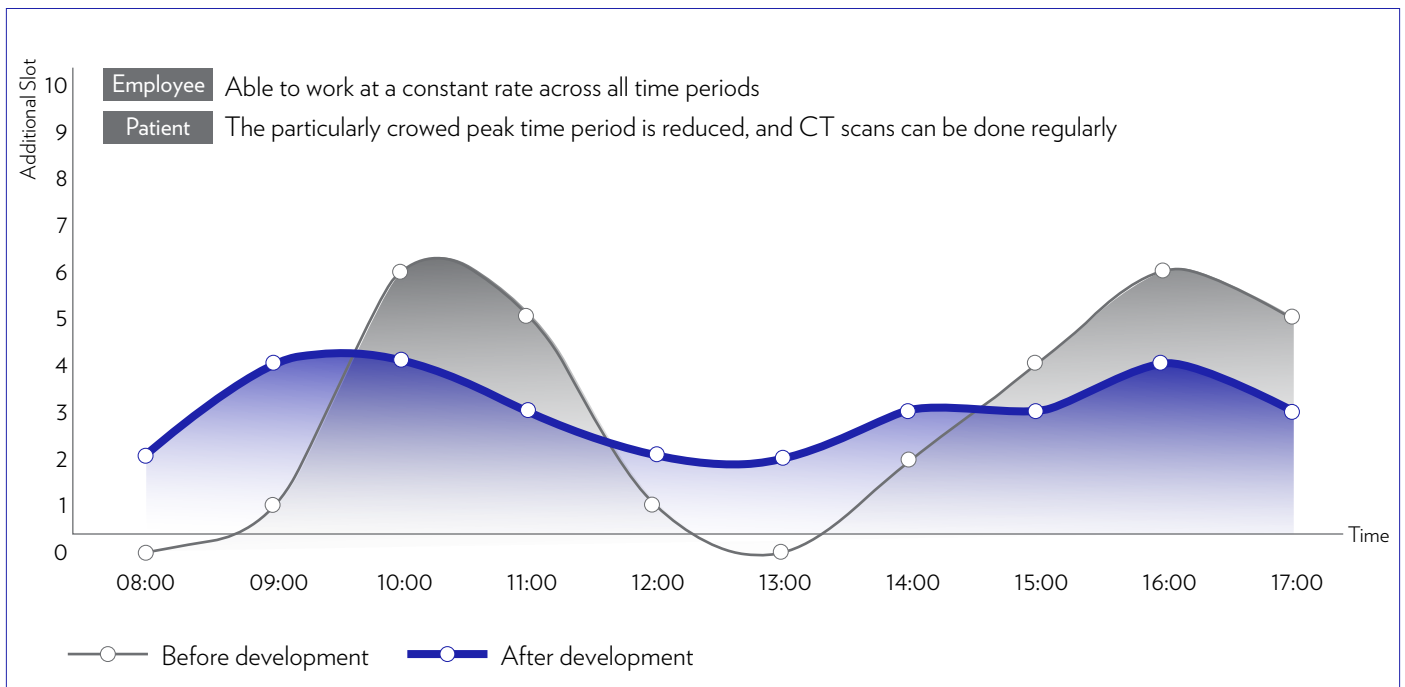


Figure 2. Comparison before and after the application of analysis results in the CT Scan Room

Another CT-specific PAN was also developed to project future waiting periods, which informs its proactive mitigation strategies.

## NEXT STEPS

As SMC works toward its Stage 7 AMAM validation, it is expected to demonstrate both clinical and operational use cases of analytics, as well as provide a comprehensive explanation of its data governance and define the success factors of its analytics implementation.

One clinical use case of analytics it is preparing to demonstrate is the Critical Interventions (Crl) system. This is a clinical decision support system for identifying patients requiring intervention at the classification stage. This system extracts from the EMR a number of data from patients visiting the ED for triage, including six vital signs data, their age and sex, and their method and route of arrival. For every ten minutes, the data is transferred to the HANA Database, which houses the Crl models, and from there, each probability is computed before being integrated back into the EMR. SMC claims that the Crl can significantly reduce the time it takes for patient intervention.

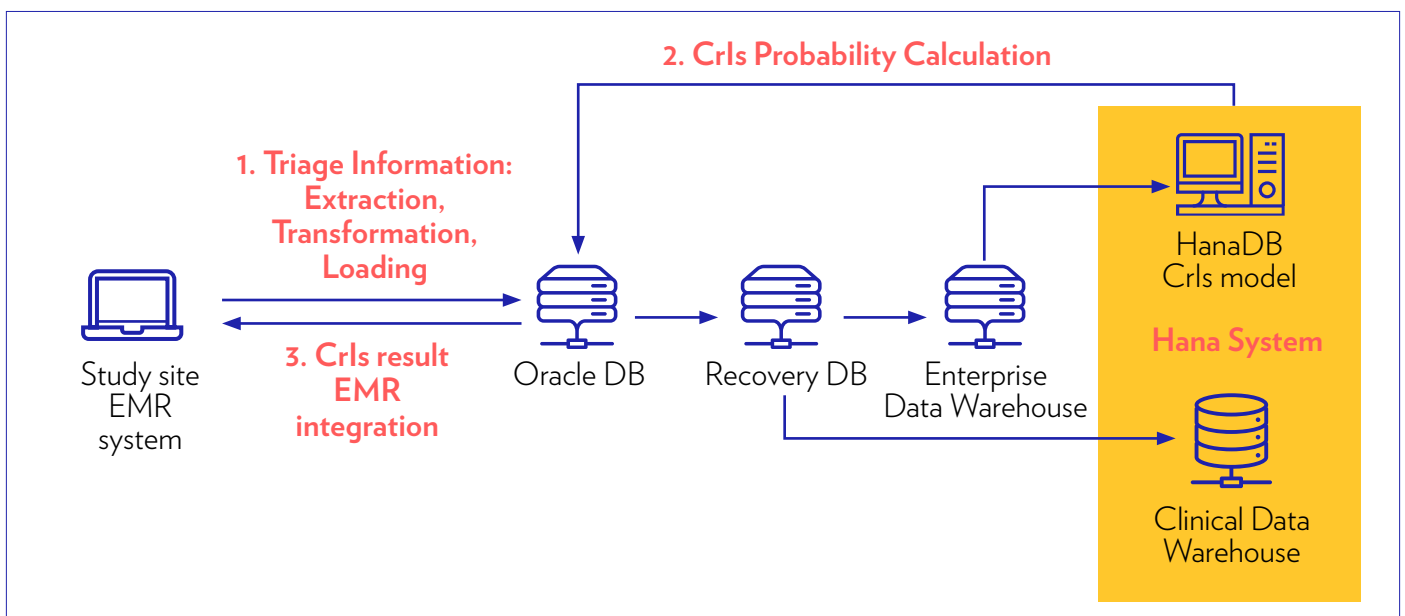


Figure 3. EMR integration process of the Critical Interventions System

Meanwhile, SMC is also currently developing a model that can predict acute exacerbations using patients' vital signs and test results. The model is intended to ensure patient safety by predicting acute exacerbation events, including cardiopulmonary resuscitation, sepsis, unscheduled ICU admissions, booster administration, and respiratory support treatments, within a 24-hour window. Aside from its eventual application in the emergency department, there are plans to apply the model to general rooms and wards. A clinical trial of the predictive AI began in October.

Additionally, the hospital has developed an AI model for predicting cardiac arrest in the ICU, which has been integrated into clinical practice to assist with optimising medical resources.

SMC is also preparing to demonstrate an operational use case of analytics, an AI system for predicting falls and bed sores for inpatients. The AI is said to help save nurses' time for assessment and documentation **“from five minutes per patient to just seconds.”**



## ON THE RECORD



**DR DEOK-HYUN HAN**

Vice Chief Medical Information  
Officer

“Digital endeavours and data are intrinsically intertwined; the data generated from digitisation must be harnessed to enhance digital processes, forming a reciprocal cyclical structure. While numerous instances exist where data is analysed and subsequently employed for clinical and operational purposes, it is imperative to define quantitative performance or value indicators at an early stage when utilising such analytical data. Determining a lucid outcome for the results of data utilisation is crucial. In this context, the HIMSS AMAM offers pertinent guidelines.”



# ***China Medical University Hospital: Driving smart hospital transformation with data and AI***



*Credit: China Medical University Hospital*

## **WHO THEY ARE**

In 1980, China Medical University Hospital (CMUH) was established as a regional hospital in Taichung, Taiwan. Affiliated with China Medical University, it later became a medical centre and the second-largest healthcare system in the country with over 2,000 beds and more than 6,000 employees. Each month, CMUH receives around 200,000 outpatients, sees about 13,000 emergency patients, admits 7,900 inpatients, and conducts over 5,500 surgeries.

The hospital is said to be the first in Taiwan to offer and integrate Western and Chinese medicine. It runs eight medical units, namely Cancer Center, Cerebral Stroke Center, Cardiovascular Center, Organ Transplantation Center, Trauma and Emergency Center, Preventive Medicine Center, Renal Care Center, and International Medical Service Center. It also runs nine disease-focused research institutes, such as the Center for Molecular Medicine, the Biomedical Technology Research Center, and the Translational Medicine Research Center.

## THE OBJECTIVE

When the AlphaGo software beat a nine-dan professional and champion in a game of Go in 2016, CMUH chairman Chung-Hai Tsai and superintendent Der-Yang Cho immediately realised AI's sweeping impact on human life and healthcare. "AI may not replace doctors but doctors who don't know AI will be replaced," they said.

Now, it is one of CMUH's goals to become a smart AI hospital by 2030. It aspires to be a smart hospital that provides "humane, intelligent, and effective care." Critical to achieving this vision is the integration of data and AI to improve healthcare delivery and enable providers' efficiency.

With no local role models and examples to follow, CMUH sought guidance from globally acclaimed models and standards to measure its efforts toward digital transformation. In recent years, underwent validations for the HIMSS [Electronic Medical Record Adoption Model \(EMRAM\)](#), [Infrastructure Adoption Model \(INFRAM\)](#), and [Adoption Model for Analytics Maturity \(AMAM\)](#).

The EMRAM measures an organisation's clinical outcomes, patient engagement and clinician use of EMR technology while the INFRAM measures their maturity in infrastructure and associated technology capabilities. Meanwhile, the AMAM gauges the analytics capabilities that an organisation gains from its analytics strategy and competency.

## FINDINGS

### Stage 7 INFRAM

CMUH is the first healthcare provider in Taiwan to be validated for Stage 7 INFRAM. A hospital at this level has achieved high data, voice, and location grades for all internal and specified external on-campus areas; implemented a high-availability wireless identity and access management solution, as well as a high-availability wireless enterprise mobile management solution on-premise and in the cloud; enforced well-defined bring-your-own-device network access policies for both staff-owned and guest-owned devices; and provided advanced security and automated access policy enforcement through identity, access and mobile device management solutions that uses a software-defined networking controller.

CMUH has segmented its IT infrastructure strategy into four domains, each symbolising an animal from the Chinese Zodiac that resonates with its cultural ethos.

- **Connectivity - Rat:** Universal connectivity is the hospital's utmost priority. It draws from the rat's agility in ensuring all devices, whether local or remote, remain seamlessly connected.
- **Equipment - Ox:** Representing strength and resilience, the ox epitomises the stability and durability of the hospital's equipment. This includes the green data centre and the integration of its hybrid cloud architecture, leveraging platforms like Azure and Google public cloud, with highly converged infrastructure.
- **Information Security - Tiger:** CMUH remains steadfast in its information security with the courage and strength of the tiger. Rooting this strategy in ISO 27001 standards, the hospital created a robust information security and privacy management system, with frequent training sessions that raised staff awareness and competency.
- **Data Management - Rabbit:** The rabbit, which exemplifies speed and precision, inspired CMUH's approach to data management. The hospital adheres to international standards, including FHIR, DICOM, SNOMED, and LOINC, ensuring interoperability and data integration.

Just four months after its Stage 6 INFRAM validation, CMUH was validated for Stage 7. It is now working to fulfil some of HIMSS' recommendations for improvement in its IT infrastructure.

One of them is aligning its governance structure, emphasising the synergy between its IT solutions and services and business requirements. The hospital is crafting mechanisms to meticulously track and realise the benefits of its IT capital fund initiatives.

Alongside actively updating transport and wireless components beyond their end-of-support dates, CMUH is fortifying its systems to proactively monitor potential firmware vulnerabilities. It is also exploring advanced location service technologies like Bluetooth Low Energy.

In cybersecurity, CMUH is currently considering the most suitable configurations for establishing a Governance, Risk, and Compliance entity that is independent of its IT team. It is also assessing the integration of a Privileged Access Management solution, targeting the supervision of critical access accounts to mitigate potential risks.

Regarding its data centre, CMUH is now crafting plans to improve its disaster recovery strategies, including the establishment of a backup mechanism located at a remote site at least 150 kilometres away from the hospital. It also continues to harness the High Availability feature of its data centre to ensure seamless continuity and resilience in operations.



**CHUEN-LIANG CHEN**

Information Vice Superintendent

“Our engagement with HIMSS has been immensely enlightening. We perceive these recommendations not merely as feedback but as constructive milestones. As we venture ahead, our dedication remains unwavering, with optimism about the future, always prioritising patient safety and medical outcomes.”

“HIMSS’ insights and recommendations have been invaluable to us following our INFRAM validation. They serve as essential markers, ensuring our IT infrastructure’s alignment with our broader commitment to patient safety and medical excellence.”



**HSIANG-MIN LI**

INFRAM Project Group Leader

## STAGE 7 EMRAM

CMUH has also been validated for Stage 7 EMRAM. Hospitals validated at this stage have proven to improve safety by optimising their EMR implementation and allowing clinicians to access critical information anytime, anywhere; increase patient satisfaction by reducing time and errors in care delivery; support clinicians by designing the EMR to their distinct uses; and secure data by having effective data policies and governance.

Prior to the validation, CMUH made some adjustments and implementations within its systems to meet the EMRAM standards. These include the implementation of the Electronic Medication Administration Record that logs all records of medications ordered and administered and ensures that a patient’s medical history is accessible throughout the hospital network.

It also integrated records from multidisciplinary teams to enhance medical collaboration. Medical professionals from different specialties have been able to share patient information and access their examination reports and medical images via the viewing function.

Moreover, CMUH clinicians now also have authorised access to the Med-cloud database of Taiwan's National Health Insurance (NHI), allowing them to query a patient's medical information. CMUH has also established a mechanism for uploading patient's medical information to the NHI.



**DR PEI-YING PAI**

Director of General Internal Medicine

“These improvements and implementations ensure that our system meets the standards required for the EMRAM assessment. They enhance the quality and accessibility of medical information, ultimately providing patients with safer and more efficient healthcare services.”

## KEY SYSTEMS

CMUH has the following systems and tools that support various aspects of healthcare delivery and data management:

- **Laboratory Information System** - This system is responsible for managing and tracking laboratory test orders and results. It plays a vital role in handling clinical chemistry, microbiology, and molecular data, with over 99% of test results stored as structured data for analysis and clinical decision support.
- **Radiology Information System** - This system manages and stores radiology images and related data. Clinicians can access images and scans through this system, aiding in diagnostics and treatment planning.
- **Pharmacy Information System** - This system is integral in medication management, employing interactive alerts to enhance medication safety. It helps in preventing issues like duplicate orders, drug interactions, and dosage errors.
- **Cardiology Information System** - This system is dedicated to the management of cardiological data and imaging, supporting the diagnosis and treatment of cardiac conditions.
- **Various medical systems** - Emergency, hospitalisation, outpatient doctor order entry system, nursing operation system, and inspection operation system. These systems allow for the comprehensive monitoring and management of patient data and results.
- **Clinical Data Repository (CDR)** - This acts as a central repository for clinical data. It consolidates various types of data, including laboratory results, images and pictures, and scans. Clinicians access this repository to view patient information and images, promoting more informed decision-making.

The aforementioned systems have been connected to facilitate efficient access to patient information and ensure seamless operations and patient safety. Most data within these systems are stored as structured and discrete data that enables trending analysis and clinical decision support.



## i.A.M.S.

A notable demonstration during the EMRAM validation was CMUH's comprehensive antimicrobial AI platform – the Intelligent Anti-Microbial System (i.A.M.S.). It features a four-in-one function which is driven by AI to identify drug-resistant strains and predict and monitor the risk of infectious sepsis and mortality. It can also make smart drug dosage recommendations and automatic comparisons of drug-drug interactions and allergy history.



### LU-CHING HO

Clinical Pharmacist /  
CMUH HIMSS Project Group Secretary

**“i.A.M.S is now 100% implemented and used in CMUH. It has been used in more than 200,000 visits since its deployment in June 2021. Three months after the system was launched, the mortality rate due to sepsis was successfully reduced by 7.1%, compared to 13.4% in the same quarter of 2020.”**

## STAGE 6 AMAM

CMUH also became the first hospital in Taiwan to be validated for Stage 6 AMAM. At this level, CMUH has demonstrated maturity in the use of predictive analytics and expanded focus on advanced data content and clinical support.

Its analytics strategies consist of:

- **Gathering** data from various sources while ensuring data integrity, accuracy, and consistency;
- **Storing** data in appropriate locations while ensuring data security, scalability, and usability;
- **Extracting** valuable information or features from the data while maintaining data quality and consistency; and
- **Providing** patient-centric descriptive, diagnostic, predictive, and prescriptive healthcare services.

The establishment of a Big Data Center, AI Center for Medical Applications, and the Digital Transformation Technology Office has been essential in achieving these strategies. So far, CMUH has developed 16 AI-driven services and 50 dashboards based on the Microsoft Power Business Intelligence platform. These AI and BI applications are covered broadly in clinical and operational areas.

CMUH has also made strategic investments in human capital to prepare staff to take on the challenges of the hospital's ongoing digital transformation. It has conducted training in AI and related fields, with more than 250 hospital staff taking one-month AI training courses.

## NOTABLE PROJECTS

During its validation, CMUH demonstrated its analysis of medication expenses. Started in 2018, the analytics project aimed to reduce instances of medication duplication in line with Taiwan's universal healthcare system and mandatory welfare policy. It implemented the medicine payment monitoring dashboard which monitors the changes in medication costs, identifies factors and causes contributing to increased expenses, and provides regular reports on cost analysis and medication trends. This project has helped CMUH realise an **annual cost savings of approximately NT\$ 200 million (\$6.2 million)**.

CMUH also showcased its ARDiTeX (ARDS Technology System) visualisation panel used in the Respiratory ICU. The platform enables near-real-time assessment of patient vital signs and ARDS (Acute Respiratory Distress Syndrome) changes. Through ARDiTeX, CMUH saw a **16% reduction in 28-day mortality among diagnosed ARDS patients**. Meanwhile, an AI-assisted chest X-ray detection model is currently being incorporated into the Respiratory ICU to further decrease ARDS mortality risks.

The hospital also highlighted its capabilities in sepsis risk prediction and antibiotic-resistant bacteria prediction through the i.A.M.S.



**WEN-SHENG FENG**

Director of Digital Transformation  
Technology Office

**“This validation serves as a crucial confirmation of CMUH’s extensive analytics infrastructure, which leverages vast and powerful data sources. It signifies CMUH’s commitment to harnessing big data for analysis and developing AI applications in the healthcare field to assist with medical prevention, diagnosis, and treatment. The focus on preventive, diagnostic, therapeutic, and prognostic aspects of comprehensive healthcare services, combining big data, medical information, and AI, has driven significant advancements in clinical applications.”**

“The ultimate goal is to use technology to elevate the quality of healthcare and patient safety within the hospital. By achieving the HIMSS AMAM validation, CMUH not only demonstrates its commitment to data-driven healthcare but also showcases its dedication to continuously improving patient care through the integration of technology and analytics.”



## ON THE RECORD



**DR DER-YANG CHO**  
Superintendent

“At CMUH, our smart healthcare vision is anchored in a patient-centred approach, aiming to refine clinical processes and elevate care quality through data analytics and AI. This approach, continuously evolving with our digital transformation journey, integrates advanced AI and BI to deliver more precise, efficient, and reliable medical solutions like the i.A.M.S.”

“Superintendent Dr Cho underscores our commitment to ‘useful, practical, and favoured’ tools and projects that enhance patient care and quality of life. Through these efforts, we aspire to make our healthcare services not only effective and efficient but also preferred and valued by our patients.”



**PROF OSCAR K. LEE**  
Vice Superintendent



**DR WEI-CHENG CHEN**  
Chief Secretary

“During these years – without any role models of smart hospitals in Taiwan – we observed and learned to figure out what a smart AI hospital is. We found that the HIMSS systems provide a systematic approach and clear criteria to achieve the goal. That’s why CMUH strongly endorses HIMSS systems to guide our directions and find out our weaknesses.”

# *An-Nisa Hospital: An in-house EMR as the foundation of digital transformation*



*Credit: An-Nisa Hospital*

## WHO THEY ARE

An-Nisa Hospital traces its humble beginnings to being a *rumah bersalin* (maternity clinic) operated by the Yayasan Permata Bunda in 1991. Later in 2000, it became a maternity and children's hospital, expanding its bed capacity from 15 beds to 47 beds. As demand for various health services have increased over time, the hospital transformed into a general hospital in 2008. It is expanding to have 187 beds, with 23 kinds of specialists, and is becoming a Center of Excellence for ophthalmology, urology and intensive care.

Located in Tangerang, a city west of the capital Jakarta, An-Nisa Hospital serves the most patients insured by Indonesia's national social security agency BPJS Kesehatan for a Type C hospital (or hospitals with at least 100 beds).

## THE PROBLEM

An-Nisa Hospital embarked on a digital transformation journey in 2016, starting with the implementation of an EMR. For years, it had been using paper-based medical records despite having a hospital information system (HIS), which consists of laboratory, radiology, inventory and billing systems.

When Indonesia implemented the *Jaminan Kesehatan Nasional* (National Health Insurance) program in 2014, the hospital had to deal with the growing number of patients it was serving. It faced an all-too-familiar challenge of operating efficiently while improving service quality amid increasing demand.

## PROPOSAL

“Our hospital director realised that digital transformation is the answer to these challenges, and our first step was to implement electronic medical records,” said Dr Dwi Edhityasrini Pratikto, chief of the Digital Transformation Team and Information System at An-Nisa Hospital.

The hospital initially had to work with a local vendor to build its comprehensive and tailored EMR system as few vendors offered such a solution then. An-Nisa Hospital implemented its first EMR in March 2019. It was first introduced in its outpatient service, followed by its emergency and inpatient departments.

However, doctors were resistant to adopting the solution then as the system was not user-friendly nor was it integrated with the HIS. Meanwhile, it also needed a solution that would help reduce some costs associated with administrative work and printing; improve the timeliness of claim submissions while handling an increase in claim volume; and facilitate patients’ access to their medical information.

## MEETING THE CHALLENGE

An-Nisa Hospital later found that the key to its digital transformation is the automation of some business processes by integrating its EMR and HIS. However, combining these two systems from different vendors was not an easy feat.

The hospital then decided to develop its own EMR and HIS from scratch in-house. It started by forming its IT team, which is composed of two medical doctors, one nurse, and one pharmacist as the product owner.

An-Nisa Hospital still met challenges along the way, particularly the lack of regulations and standards to follow in implementing an EMR and the various requests from users.



## RESULTS

Its self-developed EMR and HIS have been fully implemented since 2022 across the outpatient, inpatient, and emergency departments. The EMR has been integrated as well with the National Insurance Information System while work is underway to connect it with the latest national health data exchange platform SatuSehat.

Since implementing the integrated EMR and HIS, there is **no longer a wait time for processing medical records**. An-Nisa Hospital has also been **able to reduce administrative staffing by 60%**. Moreover, **costs related to printing medical records decreased by 78%**.

Meanwhile, a patient portal called Asha has also been developed to allow patients to access their medical information.

“We also realised there are still many things to improve on our digital transformation. It’s a never-ending learning process and digital transformation is our way of advancing hospital sustainability,” Dr Pratikto shared.

Recently, An-Nisa Hospital sought to determine its baseline level of EMR maturity by undergoing the assessment for the [HIMSS Electronic Medical Record Adoption Model](#). This digital maturity model measures the clinical outcomes, patient engagement and clinician use of EMR technology in an organisation.

Based on the assessment, An-Nisa Hospital is currently at an early stage of digital maturity with an overall 54% accomplishment against the EMRAM model. The hospital is using the results of the assessment to inform its digital health strategy and future business case. Below are HIMSS’ recommendations to build An-Nisa Hospital’s digital health maturity **over the next two years based on its assessment findings**.





Figure 1. HIMSS' recommendations to meet the Stage 6 EMRAM requirements over two years

Additionally, HIMSS recommended that An-Nisa Hospital undergo the **Digital Health Indicator (DHI)** assessment to measure its overall progress toward building a digital health ecosystem. The DHI can help determine other HIMSS Digital Maturity model evaluations the hospital can undergo to further improve its digital maturity.



## ON THE RECORD



**DR DWI EDHITYASRINI  
PRATIJKO**

Chief of Digital Transformation  
Team & Information System

“Working with HIMSS for the EMRAM assessments has been an exceptionally enriching and insightful experience. It provided a unique opportunity to collaborate with an organisation that has been at the forefront of healthcare digital transformation on a global scale. It has broadened our horizons and also enhanced our commitment to digital transformation. **HIMSS also motivated us that digital transformation is not only for premier or high-end hospitals serving private patients but also for local hospitals serving national insurance patients. The EMRAM assessment also helped us [become] a leader in healthcare innovation.**”

“Since the implementation of Ministry of Health Regulation No. 24 of 2022 which mandates hospitals to adopt EMR, hospitals have inescapably embarked on the journey of EMR integration. However, many hospitals perceive this as a mere compliance obligation. Yet, beneath this obligation lies an opportunity to enhance business processes, reduce operational costs, elevate service quality, and optimise clinical outcomes. Hospitals interested in developing EMR systems often lack comprehensive guidelines for their construction. The HIMSS EMRAM serves as an instrumental tool, aiding hospitals in charting a roadmap for EMR development as an integral component of their digital transformation journey.”

# ABOUT HIMSS

## WHO WE ARE

HIMSS is a global advisor and thought leader supporting the transformation of the health ecosystem through information and technology. As a mission-driven non-profit, HIMSS offers a unique depth and breadth of expertise in health innovation, public policy, workforce development, research and analytics to advise global leaders, stakeholders and influencers on best practices in health information and technology.

### HIMSS APAC Media Services

HIMSS APAC Media combines rich insights about the Asia-Pacific region, thought leadership in health IT, and the creativity of a media brand. Our work with health systems, technology companies, corporations, and governments empowers us to deliver trusted insight and information to healthcare IT influencers and decision-makers in the region through an expansive media portfolio.

### Why partner with us?

- Reach a targeted APAC health IT audience
- Leverage the HIMSS global brand and expertise to build credibility with your audience
- Explore a range of media options to extend your brand's visibility: from white papers to interviews to digital display advertising

For more information, contact Shereen Woon at [shereen.woon@himss.org](mailto:shereen.woon@himss.org)



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**Special Thanks**  
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