INTERACTIVE SESSION: TECHNOLOGY

Digital Transformation of Healthcare at Singapore's JurongHealth Services

Jurong Health Services, or JurongHealth, is one of Singapore's six public healthcare clusters. Healthcare clusters provide holistic and integrated care when patients move from one care setting, like a clinic, to another, like a hospital. Overall, Singapore's healthcare system comprises 8 public hospitals, 10 private hospitals, 8 national specialty centers, and an island-wide network of general medical practitioners. JurongHealth primarily manages the 700-bed Ng Teng Fong General Hospital, the 400-bed Jurong Community Hospital, and the Jurong Medical Center, all of which are located in western Singapore.

JurongHealth's goal is to provide transformative medical care for its patients through the use of innovative information technologies. Underscoring this commitment, in September 2016 JurongHealth's Ng Teng Fong General Hospital was awarded the Healthcare Information and Management Systems Society (HIMSS) Electronic Medical Record Adoption Model (EMRAM) Stage 7 Award—there are 8 stages, from 0 to 7, that measure a hospital's implementation of IT systems, and Stage 7 represents the highest level. Ng Teng Fong General thus became the first hospital in Singapore and the ASEAN region, and fifth in the Asia Pacific, to receive the award.

JurongHealth has integrated more than 50 healthcare IT systems as part of the Project OneCare initiative. The systems' implementation and integration took four years and has enabled the hospital to become paperless, scriptless, chartless, and filmless. Among the many systems implemented by the hospital are self-service kiosks to enable patients to register themselves by merely scanning their national identification cards and obtaining a queue number generated by the Enterprise Queue Management System. This unique number is used throughout the patient's visit that day for all service itineraries in the hospital. Patients refer to live screens located in the waiting areas that display a real-time queue status that shows their turn. This system has not only enabled JurongHealth to cut down on expenses but also to improve efficiency, as patients do not need different numbers for different services. It reduces waiting time and increases patient satisfaction.

Similarly, the Visitor Management System self-service kiosks enable visitors to scan their identification cards and register themselves to gain access to the hospital wards. Visitors can also register themselves and obtain an e-pass from the Visitor Registration counters that grants them access to the wards that they want to visit. The identification card or e-pass must then be scanned at the 2-in-1 Gantry when entering and leaving the ward. The 2-in-1 Gantry logs not only visitor information but also tracks staff, as they are also required to use the same gantries to visit a particular ward. Through the implementation of the Visitor Management system, the hospital can control access to the wards, and visitors or staff can be easily tracked and contacted in case of an epidemic.

Another IT system implemented is the Warehouse Management System, which eliminates the tedious process of manually counting inventory. The system uses passive radio frequency identification (RFID) technology and a two-bin shelving system to automate inventory top-up requests and improve inventory management. Once the primary compartment of the storage bin is empty, the clinical staff transfers the relevant RFID tag into a drop-box, where the reader automatically sends a request for drug replenishment, thus avoiding stock-outs.

JurongHealth has also implemented a Real-Time Location Tracking System to automatically track patients and medical equipment using Wi-Fi triangulation, low frequency exciters, and about 6,000 active RFID tags attached to patients or medical equipment. These tags continuously communicate with the low-frequency exciters to transmit data to the backend system for processing, allowing hospital staff to precisely locate patients and equipment, thus eliminating the need for tedious manual searching.

In another major move, JurongHealth made a conscious effort to ensure that the different IT systems would not be stand-alone. The hospital thus implemented an integrated Electronic Medical Record (EMR) system that combines all the functional modules of the hospital in addition to being interfaced with 140 medical devices and equipment. Using the vendor-neutral Medical Devices Middleware Integration System, data from these medical devices is directly uploaded into the EMR system, and thus no time or effort is wasted by clinical staff having to manually enter such readings, and the hospital no longer has to worry about charting errors. Being vendor-neutral also means the freedom to

adopt best-of-breed individual modules as well as a lack of reliance on a single vendor.

The EMR system has spurred other innovations such as the Electronic Patient Information Board, which enables clinic staff and nurses to view essential patient information on digital tablets, unlike most hospitals, which manually compile the information and display it at the bedside. Another example is the Inpatient Pharmacy Automation System, which receives prescriptions entered by the doctors via the EMR system and then sends machine-packed medicines to the wards using Automated Guided Vehicles that travel on pre-programmed routes and help in moving not only medication but also linen, meals, etc. At the ward, the patient's wrist tag is scanned and matched against the doctor's prescription before the medicines can be retrieved from the medical carts. Thus, only the required medication is supplied and administered to the right patient.

Another innovative use of technology is the Daily Operations Dashboard, which integrates data from different systems to show key metrics for various departments, such as emergency, outpatient clinics, inpatient wards, and surgery areas. It also analyzes, compares, and displays daily, weekly, and monthly statistics, which act as vital input for management decision making.

IT has played a key role in enabling JurongHealth to achieve its mission of providing world-class medical care at an affordable cost. As a result, JurongHealth has developed a reputation as a leading technology-driven healthcare provider as well as a role model not only in Singapore but also the entire region. This is also evident from its many accolades, which include awards for IT-driven transformation—the Project of the Year 2015–16 award by SPMI, the Singapore branch of the global professional accreditation body Project Management International—and for overall organizational transformation—"Best Companies to Work for in Asia 2014" by HR Asia.

Sources: P. Bhunia, "The JurongHealth IT Journey—Integrating IT from the Ground-Up into a New Digital Hospital," opengovasia.com, November 13, 2016, accessed December 21, 2016; JurongHealth, "Integrated Healthcare IT Systems at Ng Teng Fong General Hospital and Jurong Community Hospital win the Project of the Year Award at the SPMI Symposium 2016," www.jmc.com.sg, accessed December 21, 2016; JurongHealth, "Our Milestones," www.juronghealth.com.sg, October 2016, accessed December 21, 2016.

CASE STUDY QUESTIONS

1. What technologies are used by JurongHealth? What purpose do they serve?
2. Search the web for RFID. Suggest an example of using RFID for locating and tracking people.
3. What information systems are implemented by JurongHealth? Describe the input, processing, and output of any one such system.
4. Why are information systems important for JurongHealth?

Case contributed by Neerja Sethi and Vijay Sethi, Nanyang Technological University

The result is an information system solution to the business challenge of providing a high level of service with low prices in the face of mounting competition.

It Isn't Just Technology: A Business Perspective on Information Systems

Managers and business firms invest in information technology and systems because they provide real economic value to the business. The decision to build or maintain an information system assumes that the returns on this investment will be superior to other investments in buildings, machines, or other assets. These superior returns will be expressed as increases in productivity, as increases in revenues (which will increase the firm's stock market value), or perhaps as superior long-term strategic positioning of the firm in certain markets (which produce superior revenues in the future).

We can see that from a business perspective, an information system is an important instrument for creating value for the firm. Information systems enable the firm to increase its revenue or decrease its costs by providing