FACTSHEET ON HEALTHCARE CFC PROJECTS

Project Name: Anatomical Annotator for Improved Point-of-Care

Trial Venue: National Skin Centre (NSC)

Project Overview:
The aim of the project is to allow doctors to draw and annotate electronically over a digital image, without the reliance of paper and pen. Doctors will be able to describe the patient condition diagrammatically with precise location of the clinical findings in electronic form. All annotated charts are integrated with National Skin Centre's Electronic Medical Record (EMR) systems and retrievable during consultations. The project also seeks to establish a treatment protocol by correlating physical findings and treatment plans for better disease management.

Benefits:
- Better patient care
  Doctors can now record more accurate information which would lead to better record and chart progress of skin disorders.

Moving Forward:
Better management of the skin diseases with the help of good historical records of other patients with similar symptoms. Information collated can be used to optimize management of patient's skin disease scientifically.

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Project Name: Enhancing Patient Care and Safety Using Automated Wireless Vital Signs Monitoring and Radio Frequency Identification (RFID)

Trial Venue:
Singapore General Hospital (SGH)

Project Overview:
The project aims to enhance patient care, patient safety and operational efficiency by developing an integrated wireless vital signs monitoring system.

Known as the VEGA system, it is an integrated wireless monitoring system that can automatically capture a wide range of patients' vital signs, namely blood pressure, pulse rate, electrocardiogram (ECG), oxygen saturation, respiration rate and temperature. For a more holistic vital signs monitoring system, software modules for the direct entry of pain score have also been included.

It is part of an overall Digital Ward project initiated by SingHealth, with the objective of transforming the way healthcare professionals capture and access clinical information in an inpatient setting.

The VEGA system leverages on Radio Frequency Identification (RFID) and Wi-Fi wireless technologies, allowing vital signs readings to be captured automatically via these locally developed and customised wireless sensor devices:

- The ThermoSENSOR (Fig. 1): A coin-sized device to capture the temperature of patients. These temperature readings are transmitted automatically and wirelessly to the central server at a configurable predetermined interval using RFID technology.

- The ECG device (Fig. 2): To measure patients' ECG, oxygen saturation and respiration rate. These readings are transmitted automatically and wirelessly to the central server via Wi-Fi technology, making use of the hospital's existing infrastructure.

- The BP device (Fig. 3): To measure patients' blood pressure and pulse rate. The readings are also transmitted automatically and wirelessly at configurable predetermined interval to the central server via Wi-Fi technology.

- RFID wristbands (Fig. 4): To be worn by patients for identification and verification.

Through the VEGA system, nurses can generate electronic vital signs charts (Fig. 5) automatically, thus reducing the time and effort required to manually measure and plot the vital signs for each patient. The system also enables clinicians to view these online charts anywhere and anytime, therefore improving patient care, safety and operational efficiency.

Fig. 1: ThermoSENSOR

Fig 2: ECG Device

Fig. 3: BP Device

Fig. 4: RFID Wristband

Fig. 5: Online Charts and dashboard

Benefits:
- Improves patient safety
    i. Faster detection of abnormalities in vital signs
    ii. Reduces potential human errors with automated capture of data
    iii. Minimises unnecessary human-to-human contact during an infectious disease outbreak
- Improves patient care
    i. Less disruption to patients' rest as vital signs are recorded automatically
    ii. Nurses are able to spend more time in delivering patient care
- Improves operational efficiency
    i. Less time spent on menial tasks by nurses

Moving Forward:
Cadi will work with the clinicians and nurses on the improvements to the system for wider scale implementation in SGH.

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Project Name:
Geriartric In-Patient Nursing Record for Efficient Ward Management and Nursing Information Exchange (GinX)

Trial Venue:
Ang Mo Kio – Thye Hua Kwan Hospital Ltd (AMK-THKH)

Project Overview:
The main purpose of the project is to eradicate patient's medication errors at a hospital. It is achieved with a built-in engine that has a robust work procedure (6-Rights)** and a 3-way validation algorithm between prescription, dispensing and drug administration to ensure patient safety and hospital ward operational efficiency.

** 5-Rights is a recognized nursing good practice in the healthcare industry for medication administration which are the Right patient, Right drug, Right dosage, Right route and Right time. In MA-3, we have added the Right bed on top of the 5 rights making it a more stringent 6-Rights work process.

When a patient is first admitted into a hospital, the doctor will create an electronic in-patient medical record (eIMR) for him/her and this information is stored into a backend eIMR server. The eIMR enables the doctor to record his diagnosis, the medication, drug allergies, alerts and other information pertinent to a patient.

During the administration of drugs, this eIMR information is accessed wirelessly from the eIMR server and processed on a personal digital assistant (PDA) with barcode and RFID capabilities. **Figure 1** gives an overview of the system.
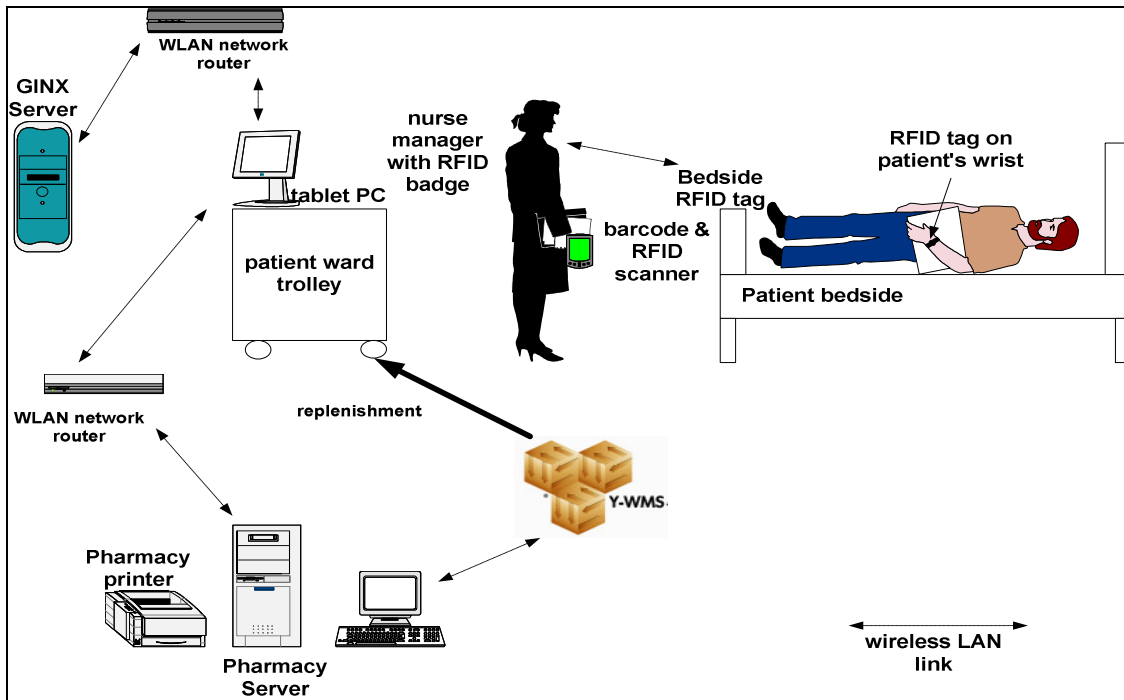

Fig 1: GinX Overview in a hospital ward

Benefits:

GinX addresses the need for a more efficient ward operation with less paper without affecting the service level of patient care or compromising patient's safety. It also streamline workflow between doctors, nurses and pharmacists throughout the patients stay in the hospital   This results in reduce human and medication errors in reading and analyzing paper based writing in dispensing and drug administration

With a robust eIMR backend, it provides related clinical information alongside medication administration to its users for comprehensive bedside care. The Electronic Inpatient Medical Record that can be shared within the hospital and also on MOH nationwide EMRX network and repository

The 6-Rights process and 3-way validation algorithm engine is carefully designed to map into the current industry good practices of nursing. This avoided the need to re-train nurses on a new procedure and provide them with the necessary information on hand at the site-of-actions to do their nursing functions. It also ensures that the proper, accurate and safe healthcare is given to the patients.

And all the necessary documentation to close a patient file when they are discharged or transferred (discharge summary) becomes a natural by-product of the medication administration workflow. This saves the doctors and nurses valuable time in preparing the discharge summary and the patients need not wait long as the document is available real-time and on-line.

Moving Forward:
GinX will be an important first step towards better patient's safety and improving the overall operational efficiency of the geriatric segment of the healthcare industry.

AMK-THKH aims to enhance the system to include more nursing management details, laboratory test results, diagnostic results like X-rays and dietary information to make the entire patient record more comprehensive and useful. The ability to share and exchange information with acute hospitals is also crucial to ensure that all related information is available electronically for the safe and continuous care of the patients.

Y3 is able to expand into the healthcare sector with the Geriatric In-Patient Record and Nursing Information Exchange system, specifically the step-down care institutions in Singapore and across the Asia Pacific region such as Japan, Korea, Australia/NZ where there is a fast growing aging population.

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Project Name:
Inpatient Vital Signs Monitoring System (VSM) – Cardiac Ward

Trial Venue:
Changi General Hospital (CGH)

Project Overview:
The objective of the project is to record and monitor the vital signs (e.g. BP, ECG, SPO2) of patients in the cardiac ward, using Blue Tooth enabled vital sign sensors and hospital's Wi-Fi network. The scope of the project includes:
• recording and monitoring of the vital signs of inpatients in Ward 38 using the Vital Sign Monitoring System.
• capturing the challenges faced in achieving the proposed solution.
• comparing the accuracy of the readings recorded against the requirements of the care providers.

- gathering feedback from patients and nursing staff on the pros and cons of implementing this system.

Benefits:

Hospital
- CGH is the first hospital to test the Ericsson's EMH 2.0 solution developed for usage in inpatient situations. The solution enables doctors to monitor the vital signs of a patient anywhere in the hospital, providing better patient care.
- Most of the solutions available today use proprietary body sensors; the VSM solution is based on an open platform, which enables CGH to connect to variety of sensors from medical device manufacturers.
- Enhances Staff's safety – By reducing the healthcare provider's unnecessary exposure to patients with communicable disease.
- Improves the accuracy of medical readings in wards.

Patient
- Patients can conveniently move around while their vital signs are being measured and monitored wirelessly.
- Enhanced patient care - By eliminating the routine tasks of checking patients for vital signs, healthcare providers become more accessible to the patients in need.

Moving Forward:

Once Ericsson implements the feedback suggested by CGH, the VSM solution will enable the patients to:
- move around the wards wearing lightweight blue tooth sensors and communication device that can measure and send the vital sign readings wirelessly to the server.
- watch TV or chat at the Ward Lounge without worrying about vital sign measurement.
- sleep undisturbed while their vital signs are being periodically measured automatically by the VSM system.
- get to have more quality time with the nurses when they need support, as the system will automatically chart the vital sign reading instead of manual charting by nurses.
- get better service by allowing the doctors to monitor the vital signs readings anywhere within CGH.

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Project Name:
Inpatient Vital Signs Monitoring System - General Ward

Trial Venue:
Gleneagles Hospital

Project Overview:
The objective of the Vital Signs Monitoring System (VSM) is to record and monitor the vital signs (e.g. BP, ECG, and SPO2) of patients in the cardiac ward; using Blue Tooth enabled vital sign sensors and hospital's Wifi network. The scope of the project includes:
- recording and monitoring the vital signs of inpatients Ward 8East (O&G/Surgical) using the Vital Sign Monitoring System.
- capturing the challenges faced in achieving the proposed solution.
- comparing the accuracy of the readings recorded against the requirements of the care providers.
- gathering feedback from patients and Nursing staff on the pros and cons of implementing this system.

Benefits:
- Efficiency

The VSM system has enhanced the efficiency of the user. The remote monitoring feature enables the nurses to monitor the health of multiple patients. This helped them prioritize work and focus their attention on the critically ill.

- Productivity

The productivity of the nurses is expected to increase to a great extent as the new system minimizes extensive rounds of the wards. The hourly monitoring by nurses will not be necessary as long as the system shows the patient to be stable and healthy.

- Patient-Friendly

Remote monitoring ensures that resting patients are not disturbed by the routine checks conducted by visiting nurses. Nurses can attend to patients who are critically ill and leave the rest undisturbed.

- Easier Handling of Patients

The patients can be registered with the system in few easy steps. The attachment and detachment of the EMH kits are done in a single step.

- Easier Handling of Kits

Ericsson ensured that the VSM kits are easy to handle even by non-technical, common users. The starting up and shutting down of the COM boxes is very simple and the process for attaching the kits is like that of any standard medical instrument available in the market.

Moving Forward:
Once Ericsson implements the feedback suggested by Parkway the VSM solution will enable the patients to
- Move around the wards wearing lightweight blue tooth sensors and communication device that can measure and send the vital sign readings wirelessly to the server

- Watch TV or chat at Ward Lounge without worrying about vital sign measurement
- Sleep undisturbed while their vital signs are being periodically measured automatically by the VSM system.
- Get to have more quality time with the nurses when they need support, as the system will automatically chart the vital sign reading instead of manual charting by nurses.

- Get better service by allowing the doctors to monitor the vital signs readings anywhere within Parkway

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Project Name:
Integrated Workbench & Clinical Pathways for Paediatric Emergency Care

Trial Venue:
KK Women's & Children's Hospital (KKH)

Project Overview:
The project aims to:
- provide a low cost 'integration' solution that helps tracking of orders and patients sent to external departments in order to move towards a paperless department with reduced patient waiting time.
- cater to an integrated A&E portal to resolve the following limitations:
  Currently, A&E doctors generate lab and radiology orders as well as prescriptions for pharmacy. These orders are printed and taken by the patient to the respective departments. The doctor is unaware of the status of the order till the result appears as a print out on his desk. The patient has to wait all these time.
- provide a user friendly template for Clinical Notes documentation to replace the manual unstructured handwritten or transcribed text documentation to complete the entire A&E procedure. This template shall provide guidance for the clinical and regulatory documentation based on the patient essential demographic data – promoting more timely and thorough documentation that assists with patient care.
- provide enhanced clinical decision support through clinical pathways, allergies, medical conditions etc. to improve the consultation process, which will consequently lead to a better turn around time.

Benefits:
- Provide readily available information through the integrated portal and hence help to improve the decision making process and improve patient experience as departments.

- Integration of the clinical pathways enable doctors to access guidelines prescribed from senior doctors for treatment of certain child related disease such as diabetes, heart problems etc.
- Improves patient tracking within the A&E workflow as information moves in a softcopy format doing away with the paper forms. Patient waiting time is reduced as lab/radiology results are notified to doctors in order system
- Clinician is able to acknowledge the XRay reports online instead of paper flow, creating the paperless environment.

- Clinician is able to view the full Emergency Department reports online with the shortest delay instead of retrieving paper report from patient's case note.
- The benefits overall hasten the consultation process, hence reduce patient waiting time.

Moving Forward:
- We want to achieve full pharmacy order integration whereby less pharmacists' intervention will be expected as we improve the workflow at the pharmacists' drug dispensing end.
- We want to achieve complete Paper-less flow for Radiology Order: Scanned patient consent form will interface over to pharmacy system instead of patients having to bring along the signed consent form.
- Prescription Orders to integrate with CMIS – Critical Medical Information Store so that pharmacists can be promptly advised on patients' Drug Allergy and patients clinical outcome can be better managed.
- Development of more clinical pathways to manage clinical outcome.
- Integration of doctors and nurses notes into 1 complete record.
- Leveraging on the system to create a paediatric injury and trauma registry as a clinical/disease registry.

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Project Name:
Mobile Healthcare Strategy: Cluster Wide (NHG) Adoption

Trial Venue:
National Healthcare Group (NHG)

Project Overview:

In July 2004, Tan Tock Seng Hospital (2004) and an industry consortium along with IDA, supported the development and solution trials of a system aimed to replace the TTSH paging system to improve communication efficiency between doctors and nurses with the use of mobile handphones.

The core of the system is built using open Instant Messaging standards and employs the ubiquitous Short Message delivery transport. This system, called Healthcare Messaging System (HMS) was the first of its kind that is known in usage in the medical community in December 2004.

National Healthcare Group (NHG) was awarded the IDA Healthcare CFC grant to leverage on the foundation and the success of the HMS project and further transform the NHG system into a complete mobile point-of-care application. This involved the full deployment of HMS across the cluster's other hospitals as well as the auxiliary medical centres and clinics in the National Healthcare Group.

Through this CFC, NUH and IMH has fully converted the doctors from use of pagers to mobile phones. The hospital-wide rollouts proceeded relatively smoothly and we expect the deployment in NHGP to be the same as well.

Benefits:
The system eliminated the need for hospital personnel to carry multiple devices and yet provide paging-like functionality with text push capabilities. The presence-based solution reduces the inefficiency of the current communication process between the nurses and doctors as it allows messages to be customized and status to be set.

The concluding result from the TTSH project and study showed that using handphones in the hospital saves time without affecting patients' safety. This represents a huge change in paradigm change in the way key frontline staff communicates with each other. The pilot is a step-wise implementation study into the numerous communication processes and responses from mission-critical medical decisions that ultimately impact the quality of care of the patients.

Moving Forward:
HMS has been proven to be a solid healthcare communication platform to build upon, and its benefits of efficiency and multi-mode communication can be extended to allied health services.

NHG is also looking at applying the closed-loop communications capability of HMS to facilitate patient step-down care, and improve inter-institutional communications, leading to better patient outcomes.

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Project Name:
Operating Theatre Scheduling and Tracking System

Trial Venue:
Singapore National Eye Centre (SNEC)

Project Overview:
The Operating Theatre Scheduling and Tracking (OTST) solution comprises of the OTST application to manage patients during day surgery activities from listing to actual day surgery operations. Paired with an automatic identification and data capture (AIDC) component, the solution aggregates patient demographics, surgery details and real-time location that presents a holistic view of day surgery activities across the day ward and operating theatres in real-time.

Benefits:
From SNEC's perspective, the project has enabled the consolidation of significant portions of the patient day surgery administrative and tracking processes under one roof, providing a single point of entry at the right time and place with end-to-end information share. It helps to reduce staff paperwork yet improves information distribution and completeness. For instance, Digital Day surgery Logbooks, compared with their paper equivalent the size of thick tomes, are more legible, virtually weightless and readily yet securely accessible to staff.

As part of the effort to provide an accurate and fast way to facilitate patient and inventory identification and tracking, automatic identification and data capture (AIDC) technology in the form of barcode scanners and radio frequency identification (RFID) equipment was incorporated. By aggregating the AIDC and application data collected during the patient's day surgery journey, real-time day surgery visibility was achieved. An example of its use is in the operating theatre area where nurse stations and offices are equipped with LCD TVs and monitor displays to provide operating theatre staff with real-time updates of patients' progress. Another enhancement tapping on this capability is the Digital surgery work lists for the day. It is now updated with time, location and status accessible by staff to facilitate better management of patient care.

Better, faster and safer. With relevant information at their finger tips as and when they need it, SNEC staff are better equipped now than before to provide better care and service for each and every patient that comes for day surgery.

Moving Forward:
Patients can look forward to a Digital Operating Theatre solution implementation where staff will be equipped to provide even better care and service via enhancements to

actively manage and track day surgery patients. New enhancements include more user-friendly screens, improved patient management and identification processes, distribution of actionable information via the use of e-mail and SMS and business intelligence capability to better discover and exploit patterns and trends.

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Project Name:
Optimised Operating Theatre Scheduling System

Trial Venue:
National University Hospital (NUH)

Project Overview:
The project is to develop an IT system is developed which can leverage on optimisation technologies to effectively schedule a patient going for operation. Traditionally the problems of scheduling are as follows:
a) There are many disparate pieces of information which are required to schedule a patient going for operation but not integrated at the point of scheduling. These include patient's preference, surgeon's availability, anaesthetist's availaiblity, operating room availability and equipement ability;
b) Scheduling is done in an electronic diary with intelligence to optimise the scheduling. For example, there are often overruns due to underestimation of time taken to do a particular type of surgery, resulting in cancellations.

Benefits:
Hospital:
• It cuts down the administrative efforts of making phone calls to get the information needed to schedule a patient going for operation.

Patients:
• The likelihood of mis-scheduling will be reduced hence reducing rates of cancellation.

At this point in time, the project team is still collecting data and fine tuning the system to get the optimisation desired.

Moving Forward:
Patients can look forward to the hospital being able to give their operation date faster and also even further reductions in cancellations.

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Project Name:
Patient Bedside Terminal

Trial Venue:
Singapore General Hospital (SGH)

Project Overview:
The Patient Bedside Terminal (PBT) is a 17-inch touchscreen integrated information system, which provides clinicians and nurses with an efficient and convenient means to access medical information at the patient's bedside. Nurses can also take meal orders for the day electronically by patients' bedside, instead of writing down orders manually. Patients, on the other hand, can speak to the nurses on duty through a video nurse call via these terminals. This means that patients can have face-face communication with the nurses without having to wait for the nurse to come physically to their bedside for non-urgent requests. They can also access TV, Internet services and video-on-demand, thus being connected to the world despite being warded in the hospital.

This solution is part of an overall Digital Ward project initiated by SingHealth, with the objective of transforming the way healthcare professionals capture and access clinical information, as well as enhancing patient care.

PBT was piloted at Ward 76 (Orthopaedic Ward) of the Singapore General Hospital (SGH). Eleven fixed-arm and mobile versions of the PBT are placed in various rooms, while one unit is placed at the nurse station to function as the Nurse Call System.

Benefits:
Patient Care and Safety
- On the spot and more eligible documentation of patients' condition.
- Minimises loss of critical information due to misplaced paper medical records.

Patient Service
- Improves patient's hospital stay with a variety of entertainment services to choose from.
- Improves doctor-patient communication.

Operational Efficiency
- Immediate access to critical patient information.
- Facilitates discussions during ward rounds.

Time Savings
- Saves nurses' time in writing down meal orders for patients and subsequently keying in the orders at their workstation.

Moving Forward:

SingHealth will explore full implementation of the PBT at the private wards at SGH, following a post-pilot evaluation with the management and users.

In the near future, the PBT will be placed on trial at other SingHealth institutions like KK Women's and Children's Hospital (KKH) and Changi General Hospital (CGH). New features will be added to meet the needs of these institutions. For example, the PBT units for KKH may include a feature allowing virtual ward round. This is useful for parents who cannot be with their children during the doctors' daily morning ward round. In this case, they can call in using their 3G mobile phones or home computers fitted with a webcam for a virtual ward visit, getting updates on their children's condition in real-time. This saves parents a trip to the hospital, and the need for doctors and parents to make arrangements to meet separately.

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Project Name:
Pilot/Trial of HL7 Module & Mobile Security Module at TTSH

Trial Venue:
Tan Tock Seng Hospital (TTSH)

Project Overview:
Currently, after a doctor orders a lab test for an inpatient, samples are sent to the lab for processing. Since 2005, TTSH and the National University Hospital's (NUH) labs have been automated and specimens are processed via robotic arms. With automation, lab test results are available much faster and automatically stored in the NHG Lab Information System (LIS). When there is a critical result, the LIS alerts the lab staff who will immediately call to inform the ward nurse. The lab staff reads out the results to the ward nurse who will repeat the results to the lab staff to ascertain accuracy. The ward nurse then identifies the doctor in charge of the patient and proceeds to call the doctor on his mobile phone to inform him. The information is also repeated between the nurse and the doctor to ensure accuracy.

The current manual process is laborious – much time is wasted between the communication of lab staff, ward nurse, and the doctor. The time could have been used by doctors and nurses to provide direct patient care. Furthermore, as many parties are

involved, there is a possibility of human error. The current manual process is laborious – much time is wasted between the communication of lab staff, ward nurse, and the doctor.

The time could have been used by doctors and nurses to provide direct patient care. Furthermore, as many parties are involved, there is a possibility of human error.

The National Healthcare Group (NHG) with the support of IDA's Healthcare CFC piloted a project at Tan Tock Seng Hospital (TTSH) from December 2006 to February 2007 to transmit inpatients' critical laboratory test results directly from the labs to doctors' mobile phones. It replaced the current manual process which took about 18 minutes. Under the pilot, it took only two minutes for critical lab test results to reach doctors.

The pilot involved 80 doctors from TTSH's General Surgery Department, which sees an average of 500 lab tests per day. About 10%, or 50, of these test results are in the critical range. Please refer to Annex A for the workflow.

Benefits:
Under the pilot, critical lab test results in the LIS were transmitted via a Healthcare Messaging System (HMS) to the mobile phone of a doctor in the care team responsible for the patient. The doctor would acknowledge by replying a return text message. If the doctor did not acknowledge, the results were automatically sent to the next most senior doctor in the care team. The whole process from the LIS to the first doctor's mobile phone took about two minutes. This meant more timely care for inpatients with critical lab results.

It also meant better use of time for doctors, nurses and lab staff. The electronic process also reduces human intervention and error.

Moving Forward:
On a daily basis, TTSH conducts an average of 12,000 lab tests. About 0.5% of all lab tests are critical cases. With the successful pilot, NHG will be implementing the electronic process to the rest of TTSH. NUH, which conducts about 10,000 lab tests daily, is next to pilot.
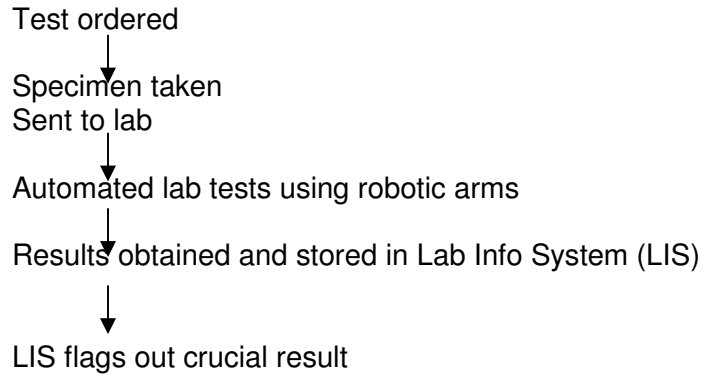
Moving forward, NHG plans to enhance the process further to transmit critical lab results directly to the mobile phone of the ordering doctor instead of a doctor in the care team. There are also plans to introduce e-ordering of lab tests by doctors, thus making the entire lab process from ordering to reporting and sending of lab results electronic and tracked for quality improvements.

NHG will also explore sending critical results of radiological investigations (e.g. x-rays) and pathology tests directly to doctors' mobile phones.
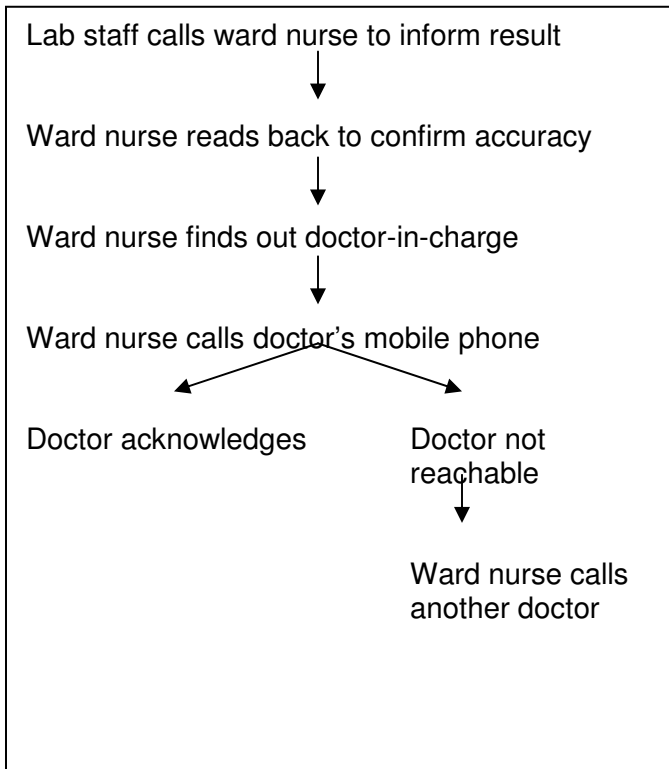
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Workflow Chart

Test ordered

Specimen taken
Sent to lab

Automated lab tests using robotic arms

Results obtained and stored in Lab Info System (LIS)

LIS flags out crucial result

Current Process	**Auto**
Lab staff calls ward nurse to inform result	Result transmitted to HMS system
Ward nurse reads back to confirm accuracy	HMS system sends an SMS to doctor
Ward nurse finds out doctor-in-charge	Doctor acknowledges / Doctor does not acknowledge
Ward nurse calls doctor's mobile phone	HMS sends message to the next most senior doctor in the care team
Doctor acknowledges / Doctor not reachable	
Ward nurse calls another doctor	