TECHNOLOGY CONSULTING
IN THE GLOBAL COMMUNITY

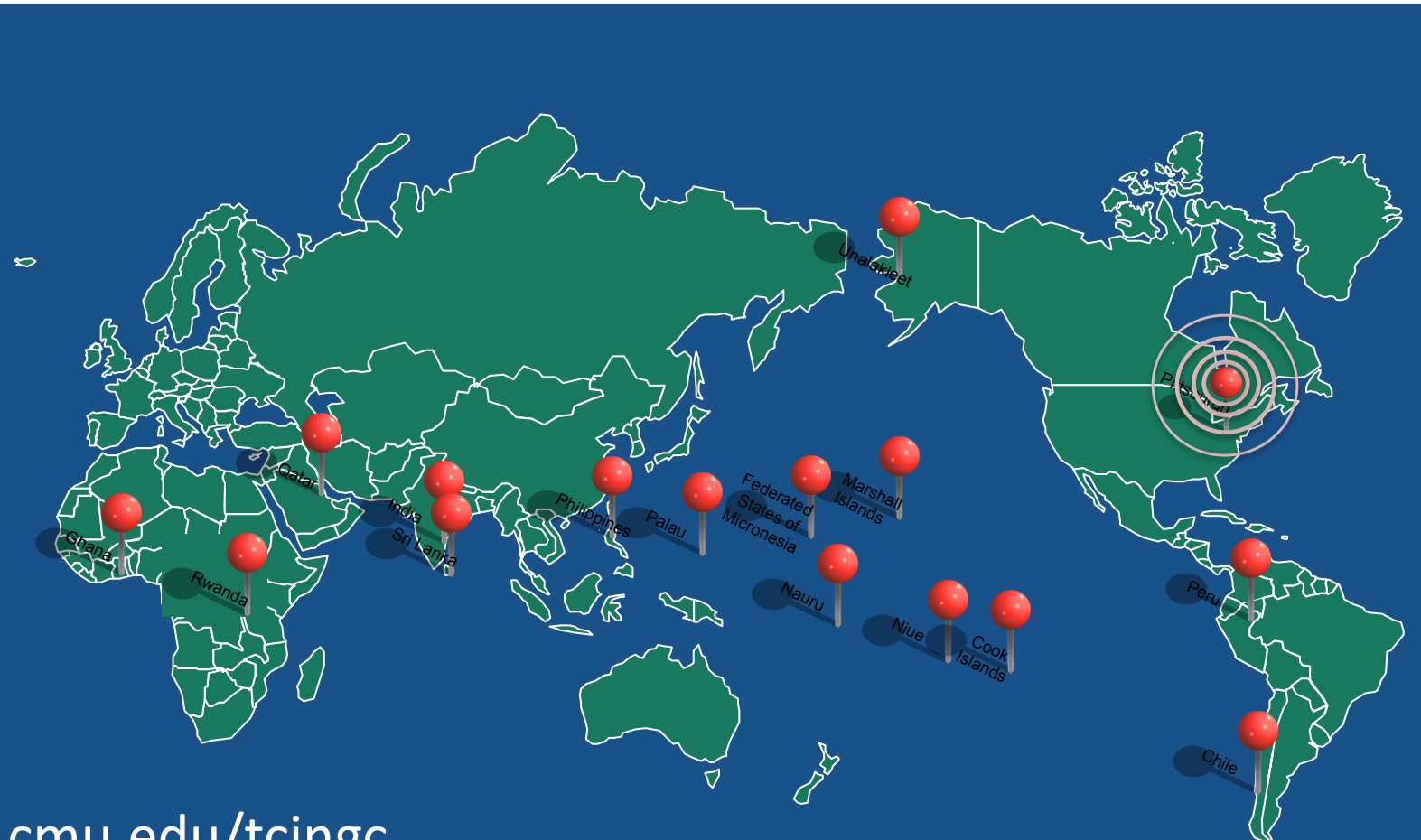
Final Consulting Report

University Hospital of the West Indies

Saachi Talwai

August 2021

Carnegie Mellon University



cmu.edu/tcingc

Health Incident Reporting System
Executive Summary

Student Consultant, Saachi Talwai
Global Community Partners: Mr. Herman Athias, Senior Director (Resigned), Information and Communications Technology, UHWI
Mr. Wayne Little , Application Specialist, UHWI

I. About the Organization

The University Hospital of the West Indies (UHWI) , formerly known as the University College Hospital of the West Indies was established in Kingston, Jamaica, in 1948. It came into being, because the medical department of the University College needed a hospital to provide its students with practical training. From then to now, UHWI has expanded to have over 15 departments ranging from General Medicine, Pediatrics, Radiology, Gynaecology to Dermatology and Psychiatry. UHWI believes in the confluence of research and quality with its mission statement being the following[1]:

> *"The University Hospital of the West Indies is committed to teaching, research and the provision of quality health care for the region. In striving for excellence, it maintains an environment conducive to an efficient, cost effective, responsive health care promotion and delivery system by incorporating the participation of all categories of staff and students, patients, their families and the wider community.*

As of today, the hospital has an average of 3000 employees[2] which include medical and administrative personnel, and 579 beds[1].

II. Creating *a digital application (web and mobile) for a reporter to log incident details*

The tangible deliverable at the end of the 10 weeks of consulting with UHWI is a Patient Safety Progressive Web App (PWA) built with Adalo and Xano. This PWA is exclusively for the reporter of an incident to log an incident and the supervisor (line manager) and doctor to fill in their reports related to the incident.
Features of this PWA include

- The initial incident form can be submitted or saved as a "Draft" by the reporter.
- Additionally details of the incident logged can also be viewed at any time. Screenshots of this Application can be viewed [Appendix D]
- Respective Forms for the line manager and doctor to fill, save as a draft and submit

Additional Recommendations (after week 10):

- Integration of notifications to be sent to doctor and line manager and User Interface
- Separate Case Management Application to be used by risk management team for incident resolution

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Programs

Apart from medical departments, UHWI has many specialized services such as[3]

- A Special Addiction Treatment Plan
- A Community Mental Health Program
- 24 hr Emergency Services
- Blood Donation Drives
- Blood Sample Testing

Staff

The staff at UHWI can be widely divided into medical doctors, nurses, and administrative staff. [4]

Category	Sub-domains
Medical Doctors	Consultants Senior Residents Residents Junior Residents Senior House Officers (SHOs) Interns
Nurses	Nursing Directors Nursing Educators Charge Nurses Nurse Practitioners Nurse Anaesthetics Mental Health Nurses Midwives Intensive Care Nurses Emergency Medicine Nurses Enrolled Assistant Nurses
Administrative/Clerical/Technical Staff	Anaesthetic Technicians CEO Clerical Officers Customer Service Agents Directors Drivers Electricians Managers Medical Chief of Staff Medical Technicians Patient Advocates Patient Care Assistants Phlebotomists Physiotherapists Radiographers Secretaries Senior Directors Technicians Telephone Operators

	Administrative Assistants

Fig 1. UHWI Staff Diversity

Technology Infrastructure and Management

Wards at UHWI are generally equipped with 1-2 desktop computers and require additional medical carts. All Information and Communication Technologies (ICT) at UHWI are managed by the Management Information Systems (MIS) Department. Their key responsibilities of the 30 member department are as follows[5]

- Providing IT support to End-Users
- Upkeep of the Local Area Network (LAN) and Virtual Private Network (VPN) infrastructure at UHWI
- Maintenance of peripheral devices like copiers and printers
- Implementing new and emerging technologies.
- Ensuring Data Security

The MIS Department is organized into sub departments, that are the following:

Chief Information Office - Mr. Herman Athias (Resigned)
MIS Administration
ICT Help Desk
Infrastructure and User Support
Applications and Software Engineering Management
ICT Project Management and Strategic Planning

Fig 2. MIS Department Organization

Led by Mr. Wayne Little , the Applications and Software Engineering Management team in UHWI primarily uses subscription based technologies (which normally are ready to use frameworks) to build web and mobile applications. The idea is to build “Low Code No Code” solutions. Using third-party subscriptions allows UHWI to focus on multiple projects and reduce a single project’s development time.

Technical terms used in the rest of the document:

1. Front-end: Technologies related to the part of an application that the user views.
2. Back-end: Technologies related to the part of an application a user can’t see, and are usually “engines” of an application. These software are usually used to implement the business logic of an application, and interact with its front-end and database.
3. CRUD: Acronym to Create, Read, Update or Delete a record from a database.
4. REST APIs (Application Programming Interface): In simple terms, APIs are pieces of code that allow two or more applications to talk to each. For Example, through an API Application1(can also be called client) makes a request to “get” data from Application2 (can also be called a server). REST APIs are a set of APIs that follow REST (Representational State Transfer) constraints. REST is a software architecture style where an RESTful API transfers a representation of the state of the resource from the server to the client[6].

Below is a list of technologies used by the hospital to build their existing applications:

Technology	Category	Description	Version Used
Xano[7]	Back-End Development	No Code Back-End to create database, populate data and create REST APIs	Paid - Prototype Edition
Adalo[8]	Front-End Tool	No code Front-End Mobile and Web Application Creator (Basic Drag and Drop components)	Free Version
Integromat[9]	Workflow Automation	Free Service to integrate multiple applications in a workflow	Free
PostgreSQL[10]	Database used in Xano	Open Source object-relational database system . Database used by	12.3

		Xano, to create tables and perform CRUD operations	
BPMN.io[11]	Business Process Management	Tool to create business process workflows	Free 2.0
Twilio Sendgrid[12]	Email Delivery	The Twilio SendGrid Email API allows host applications to send emails	SendGrid Web API v2 (Paid)
Easy Send SMS[13]	SMS Delivery	SMS tool which allows web platforms to send bulk SMS using its API	Paid
Google Data Studio[14]	Reporting	Tool to create Data Dashboards	Free
GLPI	Ticket Management	Used by UHWI Service Desk for Customer Issue Tracking	Licensed

Fig 3. Table of Software

* Red platforms indicate these technologies will be integrated into the digital HIRS system in the future.

Apart from these primary technologies, developers at UHWI follow certain software guidelines to standardize the app-development process and maintain the quality of the projects.

Guidelines From	Category	Description
SAP Fiori[15]	Front-End Designs	Promotes use of 5 design principles, with ideal User Experience being: role-based, adaptive, coherent, simple, and delightful
Australian Government API Standards[16]	REST APIs	Design Standards for the Whole of Australian Government (WoG)

		Application Programming Interfaces (API)s.

Fig 4. Software Guidelines

Technology Planning

The budget for technology infrastructure is planned annually at UHWI, with the final budget being signed off by Mr Herman Athias (resigned), the Senior Director of Information and Communications Technology at the hospital.

Communication

Internal communication and file sharing is done on the UHWI intranet. The hospital has its own domain and Google Suite with each of its staff members being given email addresses and access to Google Drive products. Virtual meetings are conducted externally and internally on video conferencing software Zoom. Most written communication is done via email.

The official UHWI website is updated regularly, with the date of the last update present on the top of the website. Donors and Funders of UHWI need to contact the Office of the CEO to make a donation to the hospital. Appreciation and credit messages for these donors are usually displayed on the website of the hospital.

Information Management

The primary information of the institution is patient data and associated financial data (invoices) stored in a Hospital Information Management System (HIMS). UHWI intended to move to a Digital Hospital Information System in 2018[17], thereby making both clinical and non-clinical operations easier. However this project is still in development.

The HIMS was intended to help in the following ways:

- Reduced waiting time for appointments
- Reduced the number of lost records
- Make patient payments more systematic
- Reduced delays in production of medical records.

Medical terms to be used in the rest of the document:

Terminology	Meaning
Health Incident	The NHS (National Health Service, UK), an incident is any event or circumstance arising from or during Activities that could have or did lead to unintended or unexpected harm, injury, distress, loss or damage to a person or property. A health incident report that provides the reader with information of an untoward event that has taken place related to the hospital. This could be Clinical or Non-Clinical. For Example: A patient might leave the hospital without being officially discharged. A Nurse who witnessed this incident reports it. Basic Reporting information could be: the name of the person involved in the incident, its timing and notes about it. Normally any individual can report an incident. The incident was resolved by the risk management team of a hospital.
Health Incident Reporting System	A workflow of people and objects (see figure 2) involved in reporting an incident.
Shift Manager/Line Manager	A Manager that supervises the proceedings of a medical ward during one or more shifts.
Nursing Quality Coordinator	Manager that ensures that nursing staff maintain quality of medical records and operations.

Fig 5. Medical Terms

Stakeholders Requirements: To implement the online HIRS, it would help to address the pain points of the people involved in the HIRS workflow and the features required according to them in the online system[Appendix A]

Fig 6. Stakeholders of the HIRS System

Based on stakeholder conversations the primary features of the HIRS platform are:

- Simple to use User Interface to fill in incident fields
- Notifications for stakeholders to fill in their section of reports
- Reporting feature to:
    - Analyze the number of incidents longitudinally (quarterly or annually)
    - Analyze the number of incidents per unit (or ward)
- Escalation (or notification) to senior management or supervisors if certain stakeholders don't complete their part of the incident form on time
- A table/ list to view approved/submitted incidents by stakeholders

Research

A leading industry example of a HIRS is the RLDatix[18] Patient Safety Platform. The Datix Platform is used by NHS, UK. The incident form provided by Datix allows the reporter log the:

- Date and Time of the incident
- Description of the incident
- Severity of injury if there was one
- Immediate Action Taken
- Witnesses to the incident
- Related individuals to the incident incase there were multiple people involved

RLDatix is a licensed software with each feature costing 3000 USD[18]. The intended HIRS solution is going to be used primarily by UHWI before a generic expansion to more hospitals in Jamaica. And so, the government funded Hospital wants to build a free platform.

A few features that RLDatix has that would be considered to be implemented in the Proposed HIRS:

- Incident Approval by various stakeholders
- Notification Emails to stakeholders
- Adding Attachments to incident reports
- Report - Creating age-groupwise incidents, incidents by type - non-clinical or clinical
- Report export into using Effects of using Datix
- Recording, investigating and learning from incidents
- Linking related incident

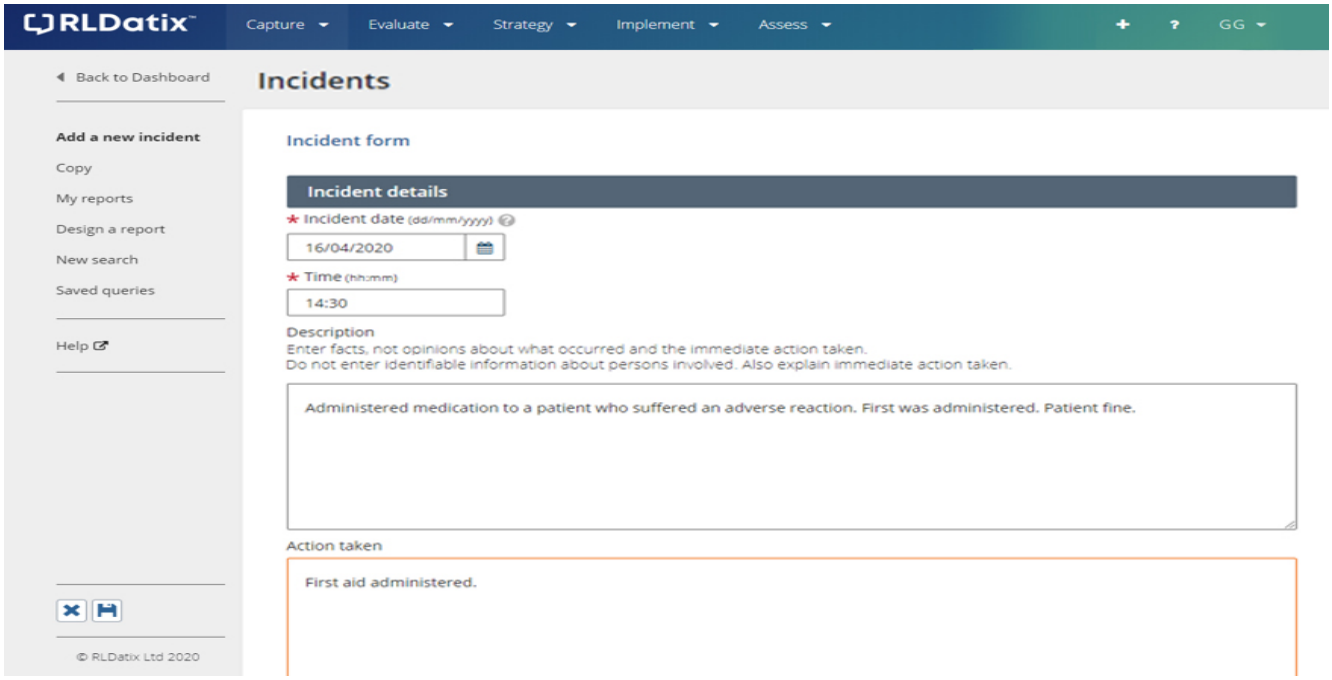

Fig 7. RLDatix Basic Features

Another consideration for an HIRS solution would be generic open source Incident Response like Spiceworks. However, Spiceworks lacks high configurability which any health incident form demands and so the hospital emphasises on creating a customized application, and rules out the use of open source software.

Technologies and Process Management Tools

The HIRS is to be implemented using:

- Adalo: Building Front-end of Application
- Xano: Back-End API construction and Database
- Future Integrations:
    a) Integromat : Workflow automation tool
    b) Twilio Sendgrid
    c) EasySend SMS - Notification

Note: The new platform would not use any retroactive data. The database will be constructed from scratch.

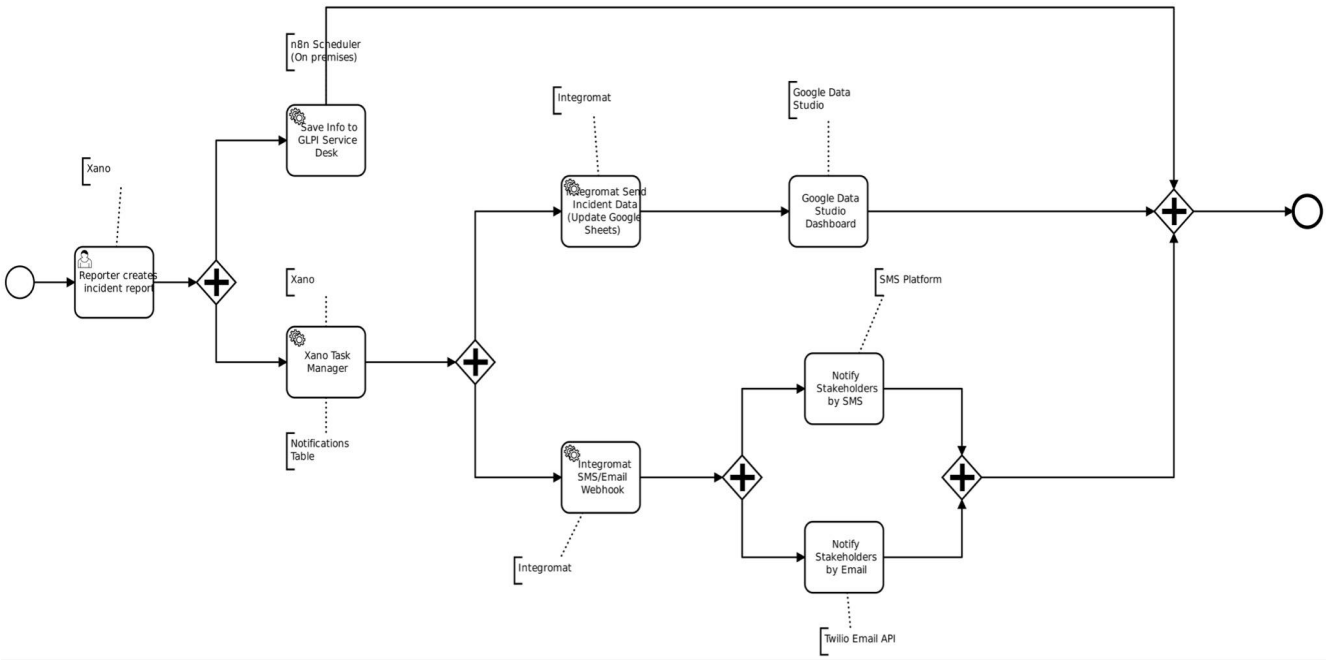

Fig 8. Proposed System Overview

II. Creating *a digital application (web and mobile) for a reporter to log incident details*

Motivation

Extensive Health Incident Reports (forms) at UHWI are currently logged on paper. This gives rise to bulk and makes archiving documents difficult. The paper-based incident reporting system at the hospital is inefficient and follows a tedious workflow. After a reporter files an incident, the report follows a long chain of approval.

Firstly the report needs to be signed by the respective doctor if a medical procedure was involved during the incident. It then goes to the supervisor (line manager) of the particular ward where the incident took place. Lastly, the report is approved by the nursing quality coordinator who sends a copy of the report to the risk management team and the customer care branch. According to nursing quality coordinator Mrs Alexander, she receives an average of 200 incident reports/month and has a hard time making copies of these reports and sending them to respective stakeholders in the Health Incident Reporting System (HIRS) i.e. the risk management team or customer care. There is a need for digitizing the entire HIRS workflow. If a legal team needs to be involved, a copy is sent to them as well. This process of getting approval and signatures on a single form is long on a paper-based system. And so, an online platform would reduce this lag in conflict resolution, with the risk management receiving the report and resolving the issue at the right time.[Appendix B]

Outcomes

The tangible deliverable at the end of the 10 weeks of consulting with UHWI is a Patient Safety Progressive Web App (PWA) built with Adalo and Xano. This PWA is exclusively for the reporter of an incident to log an incident and the supervisor (line manager) and doctor to fill in their reports related to the incident.
Features of this PWA include

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- Additionally details of the incident logged can also be viewed at any time. Screenshots of this Application can be viewed [Appendix D]
- Respective Forms for the line manager and doctor to fill, save as a draft and submit

Note: Originally the Patient Safety Application had a front-end built with another front-end no code solution called AppGyver. We pivoted at week 8, because building the front-end took longer than intended.

Activities Performed:

- Created Relational Schema [Appendix B]
- Set Up Tables for Xano
- Create scheduled task on Xano; done to send notifications for doctors and supervisors
- Create APIs on Xano
    - POST APIs for Incident Forms, Medical and Supervisor reports
    - GET APIs to display incident information and medical report information
    - GET APIs for incident metric dashboard
- Set up screens on Adalo
- Integrate APIs with User Interface

At this point basic validations have been added onto Xano's function stack feature, to pass all positive test cases of the incident.

Screenshots of the PWA attached in the Appendix [F]

Feasibility

The project intends to be done in 4 Sprints in 8 weeks, following AGILE project management. Since there are two people working on the online HIRS, Mr. Wayne Little and I, each sprint shall have no more than 3-4 Stories. A Trello Board is maintained to track our progress. The intention is to have 3 releases in the next 4 sprints. Each release would see the App being tested by a wider audience. This 3-release plan is possible if both implementers are regular and motivated throughout the project, and gain constant feedback from the stakeholders and upper management.

Sustainability

An Online HIRS training document and a quick FAQ webpage will be created and constantly updated for the end-users of the HIRS to refer to after the consultant's time at UHWI is over.

Risks

Data Security Risk: A hack into the Xano Account of the Software Development Team at UHWI could put patient data at risk.

Push Back Risk: Medical Staff preferring to use traditional paper-based incident forms, instead of going through the training of using new ones.

Appendix.

A. Table for business needs from stakeholders

Business Need/Pain Point	Raised By	Feature Required
1. Archiving of data 2. Space issues re: storage of paper forms for savings 3. Average around 200 submissions 4. More efficient system 5. Immediate notification of incident on the day it occurs 6. No insight in to what is happening on a daily basis 7. Procedure for outline and process for reporting system 8. Incomplete Incident form, requires return and tracking down persons to complete their section (physicians) , causes delays in submission to Customer Care 9. Delays in reporting 10. Lack of PCs on the wards	Judy-Ann Henry Alexander Nursing Quality Coordinator	Various methods, additional medical carts Notifications for reporter/line manager 1. Submission should be done 24hours in Nursing Admin 2. Submission in 48 hours in Risk Management 3. Minimum hours 48 4. Reporting 5. Reports Incident types, units, monthly 6. Copies of current / previous 7. Web-based desktop, for sending reports
1. Clinical and non-clinical 2. Risk and liabilities mitigation for the Hospital 3. Delayed submission of incidents reports 4. Submission might take several weeks before Risk Management department 5. Currently scanning documents to be in the archival 6. Workflow is still in a manual system 7. Identification risk management	Carl McDowell, Risk Manager	1. Notifications to the stakeholders 2. Well defined workflow online 3. For doctors (48 hrs) for completion 4. Reports for doctors with uncompleted to be forward to Senior Management
1. MOH & Min of Finance Guidelines for having certain systems in place 2. Formalizing & Documenting, integrate the policies that affect risk registers	Allison Mosely Policy Director	1. Electronic signatures will be needed - (negated because only authorized users can log in)
1. Archival of reports 2. Reports creation of Incident 3. Duplicate archives	Kerry-Ann Robinson Customer Care Branch	1. Reporting Annually

4. Unsure if all reports have been received 5. Reduce incident of lost reports 6. Reporting are not accurate based on missing, delayed incident reports		2. Reporting quarterly 3. Copies of current / previous
1. Delays in getting a resolution 2. Tedious process to manually fill form	Persona - Nurse Smith (Reporter)	1. Simple to Use UI 2. Quick Conflict Resolution
1. No reminders to fill incident form	Person - Dr. Jones	1. Simple to Use UI 2. Reminders to fill forms 3. View Outstanding and Approved Forms
2. No reminders to fill incident form	Person - Mr Yang, Line Manager	1. Simple to Use UI 2. Reminders to fill forms 3. View Outstanding and Approved Forms

B. Relational Schema - Incident Table

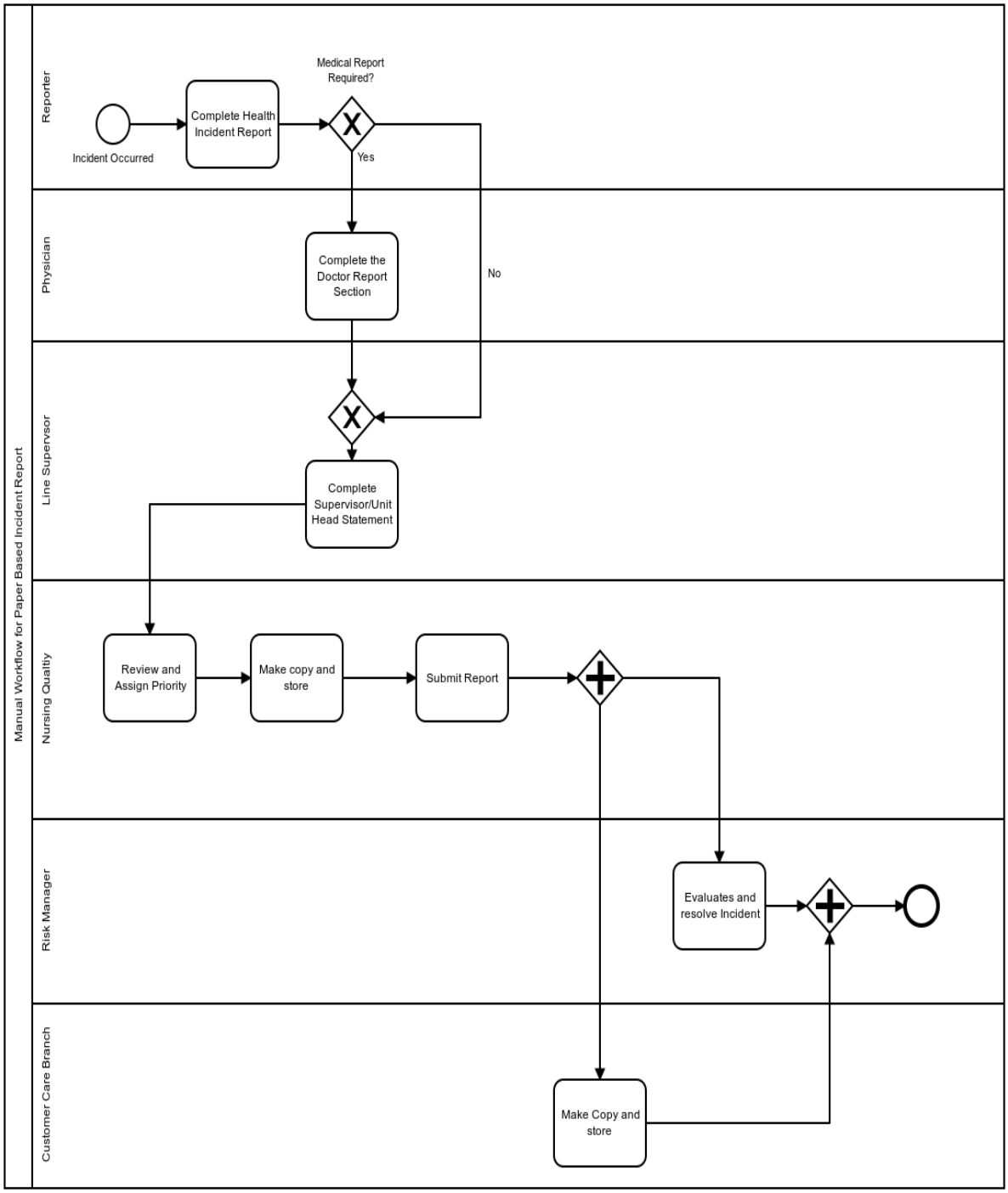
FIELD NAME	TYPE		CONDITION	SECTION
facility_id	ref id	required		
incident_status	text	auto-generated		
incident_code	text	auto-generated		
incident_medical_report_required	bool	optional		1
incident_affected_person	bool	optional		1
incident_was_witnessed	bool	optional		1
incident_occurred_on_weekend	bool	optional		1
incident_occurred_during_shift_change	bool	optional		1
incident_involved_employee	bool	optional		1
incident_datetime	datetime	**required**		1
incident_type	text	**required**		1

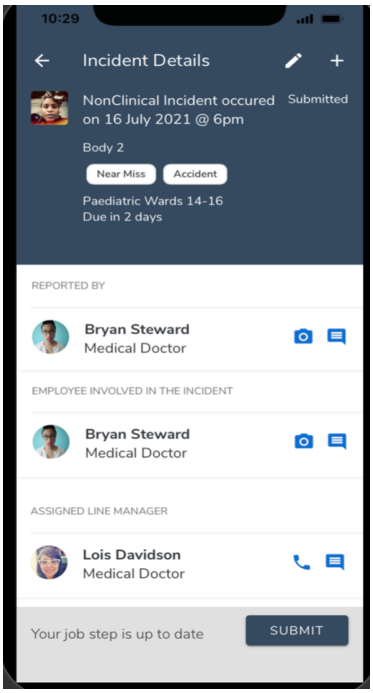
incident_category	text	**required**		1
incident_exact_location	text	optional		2
incident_location	text	**required**		2
incident_location_type	text	**required**		2
incident_action_taken_details	text	optional		3
incident_details	text	**required**		4
reported_by_user_name	text	**required**		5
reported_by_user_email	text	**required**		5
reported_by_user_license	text	optional		5
reported_by_user_phone	number	optional		5
reported_by_user_employee_number	text	required		5
reported_by_user_position	text	required		5
affected_person_injured	bool	optional	incident_affected_person	6
affected_person_birth_date	date	optional	incident_affected_person	6
affected_person_age	number	optional	incident_affected_person	6
affected_person_type	text	optional required	incident_affected_person	6
affected_person_salutation	text	optional	incident_affected_person	6
affected_person_first_name	text	optional required	incident_affected_person	6
affected_person_last_name	text	optional required	incident_affected_person	6
affected_person_gender	text	optional required	incident_affected_person	6
affected_person_condition_before	text	optional required	incident_affected_person	6
affected_person_injury_details	text	optional required	affected_person_injured	6
reported_to_date	date	optional		
reported_to_name	text	optional		
reported_to_email	text	optional		
reported_to_license	text	optional		
reported_to_phone	number	optional		
reported_to_employee_number	text	optional		

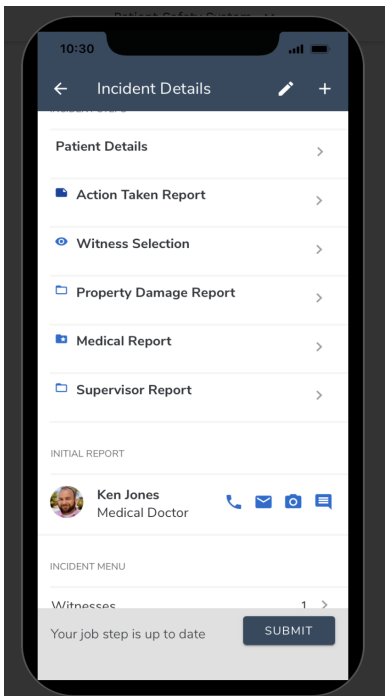
reported_to_position	text	optional		
supervisor_name	text	required		7
supervisor_email	text	required		7
supervisor_license	text	optional		7
supervisor_phone	number	optional		7
supervisor_employee_numbe r	text	optional		7
supervisor_position	text	required		7
doctor_name	text	optional required	incident_medical_report_r equired	8
doctor_email	text	optional required	incident_medical_report_r equired	8
doctor_license	text	optional	incident_medical_report_r equired	8
doctor_phone	number	optional	incident_medical_report_r equired	8
doctor_employee_number	text	optional	incident_medical_report_r equired	8
doctor_position	text	optional required	incident_medical_report_r equired	8
patient_doctor_name	text	optional		
patient_doctor_email	text	optional		
patient_doctor_license	text	optional		
patient_doctor_phone	number	optional		
patient_doctor_employee_nu mber	text	optional		
patient_doctor_position	text	optional		
patient_contact_phone_number	number	optional	affected_person_type="Pat ient"	9
patient_registration_number	text	optional_req uired	affected_person_type="Pat ient"	9
patient_ward	text	optional	affected_person_type="Pat ient"	9
patient_bed_number	text	optional	affected_person_type="Pat ient"	9
patient_diagnosis	text	optional	affected_person_type="Pat ient"	9

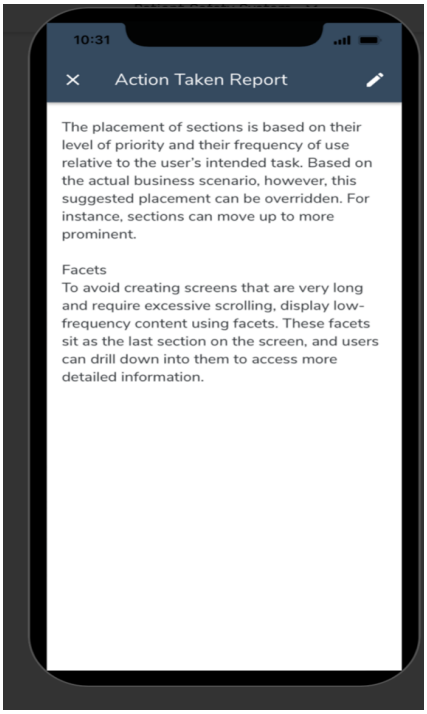
involved_employee_duty_type	text	optional	incident_involved_employee	10
involved_employee_employment_type	text	optional	incident_involved_employee	10
involved_employee_position	text	optional required	incident_involved_employee	10
involved_employee_name	text	optional required	incident_involved_employee	10
involved_employee_email	text	optional	incident_involved_employee	10
involved_employee_license	text	optional	incident_involved_employee	10
involved_employee_phone	number	optional	incident_involved_employee	10
involved_employee_employee_number	text	optional required	incident_involved_employee	10
involved_employee_duty_assigned	text	optional	incident_involved_employee	10
property_damaged	bool	optional		11
property_damaged_reported	bool	optional		11
property_damaged_details	text	optional required	property_damaged	11
RETURNED OBJECT				
submission_datetime	datetime			
submission_message	success or error message			
submission_success	bool			
submission_section_error	number			
submission_status	ok/error			
submission_record_id	number			

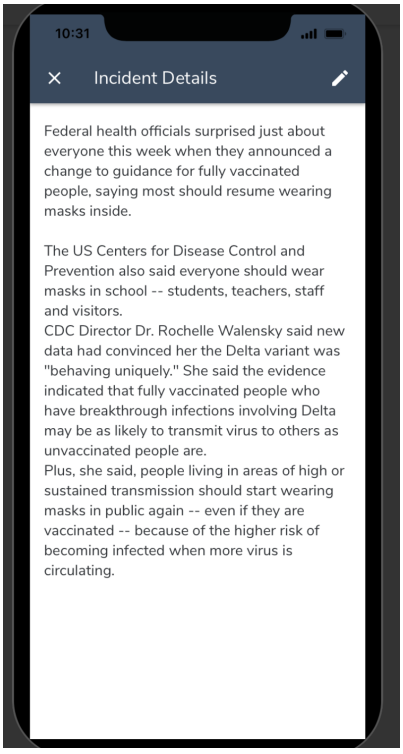
C. Incident Reporting Workflow

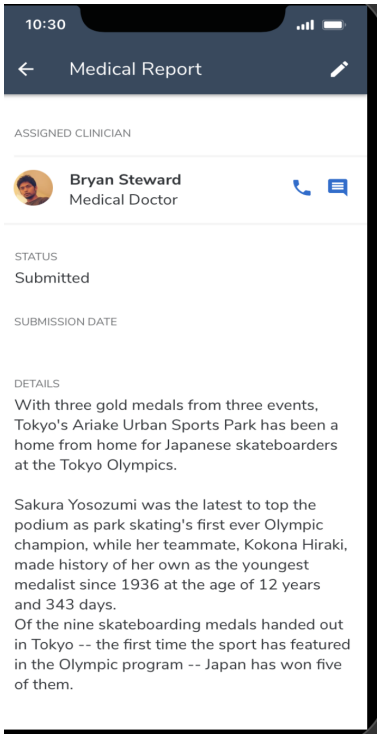



10:29
Incident Details
NonClinical Incident occured on 16 July 2021 @ 6pm
Submitted
Body 2
Near Miss
Accident
Paediatric Wards 14-16
Due in 2 days
REPORTED BY
Bryan Steward
Medical Doctor
EMPLOYEE INVOLVED IN THE INCIDENT
Bryan Steward
Medical Doctor
ASSIGNED LINE MANAGER
Lois Davidson
Medical Doctor
Your job step is up to date
SUBMIT


10:30
Incident Details
Patient Details
Action Taken Report
Witness Selection
Property Damage Report
Medical Report
Supervisor Report
INITIAL REPORT
Ken Jones
Medical Doctor
INCIDENT MENU
Witnesses
1
Your job step is up to date
SUBMIT


10:31
Action Taken Report
The placement of sections is based on their level of priority and their frequency of use relative to the user's intended task. Based on the actual business scenario, however, this suggested placement can be overridden. For instance, sections can move up to more prominent.
Facets
To avoid creating screens that are very long and require excessive scrolling, display low-frequency content using facets. These facets sit as the last section on the screen, and users can drill down into them to access more detailed information.


10:31
Incident Details
Federal health officials surprised just about everyone this week when they announced a change to guidance for fully vaccinated people, saying most should resume wearing masks inside.
The US Centers for Disease Control and Prevention also said everyone should wear masks in school -- students, teachers, staff and visitors.
CDC Director Dr. Rochelle Walensky said new data had convinced her the Delta variant was "behaving uniquely." She said the evidence indicated that fully vaccinated people who have breakthrough infections involving Delta may be as likely to transmit virus to others as unvaccinated people are.
Plus, she said, people living in areas of high or sustained transmission should start wearing masks in public again -- even if they are vaccinated -- because of the higher risk of becoming infected when more virus is circulating.


10:30
Medical Report
ASSIGNED CLINICIAN
Bryan Steward
Medical Doctor
STATUS
Submitted
SUBMISSION DATE
DETAILS
With three gold medals from three events, Tokyo's Ariake Urban Sports Park has been a home from home for Japanese skateboarders at the Tokyo Olympics.
Sakura Yosozumi was the latest to top the podium as park skating's first ever Olympic champion, while her teammate, Kokona Hiraki, made history of her own as the youngest medalist since 1936 at the age of 12 years and 343 days.
Of the nine skateboarding medals handed out in Tokyo -- the first time the sport has featured in the Olympic program -- Japan has won five of them.