La Maternidad de Maria
Final Consulting Report

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La Maternidad de Maria
Executive Summary

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I. About the Organization

"The Mission of the Center for Social Works in Chimbote has spanned more than 50 years and has over the years reached out to serve the destitute poor in need of medical assistance"

Established in 1966, La Maternidad de Maria was created with the purpose of providing affordable medical care to the community of Chimbote, Peru. Since its inception the organization has developed into a full-service hospital with 9 departments, and 24/7 service. While the hospital has managed to sustain this growth with a two person IT staff and limited technical capacity, the hospital's rapid growth has put a strain on the IT infrastructure, posing several issues ranging from imminent to long-term. During our time in Chimbote, our goal was two-fold: Document the current IT infrastructure/process and identify high priority issues that could be addressed in our 10 weeks here.

II. Develop & Deploy Automated Backup in Physical Therapy

It was noted during the mapping of the IT infrastructure that the physical therapy department was completely siloed from the rest of the network and no backup procedure was in place. It was agreed that not only should an automated backup process be developed for the Physical Therapy department, but that the process should be documented for its eventual deployment throughout the hospital.

Outcomes & Recommendations

- Backup script written and tested.
- Backup process deployed and documented.
- Backup process should be implemented on all administrative computers, which are currently backup up using manual methods.

III. Develop and Implement Physical Therapy Database

Another major issue identified in the Physical Therapy department was the lack of a database to gather and organize patient data. The current system was a mix of written and digital records, store in various folders (physical and digital). Due to the rotating nature pf the physical therapists, therapists often saw patients without information regarding their previous appointments or notes from prior physicians. It was recommended that a single database be created to provide therapists with detailed patient records.

Outcomes

- Database created and documented
- Staff trained over a two-week period

Risks/Recommendations

- Database may have issues regarding scaling, due to it being run on Microsoft Access.
- The hospital should look to integrate database into its existing Sybase database in the long term.

IV. Data Analysis and Report Creation

The hospital administration identified several areas of the hospital where data collection and reporting were necessary. Specifically, the Hospital Director requested a tri monthly report on general hospital patient inflow statistics, and the accounting department was in need of reports detailing patients with outstanding balances.

Outcomes

- Tri-monthly statistical report created for the Hospital Director
- Report on outstanding balances created for the Head of Accounting
- Report was documented, commented, and IT staff were trained to produce the report

V. Install Payment System in Pharmacy Process

It was observed that the process by which patients obtained their pharmacy prescriptions was highly inefficient and placed undue pressure on the cash office. It was recommended that the pharmacy have a dedicated cash register to process transactions rather than sending patients to a sperate line, and then providing them with their prescriptions upon their return with proof of payment.

Outcomes

- Cash register implemented in the Pharmacy over a one-month testing period.

VI. Create Patient Profile Connecting SIAH and SIGELab

In our first meeting with the Hospital Director, the lack of integration between the SIGELab and SIAH databases was identified as a high priority issue. While it wasn't feasible to complete this project in our 10 weeks here, we successfully created a preliminary integration using Microsoft Access. In Access we connected to both SIAH and SIGELab simultaneously and wrote queries producing a single patient profile, which patient characteristics and past visits to the hospital.

Outcomes

- Patient profile created in Microsoft access
- Process fully documented and tested on IT computer

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The final report will address three major categories: A detailed report on the structure of the organization will be laid out, with each area's issue of priority explained. Second, we will explain in detail the results of projects we were able to complete during our time here. Finally, we will highlight key recommendations that we were not able to carry out, but strongly recommend the hospital look into moving forward.

I. About the Organization

Organization

The Mission of the Center for Social Works in Chimbote has spanned more than 50 years and has over the years reached out to serve the destitute poor in need of medical assistance. The present rate of unemployment and underemployment in Chimbote is estimated at about 70%. Although over the years some things have improved but vast numbers of the population continue to live in straw shacks or provisionally constructed huts without benefit of water, light or sewage. The lack of sanitation, along with deficiency in nutrition aggravates the staggering health problems associated with slum living.

The health situation was dire when the first Missionary Priests of the St. James Society, Boston, MA arrived in 1963 to serve the spiritual needs of the people of Chimbote. Along with spiritual needs of the people they saw tremendous need to help in some way to alleviate the medical needs of the poor in the area. They started with a small out-patient clinic and because of the ever-soaring infant mortality rate, a small maternity hospital - Maternidad de Maria - was opened to provide improved birthing services in an effort to stem the tide of maternal/infant deaths. This work became known as the Center for Social Works - Maternidad de Maria.

There are currently - June 2019 - roughly about 180 employees working at La Maternidad de Maria. The hospital now has three main functions, Post-Medicine, Maternity and Laboratory. Those are then categorized into subgroups and even includes a Pharmacy and a small Emergency room for less severe cases that can be treated with La Maternidad's resources. Since La Maternidad is dedicated to helping bring treatment to the less fortunate their budget size is not as expansive as a normal hospital of similar size. Therefore, their budget is smaller than expected for the number of patients that La Maternidad de Maria treats on a daily basis - about 1,000 patients per day.

The high-level problems that La Maternidad de Maria faces are poor documentation of patient care and a disconnect between the two major databases utilized. Due to this the processes are not documented well and are not evolved - there are too many steps and redundancies occurring throughout the entire hospital. This issue also stems from a lack of unique identification for each patient within the two databases - detailed below in the Technology Infrastructure section. In

general, there are several things that can be done to improve this hospital from an IT perspective : process and implementation, as well as system maintenance.

Facilities

The Hospital is located in a 10,000 square meter compound, with all buildings (bar a few exceptions) operating without air conditioning or heating. Given the relatively mild nature of Chimbote's yearly climate, this does not seem to present significant issues to the staff of the visiting patients. The compound consists of 7 main office building areas, each of which houses at least one major department. The buildings are largely dedicated to the major departments of the Hospital: Post Medical Services, Maternity, Laboratory, Orphanage, Warehouse, and Maintenance. Of the 7 building areas, Post Medical is the only one with a second story area, which is used to house various consulting rooms, specialist offices, as well as the server room. This building also provides space for general hospital departments such as pharmacy, triage, check-in, and cash registers. See Appendix A for an image of the hospital layout legend.

Programs

DIRECTORATE GENERAL

The General Directorate is the governing body of the Institution, it is commissioned by a General Director.

EXECUTIVE OFFICE OF PLANNING AND ADMINISTRATION

It is the support body, responsible for ensuring that the Center has the necessary manuals, materials, resources and economic, as well as maintenance and general services, for the fulfillment of the mission and strategic objectives. It depends hierarchically on the General Director.

OFFICE OF STATISTICS

It is the organic unit of support, responsible for ensuring that the Center has the health and administrative statistical information required for the fulfillment of the mission and the strategic objectives assigned to the Center. Depends hierarchically on the Executive Office of Planning and Administration.

INFORMATICA OFFICE

It is the organic support unit, responsible for ensuring that the Center has computer support, and integration of information systems required for organizational processes and compliance with the mission and strategic objectives assigned to the Center. Depends hierarchically on the Executive Office of Planning and Administration.

LOGISTICS OFFICE

It is the organic support unit, responsible for conducting the efficient and effective logistic process, in order to provide the goods and services for the strategic objectives of the Center. Depends hierarchically on the Executive Office of Planning and Administration.

ACCOUNTING OFFICE

It is the organic support unit, responsible for conducting the execution of the technical processes related to the administration of economic resources, carrying the financial statements in a timely

manner for the fulfillment of the strategic objectives of the Center. Depends hierarchically on the Executive Office of Planning and Administration.

OFFICE OF COLLECTION OF FUNDS

It is the organic support unit, responsible for collecting and controlling daily income and expenses, for the fulfillment of the mission and the strategic objectives assigned to the Center. Depends hierarchically on the Executive Office of Planning and Administration.

OFFICE OF GENERAL SERVICES AND MAINTENANCE

It is the organic support unit, responsible for ensuring that the Center has the necessary cleaning, security, maintenance and general services support. Depends hierarchically on the Executive Office of Planning and Administration.

HOME VISIT

It is the support body responsible for making visits to patients with low economic resources. It depends hierarchically on the General Director.

MEDICAL CENTER

It is the online body responsible for carrying out activities of diagnosis, treatment and medical assistance to patients. Maternity of Mary has several specialties including Cardiovascular, Cardiology, Surgery, Gastroenterology, Alternative Medicine, Internal Medicine, General Medicine, Nephrology, Neurology, nutrition, dentistry, optometry, otorhinolaryngology, pediatrics, psychology, psychiatry, urology and rheumatology. It depends hierarchically on the General Director.

OBSERVATION ROOM

It is the organic unit of line responsible for executing the nursing actions and procedures to the patient according to the doctor's instructions. It depends hierarchically on the Medical Center.

MATERNITY

It is the line organ responsible for the comprehensive care of women and newborns. It has several services including gynecology, ultrasound and colposcopy, observation room of the newborn, obstetrics, immunizations and first neonatal consultation. It depends hierarchically on the General Director.

LABORATORY

It is the line agency in charge of providing specialized technical assistance through the execution of procedures, analytical tests in liquids, tissue samples, biopsies and body secretions for the diagnosis, treatment and prevention of diseases. As well as, take, receive the samples and wash all the utensils of the service. Laboratory has services of Hematology, biochemistry, serology, parasitology, microbiology and pathology Hierarchically dependent on the General Director.

MEDICAL EMERGENCY SERVICE

It is the organic unit responsible for providing immediate patient care to save your life. It depends hierarchically on Post Medical.

PHYSICAL THERAPY AND REHABILITATION

It is the line agency responsible for developing specialized and comprehensive care by executing procedures and actions aimed at recovering physical, mental and social potentialities at their maximum level. It depends hierarchically on the General Director.

PHARMACY

It is the line agency in charge of supplying, in a timely, efficient and adequate manner, the medicines and products destined to the recovery and conservation of the health of the patients according to medical prescription. Depends on the General Director.

CUSTODIAN ROOM

It is the online body responsible for ensuring the welfare of abandoned children designated by the Judicial Branch of Chimbote. It depends hierarchically on the General Director.

KITCHEN

It is the line organ in charge of preparing food for the staff and patients of the Institution. Depends on the General Director.

Staff

The hospital staff can be divided into three general categories: Administration, Medical Care, and Laboratory Scientists.

ADMINISTRATION

The administration staff works with computers on a consistent basis, the most out of the three categories of staff. This category includes staff working in Human Resources, Accounting, and IT. Given their dependence on technology, they are also the category with which we are working with the most daily, particularly IT. These staff will also be most directly affected by the work covered later on in this report, as the data analysis and IT integration performed will allow administration staff to more effectively make administrative decisions regarding hospital needs. IT in particular will benefit from the automated back-up systems we introduce, along with other advancements. Regarding training, there does not seem to be a clear/standard procedure for training/implementing staff. IT specifically does not have a formal transition plan in place, should employees move on from the hospital. All staff have access to computers, with some given laptops. All but one of these personal computers are connected to the internet via ethernet cables.

MEDICAL STAFF

While the medical staff does not directly integrate with the hospital's technology infrastructure on a daily basis. They are the hospital's point of direct contact with patients and work most closely with the hospital's main prerogative. Thus, our work here should be done with the needs of the medical staff in mind. Aside from a few specialists, the majority of medical staff do not have personal computers, with patient prescriptions and other documentation being written on paper and then entered into the hospital database during other steps in the hospital process. Because of this, our day to day interaction with medical staff is relatively limited, although we speak with them on a weekly basis in order to ensure we are carrying out our worth with the proper context in mind.

LABORATORY SCIENTISTS

Like administration, this category of staff interacts with the hospital's technology infrastructure on a daily basis. Analysis of samples is inputted into the laboratory database by the scientists on personal laptop computers, which are connected to the hospital network via ethernet cables. The sole exception to this is the two automated analyzers, which are connected to desktop computers and feed information into the database under the supervision of two laboratory scientists. Dr. Denverli Martinez-Moreno, the lead scientist in the laboratory is an extremely important point of contact to both us and the hospital administration. As the architect of the much of the laboratory database, he possesses the most knowledge of laboratory operations as well as the structure of the laboratory database. We have conducted numerous interviews with Dr. Denverli, in which we have received detailed explanations of the laboratory process and database.

Technology Infrastructure

SERVERS

The Hospital currently utilizes two servers, which are kept in a climate-controlled server room. The two servers are siloed, with one used for the general hospital database & accounting software, while the other is dedicated to the hospital laboratory.

DATABASES

There are 4 unique databases currently in use at the hospital.

SIAH

This database is hosted by Sybase's SQLAnywhere, and was constructed through PowerBuilder. The current staff were not with the organization when the database was constructed by IT employee who no longer works with the hospital. The database is responsible for hosting information gathered by the Administration, and all Medical Services provided by the hospital, with the exception of the Laboratory and Physical Therapy. The database also serves as the Point Of Sale software for the hospital and maintains receipt records.

SIGELab

This database is hosted on Microsoft SQL Server and was constructed by an outside technical consultant in 2015. The database tables and forms were created by current head of the laboratory Dr. Denverli. The database holds all laboratory test and patient information. The database does mirror the SIAH patient ID number and receipt numbers, but autogenerates its own patient ID and receipt ID which are used as the primary keys throughout the database.

CONTASIS

This 3rd party database is used strictly by the accounting department. More information can be found at the following website: http://www.contasisarequipa.com/empresas/bienvenida

Physical Therapy Database

This database is hosted on Microsoft Access and was created by the CMU student consultants. The database is designed to document and maintain records on therapists, patients, and patient appointments. Full documentation of this dataset can be found in supporting documents provided by the student consultants.

GENERAL HOSPITAL NETWORK

The hospital previously did not have a diagram of the network layout, which is centralized around two main switches located in the server room and the maternity entrance and are ultimately connected to router in the server room. Both hospital servers are connected directly to the internet router. Except for a few printers and lone laptop, all hospital machines are connected to the router via ethernet running through the network of 12 switches. The layout of these switches is not optimized and could be a point of improvement in later projects. See Appendix B for a network diagram.

Technology Management

The IT department (consistent of two employees) is tasked with the management of the entire hospital network and infrastructure. This includes, but is not limited to, general problem solving, equipment maintenance, database upkeep, and troubleshooting all IT related issues. Network or infrastructure issues are not reported using a formal ticket system but are brought to the attention to the IT staff via personal office visit. Both IT employees share similar skillsets, with one more focused on database system upkeep while the other focuses with general maintenance & troubleshooting, as well as building a new database for the accounting department. Daily operational tasks are done on an ad hoc basis with no priority scheduling. Aside from scheduled nightly backups, anti-virus/general software & hardware updates are done as issues come up organically. Backups are done manually and stored in the IT office. All upkeep is done by the in-house IT team, with the exception of issues relating to the laboratory database, in which there is an outside contact who was responsible for the initial installation of the database software. However, this contact is generally unreliable, with response times ranging up to two months. Solutions are general found by either the IT staff or Dr. Martinez-Morales.

Technology Planning

Technology Planning at la Maternidad de Maria is done by the IT staff. There is no technology planning committee and they do not have a clear layout of what they plan to do technologically as la Maternidad advances. They mostly focus on on-site troubleshooting issues that arise with the current database software SIAH and other minimal hardware issues - that usually require little to none further information. Their current plan consists of developing an accounting software that is integrated and has daily developments using PowerBuilder - the coding development is divided between the two IT staff members.

La Maternidad de Maria would benefit greatly from a formal long term and short-term IT development plan. With this plan in place they would be able to direct their efforts in creating a more integrated technological infrastructure that will support the rapid growth of La Maternidad de Maria. Currently, IT budgeting decisions are ordered/approved by the Director of La Maternidad de Maria as issues arise. A long and short-term IT development plan would allow IT projects to be finished more quickly and would eliminate the need for unexpected budget requests.

Communication

General Internal Communication

There currently does not exist an internal email system for employee communication. Under the status quo staff create new g-mail addresses when beginning their employment, through which all

job-related communication occurs. While this is atypical by US standards, it does not appear to significantly affect day to day operations. A more immediate cause for concern is the lack of a formal ticket system by which employees across the hospital can request IT assistance. The current system of personally calling upon an IT staff member is disruptive to the IT staff and limits their ability to plan out their day and prioritize tasks.

Data Sharing

There is not a formal process for sharing hospital data internally or externally. For internal sharing, data can be accessed via SIAH (The general hospital patient database) on most hospital computers. Laboratory or accounting data can only be accessed by visiting the respective departments. Should data need to be accessed outside the relational database management system, data is simply exported and shared via email or thumb drive.

External Communication

There is no formal process for communicating with external contacts.

Public Relations

The hospital does not currently operate its own website outside the Chimbote Foundation website. A Facebook page is maintained, with a follower base of over 6,000 (https://www.facebook.com/MaternidaddeMariaChimbote/). The hospital uses this Facebook page to post updates on various health related campaigns, and other informational outreaches. Appendix C shows examples of these promotional materials.

Information Management

The vast majority of hospital data resides in two previously mentioned databases: SIAH & SIGELab - that as of now, have not been integrated. As mentioned previously, Certain information is mirrored between the two databases. However, due to the lack of database documentation much of this mirroring is either inexact or difficult to use. The SIAH database was created by an engineer in approximately 2013/2014 and left the source code along with Sybase and PowerBuilder installed. The SIAH database was then further worked on and developed by the current IT department - Denis and Jose.

Additionally, there is no formal copy guide for data entry. This can pose an issue when attempting to integrate old data with new data. The lack of database documentation also means that much of the information on the purpose of tables and fields is known only by the IT staff and select hospital staff.

Business Systems

Accounting is currently the only department within the hospital that can be considered a ‘business system’. Daily accounting is done using CONTASIS, a general accounting software used in much of Latin America. The hospital is currently investing a significant amount of IT staff time into the development of a custom database system, which would exclude the need for CONTASIS. This new system is being developed by one IT staff member, using Sybase SQL Anywhere and Power-builder. The current head of accounting is not a full-time employee, but rather a local professor who devotes his time to various local organizations in Chimbote. Interviews and conversations with staff working in payroll and accounting have unveiled various issues with the

current system that should be addressed. Payroll specifically suffers from a lack of integration and automation. Under the current system, staff hours are managed in using the Attendance Management software. Raw data is then extracted from Attendance Management and entered into the payroll system manually. The payroll system is not a dedicated program, but rather a collection of excel documents constructed by the previously mentioned head of accounting. Lack of excel training results in various process inefficiencies, per our outside observation.

II. Develop & Deploy Automated Backup in Physical Therapy

Motivation

At the time of our arrival, the Physical Therapy department was siloed from the rest of the hospital network and all IT infrastructure. It was noted that all digital physical therapy work was done on a single laptop used by the secretary. All patient session notes were stored physically in a closet. The laptop used by physical therapy had battery issues due to its age and was not backed. A single crash or user error could put the entire department at risk of losing large amounts of data.

Outcomes

The first step in developing a backup procedure was research different possible solutions and utilize the one best fitted to the needs of the hospital. Two major options were considered:

- 3rd party backup software
- Construct a new Maternidad-specific process

Ultimately, we decided to create our own new process. This was done for two reasons. First, it eliminated the possibility of a third-party program needing software updates, becoming no longer free, or losing compatibility. Second, a new process, if documented properly would be much more flexible and allow the IT staff to implement it else-where without the need for additional software installations.

Next, it was decided that Microsoft Command Console would be used to create the backup process. This was done for two reasons:

- The code written would be widely compatible even if new windows machines were brought into the hospital
- The IT staff was already familiar with the language.

With these decisions made, the project then saw three specific outputs:

1. Physical Therapy connected to hospital network
    a. The laptop was connected to the internet and the hospital server via ethernet.
2. Backup Script written, tested, and implemented.
    a. The script was written and initially tested on a windows computer
    b. The script was then tested on the IT staff computer, and the script/deployment process was explained to the staff
    c. The IT staff installed the script on the Physical Therapy laptop with our observation and the backup was confirmed the next day
3. Backup Script and deployment fully documented
    a. Script code was fully documented and explained
    b. Installation guide was created with screenshots for each specific step

The script installation guide and documentation can be found in the supporting materials provided to the hospital.

The script written has the following capabilities:

- Backup time of day and frequency can be altered
- Source of backup can be easily altered
- Backup only overwrites data that is new or has been modified. This speeds up the process and reduces the risk of error.

Recommendations

We strongly recommend that the backup process developed is deployed on all administrative computers currently being backup up to the server manually. When looking at backup files on the server, it was noted that significant space was being taken up by unnecessary files as a result of poor backup practices. While improved backup training practices would be beneficial, an automated backup would minimize server exposure to hospital staff and eliminate the possibility of human error.

III. Develop and Implement Physical Therapy Database

Motivation

When we first arrived in Physical Therapy, we noticed that most of the work was done on paper and was being manually duplicated onto an Excel sheet by the secretary of Physical Therapy. There was no access to immediate patient data. We decided to that creating a digital platform that can track patient history and patient appointments thus helping improve the efficiency of the work environment; enabling the department to provide a better patient experience.

After our research was conducted, we decided that the best plan of action was to create an Access database that could be stored locally and that is compatible with the SIAH database which uses SQL server, as well. This allows for future iterations of the database to be compatible when the hospital decides they will integrate all three databases.

Outcomes

The first step was to study the current paper process that the physical therapists were using to run the department and to derive from that how to begin building the database. Their needs were as follows and the outcomes were outlined due to their necessities:

- 80% success rate in eliminating paper trail for the future of Physical Therapy
- Decreasing wait times
- 100% improving the documentation of patient history
- Keeping track of appointments

After the delineation of the outcomes we began to write the Access database with the following conditions which were prompted by our motivations:

- Create standardized naming scheme
- Create form that writes directly to new database
- Eliminate handwritten log-keeping
- Create form/set up database on laptop
- Test Process

The Access file has two Queries with attached forms that with the click of the button would print the daily patients for the physical therapists and also the monthly statistics of what patients were entering the department. The forms also include patient details, patient history, appointments, and receipts. There is also a separate form to input the licensed physical therapists, therefore, they can be pulled in the patient database.

All of the included information for the database is documented in an additional Word document that will be provided. The source file has also been provided to the IT department so that any errors or future improvements can be easily remedied/executed. The process is also fully documented in case there are any questions on the process for the different personnel using the platform.

Recommendations

The first recommendation is that the hospital continue to facilitate the work of this database in Physical Therapy for Adults. This includes: IT maintenance for the laptops that are currently implemented (one for the secretary and one for the therapists), to run cables that connect directly to the server to improve connection, a cable that connects directly to a router to reinforce the Wi-Fi connection, another laptop for the facilitation of usage for the physical therapists. These technological recommendations and support will help run the database smoothly.

The second recommendation is that the hospital implement the database as a separate clean database in Physical Therapy for Children after the trial period for Physical Therapy for Adults is concluded and evaluated. This system should be used in both areas since the therapists are rotating between the two departments and the operations are done individually.

The third recommendation is to study the documentation for the creation of this first database and use it as a template to record patient records in Post Medical, as well. This will begin to eliminate the paper trial in the majority of the hospital and will improve the transition from paper to digital.

IV. Data Analysis and Report Creation

Motivation

While the hospital currently collects data on patient type and origin, there is no analysis done on said data to help guide the hospital's short and long-term goals. Hospital patients currently fall into three separate categories: Patients referred to La Maternidad from the local public hospital These patients pay the public rate for services provided), Patients referred to La Maternidad from private doctors (these patients pay the private rate for services provided), and direct patients of La Maternidad, who pay either a lower rate or have their costs completely exonerated by the Hospital Director or Head of Human Resources. Statistics on patient type would provide the hospital with valuable information regarding hospital reach and revenues.

A second need for analysis was brought to our attention by the head of the accounting department, regarding inefficiencies in communication between Accounting and the Laboratory. Given the separated nature of the SIAH and SIGELab databases, the hospital currently did not have an analysis of whether laboratory test results were being printed for patients despite them holding an outstanding balance in the SIAH database. While these errors will eventually need to be prevented, it is important that the accounting department is aware of number of these errors in order to make the appropriate book changes.

Outcomes

Before creating the report, a meeting was held with the Hospital Director and Sister Maggie regarding what specific statistics would help them from an administrative standpoint. The following statistics were highlighted:

- Number of services provided per area of the hospital
- Average price paid for service area
- Exonerations by area and type
- Exonerations by date
- Top 10 most common services provided

The next step was to determine which platform would be used to create the report. Two options were considered: Microsoft Excel, and R. R was chosen for two reasons:

- The report was to be as automated as possible, which would require macros in Excel. This meant that either option would require additional training of the IT staff
- Our team was more experienced in R, and would be able to better comment and document the report

The report was created so that only two actions would be required of the IT staff:

- Exporting the desired data from the SIAH and SIGELab databases
- Clicking run on the R Script

Prior to documenting, the report script was tested using several different datasets to ensure the code would not break. The report was then presented to the Hospital Director and underwent one round of edits. Next, the report for Accounting was developed. R was chosen for the report for the same reasons given above. An additional reason being that data from both SIAH and SIGELab would be used, additional layer of complexity difficult to navigate in Excel. Our report for the Accounting department gave us the following observations:

- In the year 2019, 34 patients had received all the tests results from their laboratory orders despite having an outstanding balance on the receipt
- There are a great number of tests with receipts in the SIAH database but no corresponding tickets in SIGELab

The following outcomes were seen at the end of this project.

- Tri-monthly statistical report was created
- Accounting report was creating
- R code was thoroughly documented, and each line of code was explained in detail to the IT staff.

Recommendations

The next step we recommend for this project is to further the automation of the two reports created. While the time to produce the reports currently is roughly 10 minutes per report, this process could be fully automated which would reduce the likelihood of user error, and the workload for the IT staff, who currently have to be directly requested for the report whenever it is needed.

The second recommendation is to investigate the reason for there being tests ordered in the SIAH database but without corresponding ticket numbers in SIGElab. It is likely that this is simply due to a backlog of tests in the laboratory, meaning that tests with receipts in SIAH have not yet been entered into the SIGELab database. This would explain the large number of laboratory receipts in SIAH with no ticket numbers in SIGELab.

V. Install Payment System in Pharmacy Process

Motivation

When documenting the hospital process flow, it was noted that patients needed a prescription from the pharmacy went through an inefficient process. Under the old system, a patient would wait in line at the pharmacy and then present their prescription to the pharmacist. The Pharmacist would then confirm that they had the medicine in stock, build the receipt in SIAH, and then send the patient to the cash office where they would wait in line before paying for the prescription and obtaining the receipt. Finally, they would return to the pharmacy and receive their medicine after waiting in line again.

We recommended that this process be significantly simplified by placing a cash register in the pharmacy. This would eliminate unnecessary wait times and reduce the chance of error. Under the old system there was an issue with poor communication resulting in duplicate receipts or patients being created in the SIAH database.

During our investigation, we calculated that the average processing time at the cash office and pharmacy was 38 seconds and 52 seconds respectively. The cash office and pharmacy had a respective average of 6.5 and 1.25 patients in line at any given time, meaning that the current system added a little over 5 minutes to the patients process flow time. Placing a cash register in the pharmacy would remove this five minute of wait time from the overall process flow. In Appendix D, we see the visual difference between the old process flow diagram and the recommended one.

Outcomes

Initially, it was recommended that the pharmacist be responsible for performing payment transactions. This seemed reasonable given that the pharmacists were already building the receipts in SIAH. All that was left was to receive the payment produce the change and receipt. This proved to be too overwhelming to the pharmacists working behind the counter, who explained to us that their workload was already high; pharmacists were responsible for manually taking inventory of the entire pharmacy throughout the day. To work around this, it was decided that a dedicated cash register and cashier would be moved from the cash office into the pharmacy. This would ensure that the process was made more efficient without increased the pharmacist workload.

As a result of this process change, the following improvements were recognized:

- Patient flow time reduced by an average of 5 minutes.
- Patient throughput diverted from the cash office to the pharmacy, resulting in shorter lines and less pressure on the cash office.
- Process for installing new cash registers tested and shown to be replicable in other areas of the hospital.

Recommendations

It is recommended that the hospital seek to reduce the pharmacist's workload, especially with regards to taking inventory. The pharmacist explained to us that they are held financially responsible for any discrepancies in the inventory, which places a large amount of pressure on the manual inventory system. The hospital should move towards a more digital inventory system, instead of the current system which relies on handwritten notes. This would not only reduce the workload, but it would also eliminate the likelihood of human errors. Discrepancies would also be much easier to spot in a purely digital format as opposed to the current mixed one.

Using barcodes to take inventory would also make back-entering information much simpler. In addition to taking pharmacy inventory, the pharmacists must each day check and enter the transactions made by the maternity overnight. In our meeting with the Hospital Director, we discovered that the medicines in the pharmacy already have individual codes. This mean that just either a new database needs to be created specifically for inventory, or SIAH should be expanded to allow for digital warehousing.

VI. Create Patient Profile Connecting SIAH and SIGELab

Motivation

During the first week of our stay in Chimbote, the Hospital Director explained to us that one of their largest IT goals was to fully integrate the SIAH and SIGELab databases. Several pressing issues motivated this:

- The division between the two databases allowed for errors and poor communication between the two departments
- Backchecking orders is difficult under the current system
- It is currently not possible to view a patient's complete hospital history on one page

Unfortunately, given our skillset and amount of time we had, we determined that creating an integrated database would not be feasible. However, we determined that it would be possible to find a way to access both databases within the same interface, and document the process for building queries that would allow for staff to pull up patient information and all past services (both from the laboratory and the general hospital) on the same page.

Outcomes

Several options for opening the two databases in the same interface were explored. The primary difficulty was that the SIGELab database is run through Microsoft SWL Server, which is difficult to access via other platforms. Ultimately, we decided to use Microsoft Access to join the two databases. First, because Access was easily compatible with SQL server, and second because the TI staff would already have a good deal of familiarity with the platform.

Using Microsoft Access, we were able to establish live connections to the SIAH and SIGELab databases. This connection did not allow for simultaneous editing of the two databases, but it at the very least allowed for queries to call on tables from both databases. With this ability, we were able to develop three specific final queries:

1. Patient Bio
    a. This final query shows all patient information from SIAH such as age, contact information etc., and patient measurements from SIGELab like height, weight, etc. it also displays the date of the patients most recent visit.
2. General Services
    a. This final query displays all patient receipts from the SIAH database grouped by patient ID.
3. Laboratory Services
    a. This final query displays all laboratory tests ordered along with their results from the SIGELab database grouped by SIAH patient ID.

With these three queries, a form was also created which enables the user to search for a patient by their name or ID, and then view the results of the three queries at the same time.

All supporting queries, final queries, forms, and sub-forms were fully documented in a separate report that can be found in the supporting documents provided to the administration and IT staff at the end of our visit. Additionally, the queries and forms were installed and tested on a hospital computer in the IT department. An IT staff member created the queries using the documentation mentioned above and ensured that it would work as planned.

Recommendations

The results of this project are more preliminary than some of our other completed projects mentioned in this report. This is for a couple different reasons. First, the ultimate goal of the hospital should be to fully integrate the SIAH and SIGELab databases. This project will take a dedicated team and quite some time but is the long-term solution to the hospital's problem. The queries written and documented during our time here should provide the hospital with a starting point for the hospital.

Second, the large amounts of data hosted in SIAH and SIGELab mean that Microsoft Access is not the best long-term option for a patient profile form. Access struggles with large databases and can take too long to process the complex queries we've created. The IT staff should look into developing this patient profile on a more sustainable platform. Given the rigid nature of Microsoft SQL Server, we

recommend looking at ways to access the SIAH database within SQL server. Once the connection is established, the same SQL code can be used to create the patient profile.

VII. Additional Recommendations

Implement a Barcode System in the Warehouse

During the investigation stage of our work, we encountered that the warehouse was entering their receipt information manually. This is done by two workers in the warehouse and all the receipts must be inputted in the same day. Therefore, this means that the workers would have to stay until all the receipts for the day's inventory is inputted. This system takes away from the time the workers could be using to account for materials needed or how they are organized to better facilitate their work. There is also possibility for human error in this type of system; which are then rectified by the IT staff because they are the only ones with access. This reduces the time that the IT staff could be using for IT maintenance and reduces the fluidity of the process. The receipts for the warehouse are mostly all equipped with a QR code that when scanned gives the details necessary to be inputted into SIAH.

The recommendations on how to help make this process flow more efficient is as follows:

- Using a QR code scanner from the app store that can scan each of the receipts. Therefore, the workers would only be in charge of scanning the code.
- To use the information provided by the QR code and scanner to be directly fed into the SIAH database. This can be done by using a scanner that reads the output of the QR code and then writing code within SIAH so that the information is fed through automatically.

These recommendations will help reduce any human errors and cut down on the time occupied by this process for both the IT staff and the workers in the warehouse.

Document SIAH and SIGELab Databases

While working on or previously mentioned projects, the current lack of database documentation slowed down several aspects of our work. The two IT staff members do not have the same knowledge of the different tables and their purposes in the SIAH database. This slowed down work as queries and reports calling on certain tables would need to be put on hold until the IT staff had to look over the tables and explain the purpose of each field. There were also various fields and tables which were not totally understood by any staff members. The SIGELab database specifically will require the most documentation. There is currently only 1 staff member in the hospital with knowledge of all the relevant tables and queries (Dr. Denverli Martinez-Moreno). Should he eventually leave the hospital or take a leave of absence there would be nobody at the hospital with a similar level of knowledge of the SIGELab database. Within SIGELab, there are also a number of tables and fields which even Dr Martinez-Moreno does not fully know.

It would be in the strong interest of the hospital to commit to a project of formally documenting each table in each database. This documentation should not only explain the purpose for each table, but also each field in the tables as well as explain the database relationships and design. There are a few different tools the hospital can use to do this.

- SQL Server and SyBase both have options for auto-documentation. This will create a report of the relationships and specifications of the database tables. It will not, however, allow staff to write explanations of tables or edit information.
- Word/Excel documentation. This is more time consuming but building documentation in Word or Excel will allow for detailed explanations of both databases.
- 3rd party software such as RedgateSQL Doc, ApexSQL Doc, and Elasoft SQL Doc allow you to auto-document the database but also write your own descriptions for tables and fields.

We recommend that if the first option is chosen, that further documentation be provided via Word/Excel. It is very important that descriptions are included in the documentation so that new staff or consultants have material to review.

Server Maintenance Plan

While installing the automated backup for Physical Therapy, found that the server responsible for running the SIAH and CONTASIS databases was 20 gigabytes from full capacity. Given the high volume of data processed by the hospital daily, this was immediately flagged has a priority issue. The server was de-fragged and duplicate/unnecessary files were removed. At our last review, the server had 100 gigabytes of storage remaining. We strongly recommend that scheduled server maintenance be implemented as soon as possible. Maintenance details should be developed by the IT staff, but the following are some recommendations for tools that should be used.

- De-fragmentation tools. When the server is writing new data into its physical storage, some blocks of data become separated, slowing down the computer and taking unnecessary space. A de-fragmentation tool reorders these blocks of data sequentially and is a simple way to clear more space. Windows computers have a built-in disk de-fragmented, so a third-party software won't be necessary.
- Windows Disk Cleanup. This is another windows feature that will allow you to delete temporary files, clear the recycling bin, and other unnecessary items.
- Removing duplicate files. There are many tools available which allow you to search for and delete identical files. Duplicate Sweeper (https://www.wideanglesoftware.com/duplicatesweeper/) Is one tool available online.
- Backup procedure review. It is recommended that the IT staff meet with each department to in order to write down specifically what information is needed on the server. It is possible that unnecessary files are being backed up onto the server.
- Finally, a plan for server replacement should be developed in the case of server failure or scheduled replacement. The hospital does not currently have a plan for the replacement of an old or failing server.

Ticket System for IT Troubleshooting

An issue we noticed during our time here is the accessibility of the IT staff to the rest of the hospital. While it is a good thing for the IT department to be well integrated and connected to the rest of the hospital, the lack of a formal request process makes it difficult for the IT staff to plan their schedules. Troubleshooting issues area are brought directly to the IT staff, and responsibilities are often brought on with short notice. There will always be unplanned issues that the IT staff will need to address, such as random computer shutdowns or critical program crashes. However, non0ritical tasks would be better serviced if there were a way to formally submit and organize them. Recurring responsibilities could also be processed through this system, so that IT can plan the weeks schedule and better attend to sudden issues that arise. The following are examples of free IT ticketing systems that could be considered by the hospital, although it may prefer to seek out Spanish options.

- ManageEngine ServiceDesk Plus https://www.manageengine.com/products/service-desk/it-service-desk.html?utm_medium=ppc&utm_campaign=SDP-US&utm_source=capterra
- SpiceWorks https://www.spiceworks.com/

Patient Care Documentation

In the current SIAH database, there is no documentation of patient care such as session notes, doctor recommendations. This is partially because most doctors do not have their own computers. While paper records exist, these are difficult to access and not readily available to staff who would benefit from seeing this information. The database set up for Physical Therapy can serve as groundwork for how patient notes/history could be implemented in the SIAH database. A user should be able to look up a patient by their code and/or name and see past session notes. This information will be helpful for several reasons:

- Doctors can make more informed consultations if patient records are immediately accessible.
- Seeing what doctors have seen a patient in the past can enable greater cooperation between doctors.
- Decisions made by triage will be more informed if backed by a patient's immediate clinical history.

Conclusion

Despite the number of recommendations in our report, it is our opinion that the hospital's IT network and infrastructure is extremely sophisticated given the rapid growth of the hospital in recent years. Now that the organizational structure of the hospital has stabilized, we recommend that the Maternidad begin to develop long-term plans for future IT projects, while formalizing their current systems. Much of the current IT network functions well during day to day operations, improving documentation and standardizing practices will ensure that unexpected issues do not derail the hospital's IT moving forward.

About the Consultants

Cesar Ruiz

Cesar Ruiz is a 2nd year master's student at Carnegie Mellon University where he is obtaining his M.S. in Public Policy. After returning to the US he will begin a new position as a research fellow for the FDA where he will begin his career in analytics.

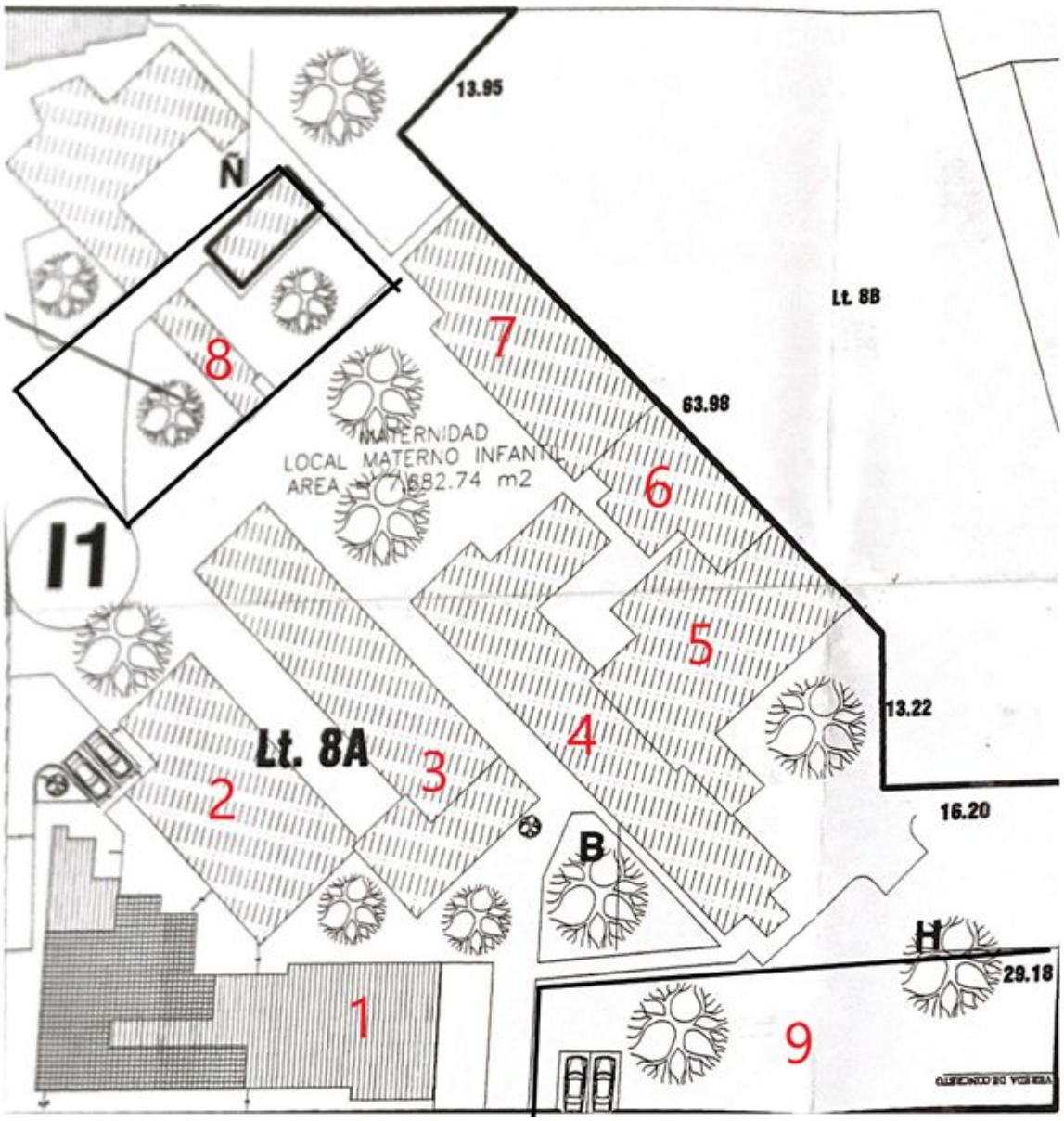
Carolina Quintana

Carolina Quintana is a 3rd year undergraduate student at Carnegie Mellon University. After returning to the United States she plans to finish her minor in Media Design and obtain a master's at Carnegie Mellon. She has worked on various volunteer projects in foreign countries, such as, an interactive documentary in Cuba and hopes to continue working on similar projects.

Appendix

Appendix A

View of hospital layout with legend



Hospital Layout Legend

1	Post Medical Services - General Consultation & Specialist Offices - Pharmacy - Triage - General Waiting Room - General Check-in - Payment Office
2	Laboratory - Sample Testing - Blood Sampling
3	Administration & Maternity - Secretary Office - Directors Office - Maternity Ward
4	Human Resources/Maternity/RENEIC/Emergency Room - IT Department - RENEIC: Government New Birth Registration Office - Maternity Waiting Room
5	Recent Births & Equipment Sterilization
6	Hospital Kitchen
7	Physical Therapy
8	Warehouse
9	Orphanage/Children's Therapy

Appendix B

IT Network Diagram for La Maternidad de Maria

Appendix C

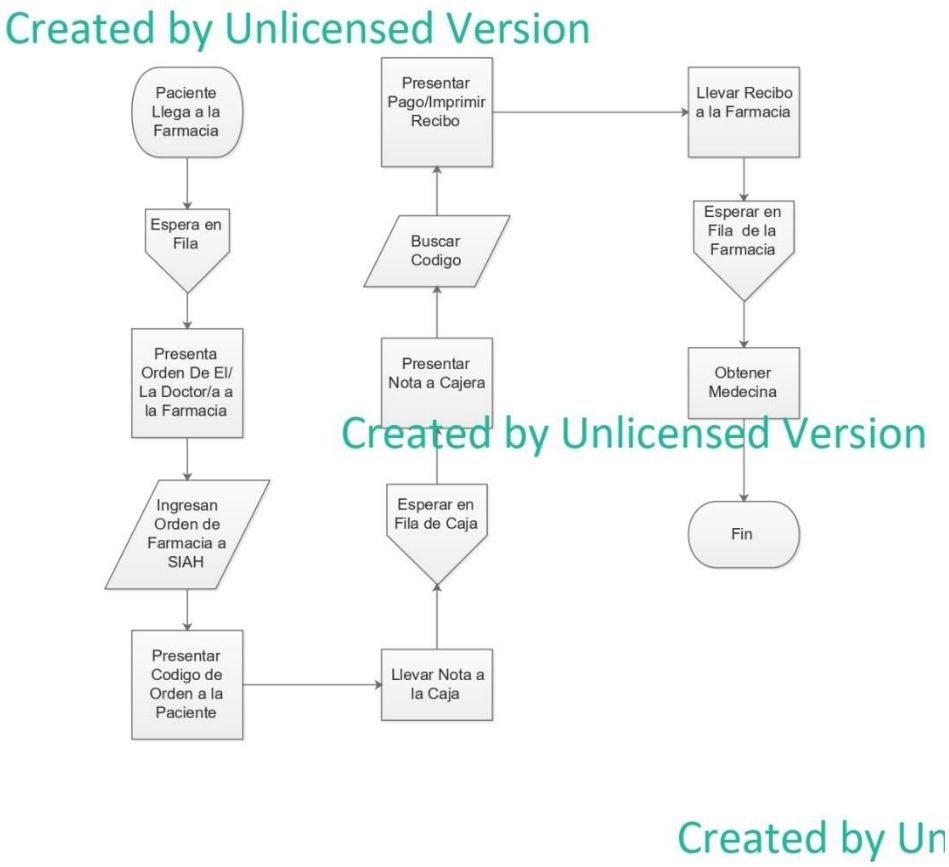
Examples of Maternidad de Maria promotional materials posted on Facebook


Maternidad de Maria Chimbote
June 14 at 11:13 AM ·
#Salud
Todos los alimentos industrializados que se vendan en el Perú estarán obligados a partir del 17 de junio de 2019 a llevar octógonos de advertencia (🔴) que informen que su contenido excede los parámetros establecidos por la ciencia para el sodio, azúcar, grasas saturadas o grasas trans.
See Translation
ALTO EN GRASAS SATURADAS
ALTO EN AZÚCAR
ALTO EN SODIO
CONTIENE GRASAS TRANS
LAREPUBLICA.PE
Octógonos: alimentos calificados como "productos grasas trans" son los más nocivos para la salud
57
1 Comment 29 Shares

Appendix D

OLD PROCESS

Flow diagram of pharmacy process prior to our visit



NEW PROCESS

Flow diagram of pharmacy process after our recommendation