NURS 299
EHR Project Proposal

Members and Roles
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Introduction
Swaziland has the highest prevalence rate of HIV-infected adults in the world (CDC), and an estimated 63% of the population lives in poverty (World Bank). Consequently, caretakers die—leaving orphans and vulnerable children as half of Swaziland's population (UNICEF). These children are left with no hope of escaping the cycle of poverty. Heart for Africa (HFA) is working to help alleviate this problem.

To provide some background, Project Canaan (HFA's land development project in Swaziland) is composed of various projects focused on HOPE: Hunger, Orphans, Poverty, and Education. Its main focus is the children's home, which raises orphans and abandoned, neglected, and/or abused children. Currently, dozens of aunties and uncles help raise 170+ children ranging from a few months old to primary school-age. The caretakers comprise mostly of people from the local Swazi community, so the children at Project Canaan are experiencing the Swazi culture and learning the siSwati language.

Project Canaan comprises of many other projects, including a chicken barn, a farm, a greenhouse, an artisans workshop, a woodshop, a medical clinic, and a community outreach initiative. All of these projects employ local Swazis, and there are workshops that educate these employees on subjects like HIV/AIDS and family planning.

Statement of the problem or objective of the project
The current health record system in the children's home and clinic of Project Canaan is a paper documentation system. Actions like pulling/returning files, making new files, hole-punching papers, and preparing vaccination lists take up an unexpected amount of time, which can easily add up to be 2 hours each day. On most days, the nurses end work about an hour later than they should. This time could be used for more important actions that lead to better care, better record-keeping, and much less confusion. The objective of this project is to construct an electronic health record (EHR) system that will replace this paper documentation system. The EHR will need to be adjusted to fit the needs of a developing country like Swaziland, where electricity is unstable and access to the internet is expensive.

We have conducted preliminary research and have found no competing products—simple but effective EHRs that can be installed at little to no cost in low-resource settings. This includes EHR systems that are customizable to the needs of organizations like HFA, are not overly

complicated, and are suited for locations where there is no Wi-Fi, limited or expensive data, and limited resources. The free or low-cost EHRs found online are not suitable because they require internet access when using the system, are expensive, are not customizable, are not easy to use for those without much computer training, and/or are too complicated (having an excessive number of drugs not available in the many low-resource settings).

Details of the Project
We have talked to faculty members and done research online to determine that a simple EHR for HFA is feasible to construct and implement. The engineering students have the background knowledge and resources at Penn to be able to develop the EHR's various aspects. We will be meeting weekly to discuss the progress and next steps, and students will work on their respective parts on their own. Students will be divided into the following sub-teams and roles:

Server-side Database Team: Will be building the SQL/Mongo database and building schema (an API for accessing the server and getting information). This will be written in JavaScript.
Client-side JavaScript Team: Will be in charge of writing the JavaScript according to the requests of HFA. This will include writing code in React.js, Express.js, and Node.js.
User Interface/UX Design Team: Will include drawing paper sketches of the design and then recreating them through CSS/Bootstrap. This will also include User testing, which includes asking test subjects to see how easily they can navigate around the database.
Hardware and Reliability Team: Will be in charge of building the physical server and designing the parts of the EHR system so that scalability, consistency, and failure-prevention are met. This includes use of Linux and Raspberry Pis, as well as routers and WLAN.

We have also planned a layout that will be used to construct the EHR this upcoming semester. I believe that this EHR will significantly improve health care for organizations by providing a singular resource for health records, time-saving features like monthly immunization lists, and features like nursing assessment checklists that will improve patient care. An example of the "Summary" page is on the next page.

Summary	**Albert Phangani**			DOB: 28-12-14
Problem List	Sex: M		Weight: 12.6 kg	
Chronic problems	Age: 36 months		Height: 88 cm	
Acute problems				
Medication list	**Allergies**: none			

Summary	**Upcoming updates**: 28-12-17 3 year immunizations
Problem List	28-12-17 Well Child Check

Summary
Problem List
  Chronic problems
  Acute problems
  Medication list
Nurse Notes
Immunization Record
Well Child Checks
HIV/TB Testing
Growth Charts
  2 - 20 years
  Birth - 36 months
    Head circumference
    Length
Scans
  Reports
  Referrals
Social History

Pharmacy

Chronic Medication List

Start date	Name of Rx	Dose	End date
19-01-16	Probiotic	Daily	(cont.)
18-05-17	Cetirizine	2.5 ml daily	(cont.)

Acute Problems

Date of onset	Diagnosis	Treatment	Date of resolution
24-03-17	Fungal infection	Ketoconazole	(cont.)
28-06-16	Eczema	Biocort Aqueous BD	15-03-17

Chronic Problems

Date of onset	Diagnosis	Treatment	Date of resolution
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Brief social history: Mother abandoned child with father. Mother now in prison for dumping baby.

The EHR will include the following information (using the language in the HFA paper charts):

Patient information
- Name (given name, English name)
- Date of birth
- Sex
- Allergies
- Parents' names (if known)
- Birth order
- Feeding history (when child is weaned, name of formula, age introduced to formula)
- Social history
- Immunizations (dates due/administered, name of vaccine, lot number)
- Vitamin A supplements and deworming tablets (dates due/administered, lot number)
- Medicines + Problem List
  o Chronic medicine list (start date, drug name, dose, end date)
  o Problem list (date of onset, diagnosis, treatment, date of resolution; includes both acute and chronic problems)
  o Medication list (start date, drug name, dose, end date)
- Well Child Check (date due/administered; rest of information is on the WCC pdf)
- HIV and tuberculosis testing (date of arrival at Project Canaan, test date 6 weeks from arrival, mother's status; test: date, positive/negative, type of test)
- Growth charts (from CDC: birth to 36 months old, 2 to 20 years old)
- Nurse notes (date, name of nurse, nursing diagnoses; much of this format will be updated to include checklists for more thorough assessment)
- Scanned file uploads (name of the file, date, organization, etc.)
- Space for outside referrals

<u>Features</u>
- Ability to upload and print scanned documents and pictures
- Ability to run reports, including but not limited to:
    o Monthly immunization and WCC lists
    o List of people who have had a certain disease (ex: varicella)
    o List of children with HIV/AIDS
    o List of underweight/underdeveloped children
    o List of children who need physical therapy
- Ability to input data points of length, height, weight, and head circumference directly onto CDC growth charts
- A "Pharmacy" section that keeps track of the amount of each medicine used, the amount left, and the amount that needs to be ordered for a specified period in the future

This project will be a pilot project for the broader application of the EHR. We are developing this system to implement at HFA in Swaziland to see if there are problems or aspects we can improve on for its installation process and use. This information will be used to develop a template EHR that can be used by similar organizations (clinics, hospitals, children's homes/orphanages, etc.) in low-resource settings.

Timeline
<u>January 10 – January 24</u>: Workshops and learning JavaScript, Bootstrap, Github. This includes homework assignments relating to features of the EHR and quizzes relating to the technical aspects of the software.
<u>January 24 – April 1</u>: Working in teams and building the system. Each team member will be part of one or more teams based on their interests and performance on the homework assignments. Each week, a different aspect of the EHR, including the EHR features listed above, will be the focus for construction.
<u>April 1 – April 18</u>: Heavy testing/debugging and adding security features (encryption, HTTPS, etc.). The testing will be done both within the team itself and with faculty members.
<u>April 18:</u> Present the EHR to Dr. Kagan and get feedback.
<u>April 19 – May 1</u>: Finalize project and debrief. Based on feedback from Dr. Kagan and other faculty members, we will reformat the EHR. Debrief by talking about improvements for the future and potential items that need to be edited during the summer.
<u>Summer 2018</u> (dates to be determined): Travel to Project Canaan to help install the EHR.

Results expected
At the end of this project, the expected result is an EHR that can be implemented at Project Canaan. With an EHR, nurses would not forget to ask for and document information about signs and symptoms, since there would be a format to follow. The EHR will have check boxes for information about the signs and symptoms and text boxes to type other notes. A child's height, weight, and head circumference measurements from monthly check ups will be automatically plotted into the CDC development charts. The system will also be able to run reports, including monthly immunization lists and reports on who had what disease/vaccine. It can also prevent errors in medication and can be used to calculate how much medicine should be ordered so they don't expire. An EHR will also be important as more children arrive and employees work on

Project Canaan. As explained previously, there are broad applications for this project—it has the potential to be altered and distributed to similar nonprofits around the world.

Manner of presentation of results (e.g. a final written report, demonstration, etc.)
There will be a demonstration of the EHR. There can also be a final written report that documents the process of constructing the EHR as well as any challenges that arose during the process. Some or all of the people participating in this project will travel to Project Canaan to help implement this system. Results can be measured and documented to be reported on when we arrive back at Penn.

Method of evaluation for project for grade
This project has a timeline for how this project should progress through the semester. Faculty advisors can observe and instruct us every week or as needed, and grade us accordingly to the progress made. The final EHR can also be graded to see if the goals for this system have been accomplished.

This project can also be graded based on each member's progress made according to one's role:
Ruth Lee (N '20): Medical Design Lead

Responsibilities	*Method of Evaluation*
Communicate with Heart for Africa about its needs, desired features of the EHR, travel logistics, etc.	Assess copies of the communications with Heart for Africa whether in intervals through the semester or at the end
Oversee the overall health care design of the EHR; making sure that it is intuitive to use and suits the needs of HFA	Assess the ease of use of the final EHR and how/if it suits the needs of HFA
Communicate with Nursing faculty members to test run the EHR and seek advice	Assess copies of the communications and records of meetings (if any) with Nursing faculty

Connor Chong (W, E '20): EHR Project Lead

Responsibilities	*Method of Evaluation*
Oversee the overall construction of the EHR	Assess the overall ease of use and functionality of the EHR
Communicate with SEAS faculty members about general qualities of the EHR (e.g., security, software and hardware design)	Assess copies of the communications and records of meetings (if any) with SEAS faculty
Facilitate communication between the different sub-teams and leads	Assess copies of the communications that facilitate information between different sub-teams and leads
Make and give the homework assignments and quizzes	Assess feasibility and accuracy of the assignments and quizzes

Desmond Johnson (E, C '19): Frontend Software Lead

Responsibilities	*Method of Evaluation*
Oversee the client side methods and navigation methods	Assess the performance and accuracy of client side code

Mark Choi (E '21): Backend Software Lead

Responsibilities	Method of Evaluation
Oversee the database and database pipeline that allows data to be consistent and durable	Assess the security, durability, and consistency of the database
Write database methods that allow easy communication with the server	Assess ease of access

Hiyori Yoshida (W, E '21): UX Design Lead

Responsibilities	Method of Evaluation
Oversee the design and user interface that allows for smooth and easy navigation	Assess the performance, quality, and adaptability of design
Create testing groups and test user interface with different types of users.	Assess ease of use

Chris Lin (W, E '20): Hardware Design Manager

Responsibilities	Method of Evaluation
Oversee the design and hardware choices for the physical server system, including backup power, system crashes, and foreign intervention	Assess the performance and durability of design

Carsen Coggeshall (E'20): Research Lead

Responsibilities	Method of Evaluation
Oversee the research of various technologies, including cryptography, HTTPS, and SSH capabilities of the project	Assess how the system might respond to security challenges and injection attacks

References

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