CS 6440 Student Project Proposal

Project Title: Cancer Reporting from Laboratory Information Systems to State Cancer Registries	
Mentor 1 Name: Sandy Jones	**Mentor 1 Email:** SFJones@cdc.gov
Mentor 2 Name: Paula Braun	**Mentor 2 Email:** pax1@cdc.gov

Project Background: After the laboratory completes the requested cancer diagnostic and/or biomarker tests with a final pathologist rendered interpretation and the data are entered into the LIS, then a determination of reportability will need to be made based on a coded trigger list. This can be done either internally within the LIS, or externally through a decision support service, such as a FHIR Cancer Registry service. If the case is determined to be reportable, then the LIS needs to request, complete, and transmit a cancer case report, using the FHIR Questionnaire/Questionnaire Response (Structured Data Capture) resources, to the state cancer registry. The cancer case report will be a FHIR questionnaire response based on the College of American Pathologists (CAP) Cancer Protocols and electronic Cancer Checklist (eCCs) Templates: http://www.cap.org/web/home/resources/cancer-reporting-tools/cancer-protocol-templates?_afrLoop=39382695961083#!%40%40%3F_afrLoop%3D39382695961083%26_adf.ctrl-state%3D7q3ka3djh_4

Project Objective(s): FHIR-enable cancer reporting.

Description of the Solution:

1) Develop a tool that can render the CAP eCCs into FHIR Structure Data Capture (SDC) compliant forms and identify any issues with the FHIR questionnaire resource that would not facilitate the capture of data according to the CAP Cancer Protocols and eCC Templates.
    a. Based on any questionnaire design issues identified, develop recommendations for needed functionality in the FHIR questionnaire resource and/or extensions to meet the need for cancer laboratory reporting
2) Develop FHIR Server that provides the decision support to make a determination of cancer reportability requirement based on a coded trigger list (ICD9, ICD10, SNOMED lists already exist) and form manager to provide the LIS with the appropriate form for completion. (Note: This task overlaps with a similar task in the *FHIR Cancer Reporting from Physician EHRs* project).
3) Develop a tool for Central Cancer Registries to receive and process the FHIR questionnaire response (SDC) data. . (Note: This task overlaps with a similar task in the *FHIR Cancer Reporting from Physician EHRs* project).

Desired Student Skills/Background:

- Willingness to read, interpret, and ask questions about existing CDA implementation guide and make recommendations on ways to re-cast the existing implementation guide using FHIR (e.g., POST a new cancer event via a RESTFul protocol as opposed to sending a CDA document).
- Experience with RESTful interfaces, backend development, and webservers
- Clinical decision support engine

Data Requirements and Potential Sources: De-identified laboratory data in an HL7 2.3.1 or 2.5.1 message format will be provided for use. We can also provide sample CAP eCC data for use, if needed.

Other Comments:

This project team is familiar with FHIR had has participated in some connect-a-thons.

CS 6440 Student Project Proposal

Project Title: Cancer Reporting from Physician EHRs to State Cancer Registries	
Mentor 1 Name: Wendy Blumenthal	**Mentor 1 Email:** WBlumenthal@cdc.gov
Mentor 2 Name: Paula Braun	**Mentor 2 Email:** pax1@cdc.gov

Project Background: A patient has an encounter with a physician during which the physician either diagnoses or treats the patient for cancer. The physician is required by state law/regulation to report the details about the patient's cancer (including demographics, cancer diagnosis and staging information, test results, procedures, and treatments) to the state cancer registry. The physician documents the encounter information, including the patient's diagnosis, in the Physician EHR system and then the EHR system needs to make a determination of cancer reportability based on a coded trigger list. This can be done either internally within the EHR, or externally through a decision support service, such as a FHIR Cancer Registry service. If the case is determined to be reportable, then the Physician EHR System needs to transmit a cancer case report to the state cancer registry, with the content included in the Cancer Implementation Guide: http://www.hl7.org/implement/standards/product_brief.cfm?product_id=383f.

Project Objective(s): FHIR-enable cancer reporting

Description of the Solution:

4) Map the most recent CDA cancer Implementation Guide (IG) to FHIR resources to identify gaps. Specifically, this would include identifying: a) the data elements in the cancer IG that are not in the existing FHIR resources and b) the constraints on element optionality and code system/value set requirements in the cancer IG that are different than those in the existing FHIR resources
    a. Based on the data element gaps identified, develop the FHIR extensions needed for cancer reporting
    b. Develop a FHIR profile to fully describe the cancer report to be transmitted cancer, including addressing the gaps identified in constraints and vocabulary requirements
5) Develop a tool for Cancer Registry to receive and process the FHIR data. (Note: This task overlaps with a similar task in the *FHIR Cancer Reporting from LIS* project).
6) Develop FHIR Server that provides the decision support to make a determination of cancer reportability requirement based on a coded trigger list (ICD9, ICD10, SNOMED lists already exist) (Note: This task overlaps with a similar task in the *FHIR Cancer Reporting from LIS* project).

Desired Student Skills/Background:

- Willingness to read, interpret, and ask questions about existing CDA implementation guide and make recommendations on ways to re-cast the existing implementation guide using FHIR (e.g., POST a new cancer event via a RESTFul protocol as opposed to sending a CDA document).
- Experience with RESTful interfaces, backend development, and webservers
- Clinical decision support engine

Data Requirements and Potential Sources: I think we'd have to use synthetic data. We have developed synthetic CDA cases (~a few hundred) for the MU2 cancer IG for testing our validation tools. For the MU3 IG, however, we only have a very small number of synthetic CDA cases (~5) developed for the ONC validation process. And if we needed data in the FHIR format (e.g., for task 2 above), we'd have to develop new synthetic data.

Other Comments:

This project team is familiar with FHIR had has participated in some connect-a-thons.

CS 6440 Student Project Proposal

Project Title: Childhood Obesity – Enhancing the Patient, Provider, and Care Coordinator Apps	
Mentor 1 Name: Aly Goodman	**Mentor 1 Email:** AGoodman@cdc.gov
Mentor 2 Name: Paula Braun	**Mentor 2 Email:** pax1@cdc.gov

Project Background: The prevalence of childhood obesity has risen dramatically over recent decades, with approximately 12 million US children currently having obesity; low-income children, and those in the Southeast U.S., are at disproportionally high risk. Obesity puts children at greater risk for numerous health and social consequences, including heart disease, diabetes, asthma, school absenteeism, and mental health concerns like bullying or depression. Child obesity typically persists into adulthood: 90% of adolescents with obesity become obese adults, and incur an additional $3.5 billion in lifetime medical expenditures. Despite recommendations for universal screening of all children for healthy weight, in 2014, only 60-65% of children aged 3-17 years had a BMI percentile documented at their last outpatient visit and even fewer (40-60%) had documentation of nutrition and physical activity counseling. Clinic to community linkages for nutrition and physical activity resources or weight management programs are generally poor – making access and uptake of these key interventions by families sub-optimal.

CDC's Division of Nutrition, Physical Activity, and Obesity aims to assess the feasibility of using Fast Healthcare Interoperability Resources (FHIR) to promote an evidence-based, family and community-centered care model to help screen all children for healthy weight and behaviors, to identify children at risk for overweight or obesity, to promote improvements in weight status and in healthy behaviors, to link clinical and community programs to help remove barriers to improving behaviors among high risk populations, and to facilitate use of clinical data for evaluation or surveillance purposes.

Project Objective(s): This will be a continuation of a GT project that began in Spring 2016. We'd like to expand the functionality of the patient-facing app, provider app, and the care coordinator app.

Description of the Solution:

7) Patient-Facing App – receive height & weight & lab results from provider app, receive recommendations from care coordinator app, allow parent/patients to see community resources in their area, allow parent/patients to make appointments with local services, and perhaps interface with fitness apps
8) Provider Facing App – send height, weight, BMI, & lab results to patient-facing app, improve current functionality for e-referrals and ICD-10 coding
9) Care Coordinator App – receive e-referrals from provider facing app, send community resource recommendations in the patients' neighborhood to patient-facing app, work with Children's Healthcare of Atlanta (CHOA) to help define additional functionality

Desired Student Skills/Background:

- Ability to read and make enhancements to existing code
- Front-end web development, back end development, web servers
- Interest in improving the health of pediatric populations
- Interest in SMART-on-FHIR

Data Requirements and Potential Sources: Sample data are already loaded on the GT FHIR server. Additional data can be access from the MIHIN server or synthetic data can be created.

Other Comments:

This is CDC's most experienced team working with Georgia Tech students.

CS 6440 Student Project Proposal

Project Title: Clinical Decision Support Tool for Group B Streptococcus	
Mentor 1 Name: Gayle Langley	**Mentor 1 Email:** GLangley@cdc.gov
Mentor 2 Name: Paula Braun	**Mentor 2 Email:** pax1@cdc.gov

Project Background: Group B *Streptococcus* (GBS) GBS can be transmitted from mother to child during labor and delivery. Transmission can be prevented by providing intrapartum antibiotic prophylaxis (IAP) during labor and delivery to mothers who are known to be colonized with GBS or have other risk factors. Guidelines for IAP have been in place since the 1990s and rates of early onset GBS disease (occurring in <7 day olds) have declined by >80% since then. However, GBS remains the leading cause of neonatal sepsis in the US. Studies have shown that IAP guidelines were not properly followed in up to 60% of babies that develop GBS. We think it is because they are complicated.

Project Objective(s): Our group developed a smartphone app that contains the guidelines and then developed a clinical decision support (CDS) tool. The CDS tool was piloted at one hospital in 2014. We are in the process of revising the prototype so that it is more EMR agnostic (i.e. easier to implement at multiple places). One type of technology that we are exploring is FHIR.

Description of the Solution:

10) FHIR app (ideally a SMART-on-FHIR app) that implements (and if time permits improves) the CDS tool built by CDC

Desired Student Skills/Background:

- Front end development
- Clinical decision support
- Interest in learning about SMART on FHIR and the CDS Hooks Project

Data Requirements and Potential Sources: CDC will provide public data or specifications for synthetic data. Student team may need to help develop a limited synthetic data set to use during development.

Other Comments:

This project team is very new to FHIR and is at the beginning stages of understanding what the technology can do.

CS 6440 Student Project Proposal

Project Title: ERAS Application for Patient Education	
Mentor 1 Name: James C. Cox, PhD, GSU	**Mentor 1 Email:** jccox@gsu.edu
Mentor 2 Name: John F. Sweeney, MD, Emory	**Mentor 2 Email:** jfsween@emory.edu
Project Background: This project is on patients' uptake of Enhanced Recovery After Surgery (ERAS) protocols. Such protocols offer standardized perioperative evidence-based care. They are widespread in Europe and shown to improve quality of medical care (reducing complications and hospital length of stay) in Randomized Controlled Trials. Emory University Hospital is currently implementing ERAS protocols in some surgeon groups.	
Project Objective(s): Empowering patients to actively participate in implementation of ERAS protocols.	
Description of the Solution: We are interested in development of a user friendly application for use by patients in the hospital. This would *not* have to be SMART on FHIR. There currently exists a colorectal ERAS patient education booklet, that is provided to some surgery patients at Emory University Hospital. The app could incorporate the existing content of the booklet "Preparation for Surgery, Day of Surgery, Hospital Stay and Leaving the Hospital". The app should be interactive and able to monitor and alert the patient (or a family member) when ERAS targets for the patient are missed. Ideally it should also be able to record the responses to alerts.	
Desired Student Skills/Background: Expertise in developing apps for tablets and mobile phones	
Data Requirements and Potential Sources: "Preparation for Surgery, Day of Surgery, Hospital Stay and Leaving the Hospital" is a detailed source of patient education material for active patient engagement in ERAS protocols	
Other Comments: Interested students are cordially invited to work with us on this project.	

CS 6440 Student Project Proposal

Project Title: FHIR Interface to Controlled Substance Database	
Mentor 1 Name: Jeff Duncan	**Mentor 1 Email:** jduncan@utah.gov
Mentor 2 Name: Paula Braun	**Mentor 2 Email:** pax1@cdc.gov

Project Background: Drug poisoning deaths are now the leading cause of injury related deaths nationwide. Office of the Medical Examiner (OME) pathologists and investigators need access to relevant clinical information during the completion of a medicolegal death investigation. One potential resource is the Controlled Substance Database (CSD). The CSD is a repository of prescriptions for controlled substances designed. OME pathologists currently must log in to a separate system to access the CSD. The Utah Department of Health currently has a view into the CSD for epidemiologic analysis. A FHIR interface between UMED (the OME's case management system) and CSD could be used to enable pathologists and investigators to access a deceased person's controlled substance history from within the UMED application. UMED would send personal identifiers such as name, date of birth, sex, and CSD would return prescription history information.

Project Objective(s): Develop a FHIR interface to the Controlled Substance Database and to UMED (the medical examiner's case management system) to enable providers to access a deceased person's controlled substance history from within UMED.

Description of the Solution:

11) Develop a FHIR interface to the Controlled Substance Database
12) Develop a FHIR interface to the UMED (the medical examiner's case management system)
13) Develop a mechanism, using FHIR, for providers to access a deceased person's controlled substance history from within UMED

Desired Student Skills/Background:

- Experience with RESTful interfaces, backend development, and webservers
- Interest in FHIR enabling existing systems.
- Interest in innovative solutions to combat prescription drug overdoses

Data Requirements and Potential Sources: Public or synthetic data can be used for these purposes

Other Comments:

The State of Utah is a very advanced public health partner. This project provides an excellent opportunity for students interested in developing novel solutions to help combat the current prescription drug overdose epidemic.

CS 6440 Student Project Proposal

Project Title: FHIR Interface to Directory of Clinicians	
Mentor 1 Name: Jeff Duncan	**Mentor 1 Email:** jduncan@utah.gov
Mentor 2 Name: Paula Braun	**Mentor 2 Email:** pax1@cdc.gov

Project Background: UDOH is in the process of developing a directory of clinicians (DoC) for use in multiple health department information systems that require unique provider identification. The Vital Records electronic death registration system (EDRS) for example, requires the ability to look up and verify a physician's credentials when a system account is created. On an ongoing basis, the EDRS will query DoC to ensure physicians using EDEN to certify deaths have current licensure. UDOH has worked with Utah's Division of Occupational and Professional Licensing (DOPL) to obtain a view into the DOPL licensing database for healthcare providers. This database view is used to feed data to DoC. Unlike DOPL's database, DoC will link to a master person index to de-duplicate and update current name and address information. DoC will also maintain logical links between individual healthcare providers and the institutions for which they work. For this purpose, DoC will need to query Utah's Clinical Health Information Exchange (CHIE). CHIE is an external HIE that is managed by a non-profit organization called Utah Health Information Network (UHIN). CHIE maintains a master table of providers and their affiliated organizations used to facilitate electronic claims payments.

Project Objective(s): Develop a FHIR-based solution to look up and verify a physician's credentials

Description of the Solution:

14) The DoC will obtain current provider information from CHIE using a FHIR interface.
15) DoC will send provider demographic information and will receive confirming or additional information from CHIE regarding the provider. DoC may also provide death notifications to CHIE per the use case described above.

Desired Student Skills/Background:

- Experience with RESTful interfaces, backend development, and webservers
- Interest in FHIR enabling existing systems.
- Interest in patient matching/entity resolution/data deduplication

Data Requirements and Potential Sources: Public or synthetic data can be used for these purposes

Other Comments:

The State of Utah is a very advanced public health partner. This project provides an excellent opportunity for students interested in patient matching/entity resolution/data deuplication or in gaining experience working with a HIE.

CS 6440 Student Project Proposal

Project Title: FHIR Interface to Link Death Data to Other Data Sources	
Mentor 1 Name: Jeff Duncan	**Mentor 1 Email:** jduncan@utah.gov
Mentor 2 Name: Paula Braun	**Mentor 2 Email:** pax1@cdc.gov

Project Background: The Division of Medicaid and Healthcare Financing (DMHF) in the Utah Department of Health is responsible for paying all Utah Medicaid claims. A recent audit of their systems showed that DMHF paid Medicaid claims for controlled substance prescriptions written by deceased providers. DMHF would like to receive notifications when licensed providers in Utah die so that they can flag the provider as deceased and avoid paying claims for deceased providers.

UDOH has a master person index (MPI) called DOHMPI. DOHMPI is used to link and deduplicate person-centric information in systems across the health department, including Utah's electronic death registration system, EDEN. UDOH is in the process of developing a centralized provider directory known as DoC (Directory of Clinicians) that will contain up-to-date licensing and demographic information regarding clinical providers.

Project Objective(s): Develop FHIR interfaces that will be used to flag deceased providers in the DMHF database to prevent controlled substances from being written by deceased providers and avoid paying associated claims.

Description of the Solution:

The solution will work as follows:

16) A deceased person's death is registered in EDEN. (In Production)
17) DOHMPI Agent pushes newly registered death to DOHMPI. (In production)
18) DOHMPI links death certificate data with other UDOH source programs, including DoC (We are in the process of linking DoC to DOHMPI)
19) A link between a death certificate and a provider in DoC triggers a death notification alert (In production)
20) A FHIR interface is used to push the deceased provider's information to DMHF systems. (to be developed)

The above scenario has multiple other variations, for example when a death certificate links to a birth certificate or IIS in DOHMPI, we can push the death notification to the third party system. Much of the infrastructure is in place, we need the interfaces to push to external systems.

Desired Student Skills/Background:

- Experience with RESTful interfaces, backend development, and webservers
- Interest in FHIR enabling existing systems.
- Interest in patient matching/entity resolution/data deduplication

Data Requirements and Potential Sources: Public or synthetic data can be used for these purposes.

Other Comments:

The State of Utah is a very advanced public health partner. This project provides an excellent opportunity for students interested in combating the recent epidemic in prescription drug overdoses and/or helping to reduce healthcare fraud.

CS 6440 Student Project Proposal

Project Title: Improving Medication Adherence at the Community Level	
Mentor 1 Name: Skip Clelland	**Mentor 1 Email:** CClelland@cdc.gov
Mentor 2 Name: Paula Braun	**Mentor 2 Email:** pax1@cdc.gov

Project Background: Our goal is to better understand what drives medication adherence by looking beyond individual compliance and taking into account social determinants of health community issues that may impact medication adherence within populations. The ideal solution will be a set of tools that allow community leaders to develop targeted interventions and compare the status of their communities to that of their peers and the overall population.

Project Objective(s): Develop three medication adherence type applications (patient-facing, provider-facing, and reporting) using HL7 FHIR and SMART-on-FHIR capabilities. These applications will help bridge the divide between families, clinicians, and public health so that all stakeholders are better able to understand and help promote medication adherence strategies. This document provides the desired functional requirements for each of the applications.

Description of the Solution:

21) Patient-facing app: Medications adherence is a behavior that includes decision points throughout the day that either promotes or prevents medication being taken appropriately. This should be an app for a smart phone or tablet or possibly apple watch or fitbit type product. The patient should be able to use the app in a way that captures some sort of biometric response that medication has been taken or if medication is missed after certain time then provides some sort of prompt that provides a reason why medication wasn't taken. The app should have tracking on how medication was taken and then ability to share with healthcare providers. The data from this app should flow into the electronic medical record and prescription databases so that the patient's behavioral data appears alongside the medication regiment.
22) Provider-facing app: Unlike the patient facing app looking at the behavior of taking medication, the provider facing app needs to have multiple demographics and social information along with the usual medication regiment and prescription history. This may be accomplished by using readily accessible data bases such as Census data along with current EHR database and prescription drug histories to compile a medication/social/built environment measure for physicians and pharmacists to assess problems and barriers to medication adherence. The idea is that barriers within the communities' social and built environments play a role in medication adherence and if identified then strategies could be used to promote medication adherence. An example is if you are in an area where you have many grandparents as primary care takers especially with children. This may impact adherence that may not be captured. However with Census data, this could be identified and then strategies to assist grandparents that have this role. The app for the provider would be ideal if there was some mechanism to measure complexity of the medication regimen that would assist providers in determining the feasibility of a patient adhering to the regimen. Complexities to medications include: # of medication prescribed (estimated that most people have problems take more than 6 meds per day)
    - Drug-drug interactions
    - Drug-disease interactions
    - Contraindications
    - Side effects (a major reason people stop taking meds)
    - Adverse effects (a major reason people stop taking meds)

- Dosing and timing
- Dosing regimen (e.g. once daily versus three times daily)

First Data Bank is the main source for identifying these type of complexities. These areas would need to be developed to provide an estimate for compliance. The thought is that the more complex a medication regimen, the more difficult for the patient to adhere.

Since physicians only have a limited amount of time to spend with patients this app needs easy indicators to view.

23) Reporting: The reporting app will allow healthcare providers, community resources, public health agencies, and other interested parties (e.g., Medicaid) to better understand population health. The app will provide an analytical engine so that the data can be "sliced-and-diced" and visualized or mapped in various ways. The healthcare provider-facing app should be able to call the reporting app to allow clinicians to track their own performance on medication prescribing and adherence, such as percent of patients adherence by disease state, patient adherence by percent adherence, etc.? The main purposes of the app, however, will be to extract info to send to public health (data must be de-identified) or other entities (e.g., Medicaid—data can be identifiable). Key data of public health importance include:
- Age
- Sex
- Race/Ethnicity
- BMI
- Blood Pressure
- Patient behavior info
- Laboratories (e.g., cholesterol, hemoglobin a1c)
- Counseling done (yes/no) – some drill-down ability
- Location (may need to suppressed, algorithm to send or not send on whether child can be re-identified)

Desired Student Skills/Background:

Patient-Facing App
- Front-end/UI development
- Reporting data to EMR

Provider-Facing App
- Front-end/UI development
- Open Data/Data wrangling skills
- Interest in social determinants of health, data visualization, analytics

Reporting App
- Experience with RESTful interfaces, backend development, and webservers
- Interest in data visualization and analytics

Data Requirements and Potential Sources: Students are encouraged to create synthetic data and explore open data sets to meet the objectives of the individual apps.

Other Comments:

This project will likely require three or more teams to complete. The teams will need to coordinate from the beginning. The project is well-suited for creative types who are highly self-motivated.

CS 6440 Student Project Proposal

Project Title: Modeling of Unplanned Hospital Readmissions	
Mentor 1 Name: James C. Cox, PhD, GSU	**Mentor 1 Email:** jccox@gsu.edu
Mentor 2 Name: John F. Sweeney, MD, Emory	**Mentor 2 Email:** jfsween@emory.edu
Project Background: We have previously developed two models for hospital readmission and worked with students in the course in Spring 2015 to inculcate one of them into a FHIR app.	
Project Objective(s): Develop a third model that can produce discharge recommendations for an existing clinical decision support system (CDSS). A second objective is identification of an efficient data imputation algorithm for missing observations.	
Description of the Solution: This project requires use of a supervised learning algorithm such as neural network modeling to estimate a readmission model using a large sample of data from (de-identified) electronic medical records. Patients are known to have been discharged and subsequently readmitted or not readmitted with the same diagnosis code within 30 days. In addition to patients' unvarying data (comorbidity, gender, etc.) and daily clinical data we also have normal range of values of clinical variables. Another separate dimension of this project is utilization of a data imputation algorithm because missing observations are a common feature of data from electronic medical records.	
Desired Student Skills/Background: This project would require students with a good background in machine learning.	
Data Requirements and Potential Sources: We have a large sample of de-identified electronic health records data.	
Other Comments: Interested students are cordially invited to work with us on this project.	

CS 6440 Student Project Proposal

Project Title: PHR to EHR Link	
Mentor 1 Name: Gari Clifford, PhD, Emory	**Mentor 1 Email:** gari@gatech.edu
Mentor 2 Name:	**Mentor 2 Email:**
Project Background: Significant inefficiencies exist in the medical system leading to inflated costs, high error rates, and low patient satisfaction. A patient-focused personal healthcare record on a smartphone, linked to the hospitals electronic medical record, is likely to improve appointment take-up, accurate information flow (reminders of what happened last time, and the patient's follow up actions), better communication, reduced errors (or omission and commission) and reduced visits/healthcare utilization.	
Project Objective(s): Develop a smartphone app which allows patients to see appointments, wait times, rebook, and enter / review basic medical information about themselves.	
Description of the Solution: The solution will be an app (running on Android, and if time, on iOS) to allow users to securely store data on their phone using a portable open source PHR (IndivoX). FHIR protocols will be used to communicate with Emory's EMR to allow the logging of visits, appointments, medications, history etc. Ideally the app can be used to manually and auto (re)schedule appointments, allow messaging to and the location of a patient in the hospital, allow patients to enter their worries and history, including photos and audio recordings, allow the recording of discharge instructions for alter review (with auto reminders), medication pick up/refill, rating of their experience/pain/stress levels during the experience, and tracking of their time through the healthcare syste,m.	
Desired Student Skills/Background: Java, Swift, Android, iOS, HL7, XML, SMART on FHIR	
Data Requirements and Potential Sources: IndivoX, Cerner's demo database, Emory's EMR	
Other Comments:	

CS 6440 Student Project Proposal

Project Title: Sexually Transmitted Disease Surveillance	
Mentor 1 Name: Ninad Mishra	**Mentor 1 Email:** NMishra@cdc.gov
Mentor 2 Name: Paula Braun	**Mentor 2 Email:** pax1@cdc.gov

Project Background: A number of conditions are required by law to be reported to public health agencies in every state and territory. Frequently, these reportable conditions are transmitted manually (e.g. e-mail, facsimile, paper form), which can be cumbersome, error prone, and often lacking in key demographic elements. CDC's Division of STD Prevention (DSTDP) recently provided guidance for electronic case reporting based on current c-CDA based standard (Technical Guidance for electronic STI case reporting). The proposed project would explore a FHIR based application to simplify the process of electronic case reporting and to compliment the current cCDA based reporting to the public health agencies.

Project Objective(s): DSTDP seeks to explore the use of HL7 FHIR, SMART on FHIR capabilities, and cloud based computing to support its effort to improve surveillance of sexually transmitted disease (STD) in the United States.

Description of the Solution:

24) Map the most recent c-CDA based standard for STD reporting to FHIR resources to identify gaps. Specifically, this would include identifying: a) the data elements in the STD guidance that are not in the existing FHIR resources and b) the constraints on element optionality and code system/value set requirements in the STD guidance that are different than those in the existing FHIR resources
    a. Based on the data element gaps identified, develop the FHIR extensions needed for STD reporting
    b. Develop a FHIR profile to fully describe the STD report to be transmitted, including addressing the gaps identified in constraints and vocabulary requirements
25) Develop a tool for the public health agency to receive and process the FHIR data.
26) Additional functionality (assessing STD burdens and trend) may be added as time permits

Desired Student Skills/Background:

- Willingness to read, interpret, and ask questions about existing c-CDA implementation guide and make recommendations on ways to re-cast the existing implementation guide using FHIR (e.g., POST a new STD event via a RESTFul protocol as opposed to sending a c-CDA document).
- Experience with RESTful interfaces, backend development, and webservers
- Analytics to assess disease burden and trends

Data Requirements and Potential Sources: CDC will provide public data or specifications for synthetic data. Student team may need to help develop a limited synthetic data set to use during development

Other Comments:

Collaboration on this project will assist CDC in advancing tools for capturing STD morbidity data and assessing STD burden and trends. Through participation in the project, the student will gain experience of working in federal sector and will have an opportunity to suggest technology innovation for the nationwide impact. The students will also have the opportunity to gain exposure to the CDC experts and infrastructure.

CS 6440 Student Project Proposal

Project Title: SMART on FHIR Application for an Existing Clinical Decision Support System (CDSS) for Hospital Discharge Decision Making	
Mentor 1 Name: James C. Cox, PhD, GSU	**Mentor 1 Email:** jccox@gsu.edu
Mentor 2 Name: John F. Sweeney, MD, Emory	**Mentor 2 Email:** jfsween@emory.edu
Project Background: The mentors developed an alpha version of a clinical decision support system (CDSS) for hospital discharge decision making. The CDSS performed well in experiments with residents and advanced medical students.	
Project Objective(s): This project is development of the beta version of the CDSS as a SMART on FHIR application.	
Description of the Solution: Clinical trials on hospital wards can best be conducted with a SMART on FHIR application for the CDSS that interacts with electronic health records in real time.	
Desired Student Skills/Background: Expertise in SMART on FHIR development.	
Data Requirements and Potential Sources: We have de-identified electronic medical records data.	
Other Comments: Interested students are cordially invited to work with us on the project.	

CS 6440 Student Project Proposal

Project Title: CDC Post Discharge Stroke Patient Data Reporting App	
Mentor 1 Name: Arun Srinivasan	**Mentor 1 Email:** ASrinivasan1@cdc.gov
Mentor 2 Name: Jason Bonander	**Mentor 2 Email:** JBonander@cdc.gov

Project Background: In order to get an adequate understanding of which events are more likely to lead to readmission, the Coverdell stroke registry project at CDC is interested in collecting data once the patient transitions from the hospital to their next care setting (e.g. home, inpatient rehabilitation, nursing home). Automated identification of eligible stroke cases, chart abstraction of data elements from EHR and write back of post discharge data into EHR can improve the process by bring consistency, reduce re-entry of data and increase quality of the data reported.

Project Objective(s): Develop FHIR-based solutions for Cohort Identification and Management, Data Collection Form, Reporting, Visualization.

Description of the Solution:

1) Identify stroke patients for follow up data collection using synthetic patient records in an EHR
2) Use smart phone/web-based interaction to collect additional data upon 30 days from discharge
3) Submit as questionnaire response data back to EHR and add to the patient record using appropriate FHIR resource
4) Generate a report to stroke registry using an approved file format
5) Provide analytics on reporting
6) Provide secure access, workflow and permission sets for healthcare providers, post discharge care provider and public health

Desired Student Skills/Background:

- Front end development
- Experience with RESTful interfaces, backend development, and webservers
- Data visualization and analytics
- Interest in SMART-on-FHIR

Data Requirements and Potential Sources: Synthetic or public use data can be used for these objectives.

Other Comments:

- The CDC may or may not advance the concept of this project
- Security, reliability and political issues may prevent SMART on FHIR from broad acceptance
- For all of these reasons any external communications about this project need to be approved by the advisor and the CDC
- Any code and intellectual property developed for this project will be considered to be freely available to the CDC in perpetuity

CS 6440 Student Project Proposal

Project Title: Anesthesiologist	
Mentor 1 Name: Vikas O'Reilly-Shah, MD, PhD, Emory	**Mentor 1 Email:** vikas.oreilly-shah@emory.edu
Mentor 2 Name:	**Mentor 2 Email:**

Project Background: *Anesthesiologist i*s a free Android app designed for anesthesia healthcare professionals providing age and weight based guidelines for airway equipment, physiological reference data, and drug dosing. It is installed on ~100,000 devices globally.

Project Objective(s):

Description of the Solution:

1. Convert Anesthesiologist from the Android Java platform to Xamarin.
    a. The converted version should not substantially alter the look and feel of the original, nor should it substantially affect functionality. A "Go!" button may be added IF modification of the age and weight causes previously calculated values to disappear.
    b. The converted version may refactor as much of the original code as is necessary to improve efficiency, readability, etc.
    c. The converted version must be localized to at least as many languages as the original version (strings may be the same as the Android version).
    d. Survalytics may need to be modified in the data collection elements:
        a. Multiple userids for Anesthesiologist fed to Survalytics
        b. Age >89 stored as 89
        c. No GPS coordinates, only region/province/state and country.
2. The app would benefit from FHIR-mediated integration with the electronic medical record in a number of ways, including pre-population of patient specific information such as age, height/weight/BMI, estimated creatinine clearance, serum potassium and other anesthetically relevant information. This data could then be used to provide patient-specific alerts about specific information presented in the app. Intraoperative provider alerts for new information (e.g. lab results) would also be helpful.

Desired Student Skills/Background: Java (the app is currently written in Android Java), C#/Xamarin (the codebase needs to be ported to the cross-platform Xamarin framework), User Interface and Experience, Healthcare/Medicine, HIPAA, Amazon Web Services, Basic Database/SQL

Data Requirements and Potential Sources:

Other Comments:

Anesthesiologist was written in the Java programming language using the Eclipse IDE and Android SDK. It was released publicly in the Google Play App Store in 2011. A screenshot is provided in Figure 1a. The app was refined on the basis of design considerations and user feedback over the next several years. Released in 2011, it is installed on approximately 100,000 devices globally.

In 2015, the Survalytics platform was designed, written and integrated into the app. This module has been described in detail in a published journal article. Briefly, the platform allows for cloud-based delivery of survey questions and cloud storage of both survey responses and app analytics, using the Amazon Web Services DynamoDB NoSQL cloud database service.

The study of Anesthesiologist with the Survalytics package installed was launched in December 2015. From then until June 2016, 35,382 users updated the app to the study version; 20,361 (57.5%) subjects consented to enrollment. Users are from 179 countries, work in 188, and include all levels of healthcare providers.

Survalytics has now been partially converted into Xamarin C#, using Visual Studio for development. Xamarin is (https://www.xamarin.com/) as a platform built on .NET that allows for cross platform development of Android, iOS and Windows apps using native UI elements and very limited platform specific code.

CS 6440 Student Project Proposal

Project Title: Body Mass Index-Individualized Labor Progress Tracker: Development of a Mobile Application for Intrapartum Providers to Promote Optimal Labor Care & Outcomes	
Mentor 1 Name: Nicole Carlson CNM, PhD, Emory	**Mentor 1 Email:** Nicole.carlson@emory.edu
Mentor 2 Name:	**Mentor 2 Email:**
Project Background: Obese women (BMI 30 kg/m) are at elevated risk for cesarean delivery, with rates up to 5 times higher than normal weight women. Cesarean deliveries are most often indicated for obese women because of abnormally slow labor progression, a complication known as labor dystocia. In clinical practice, expectations of labor progress are not individualized by degree of maternal obesity, but instead are standardized based on the average rate of cervical dilation among healthy-weight women (about 1cm/hour). As a result, obese women are at increased risk of cesarean delivery simply because they do not proceed through labor as expected by the nurses and doctors who provide their intrapartum care.	
Project Objective(s): This project involves the development of a mobile phone application, the Labor Tracker, that would allow clinicians caring for obese women during labor to view a woman's cervical dilation progress on a graph that represents normal and abnormally slow labor progression according to that woman's BMI.	
Description of the Solution: Although information about cervical dilation among women with different degrees of obesity is available from large, multi-site studies, this data is not typically used by clinicians to guide their care of obese women. The Labor Tracker would, for the first time, provide easy access to BMI-individualized labor progression tracking for clinicians at the bedside. In addition, a patient-facing version of this application might be developed to allow both clinicians and laboring women to view graphical plots of each cervical examination result on BMI-individualized graphs for better communication.	
Desired Student Skills/Background:	
Data Requirements and Potential Sources:	
Other Comments:	

CS 6440 Student Project Proposal

Project Title: SUGARx: Strategies for Euglycemia	
Mentor 1 Name: Vikas O'Reilly-Shah, MD, PhD, Emory	**Mentor 1 Email:** vikas.oreilly-shah@emory.edu
Mentor 2 Name:	**Mentor 2 Email:**
Project Background: *SUGARx: Strategies for Euglycemia and Treatment Options* is an app currently undergoing beta-testing in the Emory ecosystem. It provides guidance for the preoperative, intraoperative, and postoperative periods for blood glucose management for patients who have diabetes or are at risk for it.	
Project Objective(s):	
Description of the Solution: The app would benefit from FHIR-mediated integration with the electronic medical record in a number of ways, including pre-population of patient specific information such as age, height/weight/BMI, estimated creatinine clearance, and home medications. Providers needing to keep track of several patients at a time would benefit from the addition of profile switching and patient list management.	
Desired Student Skills/Background: C#/Xamarin (Code is written in the cross-platform Xamarin framework), User Interface and Experience, Healthcare/Medicine, HIPAA, Amazon Web Services, Basic Database/SQL	
Data Requirements and Potential Sources:	
Other Comments:	

CS 6440 Student Project Proposal

Project Title: Emergency Department Check In	
Mentor 1 Name: Brenda O. Oiyemhonlan, MD, MHSA, MPH, Emory/Grady	**Mentor 1 Email:** Brenda.oiyemhonlan@emory.edu
Mentor 2 Name:	**Mentor 2 Email:**
Project Background: Improving Emergency Department Patient Flow	
Project Objective(s): To build an electronic platform to allow patients to sign in for treatment in an emergency department and be notified via their smart device/phone when a provider is able to see them.	
Description of the Solution: The solution can be a human person or kiosk. The idea is similar to the process that exists when a patron/customer presents to an Apple store to obtain a new piece of equipment or receive service for existing hardware. At the point of entry to the store, a customer representative meets them and checks them in. Contact information is obtained from the patron and when an Apple rep is available to see them, the patron receives a text message. Please let me know if we can add this project. Will need to complete a one week assessment of the common smart phone devices that patrons of the Grady Emergency Department have.	
Desired Student Skills/Background: Roles of team members: • Developer • Tester • Analyst **General** Excellent Written Skills Excellent Oral Communication Skills Team Oriented Flexible Problem Solving Motivated Interested in Public Health and Health Disparities (Not a must but helpful) Technical Skills: Cross-platform Development User Experience/User Interface Design Skills Graphic or interaction Design	
Data Requirements and Potential Sources:	
Other Comments:	

CS 6440 Student Project Proposal

Project Title: Health Disparities App	
Mentor 1 Name: Brenda O. Oiyemhonlan, MD, MHSA, MPH, Emory/Grady	**Mentor 1 Email:** brenda.oiyemhonlan@emory.edu
Mentor 2 Name:	**Mentor 2 Email:**
Project Background:	
Project Objective(s): To build an Android and IPhone application that will assist health care utilizers in identifying options for receiving health care services (primary care, dental health services) in close proximity to their work and their homes.	
Description of the Solution:	
Desired Student Skills/Background: Roles of team members: • Developer • Tester • Analyst **General** Excellent written skills Excellent Oral Communication Skills Team Oriented Flexible Problem Solving Motivated Interested in Public Health and Health Disparities (Not a must but helpful) Technical Skills: Cross-platform Development User Experience/User Interface Design Skills Graphic or interaction Design	
Data Requirements and Potential Sources:	
Other Comments: Infrastructure Automation • Automated app deployment • Self-healing infrastructure • Test driven infrastructure Community Building • Knowing where your users are • Understanding your users • Understanding why you do what you do • Articulating why you do what you do to your users. • Giving users something of value first • Developing and executing a launch strategy for your app Programming	

- Build the simplest responsible solution
- Pick technologies that serve the users' needs
- Have a strategic outlook on the architecture
- Understand that you will probably build the wrong app initially.
- Able to create simple code

Data visualization

- Understanding the data in your web application.
- Understanding the insights your users need to have.
- Applying data visualization theory to turn data into insight.

User Experience

- Paper prototyping.
- Usability testing.
- A/B test to improve existing features. (this is harder on mobile apps)
- Use metrics to make informed decisions.

Business

- Prioritization of features
- Finding innovative ways to maximize revenue and minimize costs.

Innovation

- Reduce cost of failure
- Challenge traditional thinking
- Broaden the scope of possible solutions

Analysis

- Understand and optimize business processes
- Understand and optimize customer workflows
- Legal requirements

Design

- Make the app pretty
- Design for target devices and user needs
- Design is how the app works not just how it looks
- Design the whole system
- Make the small things matter

Testing

- Automate!
- Find errors as soon as possible
- Identify root causes
- Test the infrastructure

CS 6440 Student Project Proposal

Project Title: HHS Ignite "Shakespeare" Project	
Mentor 1 Name: Samir Lababidi, PhD, FDA	**Mentor 1 Email:** Samir.Lababidi@fda.hhs.gov
Mentor 2 Name:	**Mentor 2 Email:**

Project Background: In the Shakespeare project we are exploring the use of big data text mining techniques to eventually look at electronic health records in real time to find changes that might indicate something is going on that FDA should know about. We are aware of many projects that are using natural language processing and other methods to code electronic health record free text. These projects are understandably taking a long time because medical language is complex. Our project is using methods that rely on trends overwhelming noise in the data, one of the promises of big data. It could fill in the gap while we wait for "smart" natural language processing to develop. In addition, FDA has been surprised several times by new syndromes that cropped up as a result of a new FDA-regulated product, which might get missed by relying on smart natural processing to code. We are hoping that our method would be able to pick these up and serve as an ongoing complement to natural language processing.

Once a change in records is noticed, other existing tools would be used to verify whether the event is something of FDA concern.

Project Objective(s): To develop a proof of concept tool for text mining of unstructured EHR notes (nursing notes, discharge summaries) from the MIMIC II or MIMIC III database in order to find new and emerging safety signals involving blood products.

Description of the Solution: For our initial prototype we are focusing on one particular medical product: transfusion of blood (whole or component). We chose this because:
- FDA staff involved with monitoring it's safety are concerned that they get too little information from the blood transfusion community.
- FDA receives just several reports a year of patient harm related to blood transfusion.
- US guidelines were very recently changed to be much more selective about giving blood because of the extent of patient harm from receiving blood.

Desired Student Skills/Background: Students are expected to have taken at least 1-2 courses in basic statistical analysis, data analysis, machine learning, or a related topic.

Data Requirements and Potential Sources: Our data set (MIMIC) has all the electronic records for critical care patients at a major teaching hospital for many years. While we have the notes, we cannot use this to simulate analyses in real time. Therefore, we will be comparing transfused patients to non-transfused patients. Another advantage of this data set is that it was used to publish a study showing that some categories of transfused patients fared worse than expected. We are flexible about using MIMIC-II or MIMIC-III, depending on which is easier for the text mining techniques. MIMIC-II is well documented and arranged by patient. MIMIC-III accommodates a change in original E H R vendor, has additional patients, has relatively little documentation, and is arranged by data type.

Other Comments:

CS 6440 Student Project Proposal

Project Title: Collect Usage Data on the Tongue Drive System	
Mentor 1 Name: Maysam Ghovanloo, PhD, Georgia Tech	**Mentor 1 Email:** mgh@gatech.edu
Mentor 2 Name:	**Mentor 2 Email:**
Project Background: The Tongue Drive System (TDS) is an assistive device, which may improve the quality of life for people with spinal cord injuries by allowing them to access computers, drive wheelchairs, and control their environment using their voluntary tongue motions. TDS harnesses the power of the human tongue, a muscle which is unaffected by even the most severe injuries to the spinal cord and many other neurological diseases. It utilizes an innovative tongue-computer interface that uses magnetic sensors to wirelessly track the motion of the user's tongue within the oral cavity and translate its motions into a set of commands that can be used to perform a multitude of tasks, including driving a wheelchair, controlling a cursor on a computer, smart phone or tablet. For more information visit: http://www2.ece.gatech.edu/research/labs/gt-bionics/research_tds.shtml	
Project Objective(s): As part of the TDS development process, we would like to use the EHR/FHIR system to collect usage data from a large number of end users in their home/office environments.	
Description of the Solution: The latest generation of TDS is a wearable device that can access the WiFi network and internet through its accompanying smartphone, to which it connects via Bluetooth Low Energy (BLE). It is important for the caregivers, and assistive technology providers to know exactly how much and for what purposes the TDS is being used in the users' (beta-testers) daily lives, and for what purpose. An EHR-enabled app can collect such information and analyze this data to create usage trends for individual users and among different user populations with various levels of disability. This valuable information can provide decision support to caregivers, patients, and families to optimize the TDS capabilities, and fine tune it to the needs and lifestyle of each individual user to maximize the TDS usage and improve the users' quality of life.	
Desired Student Skills/Background: Programming, Knowledge of cloud storage and data structure	
Data Requirements and Potential Sources: Mobile devices, starting with Android, and extending to iOS and Windows later	
Other Comments: The TDS generates these commands that would likely need to be made a FHIR Extension: 0: Neutral 1: Left 2: Right 3: Up 4: Down 5: Single Click 6: Double Click In addition it is desired to also register the battery status, and the app that is running on the smartphone from a set of apps for: Accessing the smartphone functions, accessing other computers, driving wheelchair, accessing smart home appliances such as TV, AC, Sound system, lights, etc.	