CS486C – Senior Capstone Design in Computer Science
Project Description

Project Title:	Prediabetes Intervention Mobile Application
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Project Overview:

Background: Nearly 10% of the United States population currently suffers from diabetes mellitus; a group of diseases that are the 7th leading cause of death in the United States. Given that type 2 diabetes (i.e., the most common type of diabetes mellitus) remains an incurable chronic disease for most patients, it is critical to detect the disease symptoms early, allowing for intervention measures to be taken prior to full disease onset. *Prediabetes* is a condition signaled by a higher than normal blood sugar value, but one that does not yet meet the criteria for type 2 diabetes. As such, prediabetes serves as a "warning light", and represents the most appropriate phase on the continuum of glycemia to intervene on type 2 diabetes. It is particularly important to focus efforts on reducing rates of type 2 diabetes among a racial/ethnic group with the highest rate of diabetes prevalence, the American Indian population, in which diabetes rates average 2.2 times higher than those observed among the non-Hispanic White population.

Disparities in Intervention Program Retention: Fortunately, the gold standard intervention program for prediabetes – the Diabetes Prevention Program – is incredibly effective at delaying or and even preventing diabetes onset for people with prediabetes. The Diabetes Prevention Program, which was designed to improve diet and physical activity among prediabetes patients, has been shown to result in a striking 43-58% decline in relative risk of type 2 diabetes. Importantly, this impressive reduction does not vary by race/ethnicity. Indeed, this program has been successfully translated to a culturally-acceptable Special Diabetes Program for Indians Diabetes Prevention (SDPI-DP), which was demonstrated to be effective in preventing type 2 diabetes among people of American Indian background who stay in the SDPI-DP program. Despite this impressive reduction in risk among AI patients who *stay* in the SDPI-DP, the retention rate is problematic, with only 33% of participants remaining at the program's completion. A 67% withdrawal rate indicates that American Indian individuals need additional targeted supports to complement the culturally-validated SDPI-DP in order to continue to receive benefits of the gold standard in type 2 diabetes prevention.

Current Project: In our laboratory, we study the social/psychological factors that improve prediabetes management and reduce conversion to type 2 diabetes. One aim of the current study is to explore how technological tools can help increase the SDPI-DP program retention rate among American Indians with prediabetes; this is the primary motivation for this Capstone project. Given that SDPI-DP retention declines as support for participants is reduced (e.g., reduced frequency of visits, phone calls, etc.), the goal of this project is to explore whether technology could provide a sense of community and commitment that will help keep participants engaged in the SDPI-DP well beyond the intensive early phases. The goal of this project to develop a mobile application that that will support American Indian prediabetes patients who are following the SDPI-DP lifestyle program. Specifically, our aims are to (1) develop and feasibility test a mobile

application that will identify when participants begin to disengage with the SDPI-DP protocol (e.g., by overeating or being sedentary); and (2) identify which psychological and social contexts make disengagement more likely (e.g., financial stressors, argument with a spouse). The mobile application will prompt participants to report eating behaviors, social/psychological experiences, and other related information. Specific features of the application will include:

Phase 0: Minimum viable product:
- Secure registration and account creation for participants, allowing tracking and data collection on an individual basis. Data management must be HIPPAA compliant.
- Must allow check-in of participants by opening the app, and quickly reporting on key behaviors (e.g., when they have eaten something).
- Must allow capability to send scheduled reminders to participants, including the ability to direct them to a quick poll to ask a short series of questions.
- Branching logic should allow some participants to automatically skip some questions that are not relevant to their current state.
- Bare bones administrative portal for setting up and managing study participants, and downloading resulting data sets for analysis.

Phase 1: A truly useful product
- A well-developed administrative portal that allows more advanced participants management. For example, subsamples of participants, which are drawn from a broader pool of participants, and then assigned to receive a slightly different (e.g., longer) study protocol. Specific "protocols" (i.e., a particular set of questions/polls/activities on some specified schedule) can be assigned to individual subsamples from the full participant registry.
- Offline robustness. Cell coverage on the reservation is spotty at best. A robust app will continue key data collections functions even if offline. Data/responses would be stored locally, and uploaded to the portal whenever a network connection becomes available.
- Provides ability to quickly visualize the incoming data as close to real-time as possible within the administrative portal, e.g., to identify early patterns or trends.

Phase 2: Above and beyond
- Will go beyond check-in and data collection to explore possible means of increasing engagement and commitment to the SDPI-DP among participants. Might include a "point system" with some sort of reward or incentives using the app (e.g., a picture of a puppy as a reward for eating well for participants who are motivated by puppies, a free song download through iTunes for participants who engaged in physical activity); or possibly an ability to anonymously compare your progress to others in the group (for participants who self-report that they find this type of competitive spirit motivating). Creativity on the part of the team would be very welcome here!
- In keeping with the patient-centered movement in the behavioral and medical sciences, the final version of the app will deliver an innovative intervention that will be tailored to each individual (based on preferences) and even to each individual's day and moment (depending on an individual's experience with stressors, emotion regulation, etc, as these experiences fluctuate across the day).

Public Health Impact: If completed, this capstone project will deliver (1) a mobile application that can be used to identify the engagement with the SDPI-DP; and (2) provide information on targets for retention support. The mobile app will be immediately useful in helping the team to collect more information for our diabetes research, but, more importantly, may improve retention in an-already successful early-stage diabetes prevention program among a population of patients that are at a heightened risk of diabetes. This work may have nationwide implications for similar socio-psychological studies, which are hoping to leverage the universal presence of mobile devices as cheap and effective means for collecting large amounts of data directly from patients with a minimum of life disruption. In addition, it is likely that this software product will serve as the basis for future efforts to actually change participants behavior, e.g., by intervening at a high-risk time for sedentary behavior by connecting a participant to a network of peers who are also struggling to stay with the program.

Knowledge, skills, and expertise required for this project:
- Familiarity with mobile application programming. The mobile platform (iOS or Android) will be determined early in the project, in consultation with the project team.

- Familiarity with networked mobile applications, i.e., ability of mobile applications to interact with cloud-based virtual server.
- Familiarity with basics of Web2.0 design, for development of the administrative portal for the tool.

Equipment Requirements:
- There should be no equipment or software required other than a development platform and software/tools freely available online.
- One or more mobile devices (iOS or Android) will be made available to the team for testing purposes.

Software and other Deliverables:
- A functioning mobile application meeting the above specifications, tested and ready to deploy.
- An administrative portal and data collection server, installed on a virtual service (e.g., AWS), tested and ready to deploy.
- A complete User Manual that provides clear instructions on how to use/deploy the tool, with focus on how to create/configure studies, and how to extract collected data.
- A strong as-built report detailing the design and implementation of the product in a complete, clear and professional manner. This document should provide a strong basis for future development of the product.
- Complete professionally-documented codebase, delivered both as a repository in GitHub, BitBucket, or some other version control repository; and as a physical archive on a USB drive.