CS486C – Senior Capstone Design in Computer Science

Project Description

Project Title: Parent Health Literacy Mobile App	
Sponsor Information: NAU NORTHERN ARIZONA UNIVERSITY	Olivia Lindly, PhD, Assistant Professor Department of Health Sciences Northern Arizona University olivia.lindly@nau.edu

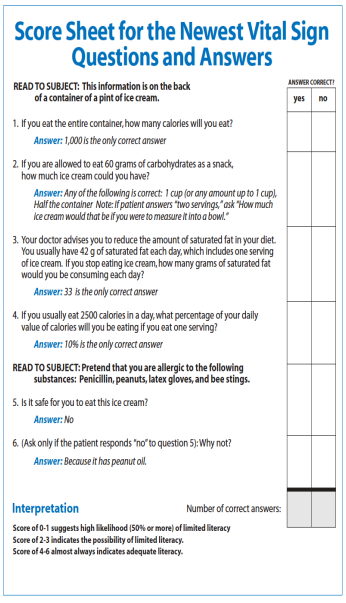
Project Overview

Background: Health literacy—an individual's ability to access, process, and use health information—plays a critical role in an individual's ability to make sound health decisions and use health services. Limited or low health literacy affects approximately 26% of the adult population in the United States. Health literacy is especially important for parents of young children ages < 12 years because parents make most health decisions and often determine health services use for their children. Furthermore, low parent health literacy has been linked to poor child health outcomes (e.g., inaccurate medication dosing, poor asthma control).

Although clinical practice guidelines encourage all health care providers to communicate and interact with their patients as though patients have low health literacy—or exercise a "universal precautions" approach—often this does not occur and perpetuates poor health care outcomes. Historically, patient health literacy has not been assessed or has primarily been assessed using paper-based, interviewer (clinician) administered screening tools in health care settings. A user-friendly, electronic health literacy screening and education tool that interfaces between patients and clinicians does not currently exist for parents of young children seeking health care.

Prior Work to Adapt & Test the Reliability of an Electronic, Self-Administered Health Literacy Screening Tool: The Newest Vital Sign (NVS) is one of the most widely used patient health literacy screening tools in health care practices nationwide. The NVS consists of 5-6 questions (Figure 1) about an ice cream label (Figure 2) that typically take 3-5 minutes to answer. The NVS has been validated for verbal, in-person administration (by a clinician) with patients who speak English or Spanish. In Canada, the NVS was adapted several years ago to be self-administered, electronically using a computer or tablet. Results from this study showed both feasibility and adequate test-retest reliability with the original, interviewer administered NVS.

Figure 1. NVS Questions & Scoring



Score Sheet for the Newest Vital Sign Questions and Answers

READ TO SUBJECT: This information is on the back of a container of a pint of ice cream.

ANSWER CORRECT? yes | no

1. If you eat the entire container, how many calories will you eat?
   Answer: 1,000 is the only correct answer
2. If you are allowed to eat 60 grams of carbohydrates as a snack, how much ice cream could you have?
   Answer: Any of the following is correct: 1 cup (or any amount up to 1 cup), Half the container Note: If patient answers "two servings," ask "How much ice cream would that be if you were to measure it into a bowl."
3. Your doctor advises you to reduce the amount of saturated fat in your diet. You usually have 42 g of saturated fat each day, which includes one serving of ice cream. If you stop eating ice cream, how many grams of saturated fat would you be consuming each day?
   Answer: 33 is the only correct answer
4. If you usually eat 2500 calories in a day, what percentage of your daily value of calories will you be eating if you eat one serving?
   Answer: 10% is the only correct answer

READ TO SUBJECT: Pretend that you are allergic to the following substances: Penicillin, peanuts, latex gloves, and bee stings.

5. Is it safe for you to eat this ice cream?
   Answer: No
6. (Ask only if the patient responds "no" to question 5): Why not?
   Answer: Because it has peanut oil.

Interpretation Number of correct answers:

Score of 0-1 suggests high likelihood (50% or more) of limited literacy
Score of 2-3 indicates the possibility of limited literacy.
Score of 4-6 almost always indicates adequate literacy.

Figure 2. NVS Ice Cream Label

Nutrition Facts

Serving Size	½ cup
Servings per container	4
Amount per serving	
Calories 250	Fat Cal 120
	%DV
Total Fat 13g	20%
Sat Fat 9g	40%
Cholesterol 28mg	12%
Sodium 55mg	2%
Total Carbohydrate 30g	12%
Dietary Fiber 2g	
Sugars 23g	
Protein 4g	8%

*Percentage Daily Values (DV) are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs.

Ingredients: Cream, Skim Milk, Liquid Sugar, Water, Egg Yolks, Brown Sugar, Milkfat, Peanut Oil, Sugar, Butter, Salt, Carrageenan, Vanilla Extract.

A recent study by Dr. Lindly and NAU students replicated the Canadian study (fall 2020 to summer 2021) by adapting and testing the reliability of an electronic and self-administered NVS. To develop the electronic NVS, the original NVS was administered to 33 adult patients from Native Americans for Community Action (NACA)

living in or around Flagstaff. This was done to determine appropriate response options for each NVS question. The PowerPoint from the Canadian study was then adapted to include these response options and recorded voice overs for each question.

In the next phase of the study the test-retest reliability and feasibility of the electronic, self-administered NVS was examined among 88 adult patients recruited from NACA or North Country HealthCare. The traditional, interviewer administered NVS took 1 minute and 26 seconds to 15 minutes to use, and the electronic self-administered NVS took 3 minutes to 12 minutes to use. Participants' scores did not significantly differ between the two NVS versions insofar as most participants had scores indicative of the same health literacy level at each time point (p = 1.0).

Current Project: Because the electronic and self-administered version of the NVS used in these prior studies is not compatible for use in most health care settings, the goal of this project is to adapt the NVS and several other commonly used health literacy screening instruments (i.e., the Brief Health Literacy Screening Tool [BRIEF] and Health Literacy Skills Instrument Short Form) for use by parents accessing health care for their young children as a mobile app and use by health care organizations and researchers as an administrative Web app. For future-proofing, the app should provide a modular architecture that allows any number of screening instruments to be uploaded for deployment via the administrative GUI in the web-app.

This application will additionally provide "gamified" lessons that help parents of all health literacy levels to ensure that their young children are receiving the care they need both in and out of the clinic. For example, one lesson might include correct medication dosing for acetaminophen (e.g., Tylenol) and ibuprofen (e.g., Motrin) by child weight; another might be a lesson/game in which parents practice the correct medication dosing by filling a cartoon syringe or cup based on their child's weight. Another possible lesson might include guidance on children's developmental milestones during the first two years and question prompts for parents to use with clinicians regarding concerns about their child's development. Data on parent health literacy and pediatric health care needs will be gathered through the application. Some 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 HIPAA compliant.
- Must allow check-in by participants by opening app, and quickly reporting on health literacy and child and family health issues.
- Branching logic should allow participants to automatically skip certain questions.
- A bare bones administrative portal for setting up and managing study participants and downloading resulting data sets for analysis.
- Option to listen to audio reading of each question and its response options
- Provides a calculator that participants can use while answering questions
- Ability to zoom in or out on images (e.g., the NVS nutrition facts label) as needed, to allow for better readability
- Minimum of 3 health literacy assessments offered
- A functional Android version of the app.

Phase 1: A Truly Useful Product

- A well-developed administrative portal that allows more advanced participant management (e.g. assigning certain lessons to certain participants) and allows for content available on the mobile app to be managed during deployment (e.g., new content uploaded, existing content edited or activated/deactivated. Also allows management of deployed health literacy screening instruments.
- Offline robustness for use in rural areas (e.g., the Navajo Nation). This might be done through a combination of allowing downloading of elements, and opportunistically connecting to service whenever it is available.
- At least 5 educational lessons and/or games
- A simple graphical tool (graphing package) to allow quick "first glimpse" visualization of incoming data within the administrative portal
- Production of an iOS version of the app.

Phase 2: Above and Beyond

- 6-10 educational lessons and/or games
- Generation of a working iOS version
- More than 3 health literacy screeners/assessment tools programmed
- Explores possible means of increasing engagement to learning about child's health issues

To maximize coverage, we will want to be able to easily produce and maintain both iOS and Android versions of this mobile app. Thus, the team should plan to evaluate and choose among the short list of cross-platform development frameworks (one codebase, able to generate Android and iOS), e.g., Ionic, Flutter, React native, etc.

Public Health Impact: A successful mobile app that provides health literacy screening and education lessons with games for parents of young children will have a positive impact in terms of facilitating more effective clinical practice (e.g., the use of universal precautions such as teach back approaches and pictograms of medication schedules by providers) and ultimately health care outcomes (e.g., more accurate medication dosing, timely developmental assessment) for children and their parents. For safety net providers in and beyond Flagstaff, this type of innovation could further help to reduce healthcare disparities for vulnerable parent-child subpopulations (e.g., Indigenous parents). The app could also be used by researchers seeking to account for and/or examine patient health literacy as part of clinical care interventions.

Knowledge, skills, and expertise required for this project:

- Familiarity with mobile application programming.
- Familiarity with networked mobile applications (the ability of mobile applications to interact with cloud based virtual servers)
- 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, if needed.
- If needed, access to a Mac will be provided to support generation of the iOS app version.

Software and other Deliverables:

- A fully functional, tested and demonstrated mobile application for the Android operating system.
- 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.
- An administrative web application/portal.