**Mobile Apps: A Transformative Technology for Program Evaluation**

**Abstract**

The 21st century might well become “The Age of Apps.” Faced with unusual challenges, Centerstone Research Institute (CRI) addressed program needs using mobile technologies. In 2011, CRI contracted with the Tennessee Department of Mental Health and Substance Abuse Services to provide evaluation services for a state-wide, peer-led holistic wellness program based on the Stanford University Chronic Disease Self-Management Program. With peer-wellness coaches working in 45 consumer-run centers across the state, there were foreseeable problems concerning data collection and organization, so CRI developed a suite of mobile apps, collectively called the Grant Evaluation Toolkit (GET), for deployment on iPads. The GET apps represent a major organizational step forward for evaluation studies, with built-in administrative and display capabilities. Increasing program complexity requires systems that can reliably store and access data in a central system. Well-designed mobile apps eliminate many of the errors associated with conventional data collection, and they are easier, more secure and more enjoyable to use.

**Introduction**

In 2008, Apple launched its App Store with 500 iPhone applications (apps) and in less than a year there were 10,000 apps available through Apple. What soon transpired was an app revolution, with Google, Microsoft, Blackberry, and others rushing to meet demand. Now, consumers can choose from hundreds of thousands of apps for purchasing movie tickets, playing games, navigating their cars, checking news, administering their finances, monitoring physical activity, managing depression, and much more. The multitude of available apps enables smartphone and tablet users to access information more efficiently, and to accomplish certain tasks that were inaccessible to consumers and businesses in the past.

Mobile data solutions for remote data entry have been used by industry and healthcare professionals for a number of years (Fischer, et al, 2003). Industrial applications initially focused on inventory control and systems management, while healthcare applications began with information retrieval and have moved steadily toward data collection, clinical decision support, point of care systems, and improving general operational efficiencies. In both cases, resource-intensive tasks have been facilitated and streamlined. Smartphone and tablet apps designed for businesses and healthcare providers have become a part of the emerging market and the demand for ever more sophisticated technology is increasing (Boulos, et al., 2011; Konstantas, et al., 2002).

The app craze has been slow to infiltrate program evaluation for data collection owing to four primary barriers. First, consumer and business oriented data gathering apps have focused on recording data, such as barcodes and GPS coordinates, rather than on manual form entry applications for surveys. Available survey apps have lacked the requisite customizability to be useful in program evaluation, partly owing to the complexity of instruments used in evaluation. With customizability comes the requirement for technical expertise, which translates into costs that often do not fit into program budgets. Second, evaluation surveys often incorporate complex logic, branching structures, and validation requirements that are only available on the most robust of platforms. Third, data security is usually a primary concern and consumer apps often do not meet the strict requirements of evaluators. Network-ready solutions that combine customizability with secured systems cost thousands of dollars per year and often lack features needed for mobile deployment. Finally, robust survey apps designed specifically for mobile devices have been slow to market and the few that are available are priced for niche markets, and priced above evaluation budgets.

Despite limitations for evaluators in the current market technology, it seems clear that mobile apps will transform evaluation in the same way that this technology has begun to transform the medical industry. This paper summarizes a first step toward that transformation. We believe that mobile apps and their supporting systems can and will solve many challenges we now face in evaluation, especially those concerning large scale data collection, data administration, and rapid reporting.

**A Call to Action**

In 2011, Centerstone Research Institute (CRI) contracted with the Tennessee Department of Mental Health and Substance Abuse Services (TDMHSAS) to supply evaluation services for a state-wide holistic wellness program, the My Health, My Choice, My Life (MHCL) Program. Based on the Stanford University Chronic Disease Self-Management Model, this program specified that “peer-wellness coaches” (PWCs) would be the liaisons to the target population, and that in addition to implementing the program, these peers would collect evaluation data. This requirement was a unique challenge for CRI, which is accustomed to employing highly trained Research Associates to collect reliable evaluation data.

CRI was faced with a demanding circumstance that required an innovative approach to data collection, but data collection was not the only problem to solve. There were also reporting and monitoring requirements to address. The program management team needed ready access to data to keep track of a variety of activities of both PWCs and participants. Experience told us that shuffling paper through this complex system would be disastrous. We felt certain that without a smart system data loss, delays, confusion, security breaches and systems failures would plague this program and that no reasonable amount of staff training would mitigate foreseeable problems. The only solution was to reduce the potential for error.

**A Unique Set of Problems:**

The most troubling problem we faced with the MHCL program was that data were to be collected by non-professionals with minimal training in 45 centers across the state of Tennessee. We could not supply the training necessary to insure high data quality, so to meet this challenge we needed to dramatically simplify the survey process while preserving the integrity of the instruments. We anticipated that non-professional surveyors would experience confusion with complex skip patterns and conditional instructions, so we would need to build skip logic into our system. We expected data entry errors to be highly problematic when manual input was required, so validation rules would need to be robust. The data being collected contained personal health information (PHI), so we would need to secure our systems in compliance with HIPPA standards. Mobile devices can be lost or stolen, so mitigating security protocols would be required. The National Outcomes Measure Scale (NOMS) instrument changes periodically and thus required a system that could be easily modified. We also anticipated that the needs of our evaluation client might periodically change and new instruments and functionality would likely be requested. Thus scalability would be a requirement.

Three primary instruments were used in the evaluation: 1) the National Outcomes Measurement System (NOMS), a federally required multiple item survey, 2) the Health and Self-Management Questionnaire (HSMQ), a version of the Chronic Disease Self-Management Questionnaire modified to better serve the target population of the MHCL program, and 3) the Recovery Assessment Scale (RAS), a 20 question (short version) Likert Scale instrument used to measure recovery. Two of these instruments, NOMS and HSMQ, presented a challenge to survey construction because they employed complex skip patterns, confusing instructions and conditionals.

In addition to the primary instruments, the program management for MHCL also needed to track the activities of their PWCs using an activity log and they wanted to take attendance at group meetings using an electronic check sheet that they could populate with participants. In order to manage PWCs and monitor program progress, the program managers needed administrative functionality and a data dashboard. Such features would benefit the evaluation team as well, by cutting down on technical assistance and ancillary reporting

We found one commercial vendor that met our minimal requirements for security and functionality, but the cost of over $13,000 per year was unsustainable. Our solution was to draw on in-house technical resources to create our own mobile app system.

**Technical Challenges**

As we studied all of the challenges presented by the program, it became clear that we needed a distributed data collection network linked through a central database hub coupled to a reporting interface. Data would have to be encrypted in transit, secured with login credentials, and the survey system would have to incorporate virtually foolproof logic and data validation. We would need to rely on scalable technologies that worked on multiple platforms, and yet could be optimized for mobile devices that could be easily used by PWCs.

We chose the mobile broadband enabled Apple iPad as a reliable tablet computer. The tablet platform has been shown to be as efficient as paper forms for data entry (Cole, et al., 2006) and this platform has many other benefits. In mobile application development, the choice to write an application as a web app or as a native iOS app (which would go through Apple's submission process) is a complicated one, and depends on the specific requirements of the application and its intended audience. A native iOS app would have greater visibility to the public through the AppStore and greater monetization potential by selling the app. On the other hand, a web app would have a lower cost of development, shorter time to implementation, and easier maintenance requirements, as well as the ability to deploy to platforms besides iOS, with little or no additional development.

The Apple submission process can be onerous and prone to extended delays. Organizationally we had no experience with iOS apps, and we did not see how the benefits of greater visibility or monetization would apply to our situation. After careful consideration, we decided to build a web app.

**System Specifications for Our Grant Evaluation Toolkit (GET) App**

Our app was christened the Grant Evaluation Toolkit (GET) App. The engine of the GET App was a SQL Server database operating under a .NET web service. The front end was subdivided into a survey application and an administrative application. The survey app was written primarily in jQuery Mobile (<http://jquerymobile.com/>), while the administrative app was primarily written in AngularJS (http://angularjs.org/).Both connect to the web service using AJAX. Because data caching occurs on iPads and other mobile devices we employed MobileIron as a failsafe for device loss. MobileIron allows a central administrator to locate and wipe clean any lost iPad.

For our data dashboard, we used QlikView, a powerful business intelligence dashboard system that allows data sources to be combined, displayed, and manipulated.

**An Evaluation Transformed**

The GET App has been a tremendous success. It is easy to use, reliable, secure, and enjoyable to operate. We found that by replacing survey instructions with built-in logic, even complex survey instruments, such as NOMS became effortless to use. The lack of procedural instructions also cuts down the time required to administer the survey. Validation rules virtually eliminated manual data entry errors and the administrative functions allow program personnel to do additional error correction and to monitor critical program activities, saving evaluation resources. The data dashboard allows program personnel to monitor trends, identify areas for immediate program improvements, and answer many of their own questions without any intervention from our evaluation staff. Our encrypted systems protect personal health information, with aggressive, HIPPA compliant protocols. Individual iPads are protected by MobileIron and enterprise level security systems, just in case they get lost or stolen. The GET App systems are highly scalable and flexible, so we are able to rapidly add instruments upon request.

The GET App was unquestionably transformative for the MHCL program evaluation. It allowed us to deploy farther and wider than we could have without it, to gather reliable data without investing in exhaustive training, and to deliver a much better service for a comparable cost. Now that our app system is fully developed, we anticipate additional cost savings to our future clients.

**Unanticipated Consequences of an Evaluation Transformed**

The evaluation team worked closely with the PWCs and their supervisors in order to ensure a thorough understanding of the survey instruments, the iPad, and the GET App. As a result of this enhanced understanding of the instruments, the participant’s response to the items, and the overall purpose and use of the evaluation data, PWCs became very invested in the evaluation. They understood how the program evaluation involves the holistic examination of a program including its environment, client needs, procedures, and outcomes and the importance of using systematic data collection and analysis procedures in order to assess program impact. As a result they were interested in outcomes and very open to recommendations for improving the program and strategies for ongoing evaluation and improvement. We attribute much of this positive response to the accessibility of outcomes afforded by our integrated technologies. Program managers and PWCs had ready access to important evaluation data that are usually not readily available without technological enhancements. Thus they were able to monitor program progress and gain a broader understanding of the impact of their efforts.

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