mCare: Leveraging a Mobile Health Application to Manage TBI, PTS and Mental Behavioral Health Among Wounded Warriors

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ABSTRACT

Thousands of soldiers return from conflicts worldwide with traumatic brain injury (TBI), post-traumatic stress (PTS), and/or mental and behavioral health co-morbidities. These soldiers require unique rehabilitation services, and often receive them through outpatient care. Mobile health represents a technology which assists in bridging the "life space" between face-to-face clinic encounters. The mCare project is a mobile health application that was developed with a primary objective of providing additional resources to Wounded Warriors receiving outpatient care. The United States Army Medical Research and Materiel Command (USAMRMC) Telemedicine and Advanced Technology Research Center (TATRC) evaluated mCare in a prospective two-armed randomized controlled trial conducted at four Community Based Warrior Transition Units (CBWTUs). One hundred and eighty-two soldiers enrolled in this study between April 2011 and January 2012. A subset of soldiers enrolled in the mCare randomized controlled trial were diagnosed with TBI, PTSD, and/or mental and behavioral health issues. This presentation will discuss these soldiers' utilization of mCare throughout the study duration, and how these behaviors compared with that of their counterparts. Lessons learned from the mCare study will be discussed with respect to best practices for mobile health in future applications.

1.0   BACKGROUND

The US Army Medical Command provides medical care to a contingent of geographically dispersed wounded warriors through Community Based Warrior Transition Units (CBWTU). These units are regionally located and provide remote case management services for those wounded warriors who are eligible to recover and rehabilitate in their home communities. From ranges up to several hundred miles, CBWTU care teams coordinate the medical appointments, track recovery progress, support administrative Army tasks, and facilitate transition to civilian life. Primary challenges to this complex environment include long distance communication, supporting a clinically heterogeneous caseload, and coordination with non-DOD providers. Leveraging the ubiquity of cell phones with a commercial off the shelf secure messaging platform, the US Army has been able to field test a HIPAA-compliant messaging application called mCare on a wide range of smartphones and feature phones. mCare is a cell phone based bi-directional messaging system developed by merging Consumer-off-the-Shelf (COTS) technologies with a government developed portal interface by the US Army Medical Research and Materiel Command's (USA MRMC) Telemedicine and Advanced Technology Research Center (TATRC). mCare was developed by. The mCare application has enriched the care team's capability to interact with patients in real-time, during windows between appointments and phone conversations in what is known as the "life space". From the mCare web portal, care teams can send announcements, personalized messages, health and wellness tips, appointment information, post-deployment resources, and questionnaires to patients. Patients receive and respond to this information securely on their cell phones. Their responses are monitored from the web portal, and can be trended graphically over time to assess pattern behaviors and assist in triaging caseload. The objective was to create a HIPAA-compliant messaging system that would operate on wounded warriors' existing mobile

devices (cell phones), in a manner uniquely distinct from text messaging or email. mCare was designed to run on multiple cell phone platforms (smart phones, non-smart phones) and major (Tier 1) US wireless carriers. mCare interactions were designed to be simple 1-button/character clicks.

2.0 METHODS/MATERIALS

In May 2009, mCare was launched at 5 sites (Community Based Warrior Transition Units [CBWTUs]), to assess how mCare could augment remote case management services to a geographically dispersed wounded warrior population. The US Army Medical Command provides medical care to a contingent of geographically dispersed wounded warriors through Community Based Warrior Transition Units (CBWTUs). These units are regionally located and provide remote case management services for those wounded warriors who are eligible to recover and rehabilitate in their home communities. From ranges up to several hundred miles, CBWTU care teams coordinate the medical appointments, track recovery progress, support administrative Army tasks, and facilitate transition to civilian life. The mCare Project was introduced at five specific CBWTU sites: Alabama, Florida, Illinois, Massachusetts and Virginia.

mCare employs a bring your own device (BYOD) model, where patients can access the system with their personal feature phone or smart phone to access the secure mobile messages. The process for initializing communication through the system begins with the provider developing a message within the secure website and then scheduling it for delivery to the patient's phone. The patient then enters their personal pin and opens the mCare application on their phone; they may also receive a notification that a message is available within their mCare application through and a SMS alert. Once in the mCare application each patient's responses to messages from their care team are automatically sent back to the mCare website where providers can review and appropriately respond. Patients' responses are monitored from the web portal, and can be trended graphically over time to assess pattern behaviors and assist in triaging caseload. This is important when utilizing mobile messaging for dynamic questionnaires to trend individual, as well as group behaviour changes.

From the patient prospective, information is organized into cards within the application. Patients are able to maneuver quickly through the new messages that are within the application and locate the desired section. Patients even have the ability to enter in appointments through the application that once approved by their case management team initiates the appointment reminder feature.

The overall mCare effort had two phases: there was a feasibility (pilot) effort that was conducted from May 2009 to April 2011; and a clinical research study effort conducted from April 2011 to October 2012. The mCare Clinical Outcomes Study was a two-armed, prospective, randomized clinical outcomes study that enrolled 182 participants (TBI, non-TBI patients). There were 87 control participants who had standard of care and 95 experimental participants who had standard of care plus mCare messaging. Patients were stratified by TBI distinction, there were 158 participants (86.8%) with no TBI and 24 with suspected or confirmed TBI (13.2%) amongst both the mCare group (experimental) and control groups. Study endpoints included recovery goal awareness, patient-provider contact rates, neurobehavioral symptom severity, satisfaction with case management, general wellbeing, and system usability.

3.0 RESULTS

As of 30 September 2012, over 1000 wounded warriors volunteered for mCare. These volunteers were between ages 18-61, and varied between enlisted personnel and officers. Geographically, the users occupied 28 states and the District of Columbia, and received Army case management services from distances over 600 miles. Over 300,000 secure messages were sent including patient appointment reminders, announcements, health and wellness tips and well being questionnaires.

During the pilot study the majority of patients voluntarily utilized the system for more than nine months. The types of messages that were sent out through mCare system break down as follows: 54% were health and wellness tips, 37% were administrative annoucements and 9% were appointment reminders. Most of the users were millennials between the ages of 18-34 but generation X (35-46), young Boomers (47-56) and older boomers (57-65) made up 49% of the demographics of the users. The mCare system was utilized seven days of week by users with Monday, Tuesday and Wednesday being the highest utilization days. Most messages were answered within seven days of being sent and the large majority of messages were answered within the first twenty-four hours of being sent. The application was accessible 24 hours a day but most messages were answered at 10 am showcasing the immediate nature of mobile messaging as most scheduled messages went out at 10 am every day.

The original goal in developing the mCare system had been to improve communication and coordination between patients and providers. Specifically, to meet contact requirements between the patients and their care teams. The goal for contacts per week was 1 contact per week per case manager and 5 contacts per week per Platoon Sergeant. During the clinical research study the mean number of contacts for standard care group (no mCare intervention): 173.58 (Average of 4.8 contacts per week includes phone calls from Case Manager and Platoon Sergeant only). While the mean number of total contacts for mCare group: 1042.98 (Average of 28.97 contacts per week phone calls from Case Manager and Platoon Sergeant PLUS mCare messages). There was a statistically significance difference in mean number of total contacts among the mCare and standard care groups (p-value = 0.00). The total number of mCare contacts plus phone contacts (1042.98) was significantly higher than standard care number of total phone contacts only (173.58).

During both the pilot and the clinical research study, patient received appointment reminders 24 hours prior to an appointment, 90 minutes prior to the appointment and then a reminder to retrieve clinic notes and provide them to the care team. These were typically generated by the care team through the website. However, patients were also able to enter the own appointments into the mCare application on their phone. The 95 mCare experimental group participants entered over 900 appointments into the system throughout their 9 months study duration. These appointments had to be confirmed with their case managers prior to initialization of appointment reminders in mCare.

4.0 CONCLUSIONS

The mCare system was highly utilized by the volunteer participants in both the pilot study and the clinical research study. Patients responded favorably to the time and frequency of messaging and to the mobile messaging format that mCare provided. Most participants utilized the system for more than nine months time and responded in a timely manner to mobile messages. System acceptance was indepedent of age, location or diagnosis. The number of younger participants who were under 34 years of age (51%) was almost equal to the number of participants who were over 35 (49%), demonstrating that the technology was easy to utilize, understand and manipulate. This is also a typical population served at a CBWTU.

The greatest benefit realized was the ability to communicate with patients in the "life space" between face-to-face appointments, which allowed for an unprecedented and statistically significant number of contacts between patients and providers. However, the patient activation component should not be overlooked; patients utilizing mCare not only responded to messages that were sent to them but also initiated the appointment reminders through mCare by entering the appointments directly into their mCare application on their phone.

5.0 DISCUSSION

The success of the mCare pilot project demonstrates the feasibility of reaching a geographically dispersed population using secure mHealth technologies, to compliment clinical events with relevant and timely

information. Furthermore, mCare demonstrates the capability of distributing specialized information to patients where and when it is needed most. The lessons learned from this program have informed the military case management community on how both providers and patients can benefit from mobile communications, and suggest broader potential for secure mobile communications. mCare Mobile messages provide the ability to connect with patients in the "Life Space" between face-to-face or telephonic encounters and provide secure, substantive, retrievable content to promote patient adherence to care plans. The portability and usability of a mobile application that is also directly connected to their providers opens endless possibilities for new ways of patient to provider communication that can directly impact patient compliance and provider knowledge. Tracking patient compliance to care plans between face-to-face visits offers the opportunity to not only improve communication but also coordination of care, access to care, patient compliance and ultimately improve clinical outcomes.

Figure 1: mCare: Message Generation
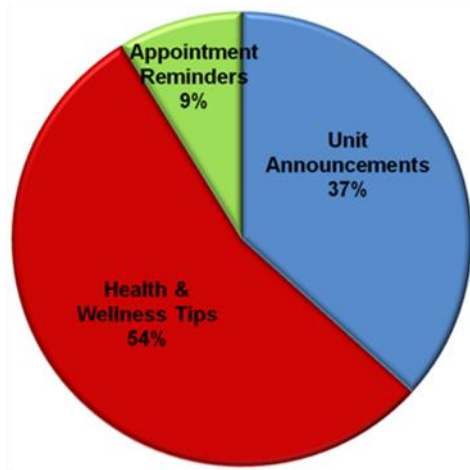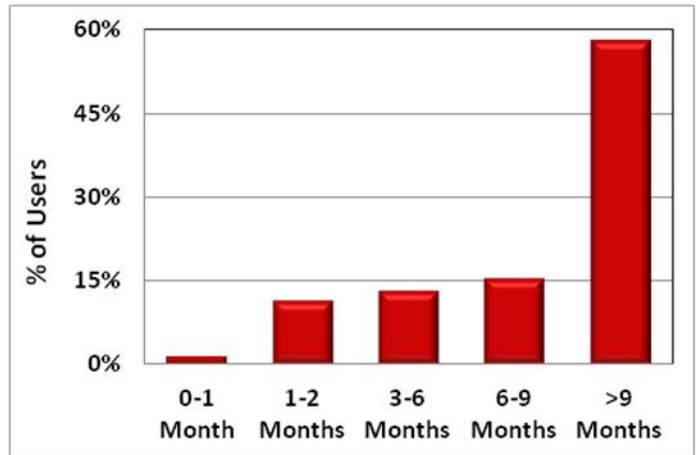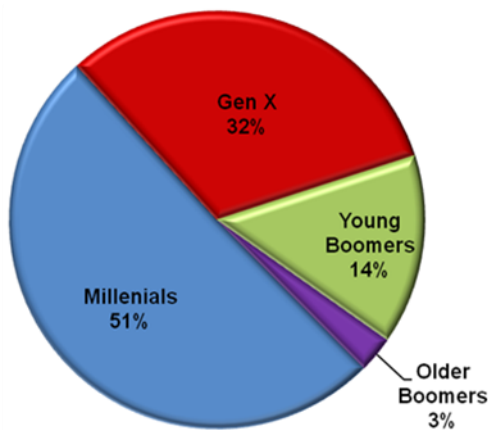
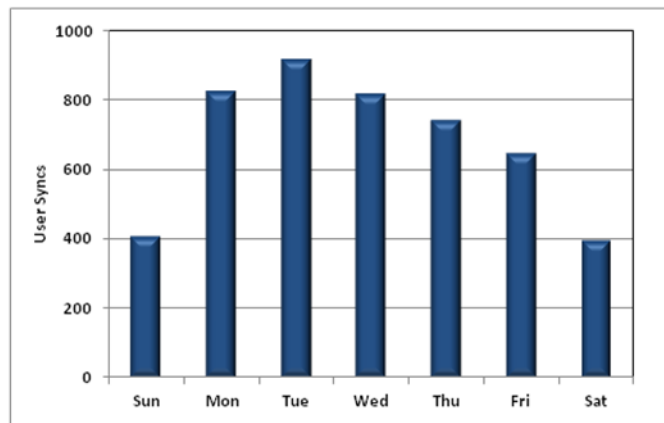**Figure 2: mCare Message Types and Duration of Usage**
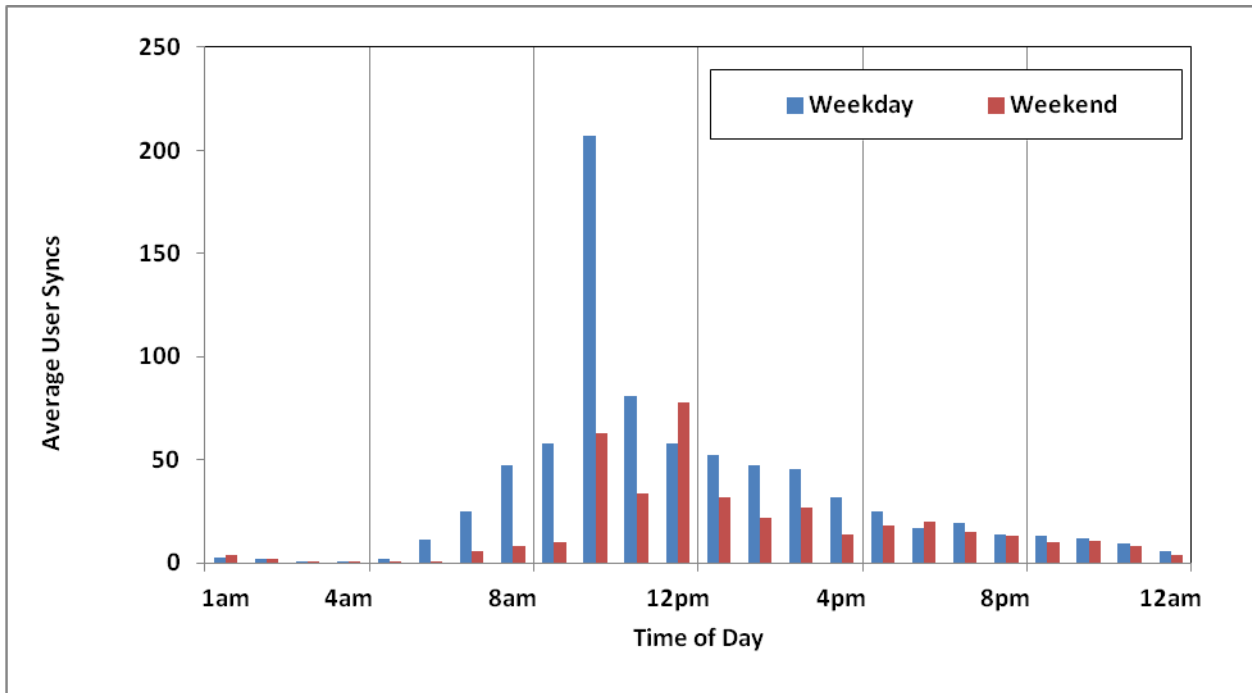

Figure 3: Demographics of mCare Users and Utilization by Day of Week

Figure 4: Time of Day for Message Response