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Abstract

Engaging Family Caregivers Translates to Better Health Outcomes and Lower Costs

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Abstract

Background: The changing demographics of the United States coupled with demonstrated savings resulting from innovative home and community-based services (HCBS) programs, has increased the demand for in-home care options for elders and individuals with disabilities. However, there is a lack of understanding as to what it takes for programs serving these populations to be optimally successful. Family caregivers provide valuable insight and real-time actionable intelligence from the home that can be leveraged to help bend the healthcare cost curve. For 12 years, Seniorlink has pioneered an innovative intensive in-home care model, Caregiver Homes, which partners family caregivers with a care team of nurses and social workers. The model provides guidance, financial assistance, and overall support to caregivers. This approach may help the management of expensive healthcare utilization and improve health outcomes. Nationally, this is the first home and community-based model to achieve the National Committee for Quality Assurance's (NCQA) highest level of Accreditation of Case Management for Long-term Services and Supports (LTSS). Evidence suggests that partnering engaged family caregivers with a care team improves health outcomes and lowers costs for the greater healthcare system, an approach supported by Seniorlink's novel strategy.

Objective: Compare the healthcare utilization of consumers (patients) served through Seniorlink's intensive in-home care model to a population of Medicare beneficiaries with functional decline, cognitive level, and medical complexity of care needs similar to the Seniorlink population.

Methods: Researchers analyzed the Minimum Data Set assessment information collected and aggregated by Seniorlink staff for descriptive data on the Seniorlink population in Massachusetts (n=1846) and Indiana (n=101) who were continuously enrolled in the program from January 1 to December 31, 2015. This information included functional limitations, dementia and psychiatric diagnoses, and chronic conditions. Utilization data were pulled from caregiver responses to an electronically-submitted daily incident and medical services questionnaire. Researchers also analyzed the 2013 Medicare Current Beneficiaries Survey (MCBS) to develop benchmark populations and report on nationally representative utilization and outcome variables for the Medicare population.

Results: In a comparison of the populations served, Seniorlink consumers had a much higher level of disability and a prevalence of dementia three times that of the overall Medicare population. Researchers found that compared to similarly disabled and cognitively impaired Medicare populations, Seniorlink consumers were significantly less likely to be admitted to the hospital, visit the emergency room, and experience falls. Seniorlink demonstrated its largest improvements over the MCBS group among medically complex consumers over age 65. This population experienced 40% fewer hospitalizations, 32% fewer ER visits, and 75% fewer falls than those on Medicare (all $P<0.05$). Furthermore, researchers identified that Medicare beneficiaries with a level of need similar to Seniorlink clients were much heavier users (>2x annual per capita cost) of healthcare than the overall Medicare population.

Conclusions: Together, these findings indicate that the use of Seniorlink's innovative intensive in-home care model engaging family caregivers is associated with minimizing negative health outcomes. Taking into account publicly available data on the cost of ER visits and hospitalizations, the potential savings of reducing those events is nearly $3M per 1000 consumers.

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Caregivers; elderly populations; people with disabilities

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Abstract

Detecting the Undiagnosed: Findings on Sleep Apnea Identification in Veterans With Insomnia Using at-Home Sleep Monitor Technology

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Abstract

Background: Sleep disorders are a serious national health issue. Insomnia and sleep apnea are the most commonly diagnosed, with serious negative impacts including increased mortality, performance problems, accidents, and health-care utilization. Given a high level of apnea in persons with insomnia (29%), the incorporation of objective measures of sleep for at-home sleep monitoring for clinical trials may assist in potential sleep apnea detection and treatment for persons with insomnia. This may be particularly important for military personnel, as a 372% increase in insomnia encounters and a 517% increase in apnea encounters was recently reported for this population.

Objective: The primary goal of this pilot trial was to assess usability and feasibility of mobile health information technologies (HITs) designed to reduce insomnia in post-9/11 Veterans. As this pilot focused on insomnia treatment with HITs, veterans with an objective sleep measure indicating moderate to severe sleep apnea were withdrawn. Participants used a home-based sleep monitor (WatchPAT) which has been validated against polysomnography and derives the Apnea-Hypopnea Index (AHI) from arterial tonometry, pulse oximetry and snoring. We report here on the positive screening rate for sleep apnea in our sample of Veterans with insomnia, a secondary but clinically significant finding within this HIT pilot.

Methods: Thirty-eight Veterans were enrolled who met criteria for insomnia on the Insomnia Severity Index, with 33 Veterans in total engaging in the first night of sleep monitoring. A WatchPAT device provided screening results based on AHI scores over 1-2 nights of home use. Those with sleep apnea above the mild range, i.e., AHI > 15 (moderate or severe), were withdrawn from the trial and referred for further assessment.

Results: Of the 33 veterans who completed the first night of sleep monitoring at home, a total of eighteen (54.5%) were identified as having moderate to severe sleep apnea as indicated through WatchPAT measurement. Demographic predictors of apnea were also explored, as apnea rates increase with age and occur more frequently in higher weight individuals. Results were unexpected given the mean age of the final sample (43.8 years, SD = 11.3), as age did not differ between those with no/mild apnea vs. moderate/severe apnea (t (31) = 0.89, ns). However, those with moderate/severe apnea had a significantly higher body mass index (BMI; 30.7, SD = 4.5 vs. 26.8, SD = 2.9; t (31) = 2.88, P<.01).

Conclusions: The pilot demonstrated a higher-than-expected positive screen rate for apnea in post-9/11 Veterans. The high co-occurrence of sleep apnea and insomnia in these Veterans suggests the need to conduct comprehensive clinical sleep assessments for Veterans reporting chronic insomnia since apnea may blunt the effectiveness of insomnia interventions. Sleep apnea is treatable and successful treatment can enhance overall health and quality of life. Given the persistence of insomnia in patients treated for sleep apnea, clinicians should also re-assess for insomnia following apnea treatment to determine whether insomnia has resolved.

The use of at-home sleep monitors may thus provide a mobile, wearable, and usable at-home sleep monitors for such assessment and treatment.

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Multimedia Appendix 1

Full poster.

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Abstract

Virtual Reality in Mechanical Ventilation Weaning After Spinal Cord Injury

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Abstract

Background: Traumatic spinal cord injury (SCI) represents an injury with devastating sequelae and limited treatment options, affecting 12,000 new patients every year in the United States. Less than 1% of patients have complete recovery at hospital discharge. Complete spinal cord Injury at and below cervical level 4 have intact diaphragmatic function and while they may initially require ventilator support post-injury, they are usually able to wean from the ventilator. The survival rate for these seriously ill ventilated patients has increased dramatically over the past several decades by utilizing resistance and endurance training with progressive ventilator free breathing protocols. Ventilator free endurance training can be adversely impacted by patient anxiety, depression and pain which are some of the most problematic consequences of spinal cord injury. If unattended, they can have an omnipresent and deleterious impact upon rehabilitation and perceived quality of life. The use of virtual reality (VR) has recently been examined in hospitalized, non-spinal cord injured patients as a complimentary tool for the management of anxiety, depression, and pain. The use of virtual reality technology as an aid to facilitate patient engagement and satisfaction with mechanical ventilation weaning in the spinal cord injury population has not been previously studied.

Objective: The objective of this study is a proof-concept to propose specific use case data and experience to determine the value of utilizing VR technology in the SCI patient population who are undergoing ventilator free endurance training while participating in a ventilator weaning protocol. We sought to gain feedback and experience from patients participating in endurance training who trialed VR during the wean period.

Methods: Patients with an SCI complete C4 level or below who were admitted to Spaulding Rehabilitation Hospital (SRH) for mechanical ventilation weaning were asked to trial public-domain VR content during their ventilator free endurance training protocol time. VR content was displayed on a Samsung Galaxy 7S using a Samsung Gear VR powered by Oculus. Patients with open cranial wounds, traumatic brain injury, seizure disorder and ocular injury or deficit were excluded. Patients were queried for any adverse effects or feelings, satisfaction, interest and engagement.

Results: Ten patients voluntarily trialed public-domain VR content during their ventilator free endurance training protocol time. No patient reported feeling claustrophobic or nauseated with the VR content. One patient reported experiencing nightmares but did not associate this with the VR experience. All patients expressed positive feelings of their immersion experience through VR. All patients expressed a sense of well-being associated with their VR experience and asked to have VR be part of their rehabilitation experience.

Conclusions: VR can be successfully incorporated into the ventilator free endurance training protocol of SCI patients in the acute rehabilitation setting. We suggest additional research and validation of VR technology in mechanical ventilation weaning in the SCI population.

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KEYWORDS

anxiety; pain; usability testing; user experience evaluation; virtual reality

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Abstract

Implementation of a RFID Tracking System to Capture Trauma Attending Arrival Times in the Emergency Department

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Abstract

Background: Critically injured patients arriving to the Emergency Department (ED) require activation of the trauma team. Patient acuity determines the level of team activation required. For the highest level of acuity, the American College of Surgeons (ACS) Committee on Trauma (COT) mandates that an Attending Trauma Surgeon be present in the ED within fifteen minutes of patient arrival in at least 80% of encounters. Poor compliance with EMR documentation of attending trauma surgeon arrival times to the ED placed Level 1 Trauma Center verification at risk for a major academic medical center. We developed an objective, automated system for documenting trauma team arrival times, utilizing Radio Frequency Identification (RFID) beacons in the ED.

Objective: Developing and testing a sustainable, objective system for measuring trauma team compliance with ACS activation requirements in the ED of a Level 1 Trauma Center.

Methods: Our team developed and trialed a system using RFID beacons as a means to triangulate badges worn by trauma faculty when responding to team activations in the ED. Revisions were made to pre-existing RFID hospital infrastructure used for equipment tracking purposes. The on-call trauma attending surgeons were asked to wear a RFID badge affixed to their hospital staff ID lanyard during our pilot study. The system captured and recorded the net time between team activation and trauma attending surgeon arrival to the ED. As a comparison, we also continued the historical practice of relying on ED nursing staff documentation in the EHR.

Results: Results were captured over a 4-month span. During that period, 57 ED patients required the highest level of team activation. Due to pilot logistics (a limited number of RFID badges prevented all attending surgeons from wearing badges at all times), Trauma faculty was wearing a RFID badge during 46 of 57 activations. There was no RFID data recorded on the other 11 activations (11 for no badge worn, 0 due to system malfunction). Trauma attending arrival was in compliance of the 15-minute window 45 out of the 46 instances (97.8% compliance rate). Of the 11 activations not recorded via RFID, 8 were documented as in compliance, and 3 were noncompliant in the EHR (1 arrival >15 minutes, 2 missing any EHR documentation; 72.7% compliance rate). Out of all 57 activations, 5 lacked EHR documentation. Within that subset, the RFID system documented compliance in 4 cases. One activation lacked EHR and RFID documentation.

Conclusions: Triangulating trauma faculty location in the ED using RFID beacons is a cost-effective, sustainable system for monitoring arrival time compliance with ACS requirements. An automated system such as our RFID program ensures that our trauma faculty meets ACS regulatory standards for a Level 1 Trauma Center. The system allows ED nursing staff to eliminate an EHR documentation step during critical initial moments in the ED. Internal review of our pilot has justified a full-scale roll-out of our RFID program to trauma faculty.

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KEYWORDS

emergency department; RFID; trauma; american college of surgeons

Multimedia Appendix 1

Full poster.

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Abstract

Predictive Modeling of Emergency Hospital Transport Based on a Personal Emergency Response System (PERS): Comparison to Clinical Outcomes

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Abstract

Background: With the worldwide increase in the elderly population, chronic diseases and associated healthcare utilization such as costly emergency department visits and subsequent hospitalizations are also on the rise. Predictive analytics can be used to identify patients at high risk for emergency utilization, using Electronic Health Record (EHR) data collected before or at hospital discharge. In addition, non-hospital data may be useful for prediction of changes in risk outside of hospital settings. Inexpensive monitoring of elderly via a Personal Emergency Response System (PERS) to identify patients at high risk for emergency hospital transport could be used to target interventions and prevent avoidable, costly long-term healthcare utilization.

Objective: The objectives were 1) to develop and validate a predictive model of 30-day emergency hospital transport based on PERS data; and 2) to compare its predictions with clinical outcomes derived from the EHR.

Methods: De-identified medical alert pattern data of 290,434 subscribers to a PERS service were used to build a gradient tree boosting-based predictive model of 30-day hospital transport, including predictors derived from subscriber demographics, self-reported medical conditions, caregiver network information, and up to two years of retrospective medical alert data. Model performance was evaluated on an independent validation cohort (n=289,426). EHR and PERS records were linked for 1,815 patients from the Partners HealthCare at Home program, to compare PERS-based risk scores with rates of emergency encounters as recorded in the EHR.

Results: After feature selection, the predictive model of 30-day emergency hospital transport included 121 predictors. Previous recent incidents and emergency encounters were among the most important variables in the predictive model. Predictors also included the number of self-reported medical conditions, and COPD, CHF, and heart conditions specifically. Other important predictors included age, gender, and the number of responders. Goodness-of-fit test and calibration plot indicated that the model predicted probabilities matched with observed outcomes across ranges of predicted risk. Performance of the predictive model of emergency hospital transport, as evaluated by area under the receiver operator characteristic curve (AUC), was 0.78. In the top 1% predicted high-risk patients, the risk of having one or more emergency hospital transports in the next 30 days was 11.6 times higher than in the overall population. Comparison with clinical outcomes from the EHR showed 3.9 times more emergency encounters in predicted high-risk patients compared to low-risk patients in the year following the prediction date.

Conclusions: Remotely collected patient data, facilitated by personal health technologies, can be used to reliably predict utilization outcomes. These predictive analytics tools can be used by healthcare organizations to extend population health management into the home. By timelier identifying of high-risk patients, interventions can be targeted to them. This could lead to overall improved patient experience, higher quality of care and more efficient resource utilization. Future studies could explore the impact of combined EHR and PERS data on predictive accuracy.

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Full poster.

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Abstract

Continuous Remote Monitoring of Vital Signs in Pediatric Population

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Abstract

Background: Wearable sensor technologies coupled with secure patient portals allow for continuous real-time data acquisition from a patient in a hospital or home setting. This combination renders more effective health-management system with faster patient-recovery times and reduced healthcare costs. VitalConnect Inc. has developed a fully-disposable, FDA-cleared (for adults) wireless biosensor (VitalPatch®) that is worn on chest. VitalPatch captures multiple medical-grade biometrics and transmits the physiological data continuously (via Bluetooth) for up to 96 hours to a relay (tablet, wireless hub). Like adults, pediatric patients (5-17 years of age) could also benefit from such small and low-profile biosensor that can collect and stream vital signs uninterruptedly to a secure patient-portal. This data can then be monitored by a clinical triage center or healthcare-provider.

Objective: Continuous remote monitoring of heart rate (HR) and breathing rate (BR) is critical during acute or chronic illnesses. The primary purpose of this study was to evaluate the performance of the VitalConnect platform in pediatric subjects during activities of daily living (ADL) to confirm accuracy of sensor measurements for HR and BR with respect to a clinical reference device, Capnostream20 (Oridion). Additionally, information on comfort and usability of VitalPatch at home was assessed for the total duration of wear.

Methods: Thirty-five children were enrolled in the study (24 between 9-17 years, 11 between 5-8 years). All subjects participated in 96-hour wear-period of the VitalPatch biosensor and performed one hour of in-lab protocol on Day1 of the wear duration. Each participant underwent stationary breathing exercises (spontaneous, metronome), ADLs with postural maneuvers and treadmill walking. The study was conducted in presence of a nurse after approval from Institutional Review Board. The performance of heart rate, respiration rate, posture and number of steps were assessed for each subject separately using the mean absolute error (MAE) between the true and measured values. The reference for posture and step count was manual observation.

Results: During the stationary condition, MAE (across 35 children) for HR and BR was 2.1±1.0 beats per minute (BPM) and 2.2±0.8 breaths per minute (BrPM) respectively compared to Capnostream20. During ADLs, MAE was 4.3±2.7 BPM for HR and 3.7±1.7 BrPM for BR. Accuracy of posture (standing, supine, walking) was >93% and step-count was >95% overall. Moreover, 80% participants rated wearing VitalPatch ‘comfortable’ without any itchiness during 96-hour wear.

Conclusions: The VitalPatch biosensor demonstrated clinically-acceptable accuracy compared to a standardized reference device for both heart rate and breathing rate. It also provided sufficiently accurate measures for activity in terms of posture and number of steps. Furthermore, when used for up to 4 days at home, there were no adverse events (i.e. rashes, dermatitis, mechanical skin injury) and user experience was satisfactory. The accuracy of vitals and ease-of-use in the home environment in children aged 5-17 illustrate the potential of VitalPatch as a non-invasive and cost-effective vital sign monitoring alternative. VitalPatch biosensor can be integrated into state-of-art devices to monitor vital signs for pediatric patients with diseases like congenital heart abnormalities and adolescent fatigue.

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Abstract

Development of a Monitoring System for Smartphone Overuse

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Abstract

Background: Smartphone overuse has become an epidemic public health concern around the world. Nowadays, the measurement of smartphone overuse, which comes to be known as smartphone addiction, is still relying on self-reported questionnaire. However, this leads to inaccuracy and it cannot perform continual measurement.

Objective: The aim of this study is to develop an IT based system monitoring daily usage behavior of smartphone automatically, which was named Smartphone Overuse Monitoring System (SOMS).

Methods: The monitoring system consists of an Android Smartphone application (SOMS App) and a web application server. The App was designed to fulfill the following core functions: 1. To collect users' general demographic data and identify the IMEI of smartphones; 2. To monitor using behavior and assess smartphone overuse; 3. To give instant feedback to users. The web server stores the data collected by the App and execute statistical analysis.

Results: We invited 11 participants to test the SOMS. The users were asked to fill out a short questionnaire at the first logon, which includes demographic information, such as name, sex, age etc. The SOMS App recorded the smartphone behavior as follows: power on/off, call in/out, screening on/off/unlock, programs usage. The data of program usage include which app and how long it was used. Once a day, the participants received a notification of the smartphone usage statistics for the last 24 hours. The users can also find key messages from the interface of the SOMS App, such as the top 10 most frequently and longest used Apps. Moreover, the SOMS App draws a fragment map, which illustrates the interrupted daily life by smartphone.

Conclusions: The monitoring system can tally the length and frequency of smartphone use and analyze the most influential Apps on people's daily life. It is not only significant for the screening of smartphone overuse but also for the development of intervention strategy.

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KEYWORDS

activity monitoring; app; behavior, addictive/*prevention & control; psychometrics; smartphone

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Abstract

The Effect of Smartphone Interventions on Patients With Chronic Obstructive Pulmonary Disease Exacerbations: Systematic Review and Meta-Analysis

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Abstract

Background: The prevalence and mortality rates of chronic obstructive pulmonary disease (COPD) are increasing worldwide. Therefore, COPD remains a major public health problem. There is a growing interest in the use of smartphone technology for health promotion and disease management interventions. However, the effectiveness of smartphones in reducing the number of patients having a COPD exacerbation is poorly understood.

Objective: To summarize and quantify the association between smartphone interventions and COPD exacerbations through a comprehensive systematic review and meta-analysis.

Methods: A comprehensive search strategy was conducted across relevant databases (PubMed, Embase, Cochrane, CINHA, PsycINFO, and the Cochrane Library Medline) from inception to October 2015. We included studies that assessed the use of smartphone interventions in the reduction of COPD exacerbations compared with usual care. Full-text studies were excluded if the investigators did not use a smartphone device or did not report on COPD exacerbations. Observational studies, abstracts, and reviews were also excluded. Two reviewers extracted the data and conducted a risk of bias assessment using the US Preventive Services Task Force quality rating criteria. A random effects model was used to meta-analyze the results from included studies. Pooled odds ratios were used to measure the effectiveness of smartphone interventions on COPD exacerbations. Heterogeneity was measured using the I(2)statistic.

Results: Of the 245 unique citations screened, 6 studies were included in the qualitative synthesis. Studies were relatively small with less than 100 participants in each study (range 30 to 99) and follow-up ranged from 4-9 months. The mean age was 70.5 years (SD 5.6) and 74% (281/380) were male. The studies varied in terms of country, type of smartphone intervention, frequency of data collection from the participants, and the feedback strategy. Three studies were included in the meta-analysis. The overall assessment of potential bias of the studies that were included in the meta-analysis was “Good” for one study and “Fair” for 2 studies. The pooled random effects odds ratio of patients having an exacerbation was 0.20 in patients using a smartphone intervention (95% CI 0.07-0.62), a reduction of 80% for smartphone interventions compared with usual care. However, there was moderate heterogeneity across the included studies (I(2)=59%).

Conclusions: Although current literature on the role of smartphones in reducing COPD exacerbations is limited, findings from our review suggest that smartphones are useful in reducing the number of patients having a COPD exacerbation. Nevertheless, using smartphones require synergistic strategies to achieve the desired outcome. These results should be interpreted with caution due to the heterogeneity among the studies. Researchers should focus on conducting rigorous studies with adequately powered sample sizes to determine the validity and clinical utility of smartphone interventions in the management of COPD.

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KEYWORDS

meta-analysis; systematic review; telemedicine; pulmonary disease; chronic obstructive pulmonary disease; ehealth; mhealth; chronic disease

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Abstract

Adherence to Smoking Cessation Medications Among Clickotine® Users

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Abstract

Background: Tobacco smoking is the leading cause of preventable death in the US, with the economic burden attributable to smoking exceeding $300 billion annually. Although smoking cessation medications are effective in clinical trials, their real-world effectiveness is sub-optimal. Poor adherence to smoking cessation medications is associated with failed quit attempts. Technology has been used to promote medication adherence in other conditions. Clickotine is a science-based mobile application for smoking cessation, designed to assist smokers according to the US Public Health Service Clinical Practice Guidelines. Clickotine has been tested in a single arm trial and shows promise as a smoking cessation aid. One core component of the Clickotine program aims to educate smokers about smoking cessation medications including nicotine replacement therapy, varenicline, and bupropion and to facilitate access and adherence to these medications through targeted Clickotine missions and personalized messages. Clickotine missions direct the user to do something specific related to their quit journey. Missions related to smoking cessation medications included “read here to learn about NRT options and efficacy”; “set a reminder to take your meds”; or “make a plan to order your refill.” Personalized messages provide encouragement and reminders and included information relevant to the user or their quit journey.

Objective: To measure use of smoking cessation medications among Clickotine users and measure medication adherence at baseline and 8-weeks in a single-arm trial of Clickotine for smoking cessation.

Methods: U.S. residents between 18-65 years of age who owned an iPhone and smoked 5 or more cigarettes daily were recruited via online advertising from May to July 2016. Respondents were pre-screened for eligibility by telephone and directed to a web portal to complete informed consent, confirm eligibility, and download the Clickotine app. Participants completed study assessments via the web portal at baseline and after 8-weeks (primary outcome). The proportion of participants using a smoking cessation medication was measured at baseline and at the 8-week outcome. To assess adherence to smoking cessation medications, the Morisky Medication Adherence Scale- 4 item version (MMAS-4) was compared at baseline and study outcome. MMAS-4 yields scores of 0-4 with greater scores indicating decreased adherence.

Results: 416 participants downloaded the app and constituted the intention-to-treat (ITT) sample in the Clickotine trial. Of these, 31 (7.5%) reported using a smoking cessation medication at baseline. At 8 weeks, 68 participants (16.3%) reported using a smoking cessation medication. Increases were observed for all medications (e.g., medications (varenicline or bupropion): 183%; NRT: 93%) and subcategories (e.g., varenicline: 233%; nicotine gum: 200%). MMAS-4 score at baseline (mean = 2.35; SD= 1.43) was significantly greater than the MMAS-4 score observed at study outcome (mean = 1.28; SD= 1.31), t(87)= 3.30, *P*=.001, and Chi-square analysis of distribution of MMAS-4 scores indicated a shift toward greater adherence from study baseline to outcome (2(4)= 10.56, *P*=.032).

Conclusions: Access and adherence to smoking cessation medications increased during an 8-week, single-arm clinical trial of Clickotine.

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KEYWORDS

applications; eHealth, health promotion; medication adherence; smoking cessation

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Abstract

The Informal Caregiver Engagement Framework

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Abstract

Background: In the United States, there were 42.6 million adults age 65+ in 2014 and that figure is expected to double by year 2060 to 98 million. According to the AARP, 90% of older adults would prefer to age in their homes, creating an ever growing need for informal caregiver (ICG) support. About 34 million Americans provided care to a person 50+ years old with an average of 24.2 hours of care per week in 2015. Caregiving comes in many forms and levels, from proving a ride to a grocery store to administering medications and help with bathing and dressing. High levels of caregiving can cause high strain on caregivers. Therefore it is important to understand informal caregiver (ICG) needs as caregivers engage in providing care at different levels.

Objective: This work aims to map different ways informal caregivers engage in providing care to an elder care recipient (CR). We sought to define stages of an informal caregiver's engagement journey to uncover their needs in a progressive fashion.

Methods: Literature review, journey mapping and a commercial landscape of ICG solutions were conducted.

Results: Five stages of engagement in caregiving process were identified including Noticing Changes, Making Adjustments, Shifting Responsibilities, Actively Helping and Running the Show. Categories of needs (e.g. communication and information), as well as tasks they may complete at each stage of engagement (e.g. share and gather information about care recipient condition in the communication need of Stage 3), were also mapped. The first two stages are the lowest level of engagement and are often hard to differentiate. The main distinction is that in Making Adjustments, caregivers have acknowledged that changes in the care recipient's health and functional abilities require some level of engagement. The informal caregiver's health and functional limitations start to limit their independence in Stage 3. Caregivers take over more responsibilities from the care recipient, mainly instrumental activities of daily living like shopping, transportation, and housework. The ICG is more deeply engaged with providing care in Stage 4. The care recipient is likely still living independently; however, doing so safely is becoming increasingly more difficult. Informal caregivers in this stage start to need deeper engagement in self-care as caregiver burden is a concern. In the final stage, the care recipient has lost their independence, relying on the ICG for most needs. The care recipient may collocate with the caregiver or alternative living arrangements like transfer to a skilled nursing facility are made. Caregivers are very familiar with the care recipient's disease and treatment options and are instead in need of emotional and decision-making support.

Conclusions: As the number of people age 65 and older continues to grow, the need for informal caregiver support will increase. Consequently, informal caregivers themselves will also need support. This work focused on revealing different stages of engagement for informal caregivers and caregiver needs at each stage. This work shows the landscape of informal caregiver needs and engagement points for which solutions can be proposed. This will help academic, legislative, and commercial entities deliver the support informal caregivers need.

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KEYWORDS

caregivers; engagement; informal caregivers; needs; journey

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Abstract

Pilot Study to Test the Utility and Acceptability of An Electronic Health Record (patientMpower) for Patients With Lung Fibrosis

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Abstract

Background: Idiopathic pulmonary fibrosis (IPF) is an irreversible condition associated with progressive dyspnoea, fatigue, cough and psychological distress. Progression of IPF impacts physical activities affecting quality of life. Forced vital capacity (FVC) is the internationally accepted spirometry marker of disease progression. The patientMpower platform promotes supported self-management, enabling patients with IPF to record relevant objective and subjective measurements and health outcomes.

Objective: Assess patients' views on the utility and acceptability of the patientMpower platform in lung fibrosis.

Methods: Thirteen patients with lung fibrosis participated in a prospective, single-arm observational study (6 weeks). Invitations were issued through the Irish Lung Fibrosis Association. There were no changes to usual healthcare. Patients independently installed the patientMpower platform to their own smartphone/tablet. Technical support was available if needed. All patients were supplied with a Spirobank Smart spirometer (MIR, Rome, Italy) to record FVC at home. Instruction on correct use of the spirometer was given, supported by instructional video content within the platform. Patients were asked to use the patientMpower platform regularly, ideally daily. Measurements included: modified Medical Research Council breathlessness scale (mMRC), medication compliance, daily spirometry (seated), step count and weekly impact of lung fibrosis on daily life [Patient Reported Outcome Measure (PROM)]. Patients' opinions on utility and acceptability were assessed by a 17-point questionnaire.

Results: 13 patients (7 male; 54%) participated. Median age: 66 years (range 37-83). Median baseline FVC: 78% predicted (range 40-123%). Twelve patients (92%) used the patientMpower platform for ≥6 weeks and 8 (61%) completed feedback questionnaires. 87% of patients (n=7/8) who provided feedback questionnaires reported their experience of the platform as "positive" and stated they wanted to continue using it. To date, 8 patients (61%), continue to actively use the platform after study completion. Nine patients (69%) used the platform within 5 days of download and twelve used it on ≥60% of days over the observation period. Three patients (23%) used it every day. Home spirometry was recorded frequently (median 69% of days; range 21-83%). mMRC data was infrequently recorded (0-7% of days). Impact of lung fibrosis on daily life (PROM) was completed frequently (median 67% of weeks). At baseline, 12 patients (92%) reported that breathing difficulties related to IPF affected their quality of life "some of the time" or "most of the time".

Conclusions: Patients with a severe life-limiting lung condition are willing and able to use an electronic health record to record objective data, symptoms and outcomes. Age is not a barrier to engaging with this technology. Regular home spirometry and recording of impact of lung fibrosis on daily life was feasible and acceptable in this patient population. A majority wished to continue using patientMpower indefinitely. This approach may be useful to capture patient-reported long-term trends in FVC and health outcomes.

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KEYWORDS

dyspnea; electronic symptom reporting; lung diseases; patient-reported outcomes; spirometry; IPF

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Abstract

A Patient-Centered Approach to Tailoring a Mobile-Based Mindfulness and Social Support Intervention for Adolescents and Young Adults With Cancer

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Abstract

Background: There is an emerging interest in identifying and meeting the unique needs of adolescents and young adults (AYA) with cancer. Roughly 700,000 AYA are diagnosed with cancer each year in the United States, and the incidence in this cohort has increased steadily over the past 30 years. Nevertheless, improvements in cancer outcomes for AYA lag far behind the advances that have been made for young children and older adults. Recent work has documented significant levels of unmet needs among AYA with cancer, particularly psychosocial challenges during the transition to adulthood—e.g., abrupt disruption to school and social life, fears for an uncertain future, and body image concerns. A mobile-based intervention for youth is an ideal way to complement treatment by delivering a psychosocial intervention which is developmentally appropriate and derived from evidence-based approaches to fostering resilience through mindfulness-based coping strategies and social support.

Objective: To use a patient-centered approach to design, and evaluate the feasibility of a mobile-based psychosocial intervention for adolescent and young adult cancer patients.

Methods: Formative research involved three steps: (1) In-depth interviews were conducted with ten AYA with sarcoma, with parents of the five adolescents, and six healthcare providers (N=21). Families were recruited from UCLA Pediatric Bone and Soft Tissue Sarcoma Program. Interview guides were based on the Resilience in Illness Model (RIM), which describes four health protective factors for resilience (social integration, family environment, courageous coping and derived meaning), and two risk factors (illness-related distress and defensive coping). Interview guides also included questions about preferences for a mobile intervention. Coding and analysis was inductive, also based on the RIM theory. (2) Adaptations were made to an existing mindfulness app (Whil Concepts, Inc.), which offers a program for youth called “Grow,” with over 500 audio relaxations. Modifications included creating a 4-week “Mindfulness for Resilience in Illness” program, with 28 relaxation exercises, and the addition of videos featuring two sarcoma survivors as program hosts. A patient advisory board was created to review drafts of content. (3) A one-month pilot study was conducted with 20 AYA cancer patients, which included using the app and engaging in a private Facebook usability group to (a) elicit beliefs about the mindfulness app and potential future enhancements, and (b) promote social support. Pre- and post-measures of mindfulness, social support, body image and quality of life were collected as well as post-intervention satisfaction data.

Results: Themes derived from the in-depth interviews were incorporated into a demonstration version of the mobile app specifically for AYA cancer patients. Quantitative and qualitative evaluation data will be presented.

Conclusions: A patient-centered approach may be a useful way to inform development of a mobile-based intervention for AYA with cancer. The intervention may be a feasible complement of medical and psychological treatment.

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KEYWORDS

adolescent; app; cancer; young adult

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Abstract

Healthcare Cost Analysis of Older Patients Using a Personal Emergency Response Service Uncovers Costs Savings Opportunity

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Abstract

Background: In the US healthcare system, half of overall Medicare and Medicaid Services reimbursement goes towards caring for the top 5% most expensive patients. However, little is known about how these patients' costs change annually prior to them reaching the top 5%. To address these gaps and investigate potential cost savings opportunities, we analyzed patient flow and associated healthcare cost trends over the period 2011-2015.

Objective: To evaluate longitudinal trends in healthcare cost of older patients using Personal Emergency Response Service (PERS).

Methods: This is a retrospective, longitudinal, multicenter study to evaluate healthcare cost of 2,643 older patients over the period 2011-2015. All patients had at least one inpatient and/or outpatient encounter, and at least one episode of home health care during the study period. In addition, all patients used PERS at home anytime during the study period. The study population was segmented by their annual healthcare expenditures into Top (5%), Middle (6-50%) and Bottom (51-100%) segments. Cost acuity pyramids were built based on these segments for each fiscal year. The longitudinal healthcare expenditure trends of the complete study population, as well as each segment, were assessed by linear regression models. Patient flows throughout the segments of the cost acuity pyramids from year to year were modeled by Markov chains. The associated costs flows were quantified over a 2-year period.

Results: Total healthcare cost of the study population nearly doubled from $17.7M in 2011 to $33.0M in 2015. This increasing trend was statistically significant (P=0.003) with an expected yearly cost increase of $3.6M. This growth was driven by a significantly higher cost increase in the Middle segment ($2.3M; P=0.002). The expected yearly costs increase of the Top and Bottom segments was $1.2M ($P$=0.008) and $0.1M ($P$=0.003) respectively, and both were statistically significant. The patients and cost flow analyses showed that 18% of patients moved up the cost acuity pyramid yearly, and their cost increased by 672% in contrast to 22% of patients who moved down with a cost decrease by 86%. The remaining 60% of patients stayed in the same segment from year to year, but their cost increased by 18%.

Conclusions: While many healthcare organizations target costly intensive interventions for their most expensive patients, this analysis unveiled a potential cost savings opportunity by managing the patients in the lower cost segments that are at risk of moving up the cost acuity pyramid. To achieve this, data analytics that integrate longitudinal data from the EHR and home monitoring devices may help healthcare organizations to optimize resources by enabling clinicians to proactively manage patients in their home or community environments, beyond institutional settings and 30-60 day telehealth services.

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KEYWORDS

Healthcare cost analysis; Cost acuity pyramid segmentation; Personal Emergency Response Service (PERS)

Multimedia Appendix 1

Full poster.

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Abstract

Is a Mobile Personal Health Record Effective Tool for Managing Patient-Generated Health Data?

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Abstract

Background: Mobile health applications and personal health records (PHRs) are considered essential tools to ensure patient engagement. Mobile PHR (mPHR) can be a platform to integrate patient-generated health data (PGHD) and patient medical information.

Objective: An mPHR developed by a tertiary hospital in South Korea has been used from Dec 2010 to Dec 2015. Patients could manage their own health data through the mPHR. By analyzing five years' PGHD, we wanted to evaluate how the PGHD were managed and to find out issues in PGHD management

Methods: Five years' log data were gathered from a backup mobile server. Users who entered PGHDs were selected then variables regarding usage of the mPHR and PGHDs were gathered. PGHDs included body weight (WT), blood pressure (BP), blood sugar test (BST), a 10-year risk of cardiovascular disease (CVD), metabolic syndrome score (META), medication schedule, and insulin. Users were divided with the presence of patient ID, users with patient ID (UPID) and users without patient ID (SUSER). If WT, BP, BST were entered at least one time per week and used for 30 days and more, they were regarded as continuously used. If CVD and META were entered at least two times and used for 180 days and more, they were regarded as continuously used. PGHD entry counts, proportion of continuous users for each PGHD were compared by user type.

Results: Total number of users were 18,265 (UPID: 16,729, 91.6%). Of all the users tracked, 3,620 entered WT, followed by BP (1,625), BST (1,374), CVD (764), META (685), insulin (72), and medication (62). Most users (from 66.8% to 88.2%) entered PGHD just one time. Entry of WT, BP, BST, CVD, and META were increased by year. Mean counts of WT, BP, and BST entry were 2.715.9, 5.943.6, 9.551.9 in UPID and 1.52.2, 9.327.8, 20.645.6 in SUSER (P=.36, .18, .006 respectively). The proportion of continuous users of BP was 2.8% (42/1,482) in UPID while 6.5% (9/139) in SUSER (P=.036). For BST, the proportion was 5.1% (62/1,220) in UPID while 14.6% (22/151) in SUSER (P<.01). There were no statistically differences between user type in WT, CVD, and META.

Conclusions: A very small portion of users managed the PGHD continuously through the mPHR. Research revealing factors promoting continuous use of PGHDs in mPHRs and consensus of continuous use of various PGHD are needed.

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KEYWORDS

mobile health; personal health record; patient engangement; patient-generated health data

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Abstract

Intuitive Interactive Platform for Preoperative Communication Between Hospital and Patients/Caregivers: Towards Community Partnership for Peri-Operative Person-Based Healthcare Model

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Abstract

Background: Preoperative phone screening of patients' recent health status and communication to patients about time of admission, surgery and fasting is the back bone of preoperative care in day surgery. Nursing staff are increasingly burdened by non-direct administrative duties, removing them from direct patient care. The amount of time nurses spend on direct patient care have been reported to be less than 40% of their working hours. This negatively impacts the quality of care, patient outcome and experience, results in job dissatisfaction and burnout among nurses. In our institution, day surgery constituted 50% of our surgical workload with an estimated 3000 cases per annum.

Objective: The objective is to develop a novel application (APP), "Image and Go" (InG), an efficient and secured closed loop system of automated electronic preoperative communication for scheduling day surgery patients. The system frees the nurses from mundane jobs of telephone screening and delivery of routine preoperative instructions and the system is enabled to highlight patients who require a follow-up phone consult for counseling enhancement. InG has minimal intrusion to the current workflow of the nurses. It does not require complicated integration with the hospital's IT system. InG provides real-time overview of the patient's response to the nurses. Nurses can adjust the instructions in a few clicks, the InG backend system automatically reschedules the affected patients. InG is a secure and convenient platform, which taps on SMS/Telegram that millions of people use daily.

Methods: We leveraged the widespread use of printed day surgery schedules in day surgery centers. We developed the InG app for iOS/Android smartphone/tablet. InG takes photo(s) of printed day surgery form(s), identifies the patients' information and carries out interactive preoperative communication with patients via SMS/telegram automatically. 1. A survey was conducted on frontline nurses directly involved in nurse-led preoperative screening and instructions to identify problems and time expenditure during the work process. 2. We evaluated the performance of InG in a mock test with 20 university students as mock patients. In the test, 12 confirmed the appointment, 6 requested for time change, and 2 requested follow-up phone calls. Then we compared the result with the traditional approach.

Results: 1. An average of 4 hours was spent in nurse-led phone calls per day. There was strong agreement among 87.5% nurses that direct patient care gave them job satisfaction, and 75% strongly agreed that it is more productive to channel time from nurse-led calling to direct patient care. Of those queried, 87.5% strongly agreed that automation with close loop increases the efficiency of the work process. 2. InG is 6.03 times faster than the traditional approach. InG took 32 minutes to complete the communication with 20 patients. The nurse could work on other duties while InG was processing the telegram communication. The traditional approach took 3 hours 13 min with 20 patients.

Conclusions: The closed loop system of automated electronic preoperative communication provides a secure and efficient communication platform for the hospital-community partnership in healthcare with better utilization of nursing time for direct patient care and greater work satisfaction.

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KEYWORDS

preoperative communication; preoperative instructions; telehealth; customer relationship management; optical character recognition; information retrieval; patient screening; automated messaging; automated interaction

Multimedia Appendix 1

Full poster.

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Abstract

Harnessing Connected Health to Improve Hospital Discharge and Patient Outcomes for Every Generation: Insights from Piloting the Corrie Platform in Post-MI Recovery

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Abstract

Background: Rapid adoption of smartphones has led to an increasing interest in connected health interventions for clinical care and remote monitoring. However, there is a large disconnect between clinical patient populations and the digital health literature, as most digital health work has occurred outside the healthcare system in younger, healthy patients. The applicability of many innovative connected health approaches across generations, particularly in older patients presenting with coronary heart disease, is a topic in strong need of further study. Our interdisciplinary team of clinicians and engineers built the 1st cardiology CareKit application ("Corrie"), focused on improving hospital discharge and empowering patients from all generations through an optimal recovery from acute myocardial infarction. We now report on our initial piloting experience with a focus on use and outcomes across generations.

Objective: In this interim analysis of the first 47 patients enrolled in the Myocardial infarction COmbined device Recovery Enhancement (MiCORE) Pilot Study, we sought to assess the feasibility and uptake of a connected health platform in patients hospitalized with acute myocardial infarction (AMI) and to assess 30-day post-discharge readmission risk across generations.

Methods: This prospective observational study enrolled acute MI patients from the Cardiac Units at two sites–Johns Hopkins Bayview and Johns Hopkins Hospital. The intervention, consisting of an Apple CareKit smartphone application ("Corrie app") and Apple smartwatch, allowed patients to develop medication self-management skills, coordinate follow-up appointments, learn about critical preventative cardiology topics via videos, and connect with health resources across the continuum of care. AMI patients were enrolled during admission and used the intervention from enrollment through 30-days post-discharge. The intervention was developed with substantial efforts to optimize user-centered design. 30-day readmission rate was assessed by chart review of electronic medical record and CRISP regional data. Descriptive statistics were performed to examine user demographics.

Results: 30-day readmission rates in Corrie-enrolled patients (0%, N=47) were significantly lower than the Johns Hopkins historical control (19%, N=200; $P<0.001$). 70.2% of Corrie patients were men and 29.8% were women, with roughly half of the patients above the age of 60 (46.8%). The mean age was 58 (SD 11), with a full range from 32-76 years. Patients represented all generations: 8.5% were from the Silent Generation (born before 1945), 55.3% were Baby Boomers (born 1945-1964), 31.9% were from Generation X (born 1964-1980) and 4.3% were Millennials/Generation Y (born 1980-1999). The proportion of White/Caucasian participants was 68.1%, Black/African American was 14.9%, American Indian/Alaska native was 2.1%, Asian was 4.2%, and unknown/other was 10.6%. Examining socioeconomic status, 10.7% had Medicaid, 8.5% had Medicare, 78.7% had private insurance, and 2.1% had no insurance. The average median income according to patient zip codes was $74,717.

Conclusions: In our study that stands out for its focus on deployment of patient-centered connected health in the clinical care setting, the Corrie platform shows evidence of uptake, feasibility, and effectiveness of digital health interventions across patients

of multiple generations and demographics. Additional studies are ongoing to evaluate differential user engagement between demographic groups with respect to specific features of the smartphone-application based intervention.

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KEYWORDS

myocardial infarction; smartphone application; wearables; smartwatch; self-management; hospital discharge; clinical care; patient empowerment; cardiology app

Multimedia Appendix 1

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Abstract

Impact of AllazoEngine-Targeted Interventions on Medication Adherence: Repeated Measures Difference-in-Differences Analysis

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Abstract

Background: AllazoHealth utilizes predictive analytics to improve medication adherence by targeting patients whose behavior can be changed with intervention programs. The AllazoEngine utilizes Rx claims, previous intervention data, and demographics to predict future adherence, to prioritize the patients whose behaviors can be changed, and to select the intervention channel and messaging most effective for each individual patient. Blue Cross and Blue Shield of North Carolina commissioned AllazoHealth's predictive analytics and separately commissioned medication intervention delivery services for this adherence program.

Objective: This study aimed to evaluate the effectiveness of the AllazoEngine and targeted interventions to improve medication adherence.

Methods: This was a double-blind, randomized controlled trial (RCT) focused on RAS antagonists, oral anti-diabetics, and Statins. Patients were randomized to receive no intervention, traditional non-Allazo-targeted interventions, or interventions targeted by the AllazoEngine. All interventions consisted of live calls, direct mail to patients, and faxes to prescribers. Patients were defined as adherent in accordance with Medicare Star ratings methodology if their proportion of days covered (PDC) was greater than 80%. Patients' adherence status in 2015 was compared to their adherence status in 2016 after the intervention period. Difference-in-Differences (DiD) analysis was used to compare the effect of each intervention method. Statistical significance was set to 10%.

Results: The primary study population consisted of 14,377 controls, 5,423 traditional non-Allazo targeted-intervention patients and 24,527 Allazo targeted intervention patients. Patients had comparable characteristics at baseline and comparable decrease in medication adherence in the pre-intervention observation period across the intervention groups. Non-Allazo-targeted interventions did not statistically improve the likelihood of adherence. Patients who received Allazo-targeted interventions performed statistically better than both the non-Allazo targeted group and control group (P=.06 and .03). Assuming net positive uplift from non-Allazo interventions, Allazo interventions accounted for 7.7 times the per-patient uplift in adherence compared to non-Allazo interventions.

Conclusions: Due to the specific study design of not including new patients, adherence decreased in each intervention group over the intervention period. However, the decrease was significantly less for those in the Allazo group compared to both the non-Allazo and control groups.

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KEYWORDS

diabetes; medication adherence; star-ratings; hypertension; predictive analytics

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Abstract

How Can mHealth Keep New Moms out of the Blue? Evidence of the Heterogeneous Treatment Effects on Depression from a Large-Scale Field Experiment

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Abstract

Background: While there is substantial evidence showing the effectiveness of mHealth in treating chronic conditions, researchers now realize that mHealth does not always benefit every patient. This heterogeneity may be due to personal factors, which moderate the effectiveness of mHealth tools. However, there is relatively little research examining these moderating factors, particularly for interventions targeting postpartum depression.

Objective: This study specifically looks at factors that could moderate the effect of an mHealth intervention on postpartum depression (PPD) among women in China, where the prevalence of PPD is 10%-15%. Two moderating factors of interest are the psychological factors of perceived susceptibility and intrinsic motivation. Perceived susceptibility is the expectant mother's perception of her and her baby's risk of health problems. Intrinsic motivation is the natural human propensity of an expectant mother to act for her and her baby's health. The hypotheses for this study are: 1) those with higher perceived susceptibility are more likely to benefit from the intervention, and 2) those with higher intrinsic motivation are more likely to benefit from the intervention.

Methods: One of the world's largest field experiments was conducted to explore the effectiveness of an SMS messaging application on the health of expectant mothers in China. The application delivered timely, accurate prenatal health messages, including some on postpartum depression, to pregnant women over the course of their pregnancy. The study enrolled 4,629 expectant mothers in northern China over a period of two years. Participants entered one of four groups, including three different treatment groups and a control group. Subjects were interviewed in postpartum home visits to obtain a measure of PPD. In total, PPD measures were obtained for 1,293 new mothers. Moderator variable data were reported by the expectant mothers at enrollment. In this analysis, the PPD outcome was measured between the treatment (comprising all three treatment groups) and the control group for expectant mothers with low versus high levels of susceptibility perception, and low versus high levels of intrinsic motivation.

Results: Results reveal significant moderating effects of an expectant mother's intrinsic motivation and perceived susceptibility on the effectiveness of the SMS intervention. Specifically, SMS was associated with reduced PPD score among expectant mothers with high perceived susceptibility by 31%, compared to the control group. However, expectant mothers with low perceived susceptibility do not seem to benefit from the SMS messaging. Also, contrary to previous studies, results show that expectant mothers with low intrinsic motivation enjoy the benefits of the intervention by a reduction of 20% in PPD score. Furthermore, those with high intrinsic motivation showed a 17% increase in PPD score.

Conclusions: Our results suggest that if resources are limited, the most efficient way to reduce PPD in a population may be to target pregnant women with high susceptibility perception and low intrinsic motivation using SMS health messaging. Our findings also suggest that those with high intrinsic motivation may not be the optimal target population for clinical mobile messaging.

Overall, the evidence generated from this large-scale field experiment contributes to our understanding of effective use of mHealth for postpartum depression.

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KEYWORDS

mHealth; postpartum depression; China

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Abstract

Towards Precision Stress Management: Design and Evaluation of a Practical Wearable Sensing System for Monitoring Everyday Stress

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Abstract

Background: Overstress is becoming an epidemic issue in modern society, contributing to a broad range of health problems ranging from depression to cardiovascular diseases. According to a 2015 national survey by American Psychological Association, 75% of Americans reported experiencing at least one symptom of stress in the past month, such as anxiety and headaches. Despite the growing evidence of the negative impact of stress, there is still a lack of practical tools that can unobtrusively gauge and manage people's day-to-day stress.

Objective: Our study aims to design, develop, and evaluate a practical wearable sensing system that can continuously and reliably infer the wearer's stress level through analyzing passively obtained bio-signals. Such a system can potentially offer individuals timely awareness of stress and personalized interventions for reducing stress.

Methods: We investigated the feasibility of using biomarkers based on heart rate variability (HRV) to infer stress. To this end, we developed algorithms that process signals from photoplethysmography (PPG) sensors (Empatica E4 wristband1) to extract an HRV-based biomarker that is indicative of stress. We then investigated the correlation between each subject's self-reported stress and the biomarker by conducting controlled, in-lab experiments designed to put subjects through structured periods of relaxation and stress. We also conducted in-field experiments to identify and deal with the practical challenges associated with measuring stress in real-life situations, such as unpredictable data quality due to motion artifacts. To evaluate the system's in-field performance, we compared the system's stress output and the self-reported stress associated with a particular daily event.

Results: A total of 17 subjects were recruited for the initial data collection. We collected more than 300 hours of data that contains activities such as working, giving a presentation, driving, doing cognitive challenges, etc. Of the activities tracked, 146 were annotated by the subjects with associated stress information (eg, "8-8:30 am, driving to work, feeling stressed about being late" and "3-4pm, attending a seminar, not stressed"). We found that the subjects are more likely to report stressful activities (114 reported) than non-stressful activities (32 reported). Compared with the reported stress information, results from the system achieve a sensitivity of 92.1% (105/114) and a specificity of 50.0% (16/32).

Conclusions: Our results suggest that the developed system can offer a reliable proxy of stress, and therefore has potential in serving as a convenient tool for gauging and understanding daily stress dynamics. The relatively high false positive rate results in a 50% specificity, which was mainly caused by interferences from subjects' physical activities. The specificity can be further improved by mitigating the impact of such interferences—for example, by taking other biomarkers and contextual information into account. In future studies, we will also explore methods of leveraging the system's continuous stress level output to generate timely notifications and personalized recommendations.

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KEYWORDS

mobile health (mHealth); stress; wearables

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Abstract

Partners eCare Research Core for Clinical Research: Pilot to Build and Test Silent Best Practice Alert Notifications for Recruiting Inpatient Study Participants

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Abstract

Background: Participant recruitment remains one of the greatest challenges for many research groups. For an observational prospective study of objective and subjective measures in outpatients with chronic obstructive pulmonary disease (COPD) to assess clinical deterioration (Emerald-COPD) at Partners Connected Health, recruiting COPD patients from the inpatient setting was inefficient and low-yielding. To screen for eligible participants, Research Coordinators spent over two hours per day manually searching through the EPIC Reporting Workbench from three hospitals and reviewing admission notes to determine whether patients met eligibility criteria.

Objective: This pilot project, conducted in collaboration with Partners eCare Research Core (PeRC), examines a new EPIC functionality built to support inpatient recruitment for clinical trials. The silent Best Practice Alert (BPA) system identifies potentially eligible participants in real time to help research teams maximize recruitment accuracy and efficiency of resources.

Methods: This out-of-the-box solution alerts study staff of the inpatient admission of potential participants through EPIC In-Basket messages. The silent BPA notifications detect an event of interest, in this case hospital admissions, using criteria pre-selected by Emerald-COPD research staff. Criteria included: patient class, admit diagnosis, prescribed medications, and presence of COPD on the EPIC problem list; these were used to flag potential participants at multiple Partners hospitals. We hypothesized that this tool would reduce the daily screening time, the number of missed potential participants as well as the time needed to recruit the targeted number of patients.

Results: To date, there have been 171 potentially eligible patients identified through BPA notifications. Of those, we have enrolled 26 participants into the Emerald- COPD study. Since implementation, there have been an average of 3 additional patients each week that were missed during our previous method of screening. In addition to expanding the pool potential participants, this tool has decreased screening time for Research Coordinators. The silent BPA screening method has proven to be 4 times faster than our previous screening method, projected to save 442.5 hours over the duration of the study.

Conclusions: Automation of the recruitment process has allowed us to identify potential participants in real time and avoid missing patients. This has made a substantial impact in raising our enrollment numbers. Silent BPA screening is a considerably faster method which allows for Research Coordinators to devote more time to other important aspects of research such as retention of enrolled participants. When time is allocated effectively, the study can run smoothly and be more cost effective. The outcomes have all been favorable, notably our experience working with the PeRC team. From the build process to implementation, the team

was responsive and engaged. This was essential to the speed of production and our encouraging progress. This innovative and instrumental functionality can be specified to the needs of other clinical research groups hoping to utilize EPIC for participant recruitment.

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KEYWORDS

electronic health record; innovation; participant recruitment

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Abstract

Screening of Atrial Fibrillation Using Wrist Photoplethysmography from a Fitbit Tracker

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Abstract

Background: Atrial Fibrillation is the most common clinically significant cardiac arrhythmia, estimated to affect between 2% (< 65 years of age) and 9% (> 65 years of age) of the U.S. population. Screening and early detection of AF can help prevent associated stroke and cardiovascular disease. Commonly used monitoring devices are limited to short periods (< 4 weeks) and are usually employed in symptomatic subjects. Wrist-worn wearables equipped with photoplethysmography (PPG) could potentially aid in AF screening, as they can be easily worn by most people for extended periods of time.

Objective: This study aimed to investigate the ability of wrist-based PPG to detect the presence of AF in subjects while at rest.

Methods: This study was conducted with the approval of local institutional review boards, and all patients provided written, informed consent. The first dataset consisted of 9 patients with persistent AF and 13 subjects with normal sinus rhythm. For these 22 subjects, PPG and ECG data were collected while sitting stationary for 15 minutes (awake dataset). A second dataset consisted of 10 patients with persistent AF and 27 subjects with no known diagnosis of AF. These subjects were asked to wear a Fitbit wrist-band which recorded PPG and accelerometry data during sleep (sleep dataset, 73 total nights). There was no overlap between subjects in the awake and sleep datasets.

Results: Data were analyzed in overlapping 1 or 5-minute windows. Pulse Rate Variability (PRV) features, PPG morphology features and accelerometer features were extracted for each window. An algorithm was trained on the awake dataset and was validated on the sleep dataset. The performance was 95.7% (98%) sensitivity (Se) and 0.8% (0.8%) False Positive Rate (FPR) for 1 min (5 min) windows. We also investigated the shortest duration of an AF episode that could be detected by using synthesized data. With 1 minute analysis windows, the algorithm was sensitive down to 40-second episodes. Using 5-minute intervals, episodes down to 3 minutes could be reliably detected.

Conclusions: Wrist-bands equipped with PPG sensors can be used to detect atrial fibrillation during sleep or during awake, stationary periods. While reliable detection of short AF episodes can be challenging due to the noisy nature of PPG signals, we have demonstrated that select PPG features can enable accurate detection of AF down to 40 second periods. These findings suggest that wrist-worn devices equipped with a PPG sensor could be used to screen for AF in high-risk subjects or monitor patients post treatment, but are limited to cases where users are not moving or exercising. Additional, larger clinical studies are planned for the future to validate these promising early results and to validate the algorithm's specificity against other forms of arrhythmia.

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KEYWORDS

cardiovascular disease; screening; atrial fibrillation

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Abstract

Chat with a Doctor: Using Asynchronous Virtual Care Access for On-Demand Physician Advice

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Abstract

Background: As an HMO, responsible for all medical costs of their member patients, Kaiser Permanente Colorado, like most providers, struggle with access: patients want to be seen by a clinician quickly and when they can't get an appointment in a timely manner, patients tend to go to higher-cost points-of-care (including the emergency department, urgent care, and other brick-and-mortar facilities), leading to enormous costs for Kaiser. A solution was needed that would bridge that gap to instantly address their patients' needs at a lower cost. Prior to launching Chat with a Doctor, Kaiser Permanente Colorado had several virtual care options in place to help connect patients with their doctor. This included emailing a doctor, scheduled phone calls, eVisits, and scheduled video calls. These options provided varying quality of resolution and most had underwhelming utilization metrics.

Objective: The pilot aimed to evaluate the effectiveness of a text-based telemedicine platform providing on-demand physician access to patients in Colorado in treating patients in a timely manner and thereby reducing unnecessary utilization of high-cost points-of-care.

Methods: Kaiser Permanente Colorado offered direct, continual patient access to family medicine and emergency medicine physicians via a HIPAA-compliant, text-first virtual care platform which was fully integrated with Kaiser Permanente Colorado's patient portal. The service is being offered to nearly 660,000 member patients in the state of Colorado.

Results: In its first few months, Kaiser Permanente Colorado physicians have effectively diagnosed and treated a wide array of conditions with Chat with a Doctor. Over 12,500 encounters were completed in the first seven months on the platform with the number continuing to grow as marketing efforts around the program ramp up. Seventy-nine percent of chat encounters are handled with advice only or a prescription, while 18 percent are referred for appointments in the Kaiser Permanente Colorado system, and one percent are referred to the ED. Additionally, encounters on the Chat with a Doctor program resulted in 54 percent fewer in-person visits to brick-and-mortar facilities during the seven days following a virtual encounter when compared to the nurse call line. In all, encounters cost Kaiser Permanente Colorado 48 percent of the cost of their nurse call line, and just two percent of the cost of an emergency department visit. As an added bonus, patient satisfaction and likelihood to recommend are extremely high, outperforming other care channels in KP Colorado because the solution improves overall patient engagement by providing a responsive service for patients to access care and answers to their questions.

Conclusions: Implementing an asynchronous virtual care platform improves access, care quality, and patient experience, while reducing avoidable utilization and overall costs of care.

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KEYWORDS

telemedicine; virtual acute care; cost of care

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Abstract

HealthPROMISE: Utilization of Patient Reported Outcomes to Measure Quality of Life in Inflammatory Bowel Disease

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Abstract

Background: Inflammatory Bowel Disease (IBD) is a chronic condition of the bowel affecting over 1.5 million people in the United States. The recurrent nature of IBD makes affected patients ideal candidates for electronic patient reported outcome (e-PRO) monitoring that centers on enhanced symptom tracking and improved communication with care teams.

Objective: The study aims to understand the impact of e-PRO utilization via a prescribed mobile application, HealthPROMISE, on improving patients' quality of life (QOL). Researchers investigated patients' use of e-PROs to determine whether physicians change treatment in response to new patient health information, and whether patients' quality of life changes over the course of the study.

Methods: In a pragmatic randomized trial at Mount Sinai Medical Center (MSMC), baseline e-PROs were measured using online questionnaires delivered through the app that assessed health literacy, disease severity, general health status, and demographic information. Patients using HealthPROMISE could update their e-PRO information and receive a disease summary and a graph trending IBD-specific QOL scores (Figure 1). Patients could also communicate over the HealthPROMISE app and discuss results with providers. Results of e-PRO data were then compared with those collected from paper-based instruments in another institution (University of Pittsburgh Medical Center, UPMC) for triangulation (Figure 2).

Results: There were 320 patients enrolled in the study. Of these, 162 were randomized to the intervention group (e-PROs), and 158 to the control group. Fatigue and tension were the two most important drivers of poor QOL in both MSMC and UPMC cohorts. Usage data showed that the majority of patients (~75%) continue to actively log into the HealthPROMISE app and update their e-PRO. Overall, QOL improved among HealthPROMISE patients over a mean follow-up of 6 months. At baseline, patients in the intervention arm reported a mean quality of life score of 30.3 ± 11.3. The last available follow-up QOL scores showed improvement among patients using HealthPROMISE to 25.3 ± 11.3 (P<0.001) (Figure 2).

Conclusions: This is one of the first randomized controlled trials of app-based PRO measure in IBD patients. A significant improvement in QOL was observed. Longitudinal e-PRO collection in IBD patients is feasible with a high degree of adoption and engagement. IBD patients who participate in their own care (via PRO) and share in decision-making have appreciably improved outcomes when compared to patients who do not.

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KEYWORDS

Quality of life; Self-Management; Inflammatory Bowel Disease; Remote Monitoring; Electronic Patient Reported Outcome

Figures

Figure 1. Report showing utilization of PROs to measure quality of life and symptoms in IBD patients.

Figure 2. Data on specific symptom drivers of poor quality of life scores (collected on HealthPROMISE platform) at MSMC (purple, n=320) compared with those collected on paper at UPMC (pink, n=685).

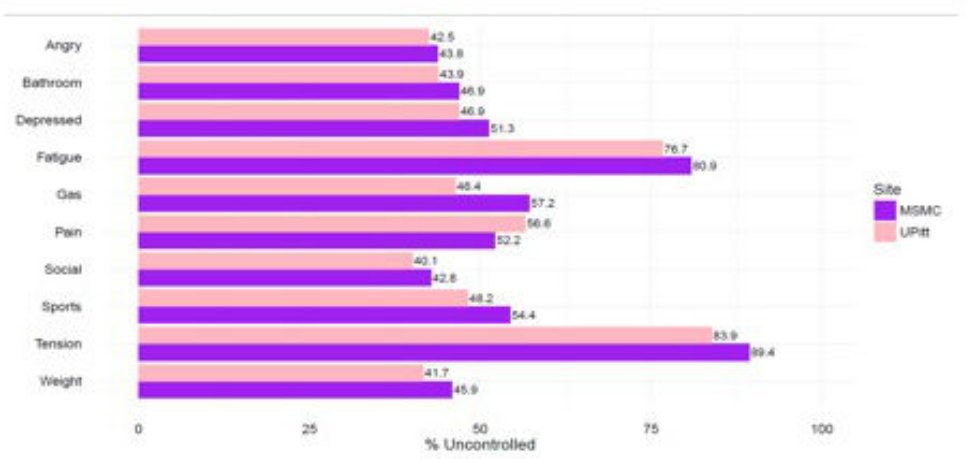
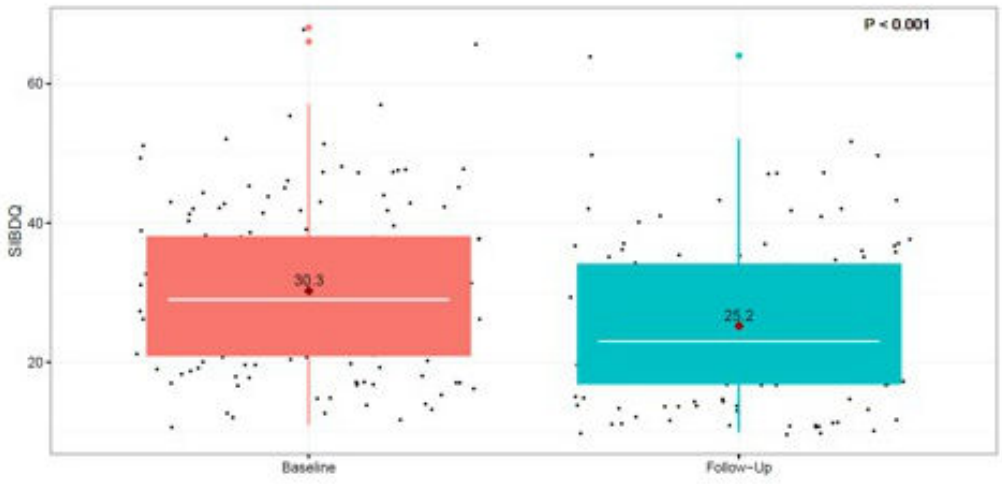


Figure 3. Interim analysis showing improvement in symptom burdenamong intervention cohort at MSMC (P- value based on linear mixed effects model).



Multimedia Appendix 1

Full poster.

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Abstrac

A Safer Transition From the Emergency Room: Using Telemedicine to Reimagine the Er Visit

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Abstract

Background: The week following ER discharge is often a challenging time for patients—whether as a result of continuing symptoms, anxiety about symptom progression, inability to access follow-up care, or remaining questions related to treatment plan or prescriptions. All have repercussions for patient safety, care quality, and satisfaction with service. Patient-centric solutions for continuity of care during this period are rare, and return visits to the ER are common. With this in mind, Emergency Medicine Consultants (EMC) re-imagined the ER visit using telemedicine to transform the 3-hour ER visit into a week-long patient relationship.

Objective: The pilot aimed to evaluate the effectiveness of a text-based telemedicine platform to provide post-acute care to patients who recently received acute care in emergency departments of several Dallas-area hospitals.

Methods: Through a partnership with CirrusMD, EMC piloted 24/7 direct, continual patient access to emergency physicians via a HIPAA-compliant, text-first virtual care platform following discharge from the ER at no cost to the patient. By the end of the pilot, the service was being offered to 30,000 patients a month at 12 hospitals in the Dallas-Ft Worth metroplex.

Results: The Safe Transitions program is achieving the triple aim of improved safety, service, and resource utilization. In the first six months of the pilot, 2,700 follow-up virtual encounters were completed, involving almost 2,000 patients. Median response time to initial patient inquiry by a physician was two minutes, with median duration of patient encounters spanning 40 minutes. Nearly 80 percent of patients who registered for the service used it, with 25 percent of patients on the platform having multiple encounters over the 7-day period. Resolution of patient issues occurred in 84 percent of encounters without brick-and-mortar referral, with additional prescriptions written in 15 percent of encounters. Service levels led 90 percent of surveyed patients to indicate that having access to Safe Transitions “improved” their experience with the health system, and 90 percent said they were more likely to recommend the health system to friends and family because of Safe Transitions.

Conclusions: Telemedicine following acute care episodes improves access and continuity of care, improves care quality, and patient experience, while reducing avoidable utilization.

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KEYWORDS

emergency department; telemedicine; post-acute care; continuity of care

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Abstract

Evaluating the Impact of a Blood Pressure Remote Telemonitoring Program (BP Connect)

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Abstract

Background: The prevalence of hypertension is around 30-45% among the general population. Hypertension contributes to 1 out of 7 deaths in the United States and approximately 70% of persons who have a first heart attack or stroke. Timely treatment and optimal management of hypertension is associated with substantial reductions in stroke incidence (35-40%), myocardial infarction (20-25%), and heart failure (>50%). Additionally, remote monitoring with active intervention by medical professionals (telemonitoring) improves drug compliance and increase the target blood pressure (BP) achievement rate.

Objective: BP Connect is a remote monitoring program to augment care and disease self-management in hypertensive patients. The program aims to engage patients in self-care by providing a secure web-based platform to record and track their BP. In addition, care providers can view the uploaded data, thereby, ensuring the continuum of care beyond the hospital setting.

Methods: A total of 288 adult patients diagnosed with hypertension (baseline blood pressure of ≥140 mm Hg systolic or ≥90 mm Hg diastolic) were recruited from primary care and specialty clinics within the Partners Healthcare network of hospitals (Faulkner, Renal, Endocrinology and Cardiology departments at Brigham and Women's Hospital and Massachusetts General Hospitals Women's Health Association). The primary outcome was the impact of BP Connect on blood pressure as measured by the change in the proportion of patients with controlled BP (ie, <140/90 mm Hg) from the initial visit to the 3-month clinic visit. Secondary outcomes included the change in systolic blood pressure (SBP) and diastolic blood pressure (DBP) at close-out.

Results: Among the 149 patients from primary care clinics who completed the program to-date 48.0% of patients had uncontrolled BP (>140/90 mm Hg) vs 64.0% at baseline (P=.01). At 3 months, there was a significant decline in the mean SBP (-10.1, P<.01) and the mean DBP (-4.3, P<.01). Among the 139 patients from specialty clinics who completed this program, BP was controlled at 3 months in 43.2% of patients compared with 11.2% patients at baseline (P=.001). A significant decrease in the mean SBP (-5.2, P<.001) and in the mean DBP (-2.5, P=.01) were also noted.

Conclusions: Overall, the BP Connect program shows potential to improve clinical outcomes in hypertensive patients. The program provides an opportunity for participants to track their BP measurements on a web platform to foster patient participation in their own disease management that may improve patient outcomes and decrease burden on the care providers.

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Multimedia Appendix 1

Full poster.

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Abstract

Development of an Engagement Engine to Support Long Term Use of Fitness Trackers and Sustain Physical Activity

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Abstract

Background: Sustained tracking of physical activity can lead to habitual exercise routines and decrease disease risk. However, many new users experience a sharp decrease in tracker use within months of initial use. Users stop using activity trackers for various reasons, including losing interest and lack of support. Innovative personalized approaches that increase continued use could lead to not only acceptance of tracking, but also to more regular engagement in exercise. Here we discuss a multi-phased approach to developing an engagement engine to support long-term use of fitness trackers by adjusting a participant's step goal based on performance and engagement during the previous week and personalized text messaging.

Objective: The objectives of this study are to first identify reasons for non-engagement with activity trackers and then build a machine learning algorithm to support continued use of activity trackers.

Methods: Overweight and obese participants (n=30) were recruited to use activity trackers to record their step counts every day for 9 weeks. Participants completed physical activity behavior-related questionnaires including Proschka's Stage of Change, Barriers to Being Active and Behavioral Regulation of Exercise Questionnaire at 0 and 9 weeks. The questionnaires generated 158 variables which were analyzed to determine their appropriateness for inclusion in the algorithm. Highly correlated and near zero variance variables were eliminated which resulted in 87 variables. To determine the number of factors needed, eigenvalues were calculated and 19 factors were generated with eigenvalues greater than one, which encompassed 98% of the variance. Shannon entropy was used to generate a weekly value, calculated from participants' step counts, that served as an indicator of how likely a participant is to be engaged with their activity tracker. The 19 factors combined with step data and a Shannon entropy value from the past 7 days served as the input to a neural network prediction model. Of the available data, 90% was used as training set for the algorithm while the remaining 10% was used as a test set.

Results: A neural network that predicts a participant's step goal based on their responses to study questionnaires, available step data and Shannon entropy value was developed. The machine learning algorithm's neural network was developed using the backpropagation method, two hidden layers, 20 nodes and learning rate equal to 0.001. Mean squared error of the model was 0.00125.

Conclusions: Artificial intelligence applied to physical activity data combined with behavioral data may be used to increase engagement with activity trackers. A follow-up prospective study is ongoing to determine the performance of the engagement algorithm.

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Abstract

Exploring the Effects of Technology-Enabled Mindfulness and Meditation on Stress Management

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Abstract

Background: Studies suggest that certain technologies may help regulate emotional states and reduce stress. Spire is a wearable device that measures breathing patterns to identify distinct emotional states—calm, tense or focus—to send feedback to the user. Muse is a meditation device that gives real time user audio-feedback based on the EEG wave patterns.

Objective: The objective of our study was to test the effect of each device on managing stress.

Methods: There were 126 participants recruited remotely and randomized to one of two interventions evaluating the Spire (group 1) and Muse (group 2) devices. Each study involved a 2-week baseline period followed by a 6-week intervention. All participants wore the Spire device in the baseline period where it collected data on the frequency and duration of calm, focus, or tense breathing patterns. Then, in group 1, feedback from the Spire device was turned on during the intervention period alerting participants of unfavorable breathing patterns on a companion app. In group 2, feedback from the Spire device remained off for the 6-week intervention period. Additionally, participants in group 2 meditated with the Muse device for 3 to 5 times per week during the intervention period. The Perceived Stress Survey (PSS-14) and Connor-Davidson Stress Resilience Scale (CD-Risc) were administered to all participants at enrollment (Week 1) and closeout (Week 8). Questionnaire and device data from group 1 and 2 were analyzed to determine the effect of each device on mental health outcomes from enrollment to closeout, and baseline to intervention, respectively.

Results: In group 1, perceived stress significantly decreased from 23.59 to 20.24 (P=.001), but there was no significant change in stress resilience [(68.25 to 69.5 (P=.44)]. In group 2, perceived stress significantly decreased from 22.49 to 19.15 (P<.001), and stress resilience scores significantly increased from 70.00 to 73.44 (P=.014). Average calm minutes per day using Spire did not significantly change for Group 1 or 2 [61.75 (SD 27.25) to 59.22 (SD 35.24) (P=.69) and 69.72 (SD 29.41) to 63.89 (SD 29.71) (P=.13), respectively]. In Group 1, average focus minutes per day using Spire significantly decreased from 64.15 (SD 31.2) to 50.79 (SD 28.73) (P=.001) minutes, but in group 2, the average focus minutes per day as measured Spire did not significantly change [82.38 (SD) to 71.29 (SD 46.55) (P=.08)]. In Group 1, average tense streaks did not significantly decrease [17.63 (SD 16.99) to 14.08 (SD 10.63) (P=.15)]. However, in Group 2, average tense streaks significantly decreased from 18.67 (SD 16.38) to 13.78 (SD 11.71) (P=.004). After controlling for age, minutes of Spire use, baseline depression, and baseline anxiety in group 1 participants, each day of Spire use was significantly associated with 53.04 (P=.02) more minutes of calm and 62.69 (P=.04) more minutes of focus mind-states. Group 2 participants had 2.9 more tense mind-state minutes (P=.02) with each day of using the Muse device after also controlling for minutes of Muse use, baseline depression, baseline anxiety and age.

Conclusions: Emotion sensing technologies may have a positive role in improving stress management.

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Multimedia Appendix 1

Full paper.

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Abstract

Using Predictive Analytics to Prevent Missed Opportunities and Achieve Higher Immunization Coverage and Timeliness

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Abstract

Background: Despite the availability of free routine immunizations in low- and middle-income countries (LMICs), many children are incompletely vaccinated, vaccinated late for age, or drop out over the course of the immunization schedule. According to WHO & UNICEF estimates, average BCG coverage in LMICs is 84% (range: 39-99%) while only 63% (range: 8-97%) children receive the last dose of measles. Without the technology to model and visualize risk on large datasets, vaccinators and policy-makers are unable to identify and target groups and individuals at high risk of dropping out. Thus, default rates remain high, preventing full universal immunization coverage. Predictive analytics algorithm leverages Artificial Intelligence (AI), and uses statistical modeling, machine learning, and multi-dimensional data mining to accurately identify children who are most likely to delay or miss their follow-up immunization visits.

Objective: We conducted feasibility testing of a predictive analytics algorithm to identify which children are likely to delay or miss the follow-up vaccines through risk profiling of clients into high-, medium- and low-risk groups. We will validate the functionality and accuracy of the algorithm though verifying what percentage of clients classified as “high-risk” actually delay or miss the follow-up immunization visit.

Methods: The algorithm was developed using existing immunization data from across Pakistan. There were 44,493 immunization records, collected from 21 immunization centers in over seven cities, used to train the system, which was then successfully piloted on 8,898 longitudinal patient records. After development, the predictive analytics module was incorporated in our existing digital immunization registry (DIR) and is currently deployed in 5 immunization centers in Karachi, Pakistan. Once the child is enrolled in the DIR, his immunization information is captured along with the salient socioeconomic and demographic characteristics. The predictive analytic technology uses data mining, statistical modeling, and pattern identification techniques to accurately forecast future immunization outcomes based on existing immunization and demographic data which are correlated to the child’s likelihood to miss or not show up on time for a vaccination visit.

Results: At the time of development, the predictive power of the system was validated through training the system on 44,493 records collected from 21 immunization centers, and was then piloted on 8,898 records. Out of a total of 8,898, the Recursive Partition Model predicted that 3,352 (38%) children would default out of which 2,500 children did default (75%). Similarly, it predicted that 5,546 (62%) children would return for next vaccine, out of which 3,751 (67%) children did return. This indicates a 70% overall accuracy rate. Over time, through artificial intelligence, as more data is captured, the system will continue to self-learn from accumulated records, recognizing influential variables, self-selecting statistical models, and continually upgrading itself to achieve highest predictive accuracy. Results from feasibility testing in 5 immunization centers are currently pending.

Conclusions: Predictive analytics is an unconventional approach to improving the timeliness of routine immunization and reducing missed opportunities; results of the pilot will provide strong evidence of the potential of predictive analytics to revolutionize immunization service delivery.

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KEYWORDS

artificial intelligence; dropout; immunization

Multimedia Appendix 1

Full poster.

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Abstract

Cloud Connected Noninvasive Device Correlation with Pulmonary Artery Pressure by Right Heart Catheterization: Implications for Diagnosis and Clinical Practice to Improve Outcomes for Heart Failure Patients

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Abstract

Background: The management of 5-6 million Americans with heart failure (HF) is costly and problematic in part due to very high re-admission rates of 25% within 30 days, and 50% within 6 months. Clearly needed is a new way to manage these patients without relying on costly hospitalizations. Clinical interventions based on standard tele-monitoring utilizing monitoring of blood pressure, weight, electrocardiograms, or rhythm strips for review, have not demonstrated a significant reduction in all cause readmissions or all cause mortality within 180 days after enrollment. Invasive devices have demonstrated that ambulatory pulmonary artery pressures (PAPs) hemodynamic measurement allow more effective HF management leading to fewer hospitalizations. The HemoTag is a new cloud-connected medical device that captures heart sounds and an ECG signal transduced via 3 thoracic electrodes. The device measures cardiac time intervals and can potentially constitute a quick and non-invasive means of assessing patient's PAP obtained by right heart catheterization. Electromechanical Activation Time (EMAT) as one of the HemoTag indices was assessed as a marker of systolic, and mean PAPs in the right heart measurements. HemoTag indices were then assessed to identify normal/abnormal PAP using prediction models.

Objective: Given the clinical and economic impact of HF hospitalizations, and in view of the risk and cost of invasive monitoring, there is a need for a non-invasive, affordable, accurate, and actionable hemodynamic measurement method that can monitor HF patients in the clinic and at home. This study provides preliminary results of HemoTag as a possible solution for remote monitoring of HF patients.

Methods: There were 20 consecutive patients recruited at the catheterization laboratory of community affiliated academic center (JFK Medical Center) from February 1 to March 30, 2017 (WIRB approved study # 20151156). Eight patients were excluded from the study as they did not meet inclusion criteria. EMAT measurements were obtained using HemoTag within 30 minutes from the right heart catheterization. Linear regression and predictive models were employed to evaluate EMAT correlation with systolic and mean pulmonary pressure. Data was entered and analyzed on MS-Excel 2016.

Results: The female to male ratio was 0.58 with a mean age 69. 59 +/- 15.63 years. The mean systolic blood pressure was 130 +/- 19.42 mmHg, mean weight was 189.06 +/- 42.32 pounds. The mean of mean pulmonary atrial pressure (mPAP) was 33.09 +/- 14.27 mmHg and mean of systolic pulmonary atrial pressure (sPAP) was 55.25 +/- 23.41 mmHg. Using a linear regression approach, EMAT correlated with mPAP with R value of 0.69 whereas overall correlation between EMAT and sPAP was R=0.65. Using clinically relevant cut-off of 25mmHg for mPAP, a prediction model constructed by logistic regression with confidence interval 0.95 demonstrates a sensitivity of 100%, specificity of 100% and accuracy of 100%.

Conclusions: HemoTag represents a potentially widely applicable technology for the assessment of pulmonary artery pressure via a non-invasive approach which can be used in the ambulatory setting or for patients at home. This has a distinct advantage over invasive pulmonary artery monitoring with similar results. Larger studies are needed to confirm the findings of this study.

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KEYWORDS

heart failure; remote monitoring; hospitalization; quality of life

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Abstract

Assessing the Use of Mobile Technology in Adult Asthma Patients: Remote Observational Study

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Abstract

Background: The National Institutes of Health Morbidity and Mortality report indicates that as high as 15.6% of the US population may have asthma. Non-adherence to daily controller medications is a common problem that has been reported to be responsible for 60% of asthma-related hospitalizations. Mean levels of adherence for asthma medications is estimated to be as low as 22%. Evidence suggests that patients over-report medication use when asked to self-estimate their adherence. Therefore, objective measurements of adherence to medicine is necessary.

Objective: The primary purpose of this study is to determine the feasibility of using the BreatheSmart platform for measuring adherence and whether it improves medication adherence to patients presenting with asthma symptoms who are managed on inhaled corticosteroids. Understanding how patients use the BreatheSmart Platform at home is essential to assess its feasibility as a solution to improve medication adherence in patients using daily inhaled corticosteroids (ICS). We anticipate this approach can be applied to real-world environments as a cost-effective solution to improve treatment plan compliance and patient self management. Secondary objectives include assessment of real-time controller medication adherence and lung function as well as frequency of rescue medication use. The result of this study allowed us to understand the process of implementing the BreatheSmart technology for management of asthma patients and facilitated the pathway to our current larger clinical trial: “Assessing the Use of Mobile Technology in Adult Asthma Patients: An Observational Study.”

Methods: This is a virtual six-month feasibility study of 20 adults and adolescent with an asthma diagnosis, using ICS for at least 3 months. Participants were recruited in the United States through social media and web-based recruitment. All participants received wireless Bluetooth-enabled inhaler sensors that track medication usage, a mSpirometer capable of clinical-grade lung function measurements, and downloaded the BreatheSmart mobile application which transmits data to a secure server. Participants were randomly assigned to one of two arms regarding lung function measurements in order to assess usability of two different techniques. Usability was assessed by patient questionnaires and opened ended question sessions. Both primary and secondary analyses are based on intention-to-treat (ITT).

Results: 100% of participants interviewed (n=18) wanted to continue using the BreatheSmart app after the study, and would recommend it to a friend with asthma. 93% of study participants responded positively to their overall experience setting up the app and hardware. Participants had 84.58% adherence to scheduled doses using their HeroTracker sensors over a 6 month period. Rescue medication usage decreased by 60% in the first 3 months and 95.3% through 6 months. We observed an 86% retention of study participants for the 6-month study duration. (Commonly reported 90-day user retention rates of fitness and health apps: 27–30%.

Conclusions: This study demonstrates that a mobile platform phone application is feasible in enabling patient asthma self-management utilizing a phone-based platform of digital devices and application. Study findings demonstrated a 48% lift in medication adherence from the baseline national mean medication compliance among asthma patients. Furthermore, use of the BreatheSmart platform was associated with a significant decline in rescue medication usage. Qualitative study participant feedback revealed that high patient retention and motivation to continue on the BreatheSmart platform was influenced by the reliability, simplicity and user friendliness of the platform’s design. More than 50% of the study participants viewed the interactions with

the study investigator as a true value add, promoting accountability and enhanced care management. These findings should be further researched with incorporation of clinician remote monitoring to evaluate the impact of the BreatheSmart platform in enhanced clinical decision making at the point of care or between clinic visits.

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KEYWORDS

asthma; medication adherence; mobile health; mHealth; mobile health intervention; mobile phone; mobile phones; mobile technology; mobile text reminders; patient monitoring; real-time surveillance; telehealth; telemedicine; text message; text messages; text messaging

Conflicts of Interest

The authors would like to disclose relationships to the company Cohero Health. Authors Melissa Manice and Anna Cushing hold shares in the company Cohero Health. Melissa Manice, Anne Tam, Emilie Melvin and Jesse Cohen are employees of Cohero Health.

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Abstract

Engaging Heart Failure Patients with Interactive Voice Response Calls and Multimedia Programs as They Transition from Hospital to Home

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Abstract

Background: When people with heart failure (HF) are discharged from hospitals, they need to manage their condition. Patients are overwhelmed and feel poorly. To avoid complications and readmissions, it's essential they quickly engage in new behaviors, such as weighing themselves each day. Patients often do not start or maintain these behaviors.

Objective: Researchers sought to measure the impact of a user-centered, interactive voice-response (IVR) phone call and multimedia program series (EmmiTransition®) to educate, and motivate patients to take self-care actions post-discharge.

Methods: Researchers analyzed call records and conducted aggregate analysis from patients who interacted with the series between August 2013 and May 2016 at UAB Medicine and other healthcare organizations. The 45-day IVR series explains key concepts and behaviors and asks patients to report information like their daily weight. Short multimedia programs provided additional information. Call records from 4,503 patients who completed the series were analyzed. There were 3,615 people who answered and interacted with the calls. Interactions were analyzed to identify the impact on driving people to report their weight daily post-discharge. The percentage of patients who reported weighing themselves daily increased steadily over the first two weeks. After viewing a multimedia program, patients could take an optional survey from Emmi Solutions. Responses and comments were tabulated.

Results: On day one of the IVR calls, 66% of UAB Medicine patients who answered the call reported their weight. On day 14 of the calls, 89% of UAB Medicine patients who answered the call reported their weight, comprising a 36% increase in reporting in two weeks. The behaviors seen over the first two weeks were sustained. For the remaining 30 days of the series, 93% of patients who answered calls continued to report their weight. There were 936 patients who opted to take the post-multimedia program survey. The survey findings were as follows: 66% showed increased confidence to ask questions; 75% were prepared to manage their health condition; 75% were more motivated to take their medications; 89% were more aware of how their lifestyle impacts health; 87% were willing to take new action to manage their health; and 88% indicated that they were motivated to change their lifestyle. Examples of patient comments follow: "Read labels and try to decrease processed foods and transfer to whole fruits and vegetables utilizing herbs for seasoning"; "making sure I have a calendar over the bathroom scales to keep track of weight instead of going my memory"; "was not aware diet soda contained high salt count. I will not drink diet sodas as often maybe a glass once or twice a week"; "I will get a flu and pneumonia shot every year. This is not something I did in the past."

Conclusions: Most patients who engaged in this series started a new behavior, regularly reporting they weighed themselves. Most people continued this behavior throughout the 45-day series. Most patients who viewed a multimedia program and completed the survey expressed plans to take specific actions or behavior changes based on information offered by the program about how to weigh themselves, reduce sodium, or manage their fluids.

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KEYWORDS

adherence; congestive heart failure; engagement; heart failure; heart failure, congestive; interactive voice response; Internet-informed patient; multimedia; online survey; patient activation; patient communication; patient education

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Abstract

Use of Electronic Patient Reported Outcomes and Automated Devices for Heart Failure Disease Management

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Abstract

Background: Congestive heart failure (CHF) is a major public health issue. Today, CHF affects 6.5 million people in the U.S. and the incidence rate is projected to rise by 46% to more than 8 million cases by 2030. Current reimbursement policies use readmission rates and length of hospital stays as indicators of quality of care, and incentivize providers to meet these quality measures as the cost of hospitalization alone significantly contributes to the overall burden of CHF on patients and health systems. Symptoms of CHF can be unpredictable and presently there are no reliable solutions to track disease control for discharged patients.

Objective: This study aims to improve patients' self-monitoring practices post-hospital discharge, quickly identify critical warning signs, decrease hospital readmissions and reduce healthcare costs for CHF patients by integrating remote monitoring ePRO into standard outpatient care practices.

Methods: The pilot study seeks to enroll 60 patients who were admitted to The Mount Sinai Hospital for acute CHF exacerbation and have access to either an Android or iOS enabled smartphone. RxUniverse (a digital platform that enables physicians to directly "prescribe" evidence-based mobile health applications to patients) will be used to prescribe HealthPROMISE and iHealth mobile apps (Figure 1). Patients update and record their CHF-related symptoms and quality of life measures daily on HealthPROMISE. Vital sign data, including blood pressure, heart rate, and weight, is collected through an ambulatory remote monitoring system that includes a smartphone application and Bluetooth-connected smart devices. ePRO data is submitted electronically to a dashboard monitored daily by a practitioner, who determines whether to continue current care or to call the patient for further assessment of symptoms (Figure 2). Any critical red-flag values automatically alert the physician and prompt the patient to seek medical attention. Enrollment barriers included: onboarding time (30 minutes), identifying patients, competition with other Mount Sinai initiatives and research trials, language barriers, and low health literacy (Figure 3).

Results: The study had 52 of the 60 patients enrolled. Thirty-eight patients (73%) continue to actively use the mobile apps and smart devices to track blood pressure and weight, 27 patients (52%) have completed one month of active use, while 5 patients have dropped out. There have been 4 hospital readmissions (7%) mainly due to non-compliance and complications from other chronic conditions (Figure 3).

Conclusions: Given the increasing burden of CHF on patients and healthcare systems, there is a critical need for an effective, sustainable, and feasible remote monitoring system for CHF patients following hospital discharge. The ability for providers to access patient-reported outcomes and vital signs in real-time can significantly impact the quality of outpatient care, potentially reducing readmissions and costs. CHF patients are showing positive health outcomes; CHF patients had a 7% readmission rate compared to the national readmission rate of >25% within 30 days of discharge. Enrollment challenges were overcome by enrolling CHF patients 2-3 days before expected discharge and adding a patient coordinator to hospital rounds. These latest advances in remote monitoring show promise for the future of technology-connected healthcare.

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KEYWORDS

congestive heart failure; sensors; quality of life; electronic patient reported outcomes; remote monitoring; self-management; hospital readmission

Figures

Figure 1. CHF Solution tool kit, including RxUniverse (used to "prescribe" patients the apps), HealthPROMISE (used for patients to track symptoms), and iHealth (used to track data from the smart devices).

Figure 2. Vital sign measurements in real time transmitted to provider dashboard.

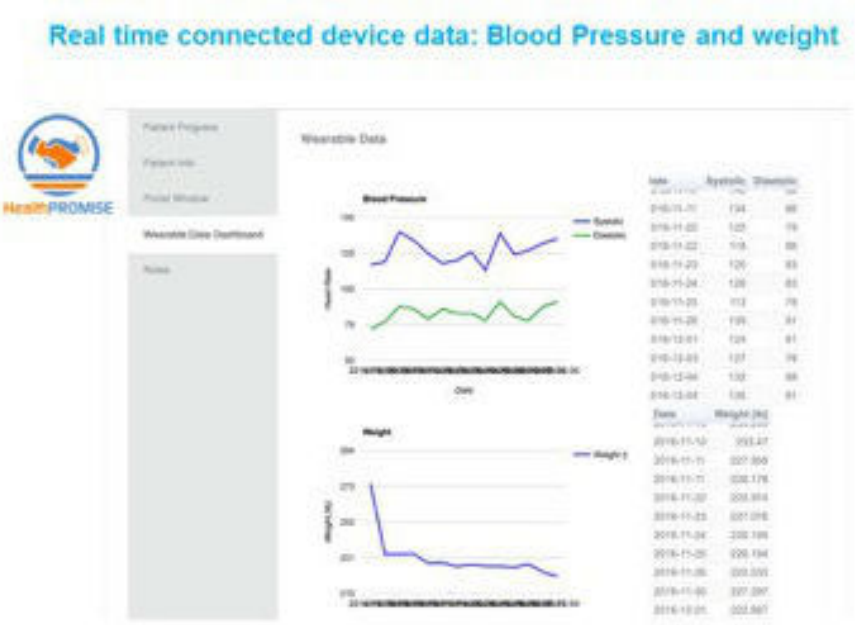
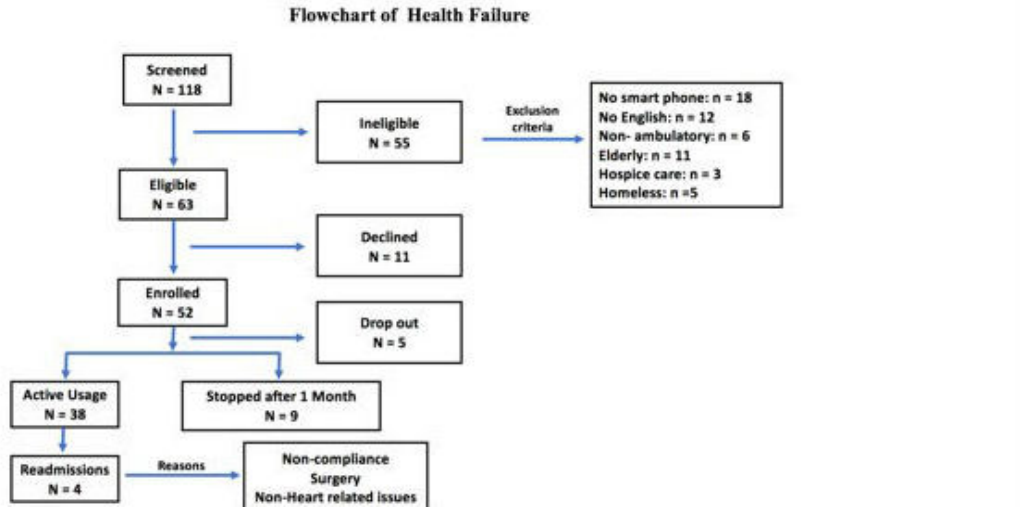


Figure 3. Enrollment flow chart.



Multimedia Appendix 1

Full poster.

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Abstract

Tracking the Trackers: Fitbit in Research, 2011-Present

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Abstract

Background: Newer consumer mHealth devices have been gaining traction among researchers and health professionals in recent years. However, the extent of how these devices are being used in research settings is unknown.

Objective: This review aims to describe the current state of Fitbit use in published research. Trends across disciplines, study designs, and device use will be identified. Implications for continued use of consumer mHealth devices in research settings will also be discussed.

Methods: Numerous publication databases (PubMed, Google Scholar, IEEE, ACM) were searched on an ongoing basis from July 2016, to July 2017 for publications, conference proceedings, and other published and peer-reviewed content using the "Fitbit" keyword. Publications that included a mention of using a Fitbit device in their methodology were retained in the analysis. The lead author maintained a reference database and categorized each reference along four dimensions: 1) device(s) used; 2) data used; 3) primary study design; and 4) participant characteristics (current database is available at https://www.fitabase.com/research-library/).

Results: Since 2011, there have been 410 references that met the inclusion criteria for this review. The most frequent study designs were validation studies followed by interventions, measurement (observational), methods, and usability studies (33%, 23%, 16%, 12%, and 11%, respectively). All currently and previously available Fitbit devices were represented in the identified research literature with the most common devices used being the Flex (n=113) One (n=98), Zip (n=78), and Charge HR (n=61). Among available data types obtained from Fitbit devices steps were overwhelmingly represented in the identified studies (n=302). However, all available data types, including distance, energy expenditure (calories burned), food intake, goals, heart rate, activity intensity (categories and MET values), sleep (classic and sleep stages), and weight, were used in at least one study. The vast majority of studies were conducted with adult participants (n=319). Studies that included older adults (n=33, adolescents (n=32), and children (n=27) participants were less common. Over 100 studies identified participants as part of a clinical population (eg, post-surgical care, cancer survivor, congenital heart disease). Trends over time indicate that new devices, and their associated data capabilities, trigger research that includes new data sets (eg, heart rate and sleep). However, these trends lag behind device availability for consumers.

Conclusions: An examination of the literature for use of devices from a leading consumer mHealth company, Fitbit, indicates that the research community is finding value for these devices across disciplines and participant populations. While the most common design seeks to validate these devices/data, there are interesting trends towards using these devices as part of behavioral interventions and in clinical environments. Additionally, the lengthy time gap between device availability and published studies is highlighted. The identified and publicly available database may serve to help researchers and clinicians across disciplines better understand the state of using consumer activity tracking devices.

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KEYWORDS

clinical research; consumer eHealth; mHealth; fitbit; wearables

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Abstract

The Burden of a Remote Trial in a Care Home Setting: Qualitative Study

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Abstract

Background: Older adults, particularly those with physical and cognitive impairments, are typically under-recruited in clinical trials, despite the fact that they experience the greatest need for healthcare services. Reasons for underrepresentation are disparate but may relate to comorbidities, communication difficulties (e.g. hearing and vision impairments) and physical immobility that constrains transportation to a research site. Remote trials supported by mobile and wearable health technologies have the potential to make clinical research participation more accessible for these groups. In order to determine the feasibility of this model, it is essential to understand the burden remote data collection places on the participants involved.

Objective: The REACHES study (Remote Assessment of Older People in a Care Home Setting) explored the burden experienced by participants in a remote trial supported by mobile and wearable technology in a care home setting.

Methods: The remote trial focused on implementing a falls prevention programme in a single care home over an eight-week period from March to May 2017. The following technological solutions were selected to support the activities of the trial: QTUG™ (Kinesis Health Technologies, Ireland), a sensor-based medical device that assesses gait, mobility, falls risk and frailty; Aging Research App (ICON Clinical Research, Ireland in partnership with mPROVE Health, US), a tablet version of the Age-Related Muscle Loss Questionnaire that assesses the impact of muscle loss on activities of daily living; and vívosmart® HR (Garmin Ltd., US) a wrist-worn device that tracks daily activity, heart rate and sleep patterns. These devices provided outcome measures for falls risk and mobility in older adults; offer a variety of data collection methods; and are conducive to remote data collection. A participatory design was used to define the study procedures from the outset. A range of qualitative methods were used to capture the “lived experience” of staff and residents participating in the trial. These included semi-structured interviews, ethnographic observations and diaries. Qualitative analytical procedures were employed using thematic analysis supported by NVivo software (QSR International).

Results: A total of 6 residents and 8 members of staff participated in the semi-structured interviews (n=14). Results showed that staff experienced extensive burden in fulfilling their roles and responsibilities to support the remote trial, whereas residents reported limited burden. For both groups, the burden of comprehending the research and associated tasks was prominent. Additionally, for staff a lack of time emerged as a substantial burden. Findings suggest that the experience of burden was not mitigated by the perceived value of the trial.

Conclusions: These findings provide insight into the experience of burden of a remote clinical trial among staff and residents in a care home setting. Understanding and mitigating the burden created by remote trials is vital to researchers and companies

attempting to scale such a model. Future research could build on the lessons learned from the REACHES study to develop a method to measure the burden remote clinical trial protocols place on patients and other stakeholders involved.

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KEYWORDS

mobile technology; older adults; remote trial; burden; wearable technology; participant experience

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Abstract

Building Mobile Technologies to Improve Transitions of Care in Adolescents with Congenital Heart Disease

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Abstract

Background: Congenital heart diseases (CHDs) are the most common type of birth defects. Improvements in CHD care have led to roughly 1.4 million survivors reaching adulthood. This emerging “survivor” population are often palliated but not cured. Thus successful transition from pediatric to adult care for CHD patients is crucial. Of adults with CHD, <30% are seen by adult CHD physicians. Transition and Transfer rates are even worse for minority and lower socioeconomic status (SES) populations. Few CHD transition programs exist, necessitating creation of a tool to assist in the transition to adult care for a diverse CHD population.

Objective: The objective of this project was to first complete a stakeholder needs assessment to inform the educational content and design of our mobile application; second, we aimed to develop the design, functional, and educational components for a mobile application guided by an adolescent CHD expert panel.

Methods: To inform our mobile application, we conducted a literature search regarding best practices in transition medicine, adolescent mobile applications, as well as expert CHD guidelines. We also conducted individual interviews in the cardiology clinic with CHD adolescents to understand possession of mobile phones, knowledge gaps, and missing transition readiness skills. We then partnered with 2 adolescent CHD expert panels, pediatric and adult cardiologists, and transition experts to further determine our educational content and mobile application design.

Results: We completed 327 individual interviews with CHD adolescents ages 15-22 years. Of these, 78.2% had moderate or severe CHD complexity; 41.6% of CHD adolescents were female; 12.7% were African American; and 35.8% were Latino. Of these patients, 36.5% had public insurance. Most patients had minimal understanding of their CHD, but expressed an interest in learning (42.2% of aged 15-17 years and 47.9% aged 18-22 years). Average transition readiness scores reflected an average of 49.4% readiness for those aged 15-17 and 58.6% for those aged 18-22. Of the adolescents, 95.8% had access to a smartphone. The adolescent expert panel expressed the need for an application tailored to their specific CHD, for quick access to specific educational questions (eg, “can I exercise”), for a forum to tell their stories or hear from others with CHD, to have mentorship, and to have a checklist so they could know what needed to be done during their transition. They also desired to make CHD clinic appointments and have a way to ask questions on the application. We subsequently built a mobile application incorporating assessments of transition readiness and knowledge, a CHD diagram, a medical summary, as well as the recommended blog, checklist, and question/answer space.

Conclusions: Based on our data of average CHD knowledge and transition readiness scores, CHD adolescents are largely not prepared for the transition and transfer to adult care. The vast majority of adolescents possess a smartphone, regardless of SES or race/ethnicity. Adolescents with CHD informed areas of focus for a mobile application to aid in the transition process that

drove the creation of our mobile application. Next steps are to conduct usability testing, to further build CHD educational content, to perform alpha and beta testing, and use focus groups to refine our current mobile application.

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KEYWORDS

adolescent health; chronic disease; health disparities; mobile health (mHealth); patient empowerment; patient involvement; self-efficacy; smartphone; user centered design

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Abstract

Feasibility of an Automated System Counselor for Survivors of Sexual Assault

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Abstract

Background: Sexual assault (SA) is common and costly to individuals and society, and increases risk of mental health disorders. Stigma and cost of care discourage survivors from seeking help. Norms profiling survivors as heterosexual, cisgendered women dissuade LGBTQIA+ individuals and men from accessing care. Because individuals prefer disclosing sensitive information online rather than in-person, online systems—like instant messaging and chatbots—for counseling may bypass concerns about stigma. These systems' anonymity may increase disclosure and decrease impression management, the process by which individuals attempt to influence others' perceptions. Their low cost may expand reach of care. There are no known evidence-based chat platforms for SA survivors.

Objective: To examine feasibility of a chat platform with peer and automated system (chatbot) counseling interfaces to provide cognitive reappraisals (a cognitive behavioral therapy technique) to survivors.

Methods: Participants are English-speaking, US-based survivors, 18+ years old. Participants are told they will be randomized to chat with a peer or automated system counselor 5 times over 2 weeks. In reality, all participants chat with a peer counselor. Chats employ a modified-for-context evidence-based cognitive reappraisal script developed by Koko, a company offering support services for emotional distress via social networks. At baseline, participants indicate counselor type preference and complete a basic demographic form, the Brief Fear of Negative Evaluation Scale, and self-disclosure items from the International Personality Item Pool. After 5 chats, participants complete questions from the Client Satisfaction Questionnaire (CSQ), Self-Reported Attitudes Toward Agent, and the Working Alliance Inventory. Hypotheses: 1) Online chatting and automated systems will be acceptable and feasible means of delivering cognitive reappraisals to survivors. 2) High impression management (IM≥25) and low self-disclosure (SD≤45) will be associated with preference for an automated system. 3) IM and SD will separately moderate the relationship between counselor assignment and participant satisfaction.

Results: Ten participants have completed the study. Recruitment is ongoing. We will enroll 50+ participants by 10/2017 and outline findings at the Connected Health Conference. To date, 70% of participants completed all chats within 24 hours of enrollment, and 60% indicated a pre-chat preference for an automated system, suggesting acceptability of the concept. The post-chat CSQ mean total score of 3.98 on a 5-point Likert scale (1=Poor; 5=Excellent) suggests platform acceptability. Of the 50% reporting high IM, 60% indicated preference for an automated system. Of the 30% reporting low SD, 33% reported preference for an automated system. At recruitment completion, ANOVA analyses will elucidate relationships between IM, SD, and counselor assignment. Correlation and linear regression analyses will show any moderating effect of IM and SD on the relationship between counselor assignment and participant satisfaction.

Conclusions: Preliminary results suggest acceptability and feasibility of cognitive reappraisals via chat for survivors, and of the automated system counselor concept. Final results will explore relationships between SD, IM, counselor type, and participant satisfaction to inform the development of new platforms for survivors.

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KEYWORDS

CBT; web chat

Multimedia Appendix 1

Full poster.

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Abstract

Evaluating the Usability and Usefulness of a Mobile Application for Atrial Fibrillation Using Qualitative Methods: Exploratory Pilot Study

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Abstract

Background: Atrial fibrillation (AFib) is the most common form of heart arrhythmia and a potent risk factor for stroke. Non-vitamin K antagonist oral anticoagulants (NOACs) are routinely prescribed to manage AFib stroke risk, however non-adherence to treatment is a concern. Additional tools that support self-care and medication adherence may benefit patients with AFib.

Objective: To evaluate the perceived usability and usefulness of a mobile application (app) designed to support self-care and treatment adherence for AFib patients who are prescribed NOACs.

Methods: A mobile app to support AFib patients was previously developed based on early stage interview and usability test data from clinicians and patients. An exploratory pilot study consisting of naturalistic app use, surveys, and semi-structured interviews was then conducted to examine patients' perceptions and everyday use of the app.

Results: Twelve individuals with an average age of 59 years and a diagnosis of AFib completed the 4-week study. All participants somewhat or strongly agreed that the app was easy to use, and 92% (11/12) reported being satisfied or very satisfied with the app. Participant feedback identified changes that may improve app usability and usefulness for patients with AFib. Areas of usability improvement were organized by three themes: app navigation; clarity of app instructions and design intent; and software bugs. Perceptions of app usefulness were grouped by three key variables: core needs of the patient segment; patient workflow while managing AFib; and the app's ability to support the patient's evolving needs.

Conclusions: The results of this exploratory study suggest that mobile tools that target self-care and treatment adherence can be helpful to AFib patients, particularly those who are newly diagnosed. Additionally, participant feedback provided rich insight into the varied needs and health experiences of AFib patients, which may improve the design and targeting of the intervention. The benefits of qualitative methods for gaining rich insight into the real-world use and acceptability of health applications are well documented, and the value of incorporating patient perspectives during the early stages of intervention design is supported by a growing body of research. Yet, it is still rare in medical research to use qualitative methods to examine patient perceptions of a treatment at an early stage, or at all, prior to implementation. This often leads to less than optimal, or even negative outcomes for patients who receive the intervention. The results from this study we hope will help clinicians and researchers in the field of AFib care learn from our qualitative research and design insights, and ultimately build better tools for patients with this burdensome condition. Additional studies evaluating the AFib Connect mobile app over a longer period, and including a larger, more diverse sample of AFib patients, will be helpful for understanding whether the app is more broadly useful and effective in supporting patient self-care and medication adherence.

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KEYWORDS

medication adherence; pilot study; nonvalvular atrial fibrillation; patient self-care; mobile application; exploratory research; usability study; acceptability study

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Abstract

Attitudes Toward Aging in Place Using Wearable and Remote Monitoring Technology Among Underserved Homebound Seniors

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Abstract

Background: Wearable and remote monitoring technology have great potential to support homebound seniors aging in place. However, the seniors' adoption of new technology has been slow, and current research has focused primarily on the rich and the motivated.

Objective: The purpose of this study was to investigate underserved homebound seniors' attitudes, including their current use, interests, preferences, and potential concerns toward aging in place using wearable and remote monitoring technology.

Methods: A cross sectional survey study was conducted with 181 seniors who were participants of the Meals on Wheels program. In order to be eligible for this program, clients must be disabled adults who are homebound and over 60 years of age.

Results: The sample had an average age of 77 years. The group of participants was 66% female, 36% African American, and 49% White. Nearly 51% of the residents sampled in this study reported that they lived alone; 22.7% lived with a spouse; and 22.7% lived with family. More than half the sample (54.7%) reported having ever used a health-monitoring device at home, such as a blood pressure monitor or a blood glucose meter. More than half of the resident had access to electronic devices such as a television (92.8%), regular cell phone (58.0%), DVD player (56.9%), or a landline telephone (53.6%). A smaller percentage had more popular electronic devices, such as a smartphone (21.0%), laptop computer (18.8%), desktop computer (12.7%), or tablet (12.2%). Only 1% of the residents sampled reported having no access to any type of electronic device. Nearly 50% of the residents surveyed had never heard of wearable health devices; most had never used such devices (84.0%). Sixty-one percent of the residents reported that they would be interested in using a wearable device. Well over half of the residents (68.5%) would prefer to wear the device on their wrist. This sample reported an interest in tracking the following with wearable devices: blood pressure (51.4%), heart rate (44.8%), exercise and physical activity (35.4%), blood sugar (34.3%), fall risk (32.6%), hours and quality of sleep (32.6%), weight 27.6%, diet (27.1%), body posture (19.3%), mood (17.7%), and other (9.9%). When asked about what concerns residents had about using wearable devices, 55.2% reported cost to be a concern. Other concerns were related to safety (20.4%), privacy (16.0%), fraud (14.4%), and overwhelming information (11.0%). Twenty-five percent of the residents reported having no concerns.

Conclusions: While the majority of the underserved homebound seniors had never used any wearable or remote monitoring technology to support aging in place, and half had never heard of them, there is a great amount of interest in using such technology in this underserved population. Cost is the primary barrier to their adoption. Additional studies are needed to examine cost-effectiveness of using such technology to prevent expensive emergency room and other health services due to poor management of chronic conditions in this underserved population.

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KEYWORDS

aging in place; homebound; wearable; remote monitoring

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Abstract

Utilizing a Teledermatology Service to Impact Knowledge Acquisition Among Primary Care Providers

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Abstract

Background: A majority of patients seeking care for skin-related complaints are evaluated by non-dermatologists—in particular, primary care physicians. However, a majority of primary care physicians do not feel confident in their ability to diagnose and manage dermatologic disease, and rates of diagnostic error are high. It has been suggested that a teledermatology service has the potential to improve the dermatologic education of internists. However, this has not to date been rigorously evaluated.

Objective: Teledermatology is the use of telecommunications tools to transfer dermatologic information. The most common modality is “store and forward” (SAF). This project proposes to evaluate the impact of a new SAF teledermatology system on a group of referring primary care providers at the Cambridge Health Alliance, in terms of dermatologic knowledge as well as subjective comfort with managing dermatologic conditions.

Methods: Recently, access to a teledermatology platform integrated within an electronic medical record system, was rolled out for the first time to several primary care clinics in the Cambridge Health Alliance network. Primary care providers were asked to complete a short survey which consisted of fifteen “Medical Knowledge Self Assessment Program” questions from the dermatology portion of an internal medicine board review course. The providers were also asked to answer subjective questions regarding perceptions about their patients' access to dermatologic care, and their relative confidence and ability to diagnose, manage, and treat different dermatologic conditions. Providers were asked to give their names so that they could be contacted in 12 months, at which time the same survey could be given again to evaluate changes in knowledge and perceptions.

Results: A total of 19 primary care providers completed the requested questions and surveys; 17 providers from the initial pool of 19 completed follow-up questions and surveys. The average score on the test of dermatologic knowledge among the participating providers increased from 11 to 11.8 out of a possible 15 questions (P=.07). Providers who performed fewer than the mean number of consultations (11 or fewer) had minimal improvement in their overall test scores, while providers who completed 12 or more teledermatology consultations during the study period demonstrated a greater improvement in their test scores. Providers also reported improvement in their perceptions of diagnosing and treating dermatologic problems.

Conclusions: Our findings demonstrate a trend towards improved knowledge acquisition among providers using the platform, correlated with the frequency with which they use the platform. In addition, subjective survey responses by referring providers indicated a trend towards improved self-assessed confidence in managing different dermatologic conditions for their patients, as well as decreased barriers to dermatologic care for their patients. Although further studies with larger sample sizes are needed, our findings indicate that telemedicine consultation can potentially be utilized to improve referring provider knowledge and confidence.

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teleconsultation; telehealth; telemedicine

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Abstract

Why Did It Fail? Surveying Employees to Improve a Tracker-Based Corporate Wellness Initiative

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Abstract

Background: In 2016, a medium-size, private company in the United States implemented a program to distribute activity trackers to its employees in order to enhance their physical activity; the company distributed 150 trackers in total. However, many employees stopped using the trackers shortly after they received them. This study explores reasons why the initiative failed, as well as ways that the company may improve future wellness initiatives.

Objective: A study was designed to gain insight into why corporate wellness programs may be unsuccessful, as well as investigate ways that they can be improved in the future. This is especially relevant as trackers in the workplace and corporate wellness programs have grown in popularity in recent years.

Methods: We used a mix of cross-sectional surveys and open-ended interviews to grasp both the quantitative and qualitative aspects of employee perceptions on trackers and tracker data. We sent an online survey to company employees via email, inquiring about the employee's current physical activity behaviors, attitudes, and expressed interests in activity trackers. In addition, we held structured interviews and follow-up phone meetings with administrative figures.

Results: Of 204 employees surveyed, 116 completed the survey and three administrators were interviewed. Employees were dissatisfied with the initiative largely due to lack of tracker choice and lack of other wellness activities offered with the trackers. While many participants reported positive feelings about tracking in general, 60.7% of respondents wanted options relating to brand and model, as 51.9% were dissatisfied with the model that they received (Jawbone). Some employees mentioned they wanted one that was waterproof, while others stated that they needed one with a longer lasting battery. Additionally, 62% of respondents expressed interest in wellness classes in the workplace, such as fitness classes or lecture-based nutrition and sleep classes, to go along with the trackers. Furthermore, 44% of respondents said that they would like to receive customized fitness advice from the program. We also gauged interest in the possibility of providing incentives to employees for reaching goals or completing challenges, as incentives may be a successful way to engage employees in a wellness initiative. However, more than half of respondents (58%) were not interested in any form of reward, incentive, or recognition. Consequently, we concluded that incentive was not among the major factors that affected employee adoption of the wellness initiative.

Conclusions: The corporate wellness program was unsuccessful largely due to the following: dissatisfaction with the specific tracker model that was selected for distribution to employees; lack of employee choice in tracker model and features; and because there were no programs implemented to support the use of the trackers to increase fitness. Based on study results, in order to increase employee participation and satisfaction, future initiatives should incorporate other workplace wellness activities (walking groups, nutrition classes) into tracker-based programs, and should provide a set of tracker options to employees, so that employees are able to select trackers that fit their individual needs.

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KEYWORDS

employee wellness; physical activity; wellness programs; workplace health promotion; tracker; activity tracker; wearable activity tracker

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Abstract

Competitive Usability Study: Ideal Checkout Experience for Prescriptions

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Abstract

Background: What makes for an ideal checkout experience for prescriptions? Due to a variety of factors, including access and convenience, greater percentage of Americans are choosing to complete prescription purchases online.

Objective: In a nationally representative remote usability study, we compared the online checkout experience between Express Scripts, Amazon, Walgreens, and CVS among maintenance medication takers between ages 21 to 65+ in order to identify the ideal checkout experience for patients.

Methods: The 24 participants recruited from across the United States completed online checkout of vitamins on Express Scripts, Amazon, Walgreens and CVS through remote screen share.

Results: Results indicate that usability and appearance play important roles in patients' judgement of trust and credibility, as well indices of loyalty (eg, likelihood of returning and referral to colleague/friend). Specifically, usability of a website was significant in terms of being positively associated with trust of the website (r=.659, *P*<.001), and loyalty to the company (r=.707, *P*<.001).

Conclusions: Recommendations for improving online checkout highlight opportunities to increase patient satisfaction and overall company revenue.

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KEYWORDS

online; prescriptions; user centered design

Multimedia Appendix 1

Full poster.

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Abstract

Assessing Depression in the Wild: Insights From Two Large-Scale Fully Mobile Randomized Clinical Trials

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Abstract

Background: The dispassionate ability of smartphones to stream real-time, personalized data from an array of onboard sensors can inform assessment and treatment of a range of medical conditions, including mental health issues. This technology can potentially address some of the known access barriers, including cost, time, stigma, shortage of mental health professionals, language barriers and other factors that prevent people from seeking help in a timely fashion. While this technology holds much promise in healthcare, its utility in describing patient phenotype from passive sensor data is unclear and an important area for research.

Objective: We will summarize the key learnings from two large-scale (>2,000 enrolled people) fully mobile clinical trials targeting depressed individuals. Both studies were designed to assess the feasibility of running a remote, randomized controlled trial via custom applications. While BRIGHTEN v1 was open to the general US population, BRIGHTEN v2 was designed to enroll both English-speaking and an underserved Latino/Hispanic population. Here we will highlight the noticeable differences in user recruitment, engagement, and daily mood prediction observed across these studies, and explore the possible differences for each.

Methods: Both studies recruited participants through ads on Craigslist, targeted social media campaigns and other online classified-like resources. In total, 7,433 people responded and were screened for eligibility. Adults (18 years and older) with mild to severe depression as determined by a Patient Health Questionnaire [PHQ-9] score ≥5 were eligible to join the study. There were 3,310 eligible participants, of which 2,176 were enrolled. Sensor-based data were collected passively, from typical smartphone usage (aggregated call logs and messaging history for people with Android-based phones, and GPS data for both iOS and Android devices). The main outcomes of the study were depressive symptomatology, quantified by the PHQ-9. Daily mood fluctuations were measured using a two-item depression questionnaire (PHQ-2).

Results: The overall compliance (the number of unique days an individual participates—i.e. completes active tasks) was drastically lower for V2 study with <40% users completing any active task during the week 1 compared to ~80% in the V1 study. Considerable heterogeneity was seen amongst individuals when comparing the association of self-reported mood (PHQ-2/9 score) to various passive features, limiting the generation of a generalized cohort-level model for predicting mood (PHQ-2/9 score) based on passive features. Personalized models predicting mood at an individual level revealed a signal for some individuals (median R2 ~ 0.25). However, predictive power in the V1 study using individual digital behavior for four weeks was modest at best (median R2 ~ 0.15).

Conclusions: These studies demonstrate the feasibility of conducting large-scale mobile-based randomized trials and a marginal signal in the passive data to predict daily mood. However, further research is warranted to assess clinical relevance. Compliance was the primary factor affecting data analysis, and it limited our ability to draw inferences or employ predictive modeling at the cohort level. Studies are required to understand barriers and facilitators that are required to engage people, especially those with mental health issues.

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KEYWORDS

Depression; Hispanic/Latino; minority group; Mobile health (mHealth); mobile health intervention; sensors; smartphone

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Abstract

Evaluation of Small Amount Mobile Conditional Cash Transfers (mCCTs) to Improve Immunization Coverage and Timeliness

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Abstract

Background: Globally, one in every five children remain unvaccinated, and over 2 million children die from vaccine-preventable diseases annually, primarily in resource-poor, low- and middle-income countries. The uptake of immunizations under routine Expanded Program on Immunization (EPI) is low due to limited geographical reach, poorly motivated staff, and parents' poor socio-economic status and opportunity cost associated with taking their child for immunization. Incentive-based approaches have been rigorously demonstrated to increase take-up and completion rates of immunization effectively. However, evidence from programs evaluating the impact of small-scale conditional cash transfers on immunization coverage is scarce.

Objective: This program aims to improve both immunization coverage and timeliness through the introduction of small mobile money-based Conditional Cash Transfers (mCCTs) for parents and performance-based incentives for vaccinators through widely available mobile money transfers. The outcome of interest is fully immunized child (FIC) coverage—i.e. a child who has received one dose of BCG and three doses of each OPV, Pentavalent & PCV immunizations, and one dose of Measles vaccines. Outcomes will be compared through a baseline and endline immunization coverage survey to determine the effect of incentives.

Methods: The two-year program is implemented in a district of Sindh province in southern Pakistan in 34 government immunization centers with 86 vaccinators. Two different incentive schemes (per fully immunized child) are deployed to determine the minimum CCT amount required for follow-up. The total per child incentive for the high-incentive scheme is USD 10.5 and USD 5.0 for the low-incentive scheme. Parents/caregivers of children (0-24 months) visiting the immunization centers for any of the six routine vaccine visits are enrolled into a phone-based digital immunization registry. At enrollment, the child's bio-data and immunization history are recorded and a unique Quick Response (QR)-code sticker for identification is pasted on the child's immunization card. For the follow-up immunization visits, 3 SMS reminders are sent to parents for each immunization. At the follow-up visit, the immunization history of the child is pulled on the phone by scanning the QR-code, and following immunization, the child is randomly enrolled (with a 50% probability) in either of the two incentive schemes. The mCCT is initiated automatically through the Registry which can be encashed through any of the mobile money retailers located in the area.

Results: The Program enrollments commenced on March 1, 2016. As of July 3, 2017, 43,418 children have been enrolled. Overall interim results show 59% and 54% age-appropriate coverage for Measles-1 and FIC (BCG+Pentavalent3+Polio3+Measles1) as compared to the baseline rate of 35% and 18% respectively. Disaggregating coverage rates by incentive schemes show 51%

and 55% rate for Measles1 and FIC in the low-incentive arm, and 52% and 55% rate for Measles1 and FIC in the high-incentive arm.

Conclusions: Small scale incentives given as mCCTs induce positive behavioral change resulting in greater immunization coverage and compliance with immunization schedules. Concrete evidence regarding the impact of small-scale incentives on immunization coverage and timeliness (as opposed to the widely available literature on large CCTs) will be available at the end of the project.

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KEYWORDS

Conditional Cash Transfer; Immunization; Timeliness; Coverage

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Abstract

A Web-Based Tool to Facilitate Shared Decision-Making Regarding Neoadjuvant Chemotherapy Use in Muscle-Invasive Bladder Cancer

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Abstract

Background: Urothelial bladder cancer kills over 16,000 people annually. Approximately 30% of affected patients have cancer cells invading the muscularis propria at the time of diagnosis. Standard management for muscle-invasive bladder cancer (MIBC) patients involves radical cystectomy and pelvic lymph node dissection. Approximately 50% of these patients will develop fatal metastatic recurrence. In an attempt to eradicate micrometastatic disease, neoadjuvant chemotherapy (NAC) was integrated into treatment. Even though studies show that this improves these patients' prognosis, population-based studies have demonstrated that NAC is still underutilized. The difficulty of predicting an individual patient's outcome with cystectomy alone and the potential added benefit with NAC was cited as a common reason for this.

Objective: The aim of this study is to develop a web-based app for MIBC patients treated with cystectomy, with or without NAC, designed to improve prediction and enhance communication of these patients' prognosis.

Methods: This study included patients from the National Cancer Database (2003 through 2011) who were diagnosed with MIBC and were subsequently treated with cystectomy. Patient, tumor, and facility-level predictors were incorporated in the outcome prediction model and a state-transition model was synthesized to calculate the 5-year death risk with and without NAC. Internal and external cross-validations were performed to validate the predictions. Using U.S. Life Tables, bladder cancer-specific and other cause mortality were distinguished from all cause mortality rates. The effect of NAC was integrated using a literature-derived hazard ratio (HR). Finally, a web-based tool was developed using the state transition model and usability testing was performed.

Results: A total of 9,824 patients who had MIBC and underwent cystectomy met the eligibility criteria and were included in the prediction model (Figure 1). Factors such as race, advanced age, higher clinical T stage, and higher comorbidity index were associated with shorter survival. On the other hand, factors like private insurance, higher income, and undergoing cystectomy at a higher volume facility were associated with longer survival. The prediction model was well-calibrated across geographical regions. Individualized survival estimates of each patient can be generated using the web-based app (BladderCancerRisk.org) by feeding in the predictor variables and a user-defined HR associated with the effect of NAC. The output of the tool is displayed using infographics (Figures 2 and 3). A cohort consisting of 13 clinicians field-tested the usability of the tool.

Conclusions: A web-based user-friendly app was developed for patients with MIBC treated with cystectomy, with or without NAC, which individualizes outcome prediction and communication in these patients, and may also facilitate physician-patient shared decision-making. This app can be easily accessed or prescribed by the physicians using the Rx Universe platform (a digital platform that enables physicians to directly "prescribe" evidence-based mobile health applications to patients).

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KEYWORDS

Muscle invasive bladder cancer; Radical cystectomy; Neoadjuvant chemotherapy; Mortality

Figure 1. Patients included in the analysis and reasons for patient exclusions.

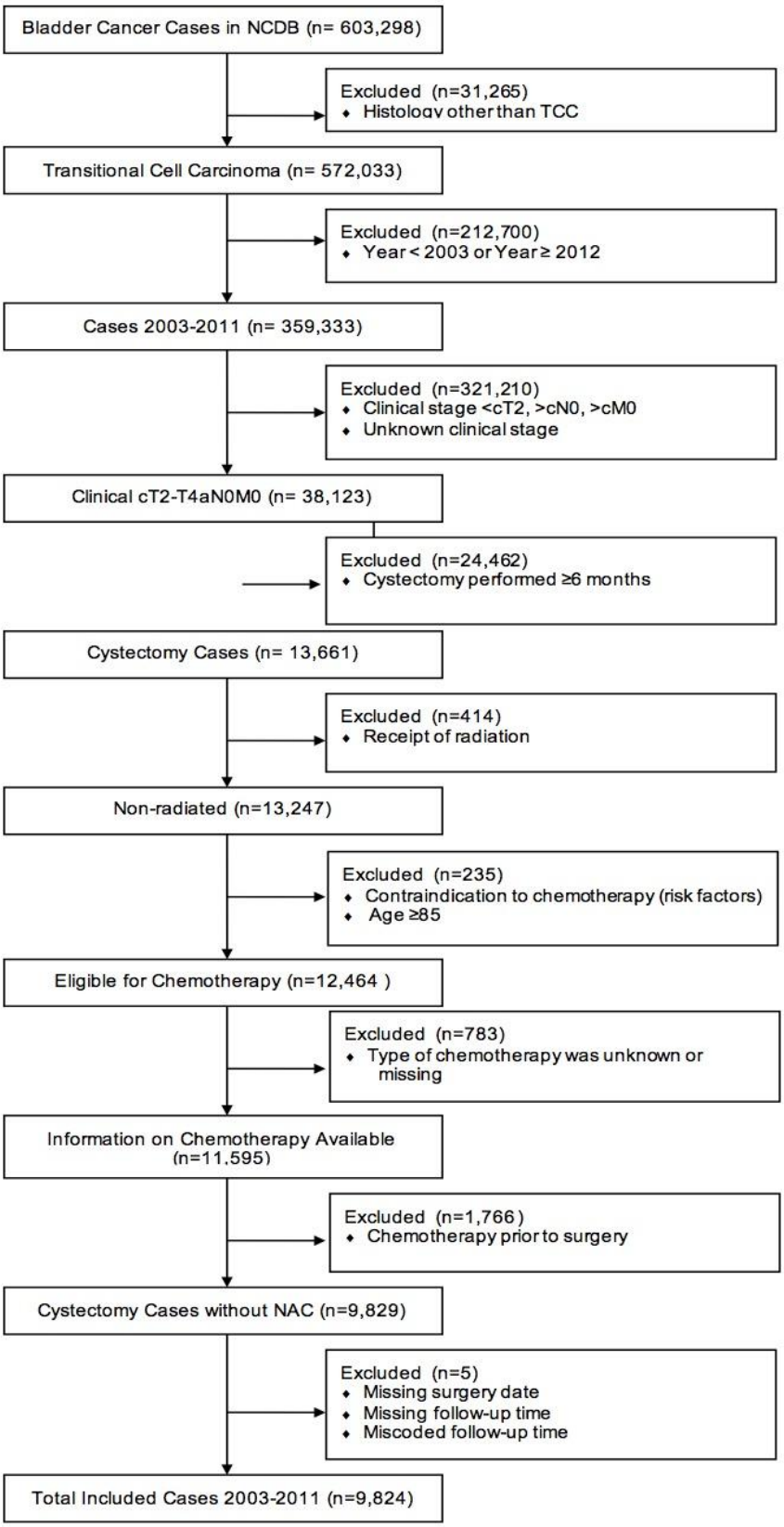


Figure 2. BladderRisk.org web-based prediction tool (a) data entry screen (b) infographics results output screen.

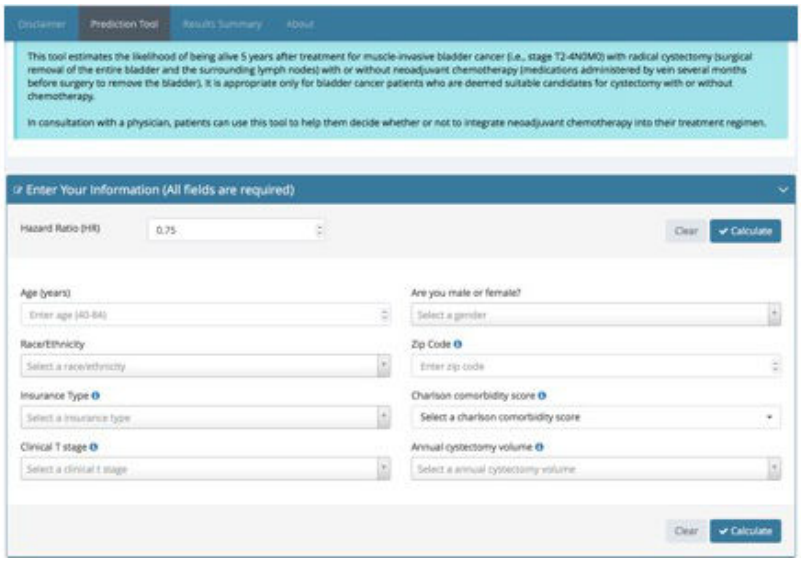
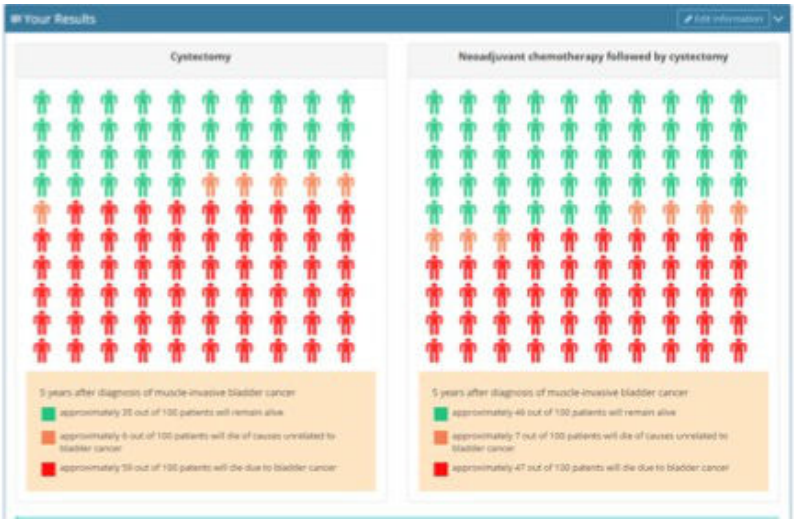


Figure 3. BladderRisk.org web-based prediction tool (a) data entry screen (b) infographics results output screen.



Multimedia Appendix 1

Full poster.

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Abstract

Review of Alzheimer's Disease Focused Mobile Applications

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Abstract

Background: As of 2017, an estimated 5.5 million Americans are living with Alzheimer's disease and related dementias (ADRD). Information and support for individuals with ADRD and their caregivers are critically needed. Technological advancements have provided patients and caregivers with tools that can provide information and education in areas such as improving awareness about the disease, disease management, and caregiving skills training. Mobile applications (apps) are an example of these tools. Studies have been conducted to assess the content of mobile apps focused on other health issues such as diabetes, weight management, and cancer; however, little is known about ADRD-related mobile apps. To our knowledge, this is the first comprehensive review of apps focused on ADRD.

Objective: The objective of this study was to review the content of ADRD-related mobile apps.

Methods: ADRD-related mobile apps were searched using keywords such as "Alzheimer", "Alzheimer's Disease" and "Dementia" in the App store for iOS-supported apps and Google Play Store for Android-supported apps. Apps were included for final review based on description, and inclusion and exclusion criteria. Three reviewers coded characteristics of the app (e.g. developer, version, number of installations, user ratings), target users, purpose, content of information provided, and technical aspects. Descriptive statistics, including frequencies and percentages, were used to analyze the data.

Results: A total of 38 apps were included in the review (16 were only available in iOS; 9 were only available in Android; 13 apps were available in both operating systems). IT companies developed 36.8% of the apps reviewed, followed by non-profit organizations (18.4%), and health-consulting organizations (10.5%). Very few apps were developed by government agencies (5.3%) or pharmaceutical companies (5.3%). Most apps were intended for caregivers of individuals with ADRD (63.2%), followed by the general population (44.7%). The main purpose of the apps was for disease management (55.3%), skills training (42.1%), disease and treatment information (34.2%), and to improve disease awareness (29.0%). Very few apps had a goal of providing peer support (2.6%). Most of the content was focused on caregiving (63.2%) and disease management (50.0%). Other information frequently presented included signs and symptoms of ADRD (34.2%), types of ADRD (31.6%), financial and legal issues (29.0%), resources for supporting patients (29.0%), and healthy lifestyle for ADRD prevention (29.0%). Few apps contained information about differences between typical aging and ADRD symptoms (13.2%), and health insurance option for ADRD patients (10.5%). Few apps had video (23.7%) or audio (2.6%) lectures or tutorials. Interactive features were limited; few apps had a function of sharing (18.4%), an app community (10.5%), or sending reminders (7.9%).

Conclusions: ADRD mobile apps that provide caregiving information can potentially benefit individuals who are supporting ADRD patients. Most ADRD mobile apps reviewed did not cover certain aspects related to ADRD, such as how to differentiate ADRD symptoms from typical aging. In addition, information provided by the apps was mainly presented in the form of text with limited audio/video options. There are opportunities for further development of ADRD apps with respect to content and format.

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KEYWORDS

Alzheimers; Caregivers; Dementia; Mobile health (mHealth)

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Abstract

E-motivate: Development of an App To Improve African Americans' Screening Colonoscopy Rates

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Abstract

Background: Colorectal cancer (CRC) is the third leading cause of death due to cancer in the United States. Compared to other racial/ethnic groups, African Americans have the highest CRC morbidity and mortality rates. Despite the proven efficacy of CRC screening, more than one-third of African Americans have not received a colonoscopy screening within the recommended time frame (one colonoscopy per ten years). It is critical to improve this group's colonoscopy screening uptake to reduce the burden of CRC among African Americans.

Objective: The primary goal was to develop a tablet app, e-motivate, which incorporates motivational interviewing principles to increase African Americans' colonoscopy screening uptake. Two-step field testing was conducted to examine the app's efficacy.

Methods: Participants (N=40) were African American primary care patients over the age of 50 (recommended age to begin screening for CRC). Immediately after receiving a colonoscopy screening referral, patients field-tested e-motivate in the primary care office, which took approximately 20 minutes. For Field Test 1, 20 participants used the app and engaged in a think-aloud exercise to assess the intervention's feasibility. The feedback from Field Test 1 was used to modify the app. Field test procedures were repeated on an additional 20 participants to confirm feasibility. The feedback from the Field Test 2 was used to further modify the app.

Results: In Field Test 1, descriptive statistics were run to determine the usability and acceptability of the app. The mean overall score on the System Usability Scale of 86.62 (possible range from 0 to 100) indicates high usability. The mean score on the Acceptability E-Scale of 4.8 (possible range from 1 to 5) indicates high acceptability of the app. Qualitative thematic analysis revealed that participants found the e-motivate 1.0 app to be user-friendly and helpful. Some participants reported difficulty with certain app functions (e.g., using a slider icon). The participants' suggestions were used to guide the development of the e-motivate app 2.0. Field Test 2 is ongoing and results will be reported in the final poster presentation. Iterations to follow will be based on patient feedback.

Conclusions: The two-step field test approach focused on user-centered design and directly informed the development of a user-friendly, patient-driven app with optimal user satisfaction and engagement to help improve screening colonoscopy uptake in African Americans. The next critical step in the app's development is to test the efficacy of e-motivate in a randomized clinical trial. If the app is successful in the RCT there is a strong case for integrating e-motivate into standard clinical practices with the ultimate goal of reducing the preventable and unequal burden of CRC among African Americans. In the future, the digital prescribing platform RxUniverse, an efficient program which enables physicians to "prescribe" evidence-based mobile health applications to a large population of patients, can be used to bulk prescribe e-motivate.

Trial Registration: Improving Colonoscopy Screening Uptake to Reduce the Burden of CRC Among African Americans

(iproc 2017;3(1):e45) doi:10.2196/iproc.8462

KEYWORDS

Colorectal cancer; Mobile application; Patient engagement; Prescribing

Figure 1. Screenshot from the E-Motivate App Interface.

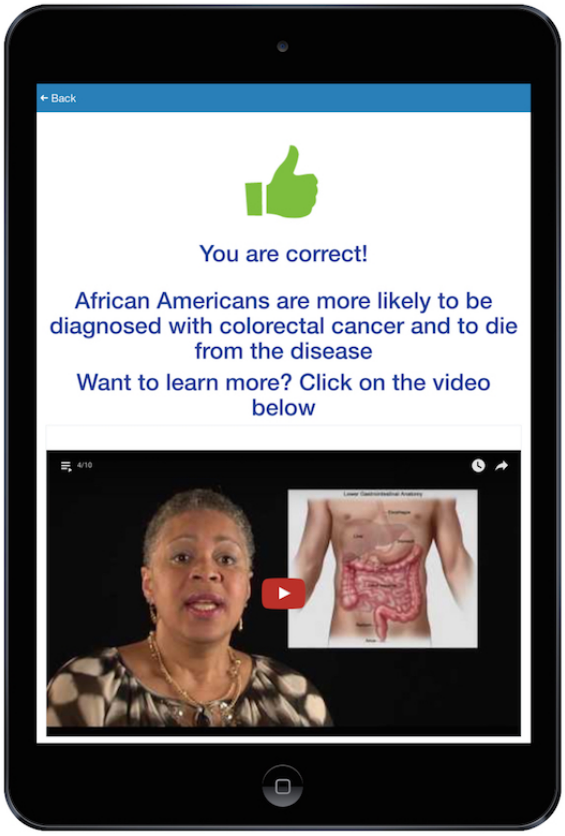
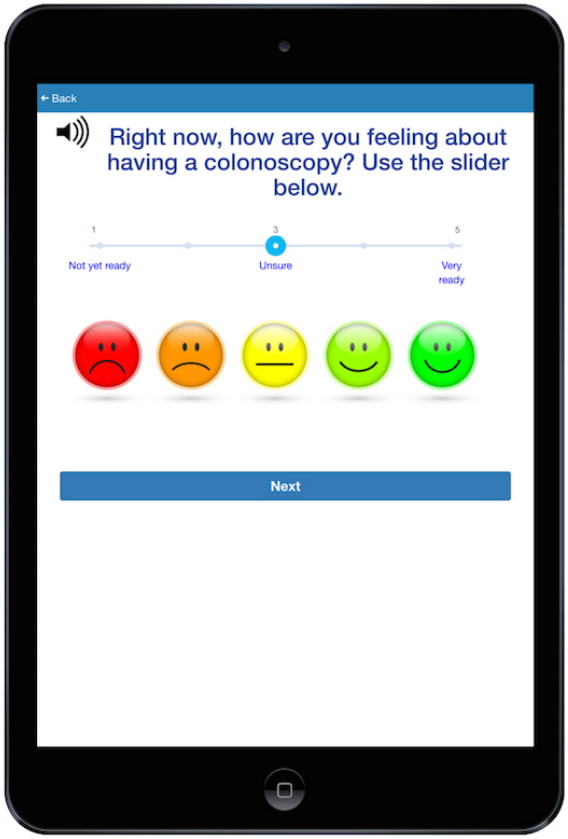


Figure 2. Screenshot from the E-Motivate App Interface.



Multimedia Appendix 1

Full poster.

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Abstract

Early User Centered Insights on Voice Integrated Technologies Through Retrospective Analysis

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Abstract

Background: There is increasing interest in incorporating voice-activated technology (VAT), such as Amazon Alexa, Google Home, and Microsoft Cortana, into the existing connected health, mHealth, and mobile medical app ecosystems. VATs allow for natural-language interactions and offer patients the promise of increased usability, greater engagement, and improved adherence to treatments and/or medications. Despite this interest, there is little ethnographic data on patients' use of VAT or unmet needs. This data is critical to developing VAT applications that interact with medical devices, where regulatory or design control considerations require a higher level of rigor compared to unregulated consumer applications. As first-mover, Amazon Alexa technology has dominated the VAT market; customer reviews of Alexa-enabled devices outnumber the next closest technology 19 to 1. We hypothesized that Amazon Alexa was a good proxy for VAT users at large, and that systematic coding and analysis of 95,000 reviews for Amazon Alexa devices could provide insights that would accelerate follow-on research efforts to support development of user-centered VAT applications for connected health.

Objective: Primarily, we sought to explore whether Amazon reviews could be used to develop initial research hypotheses, pain points, and user insights, in much the same way complaint reviews inform early development of medical devices and interventions. Secondarily, we explored whether VAT reviews could be used to identify unmet needs around VAT-for-healthcare applications.

Methods: We conducted an exploratory, manual retrospective analysis of 28,271 full-text user reviews for Amazon's Echo and Dot devices, including all reviews from February to July 2017. This represented approximately 31% of all available Amazon Alexa review data. Two authors (CT/AC) screened each review for relevance, defined as any mention of an issue related to use, misuse, unintended/unexpected event, or novel application of technology. Relevant reviews were manually coded by the authors into one or more of nine categories.

Results: There were 284/28,271 user reviews (~1%) that were relevant, yielding valuable user-related insights in our areas of interest. Most relevant reviews focused on Healthcare-Related Workarounds (141), Quality of Life Improvement (159), and Physical Disability (93). We also found relevant, useful information related to Neurological Disorder/Disability (39), Unauthorized Interactions (23), Unexpected Use Settings (33), Natural Language Barriers/Advantages (50), Companionship (50), and Noteworthy Benefits to Healthcare (16). We found the reviews to contain significant detail, allowing us to generate initial insights without the expenditure and complexity of traditional user research.

Conclusions: The results of our manual review and coding provided unexpectedly rich information regarding unique device uses, curious workarounds, and unexpected complications. This analysis offers an early effort to improve understanding of how this type of technology may be used in the medical field. Given the currently sparse literature in this space, our study provides a roadmap for future studies centered around VATs in digital health. All remaining reviews should be similarly analyzed and catalogued for future use. Such investigations could involve more detailed exploration of patient practices using other user research methods in order to inform future development in this area.

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KEYWORDS

interactive voice response; Voice Recognition; connected health; human factors; use environment; use errors

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Abstract

Wearable Activity Trackers and Older Adults: The Social Effect and Importance in Healthcare

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Abstract

Background: Many older adults develop chronic diseases, such as heart disease and diabetes, which are correlated with low levels of physical activity. Chronic diseases can result in a decreased quality of life, increased health care costs, and premature mortality. Adults, specifically older adults, who started using wearable activity trackers (WATs) have exhibited an increase in daily activity levels. Although WAT use has increased, only 7% of older adults use a WAT. The use of WATs has the potential to facilitate chronic condition self-management, with patients engaging in personalized care and health care providers receiving accurate data about patient physical activity. One benefit of WATs is the opportunity to develop social relationships. Social relationships have as much impact on physical health as physical activity. Older adults with larger networks show higher levels of health.

Objective: The purpose of this study is to explore how WATs connect older adults to those around them and to determine the benefits of sharing WAT data with healthcare providers.

Methods: Ten focus groups and 20 interviews were conducted with older adults who had varying levels of WAT use. Each participant was categorized as one of the following; long-term user (used WATs for six months or more); short-term user (used WATs for less than six months); former user; never user. Discussion topics included WAT social aspects, the frequency and benefits of sharing individual WAT data with healthcare providers, and strategies to increase the number of long-term WAT users among older adults.

Results: Preliminary data suggests that WATs have the potential to better connect people socially through their competition and gamification aspects. Trackers are able to connect numerous people together and turn an individual's health journey into an engaging and communal game. Some older adults also reported taking their WAT data to their healthcare provider. Sharing the WAT data made many of them feel like they were taking charge of their own health. The features that were reported as most commonly talked about with providers were sleep patterns, steps taken, and heart rate. A difference between the long-term and former users studied was their level in social interaction. Preliminary data suggests that more long-term users reported sharing their data with others than former users.

Conclusions: Initial analysis suggests that WAT users can benefit more from social interactions with their WATs. Tracking activity with others holds a person accountable and can make it more enjoyable. Sharing WAT data with healthcare providers has been suggested to comfort older adults by making them feel more in control of their life. Older adults can potentially talk with their doctors more intelligently about their activity levels through their WAT.

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KEYWORDS

chronic illness; health; healthcare; obesity; Older adults; social influence

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Full poster.

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Abstract

Integrating Ema, Clinical Assessment and Wearable Sensors to Examine the Association between Major Depressive Disorder (MDD) and Alcohol Use

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Abstract

Background: Depression is the leading cause of disability worldwide. Heavy drinking often co-occurs with Major Depressive Disorder (MDD), preventing the amelioration of symptoms and increasing disability. New technology-based assessment tools such as ecological momentary assessment (EMA) and wearable sensors provide the opportunity for a more detailed examination of the interplay between these two conditions. While the association between low mood and heavy drinking has been extensively examined, multi-method assessments including EMA, sensors and clinician-rated measures have not been utilized to study the association between depression and heavy alcohol use.

Objective: To examine the association between depressive symptoms and alcohol consumption by integrating multiple sources of data including EMA, clinical assessment, and wearable sensors.

Methods: Individuals with MDD complete an 8-week protocol that involves tracking depressive symptoms and alcohol consumption daily through an EMA. Mood is captured via surveys delivered twice daily that include 10 items of the Positive and Negative Affect Scale (PANAS) assessing negative affect (NA) and positive affect (PA). Participants wear Empatica E4 wristband sensors that track electrodermal activity (EDA) and accelerometer data 23 hours/day. The clinician-rated Hamilton Depression Rating Scale (HDRS) is administered biweekly to assess depressive symptoms. MovisensXS, the app delivering the EMA, tracks text messages, phone calls, location, app usage, and screen on/off behavior.

Results: To date, 16 of 30 projected participants have completed the study. All participants are expected to complete the study by 10/2017. Preliminary analyses confirmed the accuracy of the daily mood ratings. There was a significant linear relationship between NA/PA ratio from EMA ratings and the clinician-based ratings (P=1.3e-6). To focus on the association of low mood and drinking behavior, we solely included instances where NA>=PA and observed a significant association (P=0.001) between low mood (as a ratio of total NA divided by PA) and higher alcohol use. Analyses will be repeated for all 30 participants. E4 accelerometer data and location data will help elucidate whether mobility moderates the association between mood and depression, such that individuals who drink at home may exhibit greater depressive symptomatology. Finally, the association between EDA and alcohol use will be examined. Final results will be presented at the Connected Health Conference.

Conclusions: To date, results show a significant association between low mood and alcohol consumption. Results of planned analyses will further clarify the temporal association between mood and alcohol use among depressed patients, and possible moderators and mediators of this relationship. A precise understanding of the association between low mood, physiological states

and heavy drinking will facilitate the development of “just-in-time” ecological momentary interventions for both reduction of depressed mood and heavy drinking.

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KEYWORDS

alcohol; Depression; ecological momentary assessment; sensors

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Abstract

Assessing Feasibility and Acceptability of mHealth among Underserved HIV+ Cocaine Users and Their Healthcare Providers

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Abstract

Background: HIV-infected individuals with comorbidities like drug addiction have difficulty staying in medical care and adhering to antiretroviral medication which, if taken regularly, results in viral suppression and greatly reduces risk of transmission to others. Since cocaine is not amenable to pharmacological interventions, there is an urgent need for behavioral interventions. Innovative and cost-effective strategies to improve medication adherence and optimize HIV treatment outcomes may be provided by mHealth. Very little, however, is known about the acceptability and feasibility of mHealth among HIV-infected drug users.

Objective: To assess feasibility, acceptability, and barriers and facilitators of implementing an mHealth intervention among HIV-infected cocaine users.

Methods: Focus groups were conducted with 5 groups (N=20) of HIV-infected individuals who self-reported cocaine use in the past 30 days, and 3 groups (N=8) of HIV and substance use providers. Participants were recruited from clinical and community venues including HIV and drug treatment clinics, a mobile medical unit, and support groups. We asked about: previous experience with smartphones and computers; barriers and facilitators of mobile technology for health purposes; attitudes toward receiving different types of feedback about adherence behaviors. Data was analyzed using content analysis to identify salient themes from responses, facilitated by the qualitative data analysis software NVivo.

Results: Results highlighted the pattern and preference of cell phone/mobile device usage among HIV-infected cocaine users. Usage reasons included staying connected with their social network, receiving text reminders for appointments, information seeking, scheduling and recreational use. Text reminders were preferred over phone calls due to reasons of privacy, accessibility and economizing “minutes”. Patient privacy and confidence in the electronic medical system, however, were important themes among patients. Although cell phones were considered useful, some patients reported very limited computer use because of distrusting technology and worries that their medical information, particularly their HIV status, could be hacked through the phone. From providers’ perspectives, the personal interaction with patients, including via cell phones, was important to them and was often hampered by interruptions in patients’ phone use (number changes, disconnections, running out of pre-paid minutes). Communication via text message or phone calls would be most appropriate for professionals directly in charge and in continuous contact with patients, such as social workers and case managers, as opposed to physicians.

Conclusions: Participants’ beliefs and suggestions were helpful in informing the design of a subsequent mHealth pilot randomized control trial. We incorporated findings in the following ways: (1) personalized feedback from a clinician along with automated reminders and feedback; (2) an extra layer of security was added on the smartphone app; and (3) facilitated mobility and convenience by providing backpacks for all devices, considering HIV-infected participants’ concerns about their transient and unstable living

conditions. Understanding potential users' and stakeholders' perspectives is an important step in developing effective mHealth strategies to help people manage their health behaviors.

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KEYWORDS

addiction; feasibility; HIV/AIDS; mHealth; acceptability; underserved populations; cocaine

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Abstract

Detecting Influenza Epidemics Using Self-reported Data Through Mobile App (FeverCoach)

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Abstract

Background: Timely forecast of influenza activity is critical for a public health system to prepare for an influenza epidemic and mitigate its burden. Currently, influenza surveillance relies on traditional data sources such as reports from health care providers, which lag behind real-time by several days to weeks. In an effort to reduce the time lag, internet search information, voluntary web-based records, and electronic health records have been suggested as the alternative data sources for influenza surveillance. However, low specificity, low rate of report, or privacy concerns limits the use of such data.

Objective: FeverCoach mobile application provides tailored information to help caregivers manage a febrile child. Using the self-reported diagnosis data submitted to the app, we developed a new algorithm that accurately predicted the influenza trend in South Korea.

Methods: Users of FeverCoach agreed to the use of de-identified data for research purposes. The app shows information about use of antipyretics and adjuvant way to relieve fever when users enter the child's age, sex, body temperature, and the duration of fever. Users can choose from the list of 21 candidate diseases including Influenza after a physician office visit. Additional information about the disease was provided following submission of the diagnosis. Public influenza-like illness (ILI) data was obtained from the Korea Centers for Disease Control and Prevention (KCDC) website. The data was collected from September 2016 to March 2017. Ordinary least squares linear regression was used to build a model using the data from the app to predict the influenza trend. To perform linear regression, we calculate logit(Pcdc) and logit(Papp) where logit(p) is natural log of p/(1-p), Pcdc is (ILI visit counts)/(total patient visit counts) and Papp is (Influenza report on FeverCoach)/(total diagnosis report on FeverCoach).

Results: We collected 13,014 self-reported diagnoses. Of all users, 81% of the children were under 5 years of age. The animated visualization of spatiotemporal diagnosis report is available online at https://www.youtube.com/watch?v=-8kDXz43gO8. Ordinary least square regression showed significant association between logit(Pcdc) and logit(Papp) (R2=0.860, P<.001). Using this regression model, we could detect an influenza epidemic 5 days before the 2016-2017 season's influenza epidemic alert by KCDC.

Conclusions: We found that it is possible to predict influenza epidemics earlier than KCDC with a relatively small amoount data. Collection of specific and accurate data was made possible by targeting a well-defined population.

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KEYWORDS

children; epidemics; health care; human influenza; Mobile health (mHealth)

Figure 1. FeverCoach main screens. (a) input page for fever. (b) information for fever management. (c) input page for diagnosis.

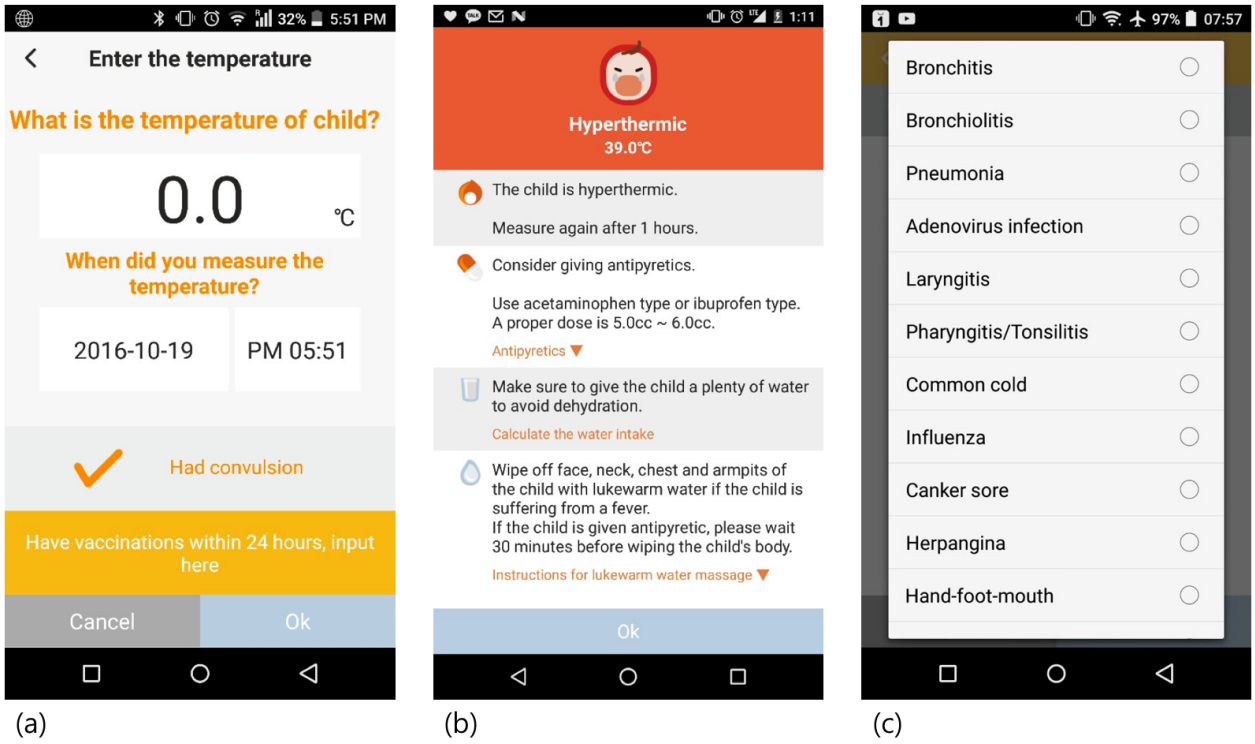


Figure 2. Visualization of spatiotemporal diagnosis report. Green circles indicate diagnosis data except Influenza and Red circles show input of Influenza diagnosis. Diameters of circles present time proximity from each reporting date of diagnosis. (a) Influenza reports on the 25th November, 2016. (b) Influenza reports on December 7th, 2016 : a day before epidemic alert of KCDC. (c) status on December 23rd, 2016. (d) status on January 28th, 2017.

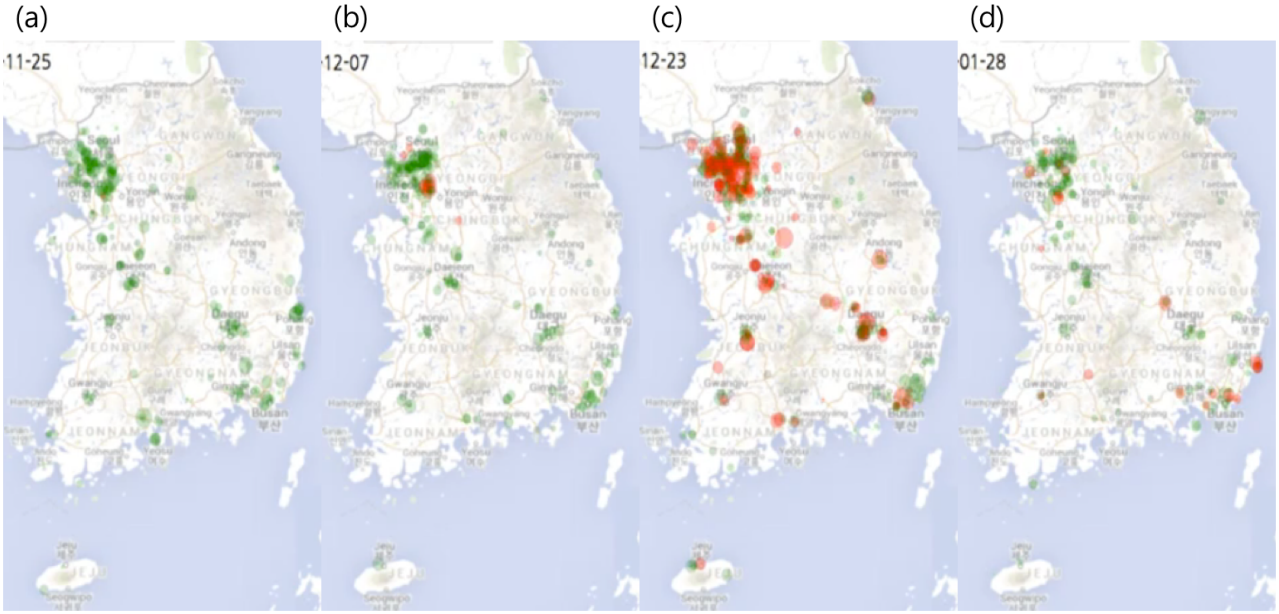
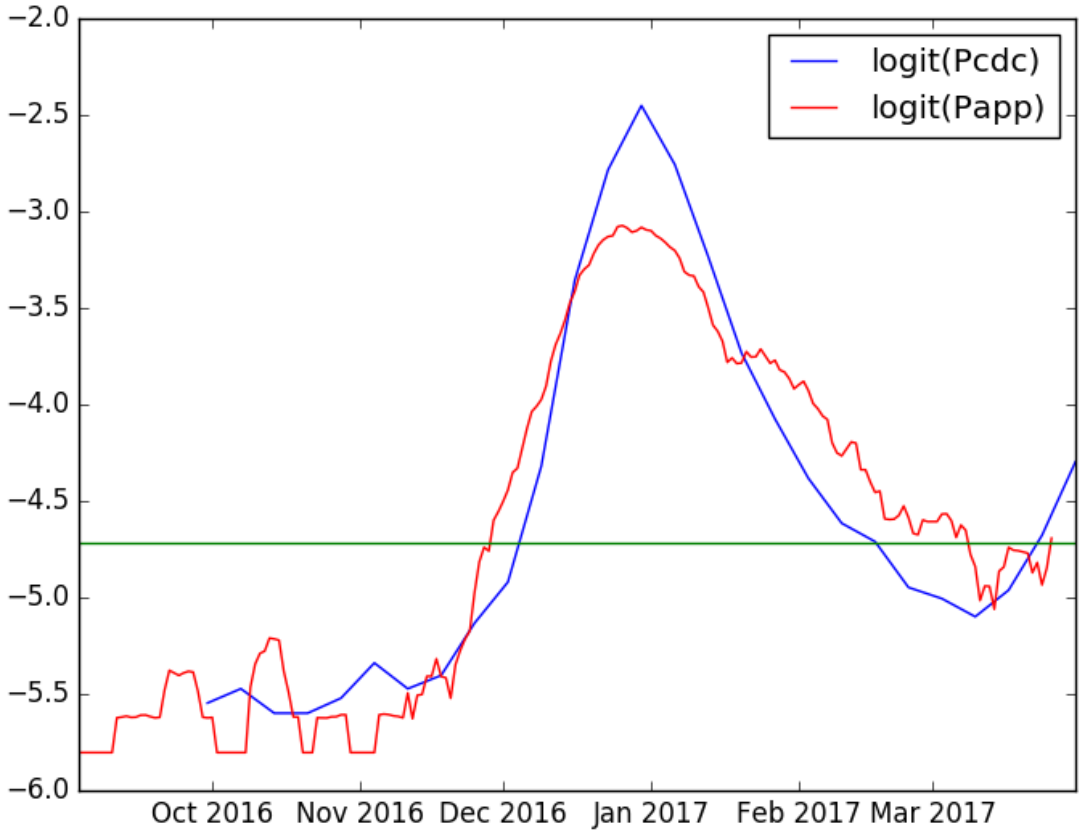


Figure 3. A comparison between CDC ILI data and FeverCoach data arranged by detection date : Pcdc = (ILI visit counts)/(total patient visit counts) and Papp = (Influenza report on FeverCoach)/(total diagnosis report on FeverCoach). Red line shows prediction of our regression model , blue line shows logit (Pcdc) and green line shows KCDC's influenza epidemic alert standard : fraction of ILI visit = 0.0089.



Multimedia Appendix 1

Data visualization of influenza report through FeverCoach from 2016 Nov to 2017 Jan. Red circles mean influenza report, green circles mean other diagnosis report. Circles are appeared from 5 days before of reporting date, and they have the biggest size on reporting date. Shrinking and disappearing takes 5 days.

[MOV File, 8MB - iproc_v3i1e56_app1.mov]

Multimedia Appendix 2

Full poster.

[PDF File (Adobe PDF File), 9MB - iproc_v3i1e56_app2.pdf]

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Abstract"

Piloting and Evaluating an Automated Text-Messaging System in the Veterans Health Administration

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Abstract

Background: The Veterans Health Administration (VA) strives to increase access and patient-centered care. “Annie” is VA’s first national automated text messaging system aimed to give patients a self-management tool to take charge of their health and become more engaged in their own care. We examined early patient/provider experiences with Annie as part of a limited field test and subsequently examined if the texting system would improve outcomes.

Objective: To understand early experiences using Annie and subsequently pilot and evaluate automated text messages to improve Veteran self-management and adherence to medications and appointments.

Methods: We conducted a national two-phase study in VA. In Phase 1, five sites conducted limited field testing and engaged 43 respondents (23 patients, 20 providers). Respondents completed surveys and qualitative interviews focused on provider adoption, integration into clinic workflow, patient ease of use, perceptions of program effectiveness, and barriers to use. In Phase 2, seven sites implemented Annie. Four intervention sites received a toolkit of materials and facilitation calls intended to enhance Annie implementation. An additional three sites received Annie without implementation support and two matched comparison sites did not receive Annie. A mixed-methods evaluation is underway, and includes pre and post patient and provider surveys and interviews, medical chart abstraction, and process measure analysis.

Results: Analysis of Phase 1 data revealed that all participating Veterans felt positive about their ability to receive a text message. All but one Veteran used a smart phone and had been using a cell phone for four years or more, with 83% sending and receiving text messages several times a day. Sixty-seven percent of Veterans agreed that Annie was easy to use, 11% felt they needed to learn a lot to use Annie, 46% felt Annie helped them take better care of their health and become more connected with their clinical team, and 91% would recommend Annie to another Veteran. Among providers, 67% agreed leadership and management would support Annie implementation and 60% would recommend Annie to another provider. Analysis of Phase 1 interviews revealed five lessons to support implementation: 1) the importance of identifying a resource person who is able to bridge technology and clinical issues; 2) promoting the evidence, innovation, and patient empowerment associated with Annie to providers; 3) focusing early Annie enrollment efforts on patients comfortable with technology and who do not need intensive follow up; 4) advertising the adaptability of Annie texting protocols; and 5) the value of Annie as a health coaching tool. In Phase 2 of Annie implementation we are collecting data on patient and provider experiences with Annie, including usability, clinical workflow fit, and clinical benefits such as improved medication adherence and fewer missed labs and visits.

Conclusions: Technologies develop rapidly and hold the allure of efficiently doing things that were once cumbersome or not possible to do in a busy clinical setting. The Annie automated text-messaging system may be able to help in this regard by offering support through self-management, coaching, and education outside of clinical encounters. Findings will inform iterative development of Annie and its national rollout.

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Abstract

The Benefits of Direct-to-Patient Data Collection for Data Consistency and Completeness: Lessons From Force-Tjr

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Abstract

Background: In 2011, the Department of Orthopedics and Rehabilitation at UMass Medical School was awarded an AHRQ grant to establish a national registry of comprehensive total joint replacement (TJR) outcomes registry, FORCE-TJR. This lead to the development of an infrastructure for successful longitudinal direct-to-patient data capture, which has now been translated into a product to support orthopedic outcomes measurement in hospitals and surgeon practices around the country.

Objective: To use data from the FORCE-TJR registry to demonstrate the benefits of direct-to-patient data capture for data consistency and completeness.

Methods: To be a comprehensive TJR outcomes registry, FORCE-TJR required the development of a data capture system that supported complete and consistent research quality data. For this work, we first explored how our data capture system differs from other commercial and research based outcomes measurement systems. We then queried our integrated database of patient-reported outcomes, risk factors, adverse events, and claims to demonstrate how these differences affect data consistency and completeness.

Results: We found that direct-to-patient data capture led to more complete measurement of adverse events as 25% of post-TJR ER visits, hospital readmission, and early revisions occurred outside of the surgical hospital. Direct-to-patient data capture increased the capture of key risk factors, such as morbid obesity, eight-fold as compared to claims data. Finally, when compared to “in-office” outcomes measurement, web-based, direct-to-patient methods increased data completion rates from 53% to 86%.

Conclusions: Web-based, direct-to-patient outcomes data collection improves data consistency and completeness as compared to other data capture methods supporting the collection of research quality data.

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KEYWORDS

patient-reported outcomes; Registries; routine outcome monitoring; orthopedics

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Abstract

Simple to Use: Reflections From a Mobile Sleep Study Pilot

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Abstract

Background: Difficulty falling asleep and staying asleep are common problems that affect over 30 million Americans. Additionally, we know that military personnel and Veterans often have insomnia problems post deployment. Home sleep monitors can be used to diagnose sleep disorders and determine if the sleep issue cause is a physical issue, such as obstructive sleep apnea. Some non-physiological causes may be improved by focusing on behavioral change, which can be assisted by mobile health (mHealth) technologies. In addition, mHealth apps are an increasingly popular method to deliver behavioral change interventions for a variety of conditions, with the cognitive behavioral therapy for Insomnia Coach app (CBT-i Coach) being particularly popular (it has been downloaded over 80,000 times in 86 countries).

Objective: In this pilot trial we assessed the usability and feasibility of mobile health information technologies (HITs) designed to reduce sleep problems in post-9/11 Veterans with chronic insomnia. We used the CBT-i Coach mobile app (based on cognitive behavioral therapy for insomnia) and supplemented it with usage instructions to enhance self-management. Participants also used a home-based sleep monitor (WatchPAT) to obtain objective sleep data to assess possible sleep apnea and to provide subjects with objective data to motivate behavioral change.

Methods: Thirty-eight post-9/11 Veterans met criteria for insomnia on the Insomnia Severity Index (ISI). We assessed feasibility and usability of the HITs over a 6-week intervention with a pre-post design. The WatchPAT was used to screen for sleep apnea, and those with moderate to severe apnea were withdrawn from the trial and referred for further assessment. Participants were given a self-management guide which detailed when to use different elements of the CBT-i Coach app, including guidance to complete a sleep diary each morning. Assessments were completed at the beginning, middle, and end of the 6-week intervention.

Results: Of the 38 enrolled, 18 participants were withdrawn for moderate or severe sleep apnea as measured by the WatchPAT, and 9 withdrew for personal reasons. Post-intervention qualitative interviews revealed that many participants found both the CBT-i Coach app and WatchPAT easy to use. Participants also liked tracking their daily sleep and seeing graphical results of their sleep changes over time, with only 2 of the final 11 participants completing CBT-I Coach sleep diaries less than 85% of the time. Exploratory analyses on the 11 completers also revealed significant but modest differences between baseline ISI scores (M=16.63, SD = 5.55) and post-intervention follow-up (M=12.82, SD = 3.74; t (10) = 4.14, P<.01).

Conclusions: We found good usability of the combined CBT-i Coach app and WatchPAT sleep intervention and determined that feasibility was reasonable, with more than half of those not excluded due to apnea completing all assessments. The pilot demonstrated reasonable feasibility and usability of the mobile HIT tools which could provide an accessible adjunct or alternative to in-person cognitive behavioral therapy for insomnia to improve the health and wellbeing of busy individuals.

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KEYWORDS

usability testing; Veterans health; sleep

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Abstract

Barriers and Facilitators to Patient Portal Implementation From an Organizational Perspective: Qualitative Study

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Abstract

Background: Patient-centeredness is an important element of high-quality care. Patient portals can contribute to the patient-centered care and are defined as “an online gateway for patients to gather and share information mostly provided by one health institution.” While portals can have positive effects, its implementation has a major impact on the healthcare institutions providing those. Little is known about the organizational factors that facilitate or hinder successful implementation. Knowledge of the specific barriers and facilitators of different stakeholders may be useful for future implementations.

Objective: The objective of this study is to identify the barriers and facilitators of patient portal implementation among different stakeholders within the hospital organization.

Methods: Purposive sampling was used to select hospitals of different classes. Two university medical centers (UMCs), 3 mid-size hospitals and 2 general hospitals were included. Per hospital three stakeholders were interviewed including: 1) medical professionals, 2) managers, and 3) IT employees. Semi-structured interviews were conducted using the comprehensive model of Grol and Wensing, which describes barriers and facilitators of change in healthcare practice. Barriers and facilitators can occur on six levels: 1) Innovation, 2) Individual professional, 3) Patient, 4) Social Context, 5) Organizational Context, 6) Economic Context. Two researchers independently selected and coded quotes by using this model. Additional factors related to technical and portal characteristics were added by using the model of McGinn et al developed for implementation of electronic medical records

Results: In total, we identified 382 quotes in 34 categories. Twenty-five categories were common for all stakeholders groups, including 16 barriers and 13 facilitators. Positive aspects related to ‘advantage in practice’ were mentioned most frequently, followed by positive ‘attitude’ and ‘motivation to change’. The main barriers were ‘resources’ (eg lack of staff), ‘opinion of colleagues’ (eg, negative beliefs) and ‘privacy and security’ (eg, strict regulations). Similarities and differences were found between stakeholder groups and hospital classes. For example, medical professionals and IT employees considered 'resources' as an essential barrier. However, their perspectives differed regarding 'opinion of colleagues' as this was a major barrier for medical professionals (eg doctors with negative attitudes), but a facilitator for IT employees (eg, portal implementation can drive a positive change). Results of mid-size and general hospitals were largely comparable, whereas differences were identified for the UMCs.

Conclusions: The model of Grol and Wensing proved to be useful in elicitation and classification of barriers and facilitators to portal implementation. However, technical and aspects related to portal characteristics (such as 'privacy and security' and 'perceived ease of use') were missing, and were added from the McGinn model. Barriers and facilitators occurred at various levels and differed between hospital classes and stakeholder groups on several aspects (eg 'opinion of colleagues' and 'cost issues'). This underscores the added value of involving multiple stakeholders in future portal implementations. The identified set of barriers and facilitators may be useful to make strategic and efficient implementation plans.

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KEYWORDS

implementation; Patient portals; Health Information Technology

Multimedia Appendix 1

Full poster.

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Abstract

Utilizing a Culturally-Modified Smartphone App to Increase Engagement in Depression Treatment among Chinese Americans: A Pilot Study

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Abstract

Background: As smartphone technology has become ubiquitous in the US society, recent research indicates there is a high rate of smartphone ownership and medical apps use among ethnic minorities. Although the actual effectiveness of medical apps is largely unknown, emerging data has shown interest and feasibility of utilizing smartphone apps to reduce health disparities and improve engagement with the health care system among low-income minorities.

Objective: This is a pilot study to evaluate the feasibility of using a smartphone application featuring a culturally-validated Chinese Bilingual version of the Patient Health Questionnaire (CB-PHQ-9) and Tai-Chi mindfulness intervention among Chinese American with depression. We hypothesize that Chinese American outpatients will be able to download the app to their personal smartphone and use it for 30 days. We further hypothesize that the culturally-customized screening tool and mindfulness intervention delivered through a smartphone app will increase the engagement to seek depression treatment among Chinese Americans.

Methods: A total of 25 participants will be recruited from outpatient psychiatry and primary care clinics at Beth Israel Deaconess Medical Center (BIDMC) located in Boston, Massachusetts. Eligibility requirements include Chinese ethnicity, fluency in either English or Mandarin Chinese, and a baseline score of 10 or higher on the PHQ-9. Participants will be instructed to use the Tai-Chi mindfulness exercise and then complete the CB-PHQ-9 once a day during a 30-day period. At the 30th day follow-up visit, a 10-minute semi-structured verbal interview and a written survey containing the System Usability Scale (SUS) will be administered to each participant to collect user feedback. The data of daily app login, CB-PHQ-9 scores, and self-reported physical location will be automatically recorded by the app.

Results: Preliminary results will be available by the time of the CHC 2017 meeting. The IRB of this pilot study is currently under review at BIDMC.

Conclusions: Preliminary results will be available by the time of the CHC 2017 meeting. The IRB of this pilot study is currently under review at BIDMC.

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KEYWORDS

Smartphone apps; Cultural psychiatry; Asian American; Depression

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