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Development of an Integrated Mobile Application for Evaluating Voiding Dysfunction: A Proof of Concept Study

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Abstract

Introduction: Bladder voiding diaries are an important part of evaluating and managing lower urinary tract symptoms but are subject to poor data quality and diary completion rates. Mobile health technology is increasingly prevalent and can help overcome the problems of traditional paper and electronic diaries.
Methods: We identified proof of concept design principles based on a literature review and needs assessment. An electronic application was developed to improve self-assessment and symptom management for patients with voiding dysfunction. We analyzed application distribution and use patterns for 12 consecutive months.
Results: We designed an electronic application with complete mobile device integration containing a voiding diary, incontinence tracker and AUA Symptom Score questionnaire. Users could enter and modify details about the volume and frequency of voiding events, including leakage and pad use. Data could be electronically shared with providers. Integrating the application on the Apple® iOS and Android™ mobile operating systems eliminated the need for patients to carry or learn to use a separate device. During the 12-month study period 1,868 unique visitors from 18 countries downloaded the mobile application and made a total of 13,145 subsequent visits.
Conclusions: This application for evaluating voiding dysfunction leverages mobile technology to overcome the limits of paper and standalone electronic formats. Domestic and international users downloaded the application and consistently logged return visits. Using mobile health in urology practices may help patients and providers better manage lower urinary tract symptoms and achieve improved control.

Key Words: urinary bladder, lower urinary tract symptoms, cell phones, mobile applications, questionnaires

Abbreviations and Acronyms

AUA = American Urological Association

EHR = electronic health record

Lower urinary tract symptoms are a common presenting complaint in male and female patients at urology clinics. Keeping a bladder voiding diary as part of a comprehensive evaluation and while monitoring the effect of interventions is recommended by the AUA[1] and ICS (International Continence Society).[2] Although voiding diaries can reliably assess voiding frequency,[3] traditional paper diaries have inconsistent patterns of data entry, poor overall completion rates and a lack of validation among numerous diary variations.[4–6]

Electronic voiding diaries were proposed to overcome these challenges. Previous studies demonstrated the acceptability of the electronic format among patients[7–9] and its superior ease of use.[9,10] In these studies the diary was programmed on a dedicated handheld device that patients carried with them. Improved usability was attributable to the device being less cumbersome than paper diaries.[9] Some providers also perceived greater accuracy and data completeness in the electronic format.[10] However, these devices have other difficulties. Patients must learn how to operate the device and carry it consistently and they can only transmit data physically in the clinic.

The increasing prevalence of personal mobile technology has the potential to make electronic diaries more patient

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centered for the diagnosis of voiding dysfunction.[11] Integrating diaries in Internet connected smartphones and tablet devices may build on user familiarity with data entry interfaces and allow for wireless data sharing with providers. A mobile application focused on voiding dysfunction could also promote symptom awareness and self-care, strategies that improve the management of numerous chronic diseases.[12]

The aims of this study were to 1) develop an electronic application with mobile device integration for evaluating and managing voiding dysfunction, and 2) characterize the distribution and use patterns of the application.

Materials and Methods

We used a proof of concept design to develop, test, distribute and assess use data for an electronic application consisting of a voiding diary, incontinence tracker and the AUA Symptom Score questionnaire.[13]

The application was programmed using Objective-C 2.0 (9magnets, Valparaiso, Indiana) and translated for the Apple iOS and Android operating systems. We performed functional prototyping and iterative testing during interface development to increase ease of use. The completed application was accepted by the Apple App Store and Google Play™ distribution platforms for iOS and Android, respectively. To maximize accessibility we made the application freely available for download.

From January to December 2012 anonymous use data were tracked using Google Analytics™. No health data entered by users were collected. We used descriptive statistics to analyze distribution and use trends.

Concord Hospital granted institutional review board approval for this study.

Results

An electronic application called Bladder Pal was developed and made available for public download. Based on needs assessment of the existing literature and the consumer market we outlined 5 proof of concept principles with the goal of improving patient symptom awareness and self-management. 1) Leverage relevant technologies in the application design. 2) Focus on self-management parameters. 3) Optimize interface usability. 4) Maximize user reporting of symptoms and management. 5) Target cost-effective solutions compatible with mass distribution. The Appendix shows application functions based on these principles.

Design of Application and Mobile Integration

The figure shows the user interface of the main functions, including the summary screen, voiding diary and AUA Symptom Score questionnaire. The summary screen shows daily intake, output, incontinence episodes and the most recent AUA Symptom Score. The summary automatically updates when new data are entered. An e-mail function sends a spreadsheet of stored data to any recipient.

The voiding diary function allows users to record daily intake and urinary output, urinary leakage episodes and number of incontinence pads used. Intake and output are entered by volume. Each output event may also be classified as a leak episode and information that a pad was used could be included. Date and time are automatically attached and erroneous entries can be deleted at any time.

The AUA Symptom Score function guides users through the standardized questionnaire regarding lower urinary tract symptoms. It calculates a total score and characterizes symptoms as mild, moderate or severe. The dates and results of past scores may be accessed and updated by users.

The application features a simple user interface with plain English text, large font size and wide touch buttons. The minimal number of screens improves navigation and helps orient first time users. Users can navigate the application using the finger swipe and data entry techniques of the native operating system.

Distribution and Use Trends

The application was downloaded by 1,868 unique users of the iOS and Android operating systems, based in a total of 18 countries (table 1). Users made a total of 13,145 return visits to the application during the data collection period (table 2). Twice as many iOS users downloaded the application as

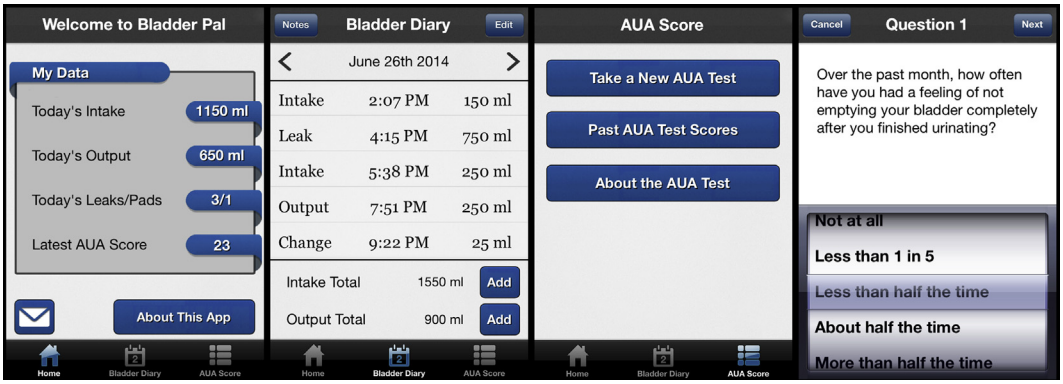

Figure. Application user interface shows summary screen, voiding diary, and AUA Symptom Score menu and questionnaire

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