Can mHealth Improve Risk Assessment in Underserved Populations? Acceptability of a Breast Health Questionnaire App in Ethnically Diverse, Older, Low-Income Women.

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Abstract

Background: Use of mobile health (mHealth) tools has expanded rapidly but little research has been done on its acceptability by low-income, diverse, older patient populations.

Objective: To assess the attitudes of a diverse group of underserved women on the acceptability and usability of mHealth tools in a clinical setting using a breast health questionnaire application (app) at a public hospital mammography clinic.

Methods: Semi-structured interviews were conducted in a breast-imaging center of an urban safety net institution from July-August 2012. Interviews included pre- and post-questions. Women completed the Athena breast health questionnaire app on an iPad and were asked about their experience and ways to improve the tool.

Results: Fifteen women age 45-75 years from diverse ethnic and educational backgrounds were interviewed. The majority of women, 11 of 15, preferred the Athena app over a paper version and all the women thought the app was easy to use. Two Spanish-speaking Latinas preferred paper; and two women, with limited mobile phone use, did not have a preference. Many women indicated that it would be necessary to have staff available for instruction and assistance if the app were to be implemented.

Conclusions: mHealth tools are an acceptable, if not preferred, method of collecting health information for diverse, older, low-income women. Further studies are required to evaluate the reliability and accuracy of data collection using mHealth tools in underserved populations. mHealth tools should be explored as a novel way to engage diverse populations to improve clinical care and bridge gaps in health disparities.

Keywords

mHealth; breast cancer risk assessment; health disparities

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INTRODUCTION

The clinical uses of mobile health (mHealth) are broad and have expanded rapidly over the past decade but there has been little research on how useful these tools are across patient populations. The ubiquity of cell phones and touchscreen technology presents the opportunity to use mHealth tools to bridge gaps in health disparities if underserved communities accept and can easily use such tools. The Pew Research Center has reported that African Americans and English-speaking Hispanics are the most active users of the mobile web, have higher rates of cell phone ownership, and use more cell phone applications (apps) (Smith, 2010). However, there are concerns that non-English speaking, low-income, and older patients will be isolated from the benefits of mHealth or will not be accepting of its adoption in clinical practices.

Few studies have evaluated the use of touchscreen technology for health questionnaires and have found that a majority of patients prefer the touchscreen to paper, including those with low health literacy and minorities (Vargas, Robles, Harris, and Radford, 2010; Hahn, Cella, and Dobrez, 2004). Additionally, studies have shown that older patients are able to use interactive touchscreen web-based software with an improved performance time as compared to a mouse (Patrick and Hsu, 2005; Lin, Neafsey, and Strickler, 2009) and that the electronic information may be more accurate than paper surveys (Vargas et al, 2010). These studies demonstrate that mHealth tools, if well designed, can be more efficient and accurate, highlighting the opportunity to help bridge gaps in disparities.

mHealth tools also provide the opportunity to radically impact the collection of patient data used for clinical care, leading to improved and more informed healthcare encounters. Studies have shown that minorities have lower participation rates in breast cancer risk reduction education and genetic testing, when appropriate, likely from the combination of a lack of information and fewer referrals to genetic counselors (Des Jarlais, Kaplan, Haas, Gregorich, Pérez-Stable, and Kerlikowske, 2005; Levy, Byfield, and Comstock, 2011; Meyer, Anderson, and Lacour, 2010; Armstrong, Micco, Carney, and Stopfer, 2005). Improved data collection allows for the opportunity to engage minority communities in prevention by increasing risk assessment and genetic counselor referrals when appropriate.

A breast health questionnaire app was developed by the Athena Breast Health Network for breast cancer risk assessment in the mammography setting. The aim of this study was to determine the acceptability and usability of this novel mHealth tool through semi-structured interviews, survey, and participant observation at a public hospital breast-imaging center serving a diverse, low-income population.

METHODS

This study consisted of a mixed-methods approach including semi-structured interview, survey questions, and participant observation. As the aim of this study was to assess the attitudes of a diverse group of underserved women on the acceptability and usability of mHealth tools, this integrated study design was purposefully selected to collect robust data regarding the context and diverse perspectives of this population around this topic. Given this focus, participants' risk assessment was not calculated.

<u>Study Participants and Setting</u>

Fifteen semi-structured interviews were conducted with women using the Athena app from July to August of 2012 in the breast-imaging center of an urban safety net institution. Full

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IRB approval was obtained from the University of California, San Francisco. Eligibility included English and Spanish speaking women over 40 years old who were able to fill out health forms without assistance. The ability to fill out health forms without assistance was determined by whether a patient independently completed the paper breast health questionnaire that all clinic patients are required to fill out prior to mammography. Women were excluded if they had a previous breast cancer diagnosis. The imaging center serves a diverse patient population, which enabled enrollment of women from various racial and ethnic backgrounds. A sample of 15 women was determined to be a reasonable sample size due to our limited funding and short timeline before the tool was implemented. Because of the nature of the interviews, the time needed for each participant was approximately one hour.

mHealth Tool

The mHealth tool used for the interviews was a breast health questionnaire app designed by the Athena Breast Health Network, a collaboration of the five University of California medical centers. The Athena Breast Health Network aims to assess the risk of breast cancer among women receiving mammograms across California with the Athena Breast Health Questionnaire administered either through an internet based survey prior to appointments or with an iPad app at the mammogram visit. The app presents one question on the screen at a time and captures data on personal health, demographics, lifestyle, family history, and breast cancer risk to incorporate several risk prediction models (Figure 1). The Athena app is currently available in English and Spanish with plans to expand to other languages.

Figure 1. *Sample Screenshots of Athena App*

Recruitment and Data Collection

As standard practice, women completed a paper breast health questionnaire before their mammography. This paper questionnaire was designed by the San Francisco Mammography Registry (SFMR), established by the National Cancer Institute Breast Cancer Surveillance Consortium (BCSC) (Ballard-Barbash, 1997). Women who were able to complete the paper breast health questionnaire without assistance were invited to participate in the study and, if interested, were consented while waiting for their mammogram. After women completed their mammography appointment, they were invited to a private conference room located in the center where we conducted the interviews and observed women using the Athena app.

An interview guide, written in English and Spanish, was designed to facilitate the interviews and ask questions before and after completing the Athena app. The interview guide was developed based on a review of the literature and the existing needs for better understanding the beliefs of underserved women regarding the use of mHealth. As a result, the questions, as listed above, established an initial framework from which themes could arise. Four fluent Spanish speakers reviewed the Spanish guide to verify the translation and ensure an appropriate literacy level. The interview guide included a combination of multiple choice, Likert scale, and open-ended questions. Three members of our research team conducted the semi-structured interviews, including a bilingual (Spanish-English) interviewer. The interviewers reviewed the guide in advance and conducted mock interviews prior to the study.

At the start of the interview, women were surveyed about their exposure to technology and their interest and concerns about using an iPad app for answering health related questionnaires. Questions in this section included: Have you seen an iPad or touchscreen tablet before? (Yes or No), interviewer showed the participant an iPad; Have you used a touchscreen before? (Yes or No); What type? (ATM, Grocery check out, Smart phone, Tablet or iPad, Computer, Other), interviewer showed the participant photos of each option; How would you prefer to answer a health questionnaire? (Pen-and-Paper, iPad, Other, Don't know). The interviewer then briefly showed each participant how to use the iPad and asked her to complete the Athena app. Two interviewers recorded notes regarding their observations of the women using the Athena app and compared these notes following each session. The interviewers were also available for assistance if needed.

Once finished, women were asked about their experience and opinion of the Athena app with the following questions:

- What are your opinions about using the iPad to answer a health questionnaire in clinics?
- Do you prefer to answer a health questionnaire by Pen-and-Paper or iPad? How did you like answering the questionnaire on an iPad? How did you like answering the questionnaire with pen-and-paper? (Liked a lot; Liked a little; Indifferent; Not very much; Not at all)
- Would you like or dislike if clinics started using the iPad instead of pen- and-paper? Why?
- What concerns/worries would you have if a clinic used an iPad?
- What was your favorite part about answering on the iPad? What was your least favorite part?
- Did you think it was easy or hard to use the iPad?

- Do you have any idea how we could make the iPad easier to use?
- Did you know how to answer all the questions or did you guess on any of them? Which ones?
- (For Spanish speaking patients) Were there problems with the Spanish translation?
- If offered at a later date, would you be interested in participating in research? If you could use a computer or cell phone to avoid traveling to the research center, how much more likely would you be to participate in research?

The interviewer noted the time it took each woman to complete the questionnaire. Once participants completed the Athena app, interviewers asked each participant to reflect on her experience using the app and her opinions of using mHealth for clinical care or research. Each interview session was audio recorded and later transcribed by a contracted transcriptionist (BITTS - Berkeley Interpreting, Translation & Transcription Services).

Data Analysis

Through detailed analysis of the transcripts, the research team was able to synthesize the feedback from the various participants. The two researchers involved in the analysis had also been present for multiple interviews and had documented their insights through the participant observation process. This gave the researchers initial conceptualization of some of the themes that were emerging throughout the study.

The next step in analysis was a thorough review of the transcripts by one of the researchers. This researcher did an initial read-through of the transcripts and took general notes, or jottings, in the margins to begin summarizing the data and to further conceptualize the emergent themes (Schutt, 2012, Chapter 10; Miles, Huberman, and Saldaña, 2014). Next, the researcher reviewed the transcripts again to assign and document codes throughout the text. The researcher also developed a matrix in Microsoft Excel to organize these codes, sorting these by code name as well as by participant (Miles, et al, 2014).

Once all the transcripts were coded, a second member of the research team, who had been present for all of the interviews, reviewed the coded data and collaborated in the interpretation process to ensure agreement and validation of the themes. Collaboratively the two researchers identified recurrent overarching themes including perceived benefits, perceived barriers, and design considerations. The inclusion of perceived benefits and perceived barriers allowed the data to be understood within the context of the Health Belief Model (Edberg, 2010).

Next, they categorized the original codes as subcategories to each of the three larger themes. During this process, the team combined, condensed, or clarified the original codes to facilitate the analysis. At this stage the researchers also identified how many of the participants provided responses that were consistent with the subcategories and then synthesized the information in the original matrix to present the data all together. Finally, the researchers returned back to the transcripts to identify specific quotes to further illustrate each theme and its subcategories (Miles, et al, 2014).

The team also compiled and quantified the responses to the structured sections of the interview guide to complement the qualitative data allowing for triangulation between data methods. The incorporation of mixed methods allowed for a mechanism to improve credibility of each participant's responses by asking related questions using both a qualitative and quantitative approach (Creswell, Klassen, Plano Clark, and Smith, 2011).

RESULTS

Fifteen women were interviewed, ranging in age from 45 to 79 years, four of whom were Spanish speaking only. Nineteen women were approached to participate and four refused, due to time constraints or disinterest. The level of education for the participants ranged from third grade to graduate school. Demographics of the sample are shown in Table 1.

Table 1. *Demographic Characteristics of Participants*

Race/Ethnicity (N)	
Non-Hispanic White	5
Hispanic	5
Black	3
Asian	2
Primary Language (N)	
English	11
Spanish	4
Age (Years)	
Mean	59.7
Range	45 – 79
Annual Salary (USD)	
Mean	$10,000 - $20,000
Range	<$5,000 - $40,000
Education (Mean Years)	
Overall	12.1
Non-Hispanic White	13.8
Hispanic	7.8
Black	14
Asian	16

Participants' exposure to and use of technology varied greatly. Fourteen women owned a mobile phone while only three of these owned a smart phone. Cell phone usage was generally high, with fourteen of the participants commenting that they use cell phones on a daily basis. Use of the internet and email was also varied. Four women reported that they never use the internet, while seven said that they use it on a daily basis (Table 2). When asked about previous exposure to touchscreen technologies and shown pictures of examples (i.e. ATM, smart phone, tablet), twelve women had used at least one type of touchscreen device and all but one woman had seen a touchscreen before. Similarly, all but one woman had seen a touchscreen tablet, such as an iPad, but only three had previously used one. The average time to complete the Athena app for all women was 16.4 minutes (range, 6.6-35 minutes). The Spanish-speaking women took longer to complete the questionnaire, averaging 24.5 minutes (Table 3).

Table 2. *Participant Prior Technology Use*

Technology Type	Daily	Weekly	Monthly	Not Often	Never
Cell Phone	14	0	0	1	0
Smart Phone	3	0	0	3	9
Touchscreen Tablet	2	1	0	0	12
Email	5	1	1	1	7
Internet	7	0	0	4	4

Table 3. *Time Needed to Complete Athena app (in minutes)*

	Mean (mean)	Range
Overall	16.4	6.6 – 35.0
Non-Hispanic White	14.1	9.0 – 20.9
Hispanic	20.9	6.6 – 35.0
Black	13.8	7.7 – 17.3
Asian	14.8	7.8 – 21.9
English Speaking	13.5	6.6 – 21.9
Spanish Speaking	24.5	12.0 – 35.0

Survey Format Preferences

Eleven of the women preferred answering the Athena app compared to the paper survey. All fifteen women interviewed indicated that the Athena app was easy or very easy to use. Two of the women, both Spanish speaking, preferred the paper version; and two women, both English speaking, had no preference. Three of the four women who did not prefer the Athena app had lower than a tenth grade education. All four women who did not prefer the Athena app were concerned that a clinic would not be able to offer the instruction necessary for them to learn how to use the device or to provide assistance while completing the questionnaire. Themes from the interview transcriptions identified perceived benefits and barriers of mHealth tools prior to use and after use, recommended design features, and implementation considerations. Participants' quotes describing the barriers and benefits of the Athena app can be found in Tables 4 and 5.

Barriers to mHealth

Unfamiliarity with the iPad

Before using the Athena app, numerous women were concerned that they would not know how to use mHealth tools as a result of being older, never having used a touchscreen before, or having limited education. Once women began using the Athena app, initial barriers included unfamiliarity with touchscreen technology and a lack of knowledge with some of the app's functionality such as scrolling. The majority of women needed initial assistance and several commented that if mHealth tools were implemented in the clinic, it would be necessary to provide instruction on how to use the device. However, once instructed, particularly for scrolling, the majority of women easily learned the new skills and thought the Athena app was easy to use. Some women did not initially know how to change an answer if they accidentally selected incorrectly; though once shown that responses could be deselected by touching again or by selecting another response, women quickly applied this skill to future

questions.

Health Literacy and Recall

Additional challenges and barriers that were mentioned while using the Athena app included issues unrelated to technology, such as health literacy and general difficulty with the vocabulary and content of certain questions; knowing or remembering family history; and recalling past medical information. Several participants discussed that these issues were also present with the paper questionnaire completed prior to their mammogram.

Security

Concerns with privacy and security were mentioned only after directly asking the participant if it was an issue. Three of the women, of diverse ethnic backgrounds and mixed levels of previous technology use, discussed their apprehension regarding the security of mHealth information collected with the Athena app. One participant mentioned that she was worried about the potential for data getting mixed up with other respondents while another was concerned about the loss of data because she did not know how to go back and find her answers. However, the majority thought mHealth tools are equally, if not more, secure than paper.

Table 4. *Identified Barriers of mHealth Use*

Barriers	Quotes
Unfamiliarity with and not knowing how to use the iPad / Need for assistance	I'm not nervous, but I'm just concerned about -- I would not know the procedure. 'cause sometimes I'm forgetful. After having a good training and if you have forgotten and someone gives you help, then it is easier. (*Translated from Spanish*) Well, right now I felt it was easy because you are here, who are very, very nice …and… and you have the patience to… to explain how to do it, but perhaps with someone else, I don't know. (*Translated from Spanish*) There was the one you had to help me with but, yeah, it was okay. I suppose if you're working it there would be somebody you could always ask, right?
Health literacy challenges	I think the only… the only thing is that you're using terms that lay people don't use. Like what's the difference between one kind of biopsy and another?
Concern with security or losing data	It might disappear if you don't have them tied down somewhere. [Laughs]

Benefits of the Athena app

Easy to Use and Fun

Women also identified benefits to using mHealth tools. The majority of participants responded that the Athena app was fast and they all commented that it was easy or very easy to use. Many were surprised at how quickly they learned to use the iPad. Features that women particularly liked included: large and easy to read text, the simplicity of only having to use a

finger to touch without needing a pen or pencil, its benefit for those with difficulty writing because of arthritis or neuropathy, and the ease of correcting mistakes. Many reported that the Athena app was "fun" to use and were interested in using smartphones, tablets, and mHealth tools after the experience.

New and Innovative

About a third of the women said that they were excited to use the iPad prior to using it. They were interested in trying something new and up to date and thought that it would be something good for them to learn how to use. Women noted that their children or grandchildren used smartphones and iPads and that they also needed to learn how to use the technology to keep up.

Comparisons to Paper Surveys

Participants made several comparisons to paper surveys. Comments included that the Athena app was clearer to see, more practical, more efficient, that it included fewer questions, that the app would save paper, and that it is not as tiring as the paper version.

Overall, the participants reported a greater number of benefits, as demonstrated by the strong preference for the Athena app. Eight women, changed their preference for completing a paper version of a health questionnaire or being unsure towards favoring the Athena app after using the tool.

Table 5. *Identified Benefits of mHealth Use*

Benefits	Quotes
New, innovative, and up to date	Interviewer: Why do you laugh when I show you that? (showing paper survey) Participant: 'Cause this is antiquated.
Easy to use and fun	Interviewer: And why do you think that it was easy? Participant: Because I can do it and I have never done it before. (*Translated from Spanish*) Interviewer: And what was your favorite part about using it? Participant: Feeling that I am learning to use it.
Need to learn eventually because it will inevitably be used more	I think [the] iPad is probably good to get used to. Yes, my son always tells me: "Mom, learn how to use a phone like this, a digital one". Oh no! I want mine, the old little one. But it is good to know. (*Translated from Spanish*)
Easier to correct mistakes than paper	… the pen and paper, if you make a mistake you got to, you know, more or less correct it and I usually always make some kind of little mistake. On this you can just change it. I liked that.
More secure than paper	If I have an iPad, I save my information, I put a password on it; that I only know. And in another form… It's like with a credit card; if only you know your code, no one is going to take out your money. (*Translated from Spanish*)

Clearer to see and easier to provide answers legibly	I liked it because it was easier to read, easier… easier to move the… Sometimes your writing is not clear and that makes it clear. … the print usually is small and you can adjust it on the tablet.
More practical and efficient	Because in many occasions you have little time to be there at your appointments and so it is faster and more practical to use the iPad. And then, a lot of times you don't bring… there isn't a pen or pencil available, and so it is very easy to use… You don't need paper, you don't need a pen. (*Translated from Spanish*)

Recommendations for mHealth Application Design and Implementation
Literacy Considerations

Based on women's comments and our observations, we found several areas that should be considered in mHealth app design to be easier to use and relevant for an older, low-income patient population (Table 6). Recognizing the difficulty that some women had with the vocabulary or wording of questions emphasizes the point that all health surveys, regardless of format, need to be written at an appropriate literacy level to meet the needs of participants with diverse educational backgrounds.

Availability for Instruction and Assistance

If implemented in a clinic, most women need brief instruction on how to use touchscreens, less than one minute, and a person available for questions. Several women explained that having support to practice new skills while using the Athena app would allow them to eventually become more independent.

Limit New Skills

The design of each question is an important component to ensure ease of use among a population with limited experience with various technologies. Women learned new skills on the iPad such as free text entry or scrolling fairly easily, but many needed to ask for instruction with each new skill. Reducing the number of different question formats used throughout the app would limit the number of skills (i.e. checking boxes, highlighting answer, scrolling horizontally or vertically, free text entry, zooming, or other touchscreen functions) necessary for completing the questionnaire. Respondents had initial difficulty with questions that necessitated scrolling down a page as they often thought that an appropriate response was not listed until they were shown that there were more options that were not initially visible. Free text entry intimidated some women and many did not know commands such as "space bar" or "return" to proceed to a new line or to submit their response. Limiting the need for these functions would improve the ease of using mHealth tools and decrease the time per question, particularly for respondents with limited experience with touchscreen technologies.

Special Considerations

A few women, especially immigrants and Spanish speaking patients, had difficulty with questions that asked for weight in pounds or height in inches due to greater familiarity with centimeters and kilograms. mHealth tools should be able to use both U.S. and metric measurements. Participants also expressed the importance of using large fonts or of including a zooming capability to increase visibility of the text. Most women preferred using their finger but a few liked the option of a stylus, especially the 74 year old participant with low levels of previous technology use. Another challenge was that one slow touch on the Athena app could

select and deselect responses, demonstrating that devices and apps need to be appropriately calibrated for slower movements that some older users may have.

Table 6. *Recommendations for mHealth tools for diverse population*

Questionnaire/ Administration	- Ensure appropriate literacy level of questions - Provide instruction and assistance - Provide a tutorial to practice touchscreen skills - Maintain good survey practices including appropriate literacy level and choice of measuring units (metric and US).
Application Design Characteristics	- Large font or zooming capability - Consistent format with limited new skills* for questions - Calibrate touch for slower movements - Indicate where to select an answer choice - Limit use of scales or selecting an answer over a continuum - Limit free text entry - Easy transition from question to question - Provide summary option for patient such as a printout

* New skills include checking boxes, highlighting answer, scrolling horizontally or vertically, zooming, or other touchscreen functions

DISCUSSION

The goal of this study was to assess the attitudes of low-income, diverse, older women on the acceptability and usability of mHealth tools in a clinical setting. Overall we found that this patient population enjoyed using mHealth for breast risk assessment and the majority of participants actually preferred the Athena app to the paper format.

This study is consistent with other work that suggests diverse populations have positive attitudes toward mHealth tools and that they feel comfortable using such tools. McGillicuddy et al. 2013, studied the use of an mHealth tool to remotely monitor renal transplant patients and found that the majority of patients had a positive attitude toward the tool as long as it came at no cost to them. As in our study, most patients owned and were comfortable using some form of mobile technology (McGillicuddy, Weiland, and Frenzel, 2013). Another study of parents of asthmatic children using a touchscreen health questionnaire with a majority of low-income Latino participants found that participants had a preference for touchscreen over paper and even had higher concordance to a nurse interviewer with a touchscreen (Vargas et al, 2010). Our study is novel in examining women's use of other technology and their comfort with such mHealth tools. As expected, women who used mobile technology or the internet more frequently had a greater preference and level of comfort with the Athena app.

Education level and English language were also associated with comfort and acceptance of the mHealth app. Surveys have shown that gains in mobile technology use by Latinos are limited to English-speaking Hispanics as language proficiency is one of the most powerful predictors of internet use (Smith, 2010). Although the Athena app was available in Spanish and English, our study demonstrated a greater comfort of English speakers with the app; however, a larger study is needed to confirm these findings. There is a concern that the increasing use of mHealth tools will not be accessible for underserved populations or

culturally and linguistically diverse populations (Tirado, 2011; Whittaker, 2012). Spanish-speaking Latinas in our population enjoyed and were able to complete the Athena app with assistance but had more reservations about mHealth tools becoming the standard of care.

Many of our study participants believed it was beneficial for them to learn how to use touchscreen devices and mobile technology. Women viewed participation in this study as an opportunity to learn how to use a new technology and were excited to use the Athena app on the iPad. Although most participants initially indicated that they preferred using paper for completing health forms, it was encouraging that most of these participants changed their preference to the Athena app after using it. All the women who previously thought they would not prefer the Athena app were surprised at how easy it was to use, and the short amount of time needed to learn how to use an iPad. Our study's findings that this population had high levels of interest to learn to use new technology as well as their ability to quickly learn to use the Athena app, demonstrates an opportunity to engage this population in mHealth through appropriate interventions and education programs.

Studies such as ours are important to demonstrate that diverse, low- income populations are interested in and accepting of mHealth tools but such tools must be appropriately designed and implemented to ensure equitable access. Women's comments about the benefits and barriers to using the Athena app were informative to redesign and improve the mHealth tool.

The importance of patient navigation in medically underserved clinical settings should not be overlooked even with potential applications of mHealth and other technologies. Almost all of the participants indicated that they felt it would be necessary to have staff provide initial instruction and to be available for assistance with questions that arose while using the app. While design improvements may reduce the need for assistance, it appears that the availability of clinic staff will be essential to the implementation of mHealth tools, especially in populations less familiar with touchscreen technology. Development of short games or primers for patients who are unfamiliar with touchscreens to use before using an mHealth app may be of great benefit for this population to teach touchscreen skills and increase self-efficacy.

Limitations of our study include the small number of interviews we conducted. The importance of the semi-structured interviews was to understand women's initial attitudes toward the Athena app in a more descriptive way and to identify any significant barriers before performing additional research. Through the interviews, we were able to gain a better understanding of women's concerns, likes, and dislikes of the tool as well as their recommendations for improvement.

A research assistant was available for women to ask questions while she completed the Athena app. In a true clinical setting, the availability of staff to answer questions may be more limited and change the experience for women unfamiliar with touchscreen technology. Another limitation of our study is the possibility of a technology bias of those who participated although participants had diverse technology exposure. Women who are more interested or curious about mHealth or the iPad would likely participate but women who declined may have been intimidated or less receptive. To address these limitations, we are currently in the process of conducting a pilot study to assess the usability and reliability of the Athena app compared to the paper questionnaire. Our pilot study will better address a participation bias as women will participate in the study while they wait for a mammogram and time restrictions will not be a valid reason to not participate.

The finding that women in our study preferred the mHealth app over paper is

encouraging given the relatively low-cost and wide accessibility of mobile technology that contribute to its popularity among minority populations. This makes mobile devices a great target for health interventions including breast cancer risk assessment and prevention. Such mHealth apps have the potential to fundamentally impact the current forms of collecting patient data, connecting with patients, and engaging minority communities. Such use of mHealth is an exciting new frontier in medicine with many opportunities particularly to bridge gaps in health literacy and disparities. Designing mHealth tools that are appropriate for diverse, low-income, older populations will broaden approaches to reach out to underserved communities and decrease inequalities in care.

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