



Tablet-based collection of patient-reported data in diverse, low-income populations: A case study in breast cancer risk assessment

Journal of Health Disparities Research and Practice

Volume 11 | Issue 3

Article 5

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2018

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Recommended Citation

O'Donoghue, Cristina; Kaplan, Celia P.; Howe, Rebecca; Esserman, Laura J.; Perez-Stable, Eliseo J.; and Ozanne, Elissa M. (2018) "Tablet-based collection of patient-reported data in diverse, low-income populations: A case study in breast cancer risk assessment," *Journal of Health Disparities Research and Practice*: Vol. 11: Iss. 3, Article 5.

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Abstract

Background: Tablets and other technologies are evolving tools to collect personalized health data. However, the quality of data collected by these tools in vulnerable populations is unknown. We explore the acceptability and reliability of a Breast Health Questionnaire app's use by diverse, low-income women against a pen/paper survey.

Methods: Women who spoke English or Spanish were recruited to complete a tablet and a paper/pen questionnaire prior to their screening mammography. The usability and reliability of the BHQ app were assessed and analyzed.

Results: Of 116 women, 94 (81%) found the app easy to use. Reliability between the app and the pen/paper questionnaire ranged from substantial to perfect agreement.

Conclusions: Women of a diverse, older, low-income population found the app acceptable and easy to use with high reliability. All patients preferred the tablet, suggesting that tablets can aid in the collection of health information and personalized risk assessments for minority populations.

Keywords

Vulnerable Populations; Precision Medicine; Risk Assessment; Tablets; Breast

Cover Page Footnote

Acknowledgements Funding for this study was supported in part by the University of California at San Francisco Center for Aging in Diverse Communities grant no. P30-AG15272 under the Resource Centers for Minority Aging Research program of the National Institute on Aging, the University of California Office of the President, the Safeway Foundation, the Avon Comprehensive Breast Cancer Center at San Francisco General Hospital and the Avon Foundation for Women. Dr. O'Donoghue's time funded in part by the University of Illinois at Chicago Eleanor B. Pillsbury Fellowship. This study was conducted as part of the Athena Breast Health Network, a collaboration across the five University of California medical centers (athenacarenetwork.org). Thank you to Alyse Wheelock and Carolina Bravo for helping to administer the questionnaires; Barbara Grimes, PhD and Jennifer Livaudais-Toman for help with the statistical analysis; and the Patient Navigators at Avon Comprehensive Breast Cancer Center at San Francisco General Hospital. The contents and views in this manuscript are those of the authors and should not be construed to represent the views of the National Institutes of Health or any of the sponsoring organizations and agencies of the US government.

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Journal of Health Disparities Research and Practice
Volume 11, Issue 3, Fall 2018, pp. 59-74

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ABSTRACT

Background: Tablets and other technologies are evolving tools to collect personalized health data. However, the quality of data collected by these tools in vulnerable populations is unknown. We explore the acceptability and reliability of a Breast Health Questionnaire app's use by diverse, low-income women against a pen/paper survey.

Methods: Women who spoke English or Spanish were recruited to complete a tablet and a paper/pen questionnaire prior to their screening mammography. The usability and reliability of the BHQ app were assessed and analyzed.

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Conclusions: Women of a diverse, older, low-income population found the app acceptable and easy to use with high reliability. All patients preferred the tablet, suggesting that tablets can aid in the collection of health information and personalized risk assessments for minority populations.

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INTRODUCTION

Personalized medicine is rapidly emerging as a new standard, where patients' care is informed by their clinical, social determinants, and genetic information (Ginsburg & Willard, 2009; Offit, 2011). A critical component of personalized medicine is an accurate medical history,

Journal of Health Disparities Research and Practice Volume 11, Issue 3, Fall 2018

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specifically family history in the field of breast cancer and breast cancer screening (Amir, Freedman, Seruga, & Evans, 2010; Murff, Spigel, & Syngal, 2004). Breast cancer risk assessments facilitate personalized medicine through appropriate screening strategies, consideration for chemoprevention and referrals to high-risk clinics for genetic counseling, but are often cumbersome for patients to complete requiring lengthy interviews of detailed family history.

The most efficient method for collecting this type of personalized data is often from the patient directly (Murff et al., 2004). Mobile apps, or application software designed to run on mobile devices such as smartphones or tablets, can be used to collect such information. However, as with most forms of technology, concerns exist about using mobile computing devices to collect these data directly from patients in all segments of the population, including older, limited health literacy, minority, and low-income individuals (Livingston, 2010). We know that minorities and older adults have difficulty with or choose not to access health portals at the same rate as non-minority and younger adults. Specifically, tablet computers are used more by younger adults with higher levels of education than other populations. Additionally, Whites are more likely to own tablets than Hispanic/Latinos (Anderson, 2015). Even though minority groups were less likely to own and use tablets, smartphones are gaining market share across diverse groups (Anderson, 2015; Martin, 2012; Smith, 2013).

Over the past decade, mobile computing, whether on smartphones, tablets, or other devices, has rapidly expanded (Bauer et al., 2014). Although 68% of adults reported owning a smartphone (Anderson, 2015) and 51% reported owning a tablet computer (Purcell, 2011) there are still concerns about how well these technologies might be accessible or embraced by diverse and older adult populations. Although ownership of mobile computing devices among diverse populations may not be as prevalent as their White counterparts, the use of these devices to access health care information is more likely as minorities use their smartphones to access health information more often than other groups (Smith, 2015), to track their health (Anderson, 2015), and to download health-related apps (Fox, 2011; Purcell, 2011). In a separate study on use of these technologies among primary care patients in the northwest United States, their use was not associated with race/ethnicity or health literacy, suggesting these tools may reach traditionally underserved populations and may have a role in reducing disparities in care (Bauer et al., 2014). This gives credence that the use of tablet computers to collect personalized health data may be a useful tool to patients and providers.

Various research has gone into different methods of data collection, comparing devices such as tablets and handheld computers to paper (Lane, Heddle, Arnold, & Walker, 2006; Shelby-James, Abernethy, McAlindon, & Currow, 2007). With the increased prevalence of tablet computers, their usability compared with paper methods has begun to be explored, but results have been inconclusive. While users may prefer to use handheld devices (Lane et al., 2006), there are conflicting findings on whether the use of apps improves completeness, time to complete self-administered survey questionnaires, data accuracy, or response rates (Marcano Belisario et al., 2015). An app can be designed to suit the needs of the desired data to be collected and can, for instance with a survey, use tools such as branching logic to facilitate and improve the quality of data collection.

The use of tablet-based questionnaires have the potential to streamline and ease collection of complex personalized information. Conversely, attempting to use a tablet to collect risk information could have unintended consequences if women are unwilling or unable to use such tools, leading to a decrease in completion of risk assessments and appropriate care. The acceptability as well as the reliability of the information are key to the successful use of these tools. To that end, we evaluated a breast health questionnaire (BHQ) app to conduct a personalized breast cancer risk assessment in the mammography setting. Given the limited research on the feasibility or usefulness of tablet computers for data collection within diverse patient populations, we aimed to explore the use of a tablet-based app for breast cancer risk assessment in a racially and ethnically, low-income population. The purpose of our study was to determine the acceptability and reliability of the BHQ app at a safety net hospital mammography center serving diverse, low-income women, and to determine its reliability against a pen-and-paper survey collecting the same information.

METHODS

Study Design and Population. Women were recruited from July 2012–January 2013 in the Avon Comprehensive Breast Care Center at San Francisco General Hospital (SFGH), which is the safety net hospital serving San Francisco. SFGH provides healthcare for individuals regardless of their insurance status or their ability to pay. Eligibility was determined by meeting the following criteria: women age 40 or older, English or Spanish speaking, scheduled for a screening mammogram, no personal history of breast cancer, and comfortable filling out forms alone as an evaluation for health literacy (Chew et al., 2008).

Breast Health Questionnaires. The tablet tool used for the interviews was a breast health questionnaire (BHQ) app designed by the Athena Breast Health Network, a collaboration of the five University of California medical centers. The Athena Breast Health Network routinely assesses the risk of breast cancer among women receiving mammograms at their medical centers. The BHQ app has been previously validated (Bravo, O'Donoghue, Kaplan, Luce, & Ozanne, 2014). Questions are presented one at a time through the app and it captures data on personal health, demographics, lifestyle, family history, and breast cancer risk to incorporate several risk prediction models. The BHQ app used for this study had at least a total of 42 questions that could increase based on the size of an individual's family and cancer history in the family through branching logic. After completion of the BHQ app, the data entered is uploaded and stored in a secure cloud managed by the University of California, San Francisco (UCSF). The app is currently available in English and Spanish.

The pen-and-paper questionnaire used in this study is the San Francisco Mammography Registry (SFMR) BHQ scantron form, established by the National Cancer Institute Breast Cancer Surveillance Consortium (BCSC) (Ballard-Barbash, 1997). It is 17 questions in length and is standardly administered before mammography. All women obtaining a mammogram in the San Francisco Bay area must complete the SFMR BHQ prior to their mammogram.

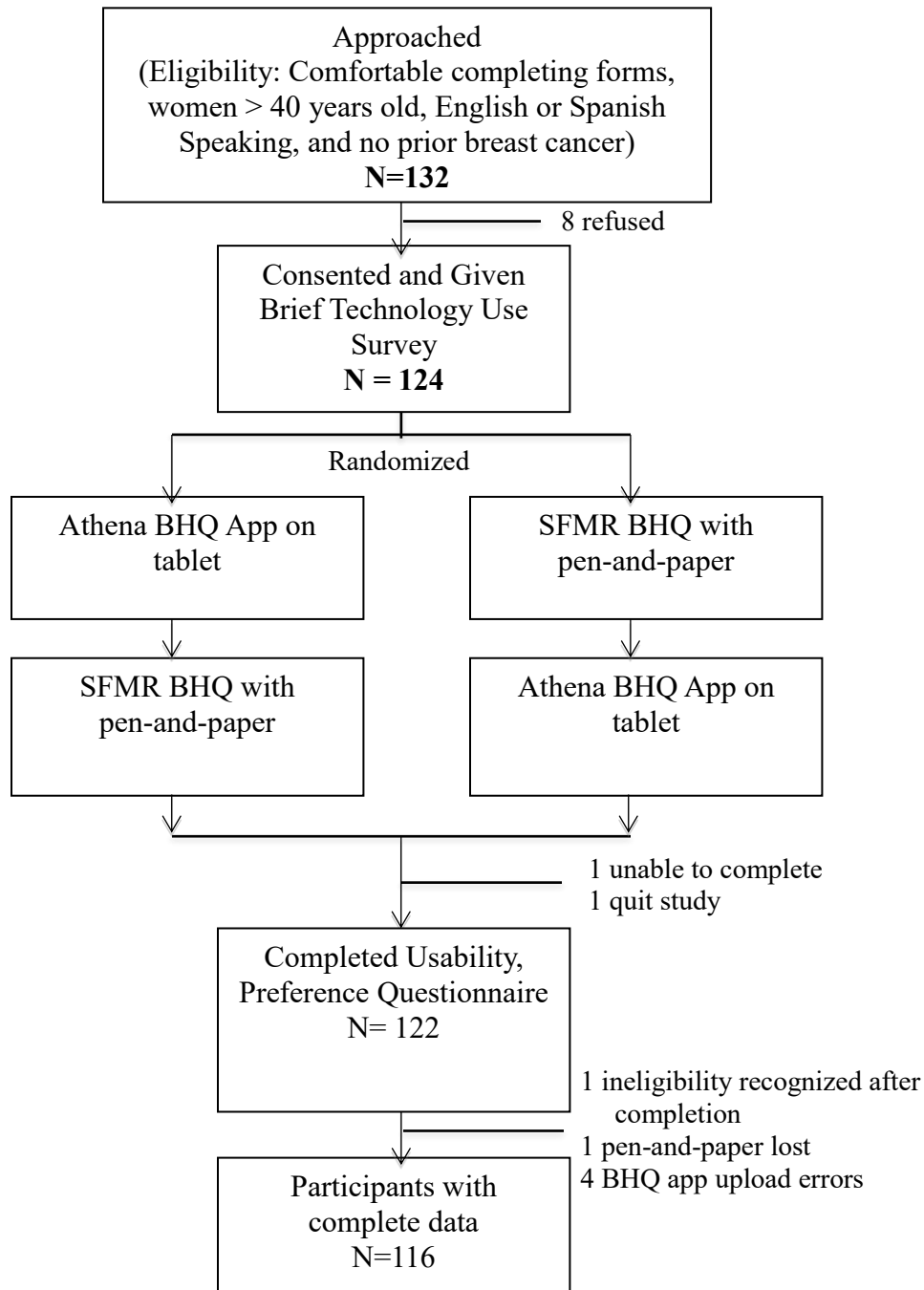
Procedures. After checking in, women were approached in the mammography waiting room and asked if they needed assistance with health forms. Women who indicated they could independently complete forms were then asked to participate in the study and consented. Women

chose which language, Spanish or English, they preferred. They completed a survey assessing their current use of technology and interest using a tablet to complete a BHQ. Participants were then randomized to complete the BHQ app or the pen-and-paper questionnaire first. Random sequence codes, stratified by race/ethnicity to ensure balance, were used for the assignment of each group. Study staff timed and observed participants while they completed the questionnaires, noting any errors or frequently asked questions. Immediately after finishing both questionnaires, participants completed a second survey assessing ease of use and interest in the two questionnaire formats.

Upon completion of the study, participants received a twenty-dollar gift certificate. All surveys and questionnaires were completed in the waiting room prior to mammography. The study protocol was approved by human subjects review committees at SFGH and UCSF. Full study scheme is shown in Figure 1.

Analysis. The two main outcomes analyzed were the usability and the reliability of the BHQ app compared with the pen-and-paper questionnaire. Usability was determined by evaluating the completion rate and time in minutes to finish each questionnaire. The reliability of participant responses across both questionnaires was determined through kappa statistics. Subgroup analyses were completed to assess differences by race/ethnicity. Descriptive analyses were conducted to examine previous technology use and interest in the two questionnaire formats. We conducted all analyses in Stata Version 11.2.

Fig. 1 Study Enrollment Flow Chart



RESULTS

Study Population. The final study population consisted of 116 women. Initially, 132 women were approached, 124 women consented, two women dropped out while completing the BHQs, one woman was ineligible because of prior breast cancer diagnosis recognized after consent, one woman's pen-and-paper BHQ was not collected, and four women's data did not properly upload from the BHQ app to the cloud. Of the two women who dropped out while completing the questionnaires, one was unable to complete either the BHQ app or the pen-and-paper questionnaire independently while the second declined to continue the study (Fig. 1). Women were from diverse racial backgrounds and had varying education and technology exposure (Table 1). Women's ages ranged from 40-74 years and 22% (n=26) were Spanish speaking only.

Patient characteristics by race/ethnicity. Patient characteristics by race/ethnicity are presented in Table 1. White and Asian women were the most likely to have a college education or higher (64% (n=74) and 43% (n=50), respectively) while Latinas had the lowest level of education with 38% (n=44) having less than a high school education (p<.001). This percentage was even higher among Spanish-speaking Latinas (54% (n=63); results not presented in table format). Receipt of prior mammogram was similar across groups, ranging from 87% (n=101) of Latina women to 92% (n=107) of White women (p=.932). While cell phone and smart phone use were similar across groups (p=0.200 and 0.775, respectively), tablet/iPad use varied, with only 24% (n=28) of Latinas reporting use versus 40% (n=46) of White women although this difference was not statistically significant (p=0.484). Of note, only 9% (n=10) of Spanish-speaking Latina women reported tablet/iPad use compared to 55% (n=64) of English-speaking Latinas.

Acceptability and preferences. After completing the BHQ app and pen-and-paper questionnaires, most women (81%, n=94) rated the BHQ app to be easy or very easy, while a few (3%, n=3) found it to be difficult or very difficult (results not reported in table format). At the beginning of the study prior to using the BHQ app, the majority of women (52%, n=60) preferred a pen-and-paper version as opposed to the BHQ app (30%, n=35). After using the BHQ app, many women's preferences changed and the majority (71%, n=82) preferred the BHQ app to the pen-and-paper version (14%, n=16). Thirty-three percent of women (n=38) changed their preference of answering a BHQ from pen-and-paper to the BHQ app regardless of which method was used first.

Performance and reliability. Women were timed using both the BHQ app and pen-and-paper questionnaire with results presented in Table 2. The BHQ app had more questions (a minimum of 25 more questions), which varied with branching logic, and took an average of 6.5 minutes longer to complete. White women were significantly faster than other groups at completing both modalities, while Spanish speaking Latinas were slowest with both questionnaires. Table 3 presents results from multivariate models exploring racial/ethnic differences in time to completion for a) the BHQ and b) the pen-and-paper survey, adjusting for education. Racial/ethnic differences in time to completion remained; Latina women took longer than White women to complete both versions of the survey and Black and Asian women took longer than White women to complete the BHQ. Overall, the BHQ app completion time divided by the pen-and-paper questionnaire completion time (i.e., completion time ratio) was equal to 2.41 and there was not a significant difference in this time ratio between racial/ethnic groups.

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The reliability of answers submitted by women on the BHQ app and pen-and-paper questionnaire consistently ranged from substantial agreement to perfect agreement with most having almost perfect agreement (Table 4). Women had most consistent agreement between the BHQ app and pen-and-paper questionnaire answering questions on their family cancer history for primary relatives (mother, sister, daughter) and rare events such as ovarian cancer and male breast cancer.

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Table 1 Patient Characteristics by Race/Ethnicity, San Francisco General Hospital

Total (N=116)	White	Black	Asian	Latina	Total	p-value
	N=26 (22%)	N=30 (26%)	N=24 (21%)	N=36 (31%)	N=116	
Age (years)						
40-50	16%	14%	4%	31%	17%	.120
50-60	42%	53%	54%	50%	50%	
60+	42%	33%	42%	19%	33%	
Mean age in years (SD)	58 (7)	57 (8)	57 (7)	53 (8)	56 (8)	.098
Education						
Some high school or less	4%	14%	13%	38%	19%	<.001
High school graduate	12%	32%	9%	29%	22%	
Some college or technical	20%	39%	35%	21%	28%	
College graduate	64%	14%	43%	12%	31%	
Had prior mammogram	92%	89%	91%	87%	90%	.932
Technology Exposure						
Cell phone	100%	100%	92%	97%	97%	.200
Smart phone	60%	57%	46%	53%	54%	.775
iPad/Tablet	40%	28%	38%	24%	31%	.484

*Percentages based on non-missing values

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Table 2 Completion time of BHQ App and pen-and-paper by race/ethnicity, San Francisco General Hospital

	BHQ app		Pen-and-paper Questionnaire	
	Total time (min)*	Minutes per question* (62 questions)	Total time (min)*	Minutes per question* (37 questions)
Mean time				
Overall	11.8	0.19	5.3	0.14
White	8.8	0.14	4.0	0.11
Latina	13.9	0.22	6.5	0.18
Spanish	14.8	0.24	7.2	0.19
English	11.8	0.19	4.9	0.11
Black	11.8	0.19	5.5	0.15
Asian	11.7	0.19	5.2	0.13

*p<.01

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Table 3 Racial/ethnic differences in time to completion between BHQ app and pen-and-paper questionnaire

	Minutes to Complete BHQ app		Minutes to Complete Pen-and-paper Questionnaire	
	Coefficient ^a	95% CI	Coefficient ^a	95% CI
White	Reference		Reference	
Latina	4.19*	1.56-6.82	1.64*	0.35-2.93
Black	2.75*	0.14-5.36	1.22	-0.07-2.51
Asian	2.77*	0.18-5.35	1.13	-0.15-2.41

^aadjusted for education level (some or less than high school, high school graduate, some college or technical, college graduate)

*p<0.05

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Table 4 Agreement between BHQ App and Pen-and-Paper Responses

	Pen-and-Paper (%)	BHQ App (%)	Agreement (%)	Kappa*
Family History of Breast Cancer	24%	28%	92%	0.80
Primary Relative (Mother, Sisters, Daughters)	13%	16%	91%	0.66
Secondary Relative (Grandmothers and Aunts)	16%	16%	92%	0.71
Male	4%	3%	98%	0.74
Ovarian	16%	16%	91%	0.69

*Interpretation of Kappa Score 0.81-0.99 almost perfect agreement; 0.61-0.80, substantial agreement; 0.41-0.60, moderate agreement; 0.21-0.40, fair agreement; 0.01-0.20, slight agreement; <0, less than chance agreement.

DISCUSSION

As the need for patient-reported personalized health data and applications for tablets and other technology expand in the clinical setting, it is important to evaluate the accessibility of these devices for older, diverse populations. Our study supports the growing literature that diverse, underserved populations are able to use these applications effectively (Anderson, 2015; Bauer et al., 2014; Fox, 2011; Purcell, 2011; Smith, 2015). In our study a tablet-based app created to develop a personalized breast cancer risk estimate through the collection of breast cancer risk information was found easy to use and acceptable among a population of diverse, older, low-income women at a safety net hospital mammography center. The app was also reliable when measured against a pen-and-paper survey collecting the same information. Our findings suggest that underserved minorities at a public hospital can use tablets in health facilities to complete personalized risk assessments and or other health information. In fact, the tablet-based risk assessments were more acceptable than pen-and-paper versions to all patients (irrespective of race/ethnicity). While Spanish speaking Latina women took longer to complete both versions of the risk assessment than Whites, the time ratio comparing completion time for both the tablet and pen-and-paper did not differ significantly across racial/ethnic groups. Further, Latinas had the lowest levels of education and exposure to iPad/Tablet use, which may explain why this group took longer to complete the risk assessment.

Our findings are consistent with a limited number of studies that have shown vulnerable populations have positive attitudes toward and feel comfortable using mHealth tools (Hahn et al., 2004; Lin, Neafsey, & Strickler, 2009; Rau & Hsu, 2005). A study on the use of an mHealth tool to remotely monitor renal transplant patients (two-thirds of whom were Black) reported that the majority of patients had a positive attitude toward the tool as long as it came at no cost to them (McGillicuddy et al., 2013). Another study using a touchscreen health questionnaire for parents with asthmatic children (the majority of whom were low-income Latinos) demonstrated preferences for the touchscreen questionnaire over paper and the touchscreen had higher concordance to a nurse interviewer than a paper version of the questionnaire (Vargas, Robles, Harris, & Radford, 2010). Our study builds on this prior research by focusing on older, diverse patients and establishing that health information collected from tablet apps can be reliable and as valid as data collected on paper.

In addition to the potential for risk assessment and cancer prevention, tools such as the BHQ app can improve the collection of patient-reported health information at the point of care. In order to facilitate personalized medicine, it is critical to collect patient-specific social determinants and medical history information efficiently, which can be accomplished through self-administered health history questionnaires. Self-administered questionnaires have long been an important method of data collection (Boissonnault & Badke, 2005; Brodman, Erdmann Jr., & et al., 1949; Gilkison, Fenton, & Lester, 1992; Gumpel & Mason, 1974; Hall, 1972; Hershberg, 1969; Rockart, McLean, Hershberg, & Bell, 1973; Seltzer & McDermott, 1999; Vargas et al., 2010) and have been associated with more active patient participation during the intake process, more complete patient records, and identification of additional medical problems not recorded in the medical record (Inui et al., 1979). Self-administered surveys (either pen-and-paper or tablet-based) are therefore a critical way to facilitate personalized medicine by identifying family history of disease,

ensuring co-morbidities are captured in medical records, and collecting adherence data regarding medications. The information can be uploaded and ease clinic flow as electronic medical records become ubiquitous. Apps to collect patient health information can be offered in many languages, may be easier than writing information, and can have functions, such as increasing the font size, which can be particularly helpful for older patients (Bravo et al., 2014).

Race/ethnicity and socioeconomic status remain significant factors in determining both access to care and health outcomes despite efforts over the last several decades to reduce health care disparities (Agency for Healthcare Research and Quality (AHRQ), 2008; Nelson, 2002). Our study has the potential to affect disparities involving uptake and understanding of breast cancer risk factors and related interventions among diverse women.

Our study indicates that the paper-and-pen and BHQ app versions of data collection were almost identical, as evidenced by the very high kappas observed. In addition, a previous publication validated the data collected by the SFMR/Breast Cancer Surveillance Consortium questionnaire (Bravo et al., 2014) which is equivalent to the pen-and-paper questionnaire that we used. Therefore, because we obtained high kappas between the pen-and-paper and BHQ app, we can also consider our BHQ app data to be valid.

If the tablet method of data collection is both valid and preferred by patients, as our study indicates, given the higher efficiencies of electronic data collection (Weber, Yarandi, Rowe, & Weber, 2005), the use of tablets to collect personalized patient data represents a superior method over pen-and-paper. Given high rates of mobile device use in older and racial/ethnic minority populations (Martin, 2012; Rainie, 2012; Smith, 2013), the use of tablets can also lead to better care and more involvement in care in diverse populations. Furthermore, this style of data collection may be expanded to smartphones and other mobile technologies to advance personalized medicine. Future research into this area would be beneficial for patient/ provider convenience and completion of pre-visit assessments.

Our study has several limitations. Although the BHQ app and the pen-and-paper had a significant overlap of questions, each survey included questions not included in the other. However, even with these differences, there was excellent agreement between the information collected using each method. A second limitation is that we only included women who stated they were comfortable completing health forms independently which likely explains why our patients had higher overall education levels than expected. This may limit the generalizability of our findings, especially among non-English speaking minorities with higher rates of limited health literacy. However, even in this group of women the app was preferred over the pen-and-paper, so further study of this population would be helpful. This limitation also emphasizes the importance of the role of patient navigators that aid women with difficulty completing forms in any modality. Finally, our study lost data of four participants using the BHQ app due to technological challenges. While this was a study specific issue, we acknowledge that loss of data can happen with electronic collection methods, as it can with paper collection methods.

CONCLUSION

Health questionnaire apps have the potential to improve the ease of collecting patient health information and family history for clinical uses such as risk assessment and breast cancer

prevention in diverse, low-income, older patient populations. With the increasing popularity of touchscreen devices, especially among minority populations, health questionnaire apps have the potential to bridge gaps in health disparities that exist in breast cancer screening and prevention. The pen-and-paper method of data collection has existed for decades with barriers that continue to exist for many. With the evolution of mobile data collection, we have an opportunity to try something new that can be integrated into clinical practice and electronic medical records. Our study demonstrates that health questionnaire apps on a tablet are a reliable method of collecting health information. Older, diverse patient populations are receptive, and possibly prefer, such clinical tools to collect health information.

REFERENCES

- Agency for Healthcare Research and Quality (AHRQ). (2008). *National Healthcare Disparities Report 2007*. Rockville, MD: Agency for Healthcare Research and Quality, Department of Health and Human Services.
- Amir, E., Freedman, O. C., Seruga, B., & Evans, D. G. (2010). Assessing Women at High Risk of Breast Cancer: A Review of Risk Assessment Models. *JNCI Journal of the National Cancer Institute, 102*(10), 680–691. <https://doi.org/10.1093/jnci/djq088>
- Anderson, M. (2015). U.S. Technology Device Ownership 2015. Retrieved January 23, 2017, from <http://www.pewinternet.org/2015/10/29/technology-device-ownership-2015/>
- Ballard-Barbash, R. (1997). Breast Cancer Surveillance Consortium: a national mammography screening and outcomes database. *American Journal of Radiology, 169*(4), 1001–1008.
- Bauer, A. M., Rue, T., Keppel, G. A., Cole, A. M., Baldwin, L. M., & Katon, W. (2014). Use of mobile health (mHealth) tools by primary care patients in the WWAMI region Practice and Research Network (WPRN). *J Am Board Fam Med, 27*(6), 780–788. <https://doi.org/10.3122/jabfm.2014.06.140108> 27/6/780 [pii]
- Boissonnault, W. G., & Badke, M. B. (2005). Collecting health history information: the accuracy of a patient self-administered questionnaire in an orthopedic outpatient setting. *Phys Ther, 85*(6), 531–543.
- Bravo, C., O'Donoghue, C., Kaplan, C. P., Luce, J., & Ozanne, E. (2014). Can mHealth Improve Risk Assessment in Underserved Populations? Acceptability of a Breast Health Questionnaire App in Ethnically Diverse, Older, Low-Income Women. *Journal of Health Disparities Research and Practice, 7*(4), 185–8. <https://doi.org/10.1126/scisignal.2001449>.
- Brodman, K., Erdmann Jr., A. J., & et al. (1949). The Cornell medical index; a adjunct to medical interview. *J Am Med Assoc, 140*(6), 530–534.
- Chew, L. D., Griffin, J. M., Partin, M. R., Noorbaloochi, S., Grill, J. P., Snyder, A., ... Vanryn, M. (2008). Validation of screening questions for limited health literacy in a large VA outpatient population. *J Gen Intern Med, 23*(5), 561–566. <https://doi.org/10.1007/s11606-008-0520-5>
- Fox, S. (2011). The Social Life of Health Information. Retrieved February 23, 2017, from <http://www.pewinternet.org/2011/05/12/the-social-life-of-health-information-2011/>
- Gilkison, C. R., Fenton, M. V., & Lester, J. W. (1992). Getting the story straight: evaluating the test-retest reliability of a university health history questionnaire. *J Am Coll Health, 40*(6),

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O'Donoghue et al.

- 247–252. <https://doi.org/10.1080/07448481.1992.9936289>
- Ginsburg, G. S., & Willard, H. F. (2009). Genomic and personalized medicine: foundations and applications. *Translational Research*, 154(6), 277–287. <https://doi.org/10.1016/j.trsl.2009.09.005>
- Gumpel, J. M., & Mason, A. M. (1974). Self-administered clinical questionnaire for outpatients. *Br Med J*, 2(5912), 209–212.
- Hahn, E. A., Cella, D., Dobrez, D., Shiimoto, G., Marcus, E., Taylor, S. G., ... Webster, K. (2004). The talking touchscreen: a new approach to outcomes assessment in low literacy. *Psychooncology*, 13(2), 86–95. <https://doi.org/10.1002/pon.719>
- Hall, G. H. (1972). Experiences with outpatient medical questionnaires. *Br Med J*, 1(5791), 42–45.
- Hershberg, P. I. (1969). Medical diagnosis: the role of a brief, open-ended medical history questionnaire. *J Med Educ*, 44(4), 293–297.
- Inui, T. S., Jared, R. A., Carter, W. B., Plorde, D. S., Pecoraro, R. E., Chen, M. S., & Dohan, J. J. (1979). Effects of a self-administered health history on new-patient visits in a general medical clinic. *Med Care*, 17(12), 1221–1228.
- Lane, S. J., Heddle, N. M., Arnold, E., & Walker, I. (2006). A review of randomized controlled trials comparing the effectiveness of hand held computers with paper methods for data collection. *BMC Medical Informatics and Decision Making*, 6(1), 23. <https://doi.org/10.1186/1472-6947-6-23>
- Lin, C. A., Neafsey, P. J., & Strickler, Z. (2009). Usability testing by older adults of a computer-mediated health communication program. *J Health Commun*, 14(2), 102–118. <https://doi.org/10.1080/10810730802659095.909487958> [pii]
- Livingston, G. (2010). Latinos and digital technology. Retrieved February 23, 2017, from <http://www.pewhispanic.org/2011/02/09/latinos-and-digital-technology-2010/>
- Marcano Belisario, J. S., Jamsek, J., Huckval, K., O'Donoghue, J., Morrison, C. P., & Car, J. (2015). Comparison of self-administered survey questionnaire responses collected using mobile apps versus other methods. *The Cochrane Library*, (7), 1–113.
- Martin, T. (2012). Assessing mHealth: Opportunities and Barriers to Patient Engagement. *Journal of Health Care for the Poor and Underserved*, 23(3), 935–941. <https://doi.org/10.1353/hpu.2012.0087>
- McGillicuddy, J. W., Weiland, A. K., Frenzel, R. M., Mueller, M., Brunner-Jackson, B. M., Taber, D. J., ... Treiber, F. A. (2013). Patient attitudes toward mobile phone-based health monitoring: questionnaire study among kidney transplant recipients. *J Med Internet Res*, 15(1), e6. <https://doi.org/10.2196/jmir.2284.v15i1e6> [pii]
- Murff, H. J., Spigel, D. R., & Syngal, S. (2004). Does This Patient Have a Family History of Cancer? *JAMA*, 292(12), 1480. <https://doi.org/10.1001/jama.292.12.1480>
- Nelson, A. (2002). Unequal Treatment: Confronting Racial and Ethnic Disparities in Health Care. *Journal of the National Medical Association*, 94(8), 666–668.
- Offit, K. (2011). Personalized medicine: new genomics, old lessons. *Human Genetics*, 130(1), 3–14. <https://doi.org/10.1007/s00439-011-1028-3>
- Purcell, K. (2011). Half of adult cell phone owners have apps on their phones. Retrieved February

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- 23, 2017, from <http://www.pewinternet.org/2011/11/02/half-of-adult-cell-phone-owners-have-apps-on-their-phones/>
- Rainie, L. (2012). Baby Boomers and Technology. Retrieved February 23, 2017, from <http://www.pewinternet.org/2012/03/28/baby-boomers-and-technology/>
- Rau, P. P., & Hsu, J. W. (2005). Interaction devices and web design for novice older users. *Educational Gerontology, 31*(1), 19–40.
- Rockart, J. F., McLean, E. R., Hershberg, P. I., & Bell, G. O. (1973). An automated medical history system. Experience of the Lahey Clinic Foundation with computer-processed medical histories. *Arch Intern Med, 132*(3), 348–358.
- Seltzer, M. H., & McDermott, J. H. (1999). Inaccuracies in patient medical histories. *Compr Ther, 25*(5), 258–264.
- Shelby-James, T. M., Abernethy, A. P., McAlindon, A., & Currow, D. C. (2007). Handheld computers for data entry: high tech has its problems too. *Trials, 8*(1), 5. <https://doi.org/10.1186/1745-6215-8-5>
- Smith, A. (2013). Smartphone Ownership 2013. Retrieved February 23, 2017, from <http://www.pewinternet.org/2013/06/05/smartphone-ownership-2013/>
- Smith, A. (2015). U.S. Smartphone Use in 2015. Retrieved January 23, 2017, from <http://www.pewinternet.org/2015/04/01/us-smartphone-use-in-2015/>
- Vargas, P. A., Robles, E., Harris, J., & Radford, P. (2010). Using information technology to reduce asthma disparities in underserved populations: a pilot study. *J Asthma, 47*(8), 889–894. <https://doi.org/10.3109/02770903.2010.497887>
- Weber, B. A., Yarandi, H., Rowe, M. A., & Weber, J. P. (2005). A comparison study: paper-based versus web-based data collection and management. *Appl Nurs Res, 18*(3), 182–185. <https://doi.org/S089718970500039X> [pii] 10.1016/j.apnr.2004.11.003