Evaluation of two mobile health apps for patients with breast cancer using the Mobile Application Rating Scale

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Background: Breast cancer is one of the most frequently diagnosed cancers worldwide. Screening, education about signs and symptoms, and improved access to treatment has helped reduce mortality. An understanding of the informational needs of women with breast cancer can help identify areas where mobile apps can further improve the experience of this patient group.

Methods: Personas are a commonly used tools in user centred design to help represent particular user archetypes. Knowledge of existing informational needs and prior research using personas in breast cancer app design were used to create two different personas through which to source apps for evaluation. The Mobile Application Rating Scale, a common evaluation framework, was used to evaluate the mobile apps across several important domains.

Results: Becca and OWise, two apps for breast cancer, were found through a discovery process in line with the personas described. Overall, both apps scored highly on the Mobile Application Rating Scale. Both apps had limited or no research to support their use in this patient group, and had issues related to data privacy. Becca scored particularly highly in domains related to accessibility while OWise's extensive range of features scored highly for functionality.

Conclusions: Both apps demonstrate the ability to fill an informational needs gap as evidenced in the existing literature. As with many mobile health apps, more clinical evidence and improved data handling would help support the widespread recommendation of their use in women who are undergoing or have completed treatment for breast cancer.

Keywords: Breast cancer; Mobile Application Rating Scale (MARS); mHealth

Introduction

Epidemiology

According to estimates of cancer incidence and mortality, breast cancer is the most frequently diagnosed cancer in 135 countries and the leading cause of cancer related mortality in over 100 (1). Globally, over 2 million cases of breast cancer are diagnosed each year, accounting for almost 1 in 4 cases of cancer in women. In the UK and the US, it is estimated that between 1 in 7 and 1 in 8 women will develop breast cancer in their lifetime (2,3).

UK breast cancer policy

Earlier detection through screening has helped improve breast cancer mortality. The UK breast cancer screening programme was the first of its kind and began in 1988. Through the programme, women aged 50–70 can receive

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Table 1 List of studies investigating the information needs of women with breast cancer

Author	Year	Design	Patient group	Sample size	Measure
Vivar *et al.*	2005	Literature review	Long term survivors	N/A	Multiple
Abi Nadar *et al.*	2016	Cross sectional	Chemotherapy	84	SNST/SCNS
Sheehy *et al.*	2018	Cross sectional	Post treatment	105	TINQ-BC
Sakai *et al.*	2020	Cross sectional	Post treatment	207	Unknown
O'Neill *et al.*	2018	Cross sectional	Young women with 1st/2nd degree BRCA relative	100	Unknown
Danesh *et al.*	2014	Descriptive	Metastatic breast cancer	59	Thematic analysis of transcripts
Dawe *et al.*	2014	Cross sectional	Outpatient surgery	19	Semi-structured interviews
Lei *et al.*	2011	Longitudinal	Chemotherapy	169	TINQ-BC
Carr *et al.*	2019	Literature review	Reconstruction post mastectomy	N/A	Multiple
Valero-Aguilera *et al.*	2014	Cross sectional	Post treatment	100	Semi-structured interviews
Miyashita *et al.*	2015	Cross sectional	Young women	163	Semi-structured interviews
Kemp *et al.*	2018	Cross sectional	Advanced breast cancer	21	Thematic analysis of interviews
Vahabi	2011	Cross sectional	Breast cancer	50	Semi-structured interviews

TINQ-BC, Toronto Informational Needs Questionnaire-Breast Cancer; SCNS, supportive care needs survey; SNST, supportive needs screening tool.

mammograms every 3 years (4).

In the last decade UK government and leading cancer charity policy has aimed to build on the success of the screening programme. Key policy themes include better education on symptoms and signs, improving lifestyles to reduce incidence, earlier diagnosis through screening, improving access to treatment, and enhancing patient experience and quality of life (5-8).

More recently, the NHS long term plan has advocated for more personalised therapeutic options and follow-up pathways for women diagnosed with breast cancer (9).

Information needs

National policy has to take a broad approach to cancer-related interventions that may not account for the needs of specific patient sub-groups. Efforts have been made to investigate the information needs of women with breast cancer (*Table 1*). The majority of studies are cross-sectional (10-18) with several literature reviews and meta-syntheses (19,20). The research is varied, investigating the information needs of women during and post treatment (10-12,15,21). Some studies have focussed on younger women with breast cancer (13,16), whilst others have focussed on long term survivors (19) and those managing advanced (17) and metastatic breast cancer (14).

Populations investigated were diverse including women from Lebanon (10), Ireland (11), Japan (12,16), America (13,14), Canada (22), Malaysia (21), Spain (15), United Kingdom (23), Australia (17) and Iranian immigrants (18). Unfortunately, most studies used relatively small sample sizes ranging from 19 participants (22) to 207 (12) making the accuracy of the insights difficult to interpret.

Furthermore, validated questionnaires like the breast cancer version of the Toronto Informational Needs Questionnaire (TINQ-BC) were not commonly employed as part of the research methodology (11,21) with many using bespoke questionnaires instead (15,16,18).

Common findings from the studies reviewed included variation in information needs based on age (10,16,19), a general preference to receive information directly from the healthcare provider (10,12,17,20), and a desire for high-quality information related to recovery and prognosis (11,14,15,20,21).

Methods

Personas

A common tool for both the design and evaluation of digital

Persona 1 (post treatment)
Background
- 65 years old
- Married with two adult children
- Retired lawyer
- Underwent a total mastectomy
- Received post-operative radiotherapy

Attributes
- Has used health apps previously to help manage mental health
- Overwhelmed by number of online resources for breast cancer
- Expected more information to be provided by her oncologist

User needs
- Requires high quality information to help her cope following completion of her breast cancer treatment
- Would benefit from curated resources relevant for her specific concerns (which include loss of confidence in her body image

Persona 2 (receiving treatment)
Background
- 40 years old
- Long term partner, one teenage child
- Product manager
- Receiving neo-adjuvant chemotherapy
- Due for total mastectomy once chemotherapy completed

Attributes
- Uses multiple apps to track exercise and nutrition
- Struggling with chemotherapy side-effects including nausea, muscle ache and fatigue
- Doesn't feel has enough time to discuss concerns with her doctors or the nurses who administer her chemotherapy

User needs
- Ability to track her symptoms so she can easily share and discuss them with her clinical team
- A way to keep track of her chemotherapy courses so she can compare symptom severity between each round
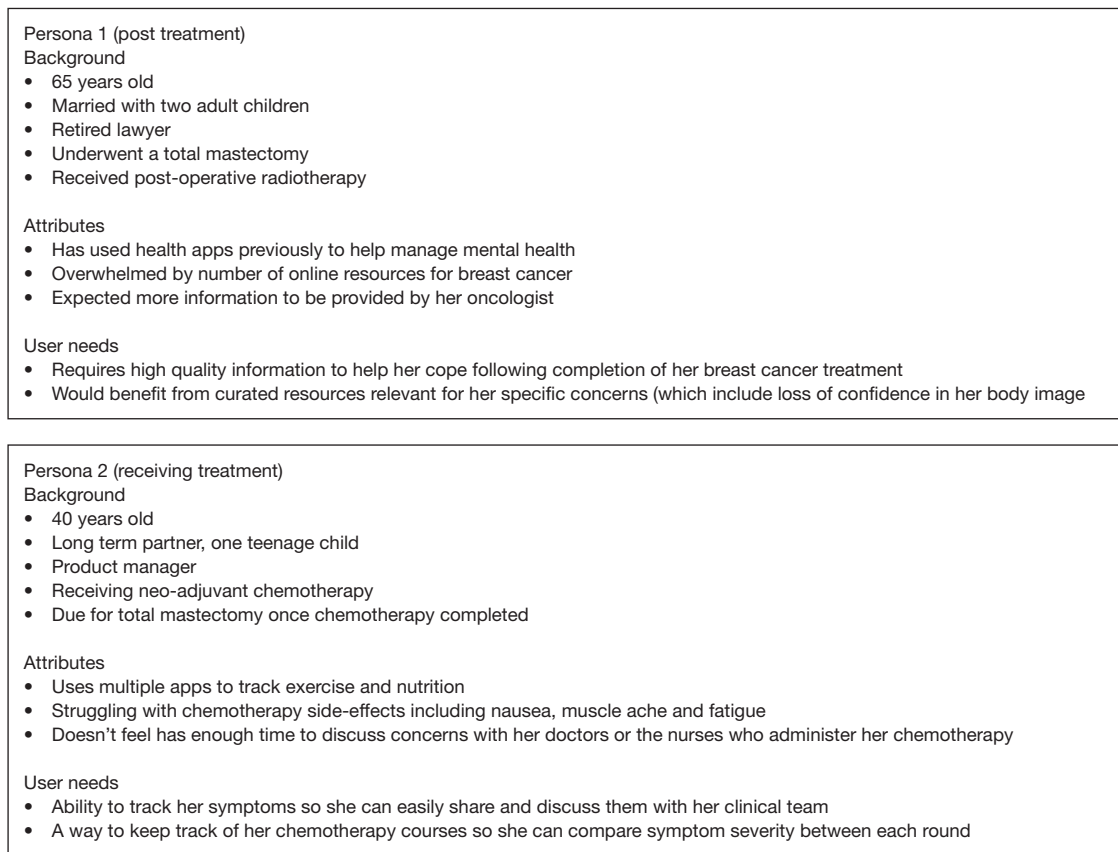
Figure 1 Two personas describing the needs of different types of breast cancer patient. Persona 1 focuses on someone who has completed treatment whereas persona 2 focuses on a patient currently undergoing treatment.

health technology (DHT), and a key component of user-centred design, is the use of personas. Personas are an empirically derived user archetype (24) that can be used to communicate the key concerns, motivations and interests of a user group. These archetypes are developed through quantitative and qualitative user experience research and serve as a useful communication tool to help developers understand the needs of target users (25,26).

Personas have been used extensively in the development of DHTs. Example patient groups include diabetics (27), older adults with heart failure (24), patients with coronary heart disease (28), multiple sclerosis (29), renal disease (30), children with cancer (31), women with gynaecological cancer (32), and older people generally (33).

It is beyond the scope of this study to undertake the qualitative and quantitative research to define persona archetypes for breast cancer patients. A review of the literature has identified several studies which have undertaken this process for specific DHT interventions.

One used a qualitative approach and focus group methodology to collect user needs and preferences for the content and features of a mobile app for arm and shoulder exercises after breast cancer treatment (34). Another similar qualitative research study using semi-structured interviews with breast cancer survivors explored user experiences and needs regarding rehabilitation and technology (35).

Based on these studies and the information needs for breast cancer patients described previously, it is possible to derive two broad archetypes for the purpose of finding appropriate DHTs to evaluate (*Figure 1*). These are patients who are currently undergoing treatment for breast cancer and those who have 'completed' treatment. The information requirements of these two groups are different. Those currently receiving treatment express a greater need for information related to treatment plans and side-effects (21), whilst those under long term follow up require help with social and physical rehabilitation (12,15), and information related to prognosis (14).

Table 2 Review number and overall rating taken from the Apple app store and Google Play store for both 'Becca' and 'OWise' (ratings collated on 22/11/20)

Name	Number of iOS ratings (all versions)	Average iOS rating (all versions)	Number of Android ratings (all versions)	Average Android ratings (all versions)
Becca	45	4.5/5	78	4.4/5
OWise	19	4.7/5	18	4.6/5

Evaluation frameworks

Over 45 different mobile health app evaluation frameworks exist, created by a combination of academic institutions (36-39), non-profit organisations (40-42) and for-profit companies (43). Some frameworks focus on a specific type of health app such as mental health (39,42,44), while others have more general use-cases. Criteria vary between frameworks, but common themes include data safety and privacy, app effectiveness, user experience, data integration, clinical relevance and credibility.

Several studies have attempted to review the myriad of different evaluation frameworks through systematic review. The results are not particularly reassuring, suggesting that many frameworks cannot be used unaltered and need to improve their assessments of possible user harm and the impact of software updates (45). There is also evidence to suggest that ratings provided by certain frameworks can be inconsistent and contradictory when assessing popular behavioural health apps (46).

For the purpose of this study, the Mobile Application Rating Scale (MARS) was used for app assessment. MARS is a popular framework and has been used in the evaluation of a variety of health apps including those for diabetes (47), gestational diabetes (48), renal disease (49), genitourinary tumours (50) and food allergies (51). Since its creation in 2015 it has been translated into other languages including Spanish (52) and German (53), and has been adapted for use by end-users of health apps (54). Evaluation of the MARS framework has shown good interrater reliability and internal consistency (38).

Results

App selection

The selection of two appropriate apps for assessment attempted to follow a discovery process in line with each of the personas described in figure 1. Persona 1 had previously used the NHS Apps Library to find other health apps related to mental health. Following the same approach, searching for 'breast cancer' on the NHS app library returns the breast cancer app 'Becca' as the first result.

The description of 'Becca' ("*Breast Cancer Now's Becca app provides specialist support to help you live with, through and beyond breast cancer*"), is aligned with Persona 1's key characteristic of having completed their breast cancer treatment and requiring support in the post-treatment phase.

Persona 2 has a high level of technological literacy and is familiar with using mobile apps to track exercise and other aspects of her daily routine. Assuming persona 2 might take a more direct route to finding an appropriate resource for her needs, using the search query 'breast cancer tracker' within the Apple app store returns 'OWise' as the first result.

The description of 'OWise' ("*…OWise gives you personalised, safe, reliable and credible information as well as practical support and guidance, in one easy-to-view place*") also aligns well with the requirements of Persona 2, particularly as she is currently undergoing treatment for breast cancer.

Evaluation results

Table 2 shows the number of user reviews and overall rating of both apps from the Apple app store and the Google Play Store, while *Table 3* shows the MARS results for both apps. Scores are provided against each section of the framework: engagement, functionality, aesthetics and information. Completed MARS assessments for both apps are included in Table S1. Scoring was carried out by the author.

Both apps have received consistently positive user reviews across the major app stores suggesting they meet user requirements and expectations to some degree. Although positive, the number of reviews for each app is limited, particularly for OWise. This is despite both apps being available for download for several years (3 years for Becca, 5 years for OWise) in the United Kingdom.

Neither app has a paid version with all functionality

Table 3 Mobile App Rating Scale scores for breast cancer apps 'Becca' and 'OWise'

Name	Engagement score	Functionality score	Aesthetics score	Information score	Mean score	Subjective score
Becca	3.6	5	4.7	4.2	4.38	3.75
OWise	4.2	5	4.7	4.3	4.55	4.75

Each app is scored against multiple domains which also contributes to an overall mean score. MARS also allows for a subjective assessment which is included in the final column but does not contribute to the overall mean score. Application of rating scale carried out by author AW. Maximum score in any domain is 5.

Available online the outset. OWise has a particular focus on physical health using predominantly monitoring and tracking functionality. Conversely, Becca is more multi-faceted in its focus aiming to provide information and education on different topics relevant for women with breast cancer.

Both apps scored similarly overall. Within the sub-domains of functionality and aesthetics, each app was able to demonstrate excellent performance, gestural design, navigation and ease of use, perhaps reflecting the fact that both products had been developed by professional agencies with a track-record in app design.

The apps differed in their engagement and information scores. For engagement, OWise's suite of features around tracking appointments, symptoms and treatment regimens made for a highly personalised and interactive experience. As a simple curator of high-quality breast cancer resources, Becca has less features to drive in-app engagement and is designed to direct users out of the app to relevant resources. Becca did have excellent accessibility features, allowing users to adjust screen size and zoom to suit their needs.

OWise scored marginally higher for the information section by virtue of having some, albeit limited, study literature to support its use in supporting women with breast cancer (55). A randomised clinical trial is underway, but results are yet to be reported. No supporting literature was found for Becca, however it was commissioned by a leading breast cancer charity and both apps have successfully gained access to the NHS Apps Library.

Discussion

Prior research investigating the effectiveness of breast cancer apps has consistently commented on the lack of a foundational evidence base to support their use. Several cross-sectional studies (56,57) and systematic analyses (58-60) have called for more evidence of clinical effectiveness and safety to support breast cancer app use.

Of the two apps assessed here, only one (OWise) has made limited progress in this area, suggesting this is an ongoing issue in the realm of mobile health apps.

Becca does have the backing of a major UK breast cancer charity and aims to link users to high-quality information related to various aspects of breast cancer. However, research to evidence how these resources meet the information needs of women who have completed breast cancer treatment would be beneficial.

From a policy perspective, where personalisation in cancer care is being increasingly promoted (9), both apps aim to provide personalised experiences for their users. OWise has sophisticated symptom and treatment-tracking functionality whereas Becca can 'learn' what sort of breast cancer content any given user is most interested in for more personalised recommendations.

Accessibility is an important component of any DHT. Despite an excellent array of symptom and tracking functionality, OWise neglected to include simple accessibility features such as text enlargement and zoom capability which negatively impacted the engagement score. These features were present in Becca and should be viewed as a baseline requirement to ensure DHTs demonstrate a high level of inclusivity for a wide variety of users. Despite appropriate accessibility measures, Becca scored poorly for entertainment and interactivity. The app might benefit from added functionality, involving gamification or mood/symptom tracking in order to drive engagement and maximise the benefit of its information resources.

Data privacy is an important domain through which to assess DHTs and is one of the more notable omissions of the MARS framework. Data related features have been explored by Orcha, which has carried out assessments of both the apps described here. Orcha rated the data privacy of Becca and OWise at 45.6% and 51.4% respectively, identifying some gaps in data encryption and a risk of identification through the data collected (61,62).

Both apps seemed well suited to the specific user needs

of the personas described in *Figure 1*. Unlike other health apps which aim to deploy one or more behaviour change techniques to impact a specific health behaviour, neither of the tools reviewed here had particular behavioural targets. However, they do address one of the key information needs of breast cancer patients—the provision of information by healthcare professionals. Becca provides an alternative source of high-quality information where this might be lacking from direct interactions with the patient's healthcare team, while OWise allows for the capture of key trends and data in order to facilitate better quality discussions with care providers. Becca also has a rich array of resources related to recovery and post-treatment care which was identified as a key information need in the existing literature.

Although both apps were consistently and positively reviewed in the respective app stores, the overall number of reviews were limited. The reasons for this could be multifactorial. From the developer's perspective, they could perhaps do more to encourage users to submit reviews and feedback. From the user's perspective, providing feedback for a breast cancer app might be of low priority during a particularly stressful and uncertain period in their life. The use of app store reviews as a measure of meeting informational needs should be supported by other datapoints. This might include user focus groups or posts made on online breast cancer patient forums that reference the apps.

Conclusions

Becca and OWise are two breast cancer apps that score well on the MARS framework and address the needs of breast cancer patients after and during their treatment respectively. Both apps suffer from a lack of evidence to support their clinical effectiveness but aim to fill an informational needs gap that has been identified in the literature. As with many DHTs, particular attention should be paid to the handling of user data, to ensure it is compliant with national and international regulation and utilises suitable levels of encryption. More emphasis should also be placed on simple accessibility features to help ensure health apps are inclusive for different user groups. This study is based on the assessment of a single assessor. Future research should employ the use of multiple evaluators to validate the scores provided through the MARS framework and to allow more accurate comparison with the existing literature around breast cancer apps.

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Table S1 The full Mobile App Rating Scale results for Becca and OWise

MARS item	Becca	OWise
App classification		
Version	1.39	2.2
Last update	3 Apr 2020	24 Oct 2020
Rating (current)	N/A	N/A
Rating (all)	iOS 4.5/5, Android 4.4/5	iOS 4.7/5, Android 4.6/5
N ratings (current)	N/A	N/A
N ratings (all)	iOS 45, Android 78	iOS 19, Android 18
Cost (basic)	Free	Free
Cost (upgrade)	N/A	N/A
Developer	Breast Cancer Now	Px Healthcare Group Ltd
	Super Being Labs	
Platform	iOS & Android	iOS & Android
Description	An app that provides strategies, hints, and tips for life after breast cancer treatment	Provides personalised, safe, reliable, and credible information as well as practical support and guidance
Focus	Happiness/wellbeing	Physical health
	Mindfulness/meditation/relaxation	Sense of control
	Relationships	
	Physical Health	
	Diet	
Theoretical background	Information/education	Assessment
	Advice/tips/strategies	Monitoring/tracking
	Skills training	Personalisation
Age group	Adults	Adults
Technical aspects	Needs web access to function	Needs web access to function
		Allows password-protection
		Requires login
		Sends reminders
Affiliations	Commercial	Commercial
Section A: Engagement		
1. Entertainment	3	5
2. Interest	4	5
3. Customisation	3	2
4. Interactivity	3	5
5. Target group	5	4
Engagement mean score	3.6	4.2
Section B: Functionality		
6. Performance	5	5
7. Ease of use	5	5
8. Navigation	5	5
9. Gesture design	5	5
Functionality mean score	5	5
Section C: Aesthetics		
10. Layout	5	4
11. Graphics	5	5
12. Visual appeal	4	5
Aesthetics mean score	4.7	4.7
Section D: Information		
13. Accuracy	5	5
14. Goals	3	N/A
15. Quality of info	5	5
16. Quantity of info	5	5
17. Visual information	N/A	5
18. Credibility	3	3
19. Evidence base	N/A	3
Information mean score	4.2	4.3
Section E: Subjective quality		
20. Recommendation	5	5
21. Frequency of use	5	5
22. Value	1	5
23. Rating	4	4
App subjective mean score	4.38	4.75
App quality mean score	4.38	4.55