

## ORIGINAL PAPER

# Analysis and adherence to guidelines of mobile health application for bladder cancer, where are we?

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## Summary

**Introduction:** Mobile health applications (MHAs) represent a tool to assist patients affected by different disease including bladder cancer (BCa), although the scientific quality and adherence to guidelines are not yet addressed.

**Material and methods:** On September 2024, we conducted a search in the Apple App Store and Google Play Store. We reviewed all mobile apps from Apple App Store and Google Play Store for BC and evaluated their usage in screening, prevention, management, and adherence to EAU guidelines.

**Results:** In total 10 MHA were reviewed. All MHAs are geared towards the patient and provide information about diagnoses and treatment of BC. The mean score was 3.29 in Engagement, 3.26 in Functionality, 3.06 in Aesthetics, 3.13 in Information, and 3 in Subjective quality respectively. MHAs reported low and medium adherence to EAU guidelines.

**Conclusions:** MHAs provide different services in many medical fields, including BCa. There are several drawbacks regarding scientific validation, content, and quality. Future research is necessary to promote new user designed, and high-quality apps.

**KEY WORDS:** Keywords: App; E-health; Mobile phone; Bladder cancer; MARS.

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## INTRODUCTION

Bladder cancer (BCa) represents one of the ten most diagnosed cancer worldwide with an incidence of 550.000 new cases per years and more than 200,000 deaths (1, 2). BCa is classified into non-muscle-invasive bladder cancer (NMIBC) and muscle-invasive bladder cancer (MIBC) depending on the cellular infiltration of cancer cells in the muscular layer. NMIB and MIBC accounts for 75% and 25% of newly diag-

nosed cases respectively (3-6). BCa treatment depends on the tumor type and stage: neoadjuvant cisplatin-based chemotherapy followed by radical cystectomy with pelvic lymph node dissections is considered the gold standard treatment for MIBC, eventually associated to adjuvant platinum-based combined chemotherapy (7).

In the metastatic setting combined method of chemotherapy, immunotherapy and targeted therapy can be used, but despite their therapeutic efficacy, they are characterized by several side effects and toxicity (8). BCa has a high impact on the quality of life (QoL) of patients and partners. Nowadays, mobile applications (apps) represent a tool to support health behavior and provide medical information and/or management of different disease (9-12). Apps can be downloaded from "Play Store" for Android and "App Store" for iOS. Nowadays their number is constantly growing, however despite this their quality assessments are still a problem. To avoid this, in the last years, a valid tool called Mobile Application Rating Scale (MARS) has been developed. The second issue related to MHA is their adherence to guidelines. To the best of our knowledge, there are no studies reporting the quality of apps for BCa and their adherence to guidelines. The aim of this study is to evaluate the quality and the adherence to guidelines of MHA developed to assist patients affected by BCa.

## MATERIALS AND METHODS

### Search strategy

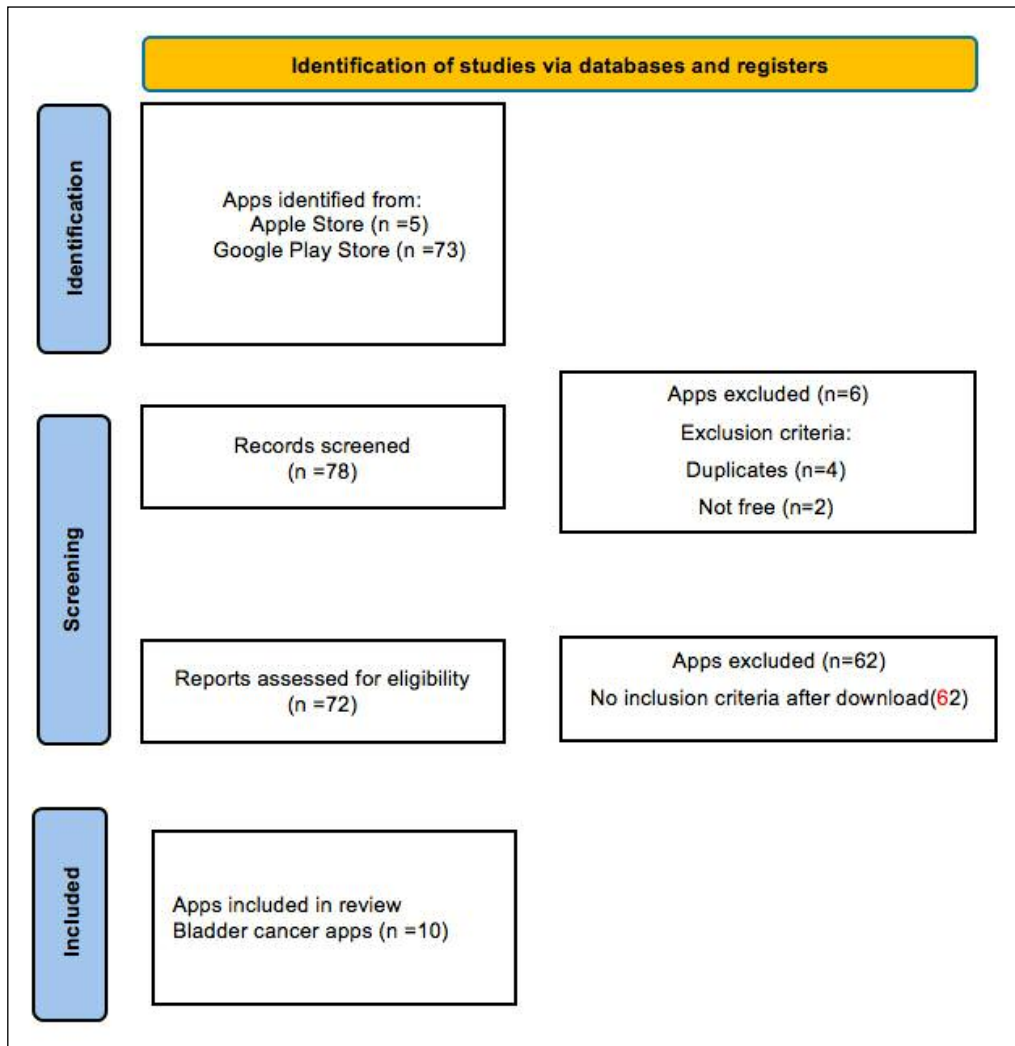
We performed an observational cross-sectional descriptive study of all smartphone apps for patients about BC available on the iOS and Android platforms and evaluated their adherence to EAU guidelines. On 24 Sep 2024, we con-

ducted a search in Google Play Store for Android phones and Apple App Store for iPhones with the keywords 'bladder cancer', 'bladder cancer treatment' and 'bladder cancer diagnosis' using the search tab. We used a wide array of keywords due to the search strategy of Google Play Store and Apple App Store which is based on finding keywords in titles, app descriptions and tags. Other searches of information provided in books or other formats were excluded. Two authors (A.F., E.D.M.) screened separately in App Store and Google Play Store apps during the search by reading the title and description in the app store. A third author (L.N.) resolved any discrepancies. At the beginning all apps were reported in Excel form and, according to the exclusion criteria, were screened. All MHAs regarding BCa, providing a service to patients, in English, and free to download were included in this analysis. Apps not specifically focused on BCa, apps not allowing access to all users and those not available in English were excluded. Successively, all reviewers downloaded and installed the apps on their personal mobile device. They interacted for twenty minutes with each app to explore its features before completing the MARS and evaluating their adherence to EAU guidelines. To assess apps, they were downloaded to either an Android or an IOS

device. If apps were available in both app stores, the iOS version was assessed.

According to criteria used in similar studies, raters gave each app a score from 0 to 3 for each of the five items. A score of "0" indicated no adherence to guidelines. A score of "1" indicated a weak adherence. A score of "2" indicated a partial or moderate adherence. A score of "3" indicated strong adherence. Where coding scores differed by 1 point, the average of the two ratings was taken. If there was a greater than 1-point discrepancy, a third author (a full professor) reviewed apps and resolved the discrepancy. The possible score on the checklist ranged from 0 to 15 for each app. To facilitate evaluation, adherence to the checklist was arbitrarily considered low with a total score ranging from 0 to 5, medium (6-10), and high (10-15).

A total of 78 apps were found by our search, of them 73 were from the Google Play Store (*Android*) and 5 of them were from the Apple App Store (*iOS*). Of the total, 72 apps were screened after removing duplicates and paid apps. Of the total screened apps, 62 apps met excluding criteria and were removed. One app resulted in both stores. In total, 10 apps were eligible for the final evaluation and were downloaded. A flow diagram based on the PRISMA statement (Figure 1) was included for the selected apps (13).



**Figure 1.**  
PRISMA.

Name of application	Download	Rating	Producer	Category
BCAN Bladder Cancer App	100+	n.a.	Bladder Cancer Advocacy Network	Health and Fitness
NCCN Patients Guides for Cancer	10.000+	n.a.	National Comprehensive Cancer Network	Medicine
ONCOassist	10.000+	4.5	Portable Medical Technology Ltd.	Medicine
Outcomes4Me Cancer Care	100.000+	n.a.	Outcomes4Me Inc.	Health and Fitness
ESMO Interactive Guidelines	10.000+	4.2	European Society for Medical Oncology	Medicine
Medscape	5 MLN+	4.7	WebMD, LLC	Medicine
Manual of Clinical Oncology	10.000+	n.a.	Unbond Medicine, Inc.	Medicine
Diseases Dictionary Offline	1 MLN +	4.4	Ufostudio	Medicine
Diseases Treatment Dictionary	500.000+	4.9	Smart Training	Medicine
Symptom Checker	5000+	n.a.	FriendsApp Listing	Medicine

**Table 1.**  
Apps characteristics.

Table 1 shows the analyzed apps characteristics. The BC apps were evaluated by four members of the research team on a 5-point Likert scale based on MARS characteristics.

#### Data extraction

On 30 October 2024 reviewers, according to previous studies modality created a predefined Excel form to collect data. The following data were extracted from MHA: title, language, customers, costs, source (*Google Play Store* or *Apple App Store*), field/disease, rating/feedback from the users and service provided.

#### Assessment of app quality and app adherence to EAU guidelines

*Mobile Application Rating Scale* (MARS), and an adherence checklist of five items (definition, physiopathology, diagnosis, risk factors and treatment) based on EAU guidelines were used to assess the MHA quality and guidelines adherence as reported in our previous studies

### RESULTS

In total 10 apps were included in the final analysis: 9 MHA were in the Google Play Store, and one from Apple store. All apps provided information about treatment, 9 apps provided information about diagnosis. Bladder cancer risk factors were mentioned in 9 MHA as well. Data about downloads were available for all MHA. The most downloaded app was Medscape in which more than five million of downloads were reported. All the apps were

planned to be used by patients. Rating was available only for 5 apps. Cumulative MARS scale scores are represented in Table 2.

#### Engagement

The score in this section was based on a 5-point Likert scale in 5 subscales (*Entertainment, Interest, Customization, Interactivity and Target-group*). The mean score was 3.29. Scores ranged from 1.4 to 4.3 out of 5.

The “*Manual of Clinical Oncology*” app (*Android*) produced by “*Unbond Medicine, Inc.*” received the highest score for the engagement. This app contains interactive features for management and prevention of bladder cancer. It also contains information about surgical management, with EAU tutorial videos explaining several surgical techniques.

#### Functionality

The score of the functionality section was based on a 5-point Likert scale in 4 subscales (*Performance, Ease of use, Navigation and Gestural design*) and the mean score was 3.26. Scores ranged from 1.5 to 4.6. “*Manual of Clinical Oncology*” app (*Apple iOS/Android*) achieved the maximum score.

#### Aesthetics

The aesthetics section was formed by a 5-point Likert scale in 3 subscales (*Layout, Graphics, Visual Appeal*) and the average score was 3.06. Scores ranged from 1 to 4.6 out of 5 and “*Medscape*” app produced by “*WebMD, LLC*” reached the maximum aesthetic score.

APP	Engagmet section A	Functionally section B	Aesthetic Section C	Information Section D	Subjective quality Section E	APP quality mean score (A+B+C+D)
BCAN Bladder Cancer App	3.6	3.3	3	3.4	3	3.3
NCCN Patients Guides for Cancer	4	4	3.7	3.3	3	3.7
ONCOassist	1.6	1.7	2	1.6	2	1.7
Outcomes4Me Cancer Care	4	4.2	3.7	3.7	3	3.9
ESMO Interactive Guidelines	4.2	4	4.3	4.3	4	4.2
Medscape	4.2	4	4.6	4.3	4	4.3
Manual of Clinical Oncology	4.3	4.6	4	4.3	4	4.3
Diseases Dictionary Offline	3.6	3.3	3	3.4	3	3.3
Diseases Treatment Dictionary	2	2	1.3	2	2	1.8
Symptom Checker	1.4	1.5	1	1	2	1.2

**Table 2.**  
MARS scale.

Title	Definition (0-3)	Pathophysiology (0-3)	Risk factors (0-3)	Diagnosis (0-3)	Treatment (0-3)
BCAN Bladder Cancer App	2	2	3	2	2
NCCN Patients Guides for Cancer	3	3	3	3	3
ONCOassist	2	1	0	1	2
Outcomes4Me Cancer Care	3	3	3	3	3
ESMO Interactive Guidelines	3	3	3	3	3
Medscape	3	3	3	3	3
Manual of Clinical Oncology	3	3	3	3	3
Diseases Dictionary Offline	2	2	3	2	2
Diseases Treatment Dictionary	2	3	2	2	2
Symptom Checker	1	0	1	0	2

**Table 3.**  
Adherence to EAU guidelines.

### Information

The information section was formed by a 5-point Likert scale in 7 subscales and the mean score was 3.13. Score ranged from 1 to 4.3. Three apps, “ESMO Interactive Guidelines” produced by “European Society for Medical Oncology”, “Medscape” and “Manual of clinical oncology”, reached the highest score in Information.

### Subjective quality

The subjective quality section consisted of 4 items. The mean score was 3, with scores ranging from 2 to 4. “ESMO Interactive Guidelines”, “Medscape” and “Manual of clinical oncology” apps reached the maximum score.

### EAU adherence checklist

We evaluated the EAU guidelines adherence in 10 apps. EAU adherence scores are represented in Table 3. The BC definition was reported in 10 (100%) apps; pathophysiology was reported in 9 (90%) apps; risk factors were reported in 9 (90%) apps; diagnosis was reported in 9 (90%) apps; treatment was reported in 10 (100%) apps. The maximum achievable score of 15 was reported by “NCCN Patients Guides for Cancer”, “Outcomes4Me Cancer Care”, “ESMO Interactive Guidelines”, “Medscape” and “Manual of Clinical Oncology” apps.

### DISCUSSION

This study represents the first attempt to evaluate the quality of MHAs designed for BCa and their adherence to EAU guidelines. The findings provide valuable insights into the limitations and potential of these digital tools in supporting Bca patients. Several key observations emerge from our analysis, shedding light on both challenges and opportunities in utilizing MHAs for this patient population. The overall quality of MHAs for Bca, as evaluated by the *Mobile Application Rating Scale* (MARS), was higher than data from previous studies evaluating MHAs for other health conditions. Mean scores for categories such as “Information,” “Aesthetics” and “Functionality” were 3.13, 3.06, and 3.26, respectively, reflecting good performance in areas critical to user engagement, learning and utility. Interestingly, MHAs that achieved higher scores in these categories were those developed with direct involvement of healthcare professional support. This finding aligns with prior research emphasizing the

importance of interdisciplinary collaboration in creating effective and reliable digital tools (14-15). For instance, Weiss *et al.* successfully developed an MHA designed to provide education, symptom tracking, and alerts for patients undergoing radical cystectomy. Their findings demonstrated the app’s feasibility, acceptability, and educational value, particularly in helping patients manage postoperative symptoms (16). Similarly, other studies, such as those by Tolstrup *et al.* and Huelster *et al.*, highlight the benefits of MHAs co-developed with multidisciplinary teams. Tolstrup *et al.* implemented a national multimodality app for Bca patients that enables symptom monitoring, provides self-management advice, and facilitates communication during clinical encounters (17). Huelster *et al.* explored the use of a mobile app combined with biometric monitoring to capture patient-reported symptoms and identify complications after radical cystectomy, demonstrating the potential of these tools to improve clinical outcomes (18). Another notable example is the work by Metcalf *et al.* which highlighted the feasibility of using a healthcare application to provide perioperative education and monitoring for patients undergoing radical cystectomy. In this pilot study, the app delivered educational content, such as detailed explanations of surgical options and postoperative care pathways, while monitoring patients through wearable devices (19). Such examples demonstrate how MHAs, when thoughtfully designed, can bridge significant gaps in patient education and postoperative care. The role of MHAs extends beyond patient education and support to include contributions to research and data collection. Smittenaar *et al.* demonstrated the feasibility of using crowdsourcing within an MHA to analyze immunostained cancer samples for biomarker discovery. This innovative approach underscores the versatility of MHAs not only as tools for patient care but also as platforms for advancing scientific research. The ability to engage patients in generating valuable clinical data highlights a dual role for these applications in improving individual outcomes and contributing to broader scientific understanding (12, 20). Despite these promising examples, our study reveals significant gaps in the current landscape of MHAs for Bca. A major concern is the lack of adherence to EAU guidelines, with less than one-third of the analyzed apps addressing essential topics such as Bca definition, pathophysiology, risk factors, diagnosis, and treatment.

This deficiency raises concerns about the reliability of these apps as educational resources and their potential to disseminate incomplete or misleading information. Adherence to clinical guidelines must be a foundational requirement for all MHAs to ensure they provide credible, accurate, and actionable information. Notably, some apps have successfully integrated guideline-driven content. For example, *Beardo et al.* developed APPv, an MHA specifically designed for the treatment and follow-up of NMIBC.

In a prospective study, APPv demonstrated a 64% concordance rate with urologist-prescribed treatments, with higher agreement in low-risk cases (77%) compared to high-risk cases (17%). Importantly, patients who adhered to treatment recommendations via APPv had significantly better outcomes, with 89.1% remaining recurrence-free compared to 61.1% in cases of disagreement. This example underscores the potential of MHAs to improve adherence to treatment guidelines and enhance clinical outcomes when they are aligned with evidence-based practices (21). The challenges faced by Bca patients, including navigating complex treatment pathways, managing post-operative symptoms, and coping with the psychological burden of the disease, further emphasize the need for well-designed MHAs (22, 23). These tools have immense potential to bridge gaps in education and support, empowering patients to better understand their condition and make informed decisions. However, the current shortcomings in quality, usability, and adherence to clinical guidelines undermine this potential. Addressing these challenges requires a multifaceted approach. First, partnerships with clinical experts and healthcare institutions are crucial for the co-development of MHAs that are evidence-based and patient-centered. Collaboration with professionals ensures that these tools reflect the latest medical standards and adequately address the specific needs of Bca patients. Incorporating expert-reviewed content and designing features that align with real-world clinical scenarios can significantly enhance the credibility and utility of MHAs (12, 25-25). Second, the promotion of standardized quality assessment frameworks, such as MARS, is vital for improving the overall quality of MHAs (12, 26). These frameworks should be integrated into both the development and evaluation processes, enabling systematic assessment of app performance, usability, and content accuracy (27). Regular use of MARS can help developers identify and address shortcomings early, ensuring that final products meet high standards of quality and reliability (28). Third, content accuracy must be prioritized by adhering comprehensively to EAU or equivalent guidelines. Developers should focus on creating comprehensive, guideline-driven content to ensure that patients receive accurate and actionable information. This step is particularly important given the complexity of Bca treatment pathways and the need for patients to make informed decisions about their care (29). Lastly, user engagement is a critical determinant of an MHA's success. Incorporating interactive and personalized features, such as symptom tracking, treatment reminders, and tailored educational content, can make these tools more appealing and better suited to the diverse needs of Bca patients (30).

Additionally, feedback mechanisms can help developers refine app features based on user preferences and experiences, further enhancing their effectiveness. Expanding research efforts to evaluate the real-world impact of MHAs is also essential for their continued development and refinement. Longitudinal studies focusing on outcomes such as treatment adherence, quality of life, patient satisfaction, and clinical results will provide valuable insights into the effectiveness of these tools.

This research can inform the development of new features and functionalities that address unmet patient needs, ultimately driving the evolution of MHAs into indispensable resources for Bca care.

## CONCLUSIONS

This study represents a significant first step in evaluating the quality and adherence to clinical guidelines of MHAs designed for Bca patients. The findings highlight the current limitations of these digital tools, particularly in terms of their quality and adherence to EAU guidelines. Despite the growing number of MHAs available, most of the apps analyzed demonstrated suboptimal performance, with low MARS scores in key categories such as information, aesthetics, and functionality. Furthermore, less than one-third of the apps adhered to essential Bca guidelines, raising concerns about their reliability and potential impact on patient care.

While some apps showed promise by integrating guideline-driven content, the overall landscape remains underdeveloped, with significant gaps in content accuracy and usability. To fully harness the potential of MHAs in supporting Bca patients, it is essential to prioritize partnerships with healthcare professionals to ensure that these tools are evidence-based, user-friendly, and aligned with clinical standards. Standardized quality assessment frameworks like MARS should be consistently applied during both development and evaluation stages to ensure high-quality outputs. Future efforts should focus on refining content accuracy, enhancing user engagement, and conducting real-world evaluations of MHAs' impact on patient outcomes, such as treatment adherence and quality of life. By addressing these challenges, MHAs have the potential to become indispensable resources for Bca care, improving patient education, clinical outcomes, and overall healthcare experiences for patients facing this challenging disease.

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## DECLARATIONS

**Ethical approval:** Not applicable.

**Consent for publication:** Not applicable.

**Availability of data and material:** The datasets used and/or analyzed during the current study are available upon reasonable request from the corresponding author.

**Competing interests:** The authors declare that they have no competing interests.

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**Authors' contributions:** EDM, AF, ES, LC, PR, LR, MO, GM, FC, BB, LDL: data analysis and interpretation, RLR, VMA, LN: study concept, manuscript original drafting; BB, UA: statistical analyses, FM, CT, histological examination, CAF, FF, DA: contribution to manuscript writing and editing. All the authors read and approved the final version of the manuscript and agreed to be accountable for all aspects of the work.

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