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Critical analysis of features and quality of applications for clinical management of acne

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Abstract

Background: Mobile medical applications (apps) for clinical management of medical conditions are increasing in prevalence. Our aim was to identify features and overall quality of acne apps that could facilitate clinical management.

Methods: We established 10 pertinent features (6 essential and 4 desirable) for an acne app through literature search and nominal group discussion. Searches were then conducted in the Apple App Store and Google Play Store. Apps which assisted with clinical management of acne were assessed for functionality and quality. Overall quality was evaluated by grading against pre-established criteria for medical apps.

Results: A total of 358 Apple apps and 256 Google apps were found. After removing apps which did not assist with the clinical management of acne, 12 Apple and 13 Google apps remained. Apps were classified as interactive, informational, or teledermatology apps. Mean Masud scores were 12.8 ± 3.7 for the Apple apps and 12.2 ± 3.7 for the Google apps.

Conclusions: Mobile acne apps can be effective in the self-management and collaborative management of acne. The current acne apps are of variable quality and none contained all 10 features crucial for effective clinical management. The shortcomings identified in this paper can guide future acne app development.

Keywords: acne, mobile applications, app, apps, self-management, self-care, dermatology

Introduction

Acne vulgaris is a common condition, ranked amongst the ten most prevalent worldwide, with a

global prevalence of 9.4% [1]. Acne vulgaris affects individuals of all ages, including 85% of those aged 12–24 [2-5]. Repercussions of acne vulgaris can include anxiety, depression, self-esteem, and body image issues that can lead to refusal to attend school or work [6]. Acne is estimated to have a socioeconomic cost of \$3 billion dollars in the U.S. resulting from treatment costs and loss of productivity of sufferers [5].

The widespread use of mobile technology in the Western world is apparent in most age groups, including millennials (those born between the years 1982–2000), [7-9], and generation Z (those born between 2000–early 2010s), [10]. A study conducted by the Pew Research Center in 2018 found that 92% of millennials in the United States own smartphones, the highest proportion amongst all age groups [11]. A major factor contributing to this extensive use of technology is the plethora of mobile applications, or apps, available for download on mobile devices. Some apps available on mobile devices are medical and patient education apps, including a few focused on dermatology [12].

Previous studies have shown that certain medical apps can be beneficial for patients if they have certain features. For instance, a study conducted by Mendiola et al. [13] found that important features for mobile health apps include the ability to export data, share information with healthcare providers, and provide rewards achieved through patient engagement. In addition, mobile apps provide general education, suggest a plan of action, and give treatment reminders. Other important features include a community forum, integration with social

media, specific symptom management tips, educational information specific to the patient's stage or severity of illness, and a tracker to monitor progress. Other key features in dermatology apps include methods for self-surveillance, grading of severity of skin lesions, and the ability to send images of skin lesions to a dermatologist [11]. Prior studies evaluated a variety of apps aiming to assist with many different skin conditions and aspects of dermatological practice, but were not focused on acne [14-17].

We explore the availability and quality of acne care apps for iOS and Android devices for content and features to identify those that may facilitate acne management. This study aims to assess currently available mobile acne apps for overall quality and features.

Methods

A literature review on potential aggravating features of acne, factors improving acne outcomes, dermatology apps, and general health apps was conducted in May 2019 in PubMed with the search terms "acne," "mobile application," "app," and "dermatology" [13, 15, 18]. With information from the review and nominal group discussion, we established the following 10 features as pertinent for inclusion in an acne app: information on acne, self-grading of acne severity, ability to take longitudinal images, a treatment journal, reminders, a food/dairy intake journal, event tracking, tutorials/demonstrations (such as proper application of topical medications), future projections, and a reward system. We further stratified these into essential and desirable. Essential features relate to the concept of self-care, previously described by Henderson, Hall, and Orem [19]. This concept includes an interpersonal element, which allows patients to increase participation in their care, thus allowing them to strengthen their relationship with the health care professional. The essential features allow for greater involvement of patients in their care. Desirable features were those which improved the patient experience in self-management of acne but were not effective as standalone features. Furthermore, desirable features also included those

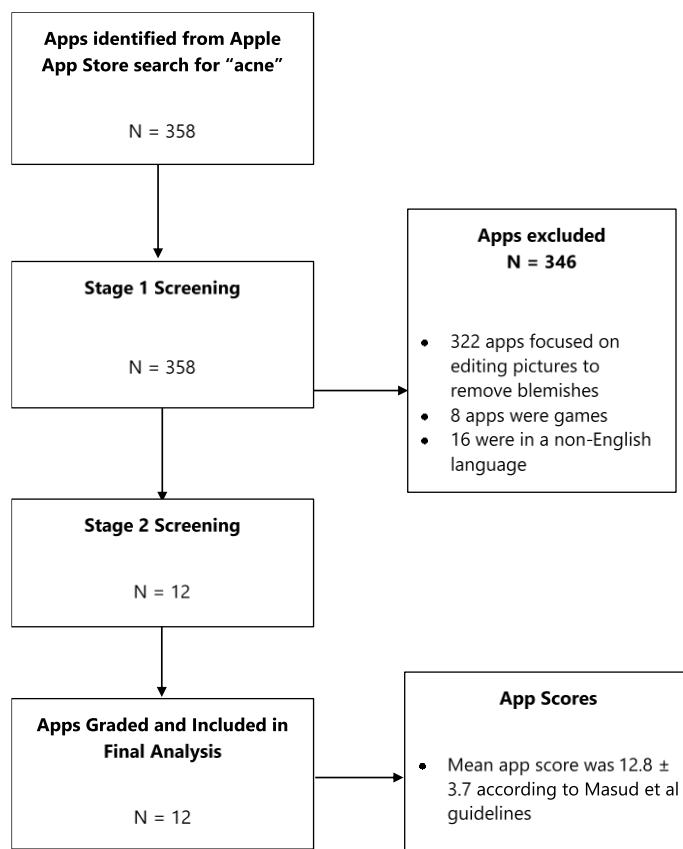


Figure 1. Flow diagram showing the total number of mobile apps found from the Apple App Store and the number of apps excluded from analysis (including reason for removal).

based on incentives or for which content is otherwise widely available and is not absolutely necessary to include in an app. There were 6 essential features (the ability to take and store longitudinal images, reminders, a food/dairy intake journal, event tracking, self-grading of acne severity, and a treatment journal) and four desirable features (reward system, future projections, information on acne, and tutorials/demonstrations).

Searches were conducted in the Apple App Store and the Google Play Store with the term "acne." Excluded from analysis were apps that were not in English, those which were games, and those that aimed to edit users' photos to remove acne. The remainder were downloaded for further evaluation. Cost of the apps and presence and quality of pertinent features was recorded. This analysis was done individually by each of two authors (RS and RK). Rating discrepancies were resolved by discussion to achieve consensus. Apps were also graded according to criteria established by Masud et al. [12]. These

include the assessment of “Educational Objectives,” “Content,” “Accuracy,” “Design,” and “Conflict of Interest” with a score from 1-4 in each category. The minimum total score is 5 and maximum is 20 (a value which we termed the *Masud score*). A high Masud score indicates that the app likely has educational value with comprehensive, accurate information and is easy to use/navigate with no conflicts of interest. As stated in the study by Masud et al., apps with scores of 5–10 are likely not useful to patients and may even be harmful to them. Apps with scores of 11–15 may be useful but will likely have some shortcomings and apps with scores of 16–20 are likely to be valuable to patients [12]. Finally, we evaluated features of the apps and gave each a feature score out of 6, indicating if they contained each of the 6 essential features previously described. This was completed by two individuals (RS and RK) with the same conflict resolution process if different scores were obtained.

Results

Searches for apps were conducted on March 26, 2019 and yielded 358 from the Apple App Store and 256 from the Google Play Store. Included for further analysis were 12 Apple App Store apps (excluded were 322 solely photo-editing apps, 8 games, and 16 in non-English languages) and 13 Google Play Store Apps (excluded were 225 solely photo-editing apps, 7 games, and 11 in non-English languages). See **Figures 1 and 2**.

The acne apps from both app stores were able to be classified into one of three groups: interactive apps (allowed patients to interact with the app and customize the experience to their own acne treatment), teledermatology apps (connected patients with a dermatologist), or informational apps (provided patients with information on acne or the treatments of acne, with little potential for interaction or personalization). The results from the app analyses are summarized below.

Apple Apps (see Table 1)

In the Apple App Store there were two interactive apps (16.7%), one teledermatology app (8.3%), and 9 informational apps (75.0%). Mean Masud score

(minimum 5 indicating low quality, maximum 20 indicating high quality) of the 12 apps was 12.8 ± 3.7 . Eleven (91.7%) had a score of 15 or less and one (8.3%) scored higher than 15 (**Table 2**).

Four apps had the top 3 Masud scores: *eTreat Acne*; *How to Treat Acne*; *Acne +* and *Acne—Causes of Pimples and Natural Organic Remedies to Heal Blemishes For Clear, Smooth Skin*. These each had Masud scores of 18, 15, 15, and 15, respectively. Regarding feature scores - *eTreat Acne* was 4/6 for longitudinal imaging,

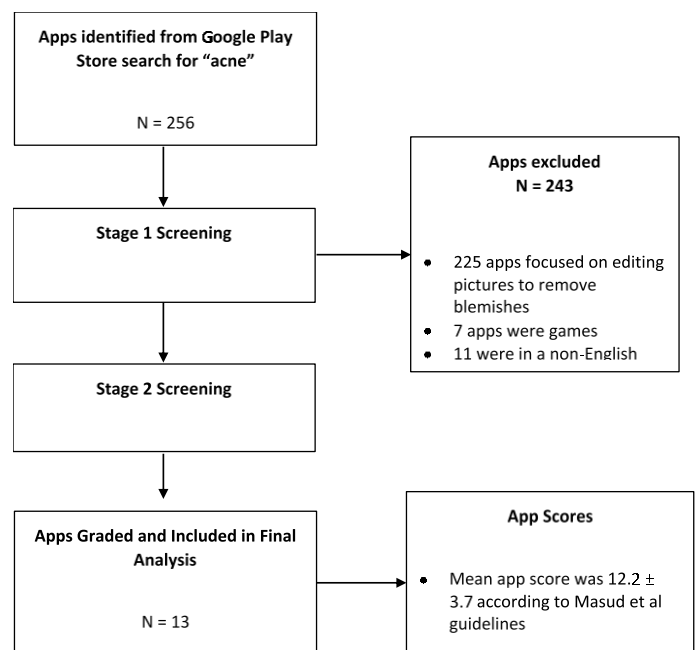


Figure 2. Flow diagram showing the total number of mobile apps found from the Google Play Store and the number of apps excluded from analysis (including reason for removal).

a treatment journal, a method to grade acne severity, and a food journal. The feature score for *How to Treat Acne* was 0/6. However, it did contain two desirable features, including information on acne and tutorials to demonstrate different treatments for acne. *Acne +* had a feature score of 0/6 as it did not contain any essential features. However, it contained one desirable feature: information on acne. Similarly, *Causes of Pimples and Natural Organic Remedies to Heal Blemishes For Clear, Smooth Skin* contained background information on acne, but did not contain other any essential features. Thus, we gave it a feature score of 0/6. Essential features absent in these apps were treatment reminders, future projections, and event tracking.

Overall, the majority of apps were easy to use and most had visually appealing interfaces. The apps were variably priced, with the costs ranging from free to \$3.99.

Google Apps (see Table 3)

In the Google Play Store, there was one interactive (7.7%), two teledermatology (15.4%), and 10 informational apps (76.9%). The mean Masud score of the 13 apps from the Google Play Store was 12.2 ± 3.7 and the maximum score was 18 (*eTreat Acne*). Twelve (92.3%) had a score of 15 or less and 1 (7.7%) scored higher than 15 (Table 4).

Apps with the top three Masud scores were *eTreat Acne*, *Acne Treatments*, *Acne Remedies*, *Remedies for Pimples*, *Acne Treatment*, *Scar Removal*, and *Acne Treatment and Remedies* with scores of 18, 14, 14, 14, and 14, respectively. For feature scores, *eTreat Acne* was 4/6 (similar to the Apple App Store) for longitudinal imaging, a treatment journal, a method to grade acne severity, and a food journal. *Acne Treatments*, *Acne Remedies*, and *Remedies for Pimples*, *Acne Treatment*, *Scar Removal* all only contained background information on acne. Thus, those were given feature ratings of 0/6. The feature score for *Acne Treatment and Remedies* was 0/6 as it did not contain any essential features. However, it contained two desirable features, including video tutorials and background information on acne. Essential features absent in all of these apps were reminders, and event tracking.

Similar to the Apple App Store, the apps found in the Google Play Store were easy to use, with user-friendly interfaces. The prices of these apps ranged from free to \$1.17.

Discussion

The advancement of mobile technology has allowed for the development of many dermatology apps. These vary in features and most have not been assessed for quality [12]. We found that the majority of acne apps had Masud scores of less than 15 (scores between 5–10 indicate apps that are likely not to be beneficial and potentially harmful and scores of 11–15 indicate that the apps may be beneficial but are likely to have shortcomings). In addition, most of the

apps lacked features which addressed essential needs arising in the treatment and management of acne. These deficiencies were reflected in low feature scores.

When treating patients with acne, a major issue is poor adherence to the prescribed treatments [15, 20]. Average adherence to acne treatments is 50–60% (with adherence being worse with chronic acne), [18, 21] and this low adherence rate may lead to unsuccessful outcomes. Improving treatment adherence is thus an ongoing need and one that could be facilitated with an appropriate acne app. Sending weekly e-mail surveys to acne patients who were prescribed topical benzoyl peroxide, in order to remind them to apply their treatments, resulted in adherence rates of 85%–132%, whereas the control group had adherence rates of 4%–80% [22]. Similarly, the ability of digital reminders to increase adherence was shown through a clinical trial involving an app targeted toward psoriasis patients. The app, which reminded patients to take their medications via email reminders, improved adherence and reduced psoriasis severity [18]. Diet (especially dairy intake and a high glycemic load), stressful life events, hormones, exercise, certain medications, appropriate skin care, patient adherence, and menstruation are all factors that may affect acne [1, 4, 23–34]. However, there is a paucity of features in current acne apps that address such factors.

The majority of acne apps lacked features which we believe would be beneficial. To address poor adherence, a reminder system would be valuable. The capacity to longitudinally track treatment progress would help guide patient care (including the decision to modify or continue current treatments). Similarly, features to track other aspects which can influence acne, such as diet, dairy intake, and lifestyle stressors, are likely to be beneficial. No current app addressed all these features in acne management.

Future directions should include the development of acne apps intended to be used for collaborative management with a healthcare provider containing essential (ability to take and store longitudinal images, reminders, a food/dairy intake journal, event

tracking, self-grading of acne severity, and a treatment journal), and possibly desirable (reward system to encourage use of the app, future projections, information on acne, and tutorials/demonstrations) features. Longitudinal images can provide an objective measure of acne over time to both patients and their health care provider. A reward system can help to enhance motivation. Reminders will be able to help improve patient adherence to the management plan. A food/dairy journal will assist patients in ensuring they avoid foods that may aggravate their acne by aiding them with adherence to a dairy-free and low glycemic index diet. Future projections of a patient's acne is helpful to have in the app because it can allow the patient to see potential results of treatments to enhance motivation. Event tracking (examples: tests or examinations, monthly menstrual cycles, other stressful events) will allow determination of association with acne flares to assess for individual triggers. Self-grading of acne severity can allow for the tracking of treatment progress and provide

another measure of treatment effectiveness. The treatment journal will allow the user to evaluate for possible changes in acne as a result of various treatments. In-app information on acne can assist the user in gaining a better understanding of their condition. Finally, linked tutorials can help patients learn/remember proper topical application technique and provide reminders on potential adverse events with acne treatments.

Conclusion

In summary, current acne apps are of variable quality and none contained all the essential features required for clinical management. The most highly rated acne app based on quality assessment (Masud score) and essential feature fulfillment was *eTreat Acne*. Nevertheless, the shortcomings we identified can inform future acne app development.

Potential conflicts of interest

The authors declare no conflicts of interests.

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Table 1. Summary of relevant mobile apps found after searching “acne” in the Apple App Store.

	Cost	Longitudinal Images	Reward System	Reminders	Food Journal	Future Projections	Event Tracking	Grading of Severity	Treatment Journal	Tutorials/Outside Links	Information on Acne
Acne Treatment – Learn How to Treat Fast and Naturally	\$1.39	No	No	No	No	No	No	No	No	Yes (Links to outside pages)	Yes
ACNE Care Treatment.	Free	No	No	No	No	No	No	No	No	No	Yes
Acne Care Guide [Guide] – Best Pimple Treatment Tips	Free	No	No	Yes	No	No	No	No	No	No	Yes
Acne Care Tips and Pimple Care Tips	Free	No	No	No	No	No	No	No	No	No	Yes
eTreat Acne	Free	Yes	No	No	Yes	No	No	Yes	Yes	No	Yes
Treatment of Acne Problems	\$3.99	No	No	No	No	No	No	No	No	No	Yes
Virtual Acne	Free	No	No	No	No	No	No	No	No	No	No
Acne – Causes of Pimples and Natural Organic Remedies to Heal Blemishes For Clear, Smooth Skin	Free	No	No	No	No	No	No	No	No	No	Yes
Acne+	\$2.79	No	No	No	No	No	No	No	No	No	Yes
ACNE Care Treatment	Free	No	No	No	No	No	No	No	No	No	Yes
ACNE Diary	Free	Yes	No	No	Yes	No	No	No	Yes	No	No
How To Treat Acne	\$3.99	No	No	No	No	No	No	No	No	Yes	Yes

Table 2. Summary of the Masud scores given to each app from the Apple App Store out of 20 according to the guidelines created by Masud et al. [9]. Apps marked with an "*" were marked "N/A" in the "Educational Objective," "Content," and "Accuracy" categories because they did not have a major educational component.

	Educational Objective	Content	Accuracy	Design	Conflict of Interest	Total Score
Virtual Acne*	N/A	N/A	N/A	4	1	5
ACNE Diary*	N/A	N/A	N/A	3	3	6
Treatment of Acne Problems	2	2	3	2	3	12
Acne Care Guide [Guide] – Best Pimple Treatment Tips	3	2	3	2	3	13
Acne Care Tips and Pimple Care Tips	3	2	3	2	3	13
Acne Treatment – Learn How to Treat Fast and Naturally	3	3	2	3	3	14
ACNE Care Treatment.	3	3	3	2	3	14
ACNE Care Treatment	3	3	2	3	3	14
Acne – Causes of Pimples and Natural Organic Remedies to Heal Blemishes For Clear, Smooth Skin	3	3	3	3	3	15
Acne+	3	3	3	3	3	15
How To Treat Acne	3	3	3	3	3	15
eTreat Acne	4	4	3	4	3	18

Table 3. Summary of relevant mobile apps found after search “acne” in the Google Play Store.

	Cost	Longitudinal Images	Reward System	Reminders	Food Journal	Future Projections	Event Tracking	Grading of Severity	Treatment Journal	Tutorials/Outside Links	Information on Acne
Acne Treatment and Remedies	Free	No	No	No	No	No	No	No	No	Yes. Provides instructions on home remedies.	Yes
eTreat Acne	Free	Yes	No	No	Yes	No	No	Yes	Yes	No	Yes
Skin Treatment – Get Rid of Acne And Pimples Natur[ally]	Free	No	No	No	No	No	No	No	No	No	Yes
Acne No More	No	No	No	No	No	No	No	No	No	No	Yes
Acne Healing	\$1.17	No	No	No	No	No	No	No	No	No	Yes
Remedies for Pimples, Acne Treatment, Scar Removal	No	No	No	No	No	No	No	No	No	No	Yes
How to Remove Acne	No	No	No	No	No	No	No	No	no	Yes. Provides instructions on home remedies.	Yes
Acne Home Remedies	No	No	No	No	No	No	No	No	No	Yes. Provides instructions on home remedies.	Yes
Acne Care Clinic	Free	No	No	Yes. Appointment Reminders	No	No	No	No	No	No	No
Acne Treatment	Free	No	No	No	No	No	No	No	No	No	Yes
Acne Remedies	Free	No	No	No	No	No	No	No	No	No	Yes
Acne Treatments	Free	No	No	No	No	No	No	No	No	No	Yes

DermCheck Dermatology	Free (with in-app purchases)	No	No	No	No	No	No	No	No	No	No
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Table 4. Summary of the Masud scores given to each app from the Google Play Store out of 20 according to the guidelines created by Masud et al. [9]. Apps marked with an "*" were marked "N/A" in the "Educational Objective," "Content," and "Accuracy" categories because they did not have a major educational component.

	Educational Objective	Content	Accuracy	Design	Conflict of Interest	Total Score
Acne Care Clinic*	N/A	N/A	N/A	3	1	4
DermCheck Dermatology*	N/A	N/A	N/A	4	1	5
Acne Healing	3	3	2	1	3	12
How to Remove Acne	2	3	2	2	3	12
Skin Treatment – Get Rid of Acne And Pimples Natur	3	2	2	3	3	13
Acne No More	3	3	2	3	2	13
Acne Home Remedies	3	3	2	2	3	13
Acne Treatment	2	3	3	2	3	13
Acne Treatment and Remedies	3	3	2	3	3	14
Remedies for Pimples, Acne Treatment, Scar Removal	3	3	3	2	3	14
Acne Remedies	2	3	3	3	3	14
Acne Treatments	3	3	3	2	3	14
eTreat Acne	4	4	3	4	3	18