Direct to Consumer Mobile Teledermatology Apps: An Exploratory Study

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Abstract

Background: *Since 2012, "Direct to Consumer" mobile teledermatology apps have become more available, relinquishing many data collection tasks normally done by healthcare professionals directly to patients.* ***Introduction:*** *To determine user friendliness, diagnostic quality, and service of commercially available mobile teledermatology apps.* ***Materials and Methods:*** *All mobile teledermatology apps available at the Apple App Store were reviewed. The two most popular mobile teledermatology apps were identified and tested together with three apps having similar functionality using a single case of a patient who was also examined by a dermatologist in-person.* ***Results:*** *Apps varied in diagnostic scope, data gathering methods, services, rendered results, and in geographic coverage and cost.* ***Discussion:*** *None of the apps take a history as thoroughly as recommended by textbooks. Key medical questions like current medications and allergies are not asked often. Most apps rendered concordant results, except for the one having the least thorough history taking.* ***Conclusions:*** *Mobile teledermatology application interfaces, services, and cost vary, with some risking medical errors and possible distribution of continuity of care. The American Telemedicine Association's guidelines for teledermatology need to address the use of direct to consumer apps. To protect consumers, app regulation, certification, or guidelines suggesting appropriate development and use might be considered.*

Key words: *teledermatology, telemedicine, technology, m-health, dermatology*

Introduction

The telemedicine market, especially in teledermatology, is growing.[1] The Apple App Store has offered "Direct to Consumer" mobile teledermatology applications since 2012, allowing patients to send pictures with descriptions of their skin conditions directly to dermatologists for diagnosis. Treatment is provided through electronic prescriptions to patients' local pharmacies. The teledermatology method resembling apps the most is store-and-forward. It has been greatly studied and has concordance to in-person examinations ranging from 48% and 94%[2] or 46% to 88%.[3] In these studies, patient medical history and images were taken by healthcare professionals or trained staff. Direct to consumer mobile teledermatology apps relinquish these tasks to patients, and each app is intended for use with a particular teledermatology service.

A recent publication summarized the features of different teledermatology applications on the World Wide Web and those available at the Apple and Google App Stores based on developer provided information.[4] This study follows up by actually testing a selected sample of these applications. Five different applications were tested with a single real case to identify their common and unique features for collecting clinically relevant information and to determine the accuracy of their related services.

Materials and Methods

The App Store analyzer App Annie[5] was used to search for direct to consumer teledermatology apps with the highest downloads. There were 24 apps available at the time, but 9 had virtually identical features, indicating the software could be rebranded and modified for different teledermatology services. The functionality and specifications of the two most popular apps were used to identify three additional ones with equal or similar functionality. The remaining apps were examined to identify features that varied from those selected. All apps tested covered a range of dermatologic conditions. While such app coverage is common, some apps specialize in the treatment of specific conditions, such as antiaging or acne, or only offer over the counter treatments.

The patient, a nonhealthcare worker, submitted case information through an iPad 3gen using each application, giving the same response to all common questions while offering additional information if the application requested it. An assistant took pictures of the patient's neck where the lesion of concern was located. The patient was encouraged to articulate any thoughts, questions, or issues while using each app, and

problems were recorded. The pictures and information were uploaded inside the apps for evaluation by their respective teledermatology services, which returned a diagnosis and a treatment plan. The patient was also examined in-person and diagnosed as having folliculitis to be treated with over the counter benzoyl peroxide for 14 days till symptoms resolve or follow-up was needed. All app data collection procedures and interfaces were compared to the history taking guidelines in Fitzpatrick's book *Dermatology in General Medicine*.[6] App service diagnoses and treatments were compared to in-person. Since apps in the Apple store have to meet the company's interface guidelines, diagnostic and treatment congruence and procedures for collecting clinically relevant information were the primary assessment criteria. The National Institute of Health Office of Human Subject Research designated the research plan as exempt from full Institutional Review Board review.

Results

Assessment results are summarized in *Table 1*. The two most popular apps are labeled A and B, while the comparable apps are labeled C–E. Apps varied in diagnostic scope and data gathering methods, diagnostic quality and rendered results, and services provided, including their geographic coverage and cost.

DATA COLLECTION INTERFACE

Most tested apps had four sections: provider selection, medical history, photos, and payment, although their order varied. Applications with multiple providers allowed users to select a specific one or choose the next available for a faster response. Short provider biographies were included for guidance. To triage patients, the tested apps use two different mechanisms. Four of the five apps asked patients to describe their problems by entering free text, followed by similar standard sets of questions such as symptom onset, duration, and severity. In the apps allowing free text entry, the patient would enter the chief complaint in layman's terms, for example, "A bump on the neck that hurts," and respond to questions giving only limited information. One app (App B) asks patients to triage themselves into disease categories such as rash&itch, bug bite&sting, and rosacea with follow on disease-specific questions, including pertinent negative and positive questions about the disease condition. The diagnostic algorithms are different for each category but overlap to some degree. The patient had difficulties deciding which categories to choose, not knowing the meaning of some medical terms or the etiology of the condition.

The quantity and range of history questions varied as well as the question type: open ended versus closed, free text versus pick list, or a combination method where typing the first letters of the word will trigger a selection list. According to Fitzpatrick,[6] history taking during a dermatology encounter should include multiple questions about the current symptoms, as well as past medical history (PMHx), including history of allergies and medications. The degree to which this framework was incorporated into the different apps varied widely, ranging from the least comprehensive (App A), asking no questions about PMHx, to the most comprehensive (App B), including almost all parts of a thorough PMHx, except family and psychiatric history.

The patient did not know how to respond to most open-ended questions, and the patient's difficulties using the onscreen keyboard for input discouraged entry of longer text. An app generating pick lists after initial typing was particularly difficult to use because once a list was displayed, the patient had to make a selection before proceeding. The patient wanted to indicate allergy to sulfa drugs generally, but was forced to choose specific ones listed. Frustrated, the patient selected the first drug, "SulfaCleanse 8-4," a topical sulfa containing lotion, downgrading a systemic allergy to oral sulfa drugs to local skin symptoms. Further tests of this app indicated that chance of error increases if medications are not fully spelled or misspelled. For a Penicillin allergy, the first response to typing the first three letters ("Pen..") is "pen needles" (a diabetic supply for insulin administration) with penicillin not being listed. If penicillin is misspelled as "Penn..," the response becomes "Pennyroyal oil (bulk)," an over the counter herbal medication for multiple symptoms, including flu and stomach upset, linked to irregular menstrual bleeding and abortion. A spell correction for penicillin was not offered, so a penicillin allergy could be missed.

The photo interface in all apps asked patients to submit a minimum of two to three pictures with some limiting the total number of photos and some not. Each app required an overview picture and one or two close-ups. The user was told to create a clear and focused picture, but none of the apps tested had image guidance or quality control tools giving user feedback if a picture is inadequate. One app, which was not selected for testing, did have a mechanism helping users center but not focus the image. Other features for measuring the size of the lesion or comparing color were absent in all apps.

Apps for services providing prescriptions asked for a patient's local pharmacy address and phone number. In most apps, this information is free texted, but some offer local pharmacy lists when users enter their zip codes. Payment is by credit card following procedures common for other online purchases. Of the tested apps, one (App C) had automatic insurance reimbursement integrated into its interface.

DIAGNOSTIC QUALITY

All apps, except App E providing free service, returned a diagnosis from the next available or selected dermatologist with

Table 1. Comparison Between Apps and "In-Patient" Examination

	APP A (MOST POPULAR)	APP B (MOST POPULAR)	APP C	APP D	APP E	IN-PERSON
Interface user friendliness						
CC/Triage method	Free text	Pick list	Free Text	Free Text	Free Text	
No. of disease categories	All	All	All	All	All	
No. of HPI questions	1	21	8	7	1	
No. of of PMHx questions	No	14	13	2	1	
Chronic illness	No	Yes	Yes	No	No	
PSHx	No	No	Yes	No	No	
Hx of immunosuppression	No	Yes	No	Yes	No	
Psych Hx	No	No	No	No	No	
Hx of blistering sunburns	No	Yes	Yes	Yes	No	
Medications (Rx, OTC, Vit., Herbal)	No	Yes (all)	Yes, No (vit./herbal)	No	No	
Allergy	No	Yes	Yes	No	Yes	
Social Hx	No	Yes	Yes	Yes	No	
Fam Hx	No	No	No	No	No	
No. of ROS system question asked	No	1	No	No	No	
Ability to free text	Yes, only	Yes	Yes	Yes	Yes	
No. of photos to be submitted	2	Unlimited	2–9	Unlimited	Unlimited	
Image guidance or quality control	No	No	No	No	No	
Diagnostic accuracy						
Diagnosis	Enlarged and/or infected sebaceous cyst or gland	Folliculitis	Folliculitis	Folliculitis	No response	Folliculitis
In-person agreement	No	Yes	Yes	Yes	–	
Treatment and recommendations	See in person dermatologist for antibiotic Rx	Rx: Clindamycin topical 1% gel, OTC: Benzoyl peroxide 10%	Rx: Doxycycline PO, Clindamycin topical 1%, OTC: Benzoyl peroxide 10%	Rx: Cleocin T gel, Triamcinolone 0.1% lotion	No response	OTC: Benzoyl peroxide 10%
In-person agreement	No	Yes	Yes	Yes	–	
Service						
Geographic availability	All states	15 States	27 States	2	1	
Price	$24.99	$40	$79, advertised as $59	$65	$ free	$35 copay
Response time	<48 hrs	<24 hrs	>48 hrs	<24 hrs	No response after 7 days	
Follow-up	No	Yes, 2 weeks	No	No	Unknown	Follow-up as needed
Note	• Only offers diagnosis and OTC trt. no eRx	• Patient could not triage himself into disease categories because of medical terminology • Offers Case manager	• Allergies and medications could not be recorded accurately • Sent report to PMD	• MD inquired about med and allergy after consult • After payment notified that app is not available in test state	• App belongs to charity foundation	

CC, chief complaint; eRx, electronic prescription; HPI, history of present illness; Hx, history; OTC, over the counter; PMD, primary medical doctor; PMHx, past medical history; PO, by mouth; PSHx, past surgical history; ROS, review of the system; Rx, prescription; trt, treatment; Vit., vitamins.

an explanation in layman terms as well as treatments. One reason there was no response using App E might be that it was developed by a charity foundation focusing on developing countries. Still, there was no feedback about users qualifying for the service. Of the four apps returning results, three had the same primary diagnosis, "Folliculitis," as the in-person dermatologist. App A's diagnosis (sebaceous gland enlargement/infection) is not a differential diagnosis of the primary "Folliculitis" diagnosis.[7] No service commented on image quality or requested new images. Services able to prescribe medication (Apps B–E) all recommended the same therapeutic regimen (topical antibiotic cream, antibacterial lotion, with or without additional oral antibiotics), but used different agents. The app (App A) that only offers diagnosis and over the counter treatment recommended seeing a dermatologist in-person for antibiotic treatment. This result was unexpected, as the dermatologist who saw the patient in-person only recommended an over the counter treatment, which the app might have also recommended if the primary diagnosis would have been correct.

SERVICES

Some apps offered additional services at no extra cost. One app's service (App C) faxes a report to the primary care provider while another (App B) will contact them if needed. This app service also had a 14-day follow-up, allowed 30 days of free messaging with the teledermatologist, and offered a care coordinator and coupons lowering prescription costs.

Apps only offering diagnosis and over the counter treatments (App A) can be used in all states. To date, 22 states allow telehealth consultation with electronic prescription writing.[8] Providers can only practice telemedicine and electronically prescribe medications in states they are licensed. Therefore, although the apps can be downloaded by users in all states, not all patients can use them. Some services cover multiple states by enlisting dermatologists licensed in each, while others restrict their service to a particular state. Geographic coverage is not always apparent to users, since apps presenting physician information, including location, may fail to notify users that it imposes a service restriction. All but one app (App D) confirms if the service would be available in a patient's state through the mobile device's own GPS location service or the pharmacy zip code. App D generated a message that the service would be unable to electronically prescribe medication to a selected pharmacy because its dermatologists were not licensed in the pharmacy's state, but only after all data were supplied and credit card information was submitted.

All apps can be downloaded for free, but the price per consultation varies. For the tested apps, the fixed price range per consultation was from $0 to $79, except for one app (App A) staggering the price by response time, charging $100 for a 4-h response, $39.99 for a 24-h response, and $24.99 for a 48-h response. The fixed price range is competitive considering America's largest private health insurance, Blue Cross Blue Shield, requires a $35 member copay for seeing a dermatologist in person[9] and the average waiting time in the United States for a new in-person dermatologist visit is around 30 days.[10]

One app (App C) asked for insurance information for direct billing, while others provide receipts patients can submit for reimbursement. Insurance coverage for stored and forward teledermatology is diverse with the Centers for Medicare and Medicaid Services covering only provider to provider consultations. Medicaid covers telemedicine services in six states and Medicare covers it in only two states (Alaska and Hawaii).[8] In the private sector, insurance reimbursement amounts depend on the carrier.

Discussion

Despite considerable differences in history taking, interfaces and cost between the tested apps, three of the four returning results had the same diagnosis and treatment plan as the in-person dermatologist. They provided an answer and treatment considerably faster than scheduling usual in-person consultations for a price equal to or one to two times the amount of the copay for an office visit. While the app giving the wrong diagnosis also was the least thorough in the history taking, a correlation between this cannot be drawn with a single case. None of the apps take a history as thoroughly as the Fitzpatrick dermatology educational textbook recommends. Two apps did not ask the user key medical questions such as current medications and allergies. Those soliciting this information did not allow it to be properly recorded, increasing the risk of missing allergies. Currently, service costs are mostly paid out of pocket. Insurance companies are slowly adapting to consumer teledermatology, but there may be possible fraud. No app verified patient information, making it easy for users to bill insurance for services to patients not covered by their policies. Although some of the apps optionally provided information to the patient's primary care provider and offered follow-up services, none of the apps has features reinforcing continuity of care and integration into medical records.

The Apple App Store has specific guidelines for app developers, including applications providing healthcare[11] that are tested before the apps become available in the store. Those guidelines ensure software functionality, compliance with Apple's user interface, license agreement, and consumer protection from fraudulent applications, but have no influence on the quality of the service offered or how well apps collect clinically relevant information.

A body that could ensure quality is the American Telemedicine Association (ATA). Its latest published "Practice Guidelines for Teledermatology" in 2007,[12] focusing primarily on hardware standards, are being updated and need to address direct to consumer teledermatology with quality standards for hardware, consumer safety, and support, as well as cost and insurance reimbursement. The ATA has started to accredit online telemedicine providers, although no teledermatology service has been accredited to date.[13] App certification might be explored as well.

Conclusions

Direct to consumer services are a radically new way of providing care in dermatology and other specialties. Evaluation of a small sample of the most popular direct to consumer teledermatology apps at the Apple App store with a single case shows that application data collection interfaces, services, and cost vary widely, with some risk of medical errors and continued care disruption. Further research with additional subjects is needed. Since the single subject in this case was university educated and still experienced problems, research should account for each subject's age and education.

This exploratory study suggests some working hypothesis for additional research: first, apps using an algorithm of multiple choice questions, pick list, and fill in the blank for history taking gather a more complete history than those that only allow free text. Medical professionals depend on a complete history to form a diagnosis from patient data. Patients using free text for history taking lack the medical expertise to provide all relevant information if not prompted by questions similar to traditional face to face encounters. Second, if pick lists are provided, they should also have a field allowing free text to submit information that is not listed or to let patients indicate that they do not understand what information is requested. Third, spelling assistance might be beneficial, but only if it offers a wide range of options common to word processing programs.

This study also raises the question whether apps should be regulated or certified, whether additional guidelines focusing on clinical content are needed for app development and use, and whether the ATA should incorporate apps into their practice guidelines, not just for teledermatology but also other specialties. In the absence of certification indicating to the end user the quality of the software and the service, patients should be cautioned about app use and encouraged to read app reviews of other users. The most appropriate use of apps might be for management and follow-up after initial in-person examination, where app functions and features could be explained as part of the initial consultation and the application outcomes could be incorporated into the existing medical record.

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