

Accuracy and efficiency of telemedicine in atopic dermatitis



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Background: Telemedicine provides accurate diagnoses for skin disorders and has gained emphasis. It may be used for the triage and management of common skin diseases in primary care, improving patients' access and reducing time to treatment.

Objective: To evaluate the proportion of atopic dermatitis patients who could be managed with the support of telemedicine and its accuracy. Second, we aimed to assess the frequency of atopic dermatitis, demographics, clinical features, and therapies dispensed in relation to the disease.

Methods: Retrospective study in a population of 30,976 individuals, assisted by telemedicine. We assessed patients with the diagnosis of atopic dermatitis and evaluated the proportion of cases referred to biopsy, in-person dermatologists, or to be managed by primary care; the treatments suggested; and telemedicine accuracy to diagnose atopic dermatitis.

Results: Atopic dermatitis was diagnosed in 1648 patients (5.3%), the sixth most common dermatosis, with 2058 lesions (3.7%) analyzed. Primary care physicians were able to manage 72% of the atopic dermatitis patients, whereas 28% of them were referred to in-person dermatologists. Accuracy for atopic dermatitis diagnosis was 84.4%.

Conclusion: Telemedicine was an accurate method and helped primary care physicians to treat 72% of the atopic dermatitis lesions, thereby optimizing the availability of in-person appointments with dermatologists for more severe cases. (JAAD Int 2020;1:175-81.)

Key words: accuracy; atopic dermatitis; efficiency; teledermatology; telemedicine.

INTRODUCTION

Telemedicine is a health care method that can be used for assessing different conditions and has been gaining prominence around the world, especially for skin lesions. Real-time and store-and-forward images are the most common types of images used in telemedicine. Although in store-and-forward telemedicine the data and images from a patient are collected and sent to a physician for later (asynchronous) analysis, in real-time telemedicine, patients and physicians exchange data and images from separate locations in real time.¹ Many studies have

shown that access to specialty care improves when telemedicine is used because it provides accurate diagnoses and reduces the time to treatment, with high patient satisfaction.²

Atopic dermatitis is a chronic pruritic inflammatory skin disease that occurs in 5% to 20% of children worldwide, but it also affects adults with a prevalence of 2% to 8%.³ It is often associated with elevated serum levels of total and specific immunoglobulin E and personal or family history of atopic diseases, including asthma, rhinitis, and allergic conjunctivitis. Mild atopic dermatitis is prevalent

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and may be manageable within the primary care setting. However, the lack of well-trained primary care physicians leads to patients' being unnecessarily referred to dermatologists, allergists, or both. If there are not enough professionals to handle this demand, appointments are filled by patients who do not need specialty care, thereby limiting the availability of visits for those who do.

The city of São Paulo has approximately 12 million inhabitants,⁴ and 58% of them exclusively depend on the public health care system.⁵ Public municipal health care focuses on primary care services, and there is a high demand for dermatologic consultative services. In July 2017, despite that the municipal public health system provided 192,203 appointments for in-person dermatologic consultations per year, 57,832 patients were

still waiting for an appointment, which could take up to 1 year to obtain. For this reason, the municipal health department has decided to implement a telemedicine project, a new model of delivering health care services for a large number of people, by establishing a partnership with Hospital Israelita Albert Einstein, a large private hospital in the city with great expertise in telemedicine. The project rationale was as follows: If the general physician in primary care could manage the less complex skin diseases with the support of telemedicine, more in-person appointments would be made available, shortening the waiting time for patients who need in-person care. The goal of our study was to answer 3 questions: (1) To what extent is it possible to take care of patients with atopic dermatitis in primary care, avoiding unnecessary consultations with the specialist? (2) What is the frequency of atopic dermatitis according to demographic/clinical data, and how is it managed? (3) What was the telemedicine diagnostic accuracy for atopic dermatitis?

METHODS

This study was approved by Hospital Israelita Albert Einstein and Municipal Ethics Committees and it is in accordance with the ethical standards on human experimentation and with the Declaration of Helsinki. It was a retrospective cohort study conducted in the city of São Paulo, where 57,832 individuals were waiting for an appointment with a dermatologist in July 2017. The municipal health

department and Hospital Israelita Albert Einstein implemented a project to assist patients who were on a waiting list after being referred for any reason to a dermatologist by the general physician. Those patients were telephoned by the municipal health department and had an appointment scheduled in 1 of the 3 public hospitals participating in the program.

Once the patient was there, a trained health care technician obtained a short history of his or her complaint and demographic data, as well as 3 photographs at different angles and distances from each lesion or region of interest, which were taken with mobile device digital cameras. For example, if the patient had a nevus on the neck and eczema lesions on the face photographed, they were counted as 2 lesions in 1 patient. If the patient had 2 areas of eczema photogra-

phed—for example, face and forearm—independently of how many individual lesions of eczema were present in those areas, they were counted as 2 lesions and 1 patient. An online platform and mobile application were developed for this project, and all the collected data were uploaded onto the platform. Only the dermatologists recruited for this project had access to the patients' data, using a secure online process (Fig 1).

From July 2017 to July 2018, 13 Brazilian board-certified dermatologists from the Hospital Albert Einstein telemedicine department provided virtual consultative support to primary care providers. They had to first decide whether the photographs of the lesions were technically satisfactory for diagnostic purposes. If not, they checked the box "bad photo" on the platform and referred the patient to a dermatologist for a face-to-face appointment. If the photograph showed good technical quality, they formulated the most probable diagnostic hypothesis and chose among 3 referral options for each lesion assessed: directly undergo biopsy and return to a dermatologist with the histopathologic examination result; attend an in-person dermatologist visit; and return to the primary care physician with the most probable diagnosis, recommendations for how to proceed with the diagnosis investigation, and how to manage the dermatosis. If the same patient had multiple lesions with different types of referrals, for the purpose of final results accounting, the referral

CAPSULE SUMMARY

- This article examines the use of telemedicine for diagnosis and treatment of atopic dermatitis, a frequent dermatosis in primary care attention, especially in children and adolescents.
- Telemedicine proved to be accurate and efficient in atopic dermatitis management along with the general physician, avoiding unnecessary in-person appointments with specialists.

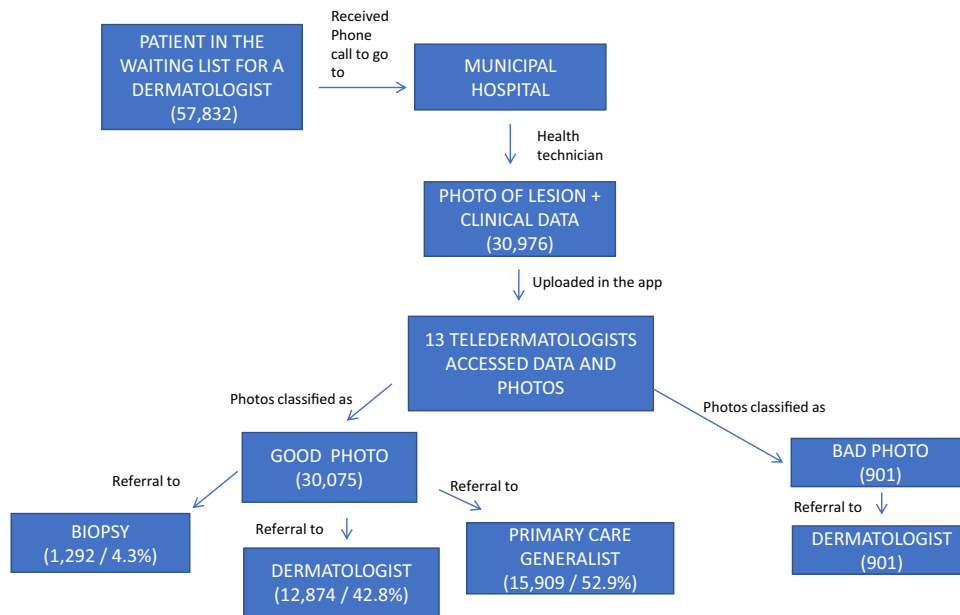


Fig 1. Telemedicine project conducted from July 2017 to July 2018 in the city of São Paulo.

for biopsy prevailed over the referral to the dermatologist, which, in turn, prevailed over the referral to the general physician (Fig 1).

After the project was completed, an anonymized database composed of information for all patients and their lesions was elaborated, with demographic and clinical data, the prescribed treatment, and the referrals made by the teledermatologists to each lesion. We selected the patients with an *International Statistical Classification of Diseases and Related Health Problems, 10th Revision* code of atopic dermatitis in the database. The frequency and clinical features were analyzed according to the patients' age and sex, as well as the treatment and referral provided by the teledermatologists. The efficiency of telemedicine was determined according to the frequency of patients referred to their respective primary care physicians, with proper orientation. Because atopic dermatitis is a clinical diagnosis, telemedicine accuracy was measured for the patients referred to in-person consultation by analyzing the proportion of the teledermatologists' atopic dermatitis diagnoses that matched the final diagnosis made by the in-person dermatologist.

To better analyze the results, our population was divided into 5 age groups: aged 0 to 2, 3 to 12, 13 to 19, 20 to 59, and greater than or equal to 60 years. The categoric data were represented by absolute (n) and relative (percentage) frequencies and expressed through contingency matrices. All the statistical calculations were performed with the 2-tailed χ^2 test with the Yates correction in GraphPad Prism

(version 6.0, San Diego, CA). The level of significance was set at 5% ($P < .05$).

RESULTS

Patients and lesions

Of the 57,832 patients waiting for a dermatologic consultation in the city of São Paulo, 30,976 individuals participated in the teledermatology project (54%), and 55,012 lesions were analyzed. The total number of patients receiving a diagnosis of atopic dermatitis was 1648 (5.3%) and the total number of lesions photographed that were considered atopic dermatitis was 2058 (3.7% of all lesions). The mean number of lesions photographed per patient was 1.25. Fig 2 shows the frequency of lesions diagnosed as atopic dermatitis, according to age and sex. It was more common among male participants in the group aged 0 to 2 years, but with no statistically significant difference. In the group aged 3 to 12 years, female patients showed absolute higher values, but no statistical significance was found. In the group aged 13 to 19 years, female patients were more affected than male patients ($P = .049$). In the group aged 60 years and older, male participants were more frequently affected by atopic dermatitis ($P = .003$).

Atopic dermatitis was the first cause of consultation for subjects up to aged 12 years, corresponding to 21% of all complaints. It held the second position in the group aged 13 to 19 years (after acne at position 1; data not shown), corresponding to 6% of all cases. Atopic dermatitis was diagnosed in 2% of adults (17th place in the list) and 1% (24th rank) of the geriatric population.

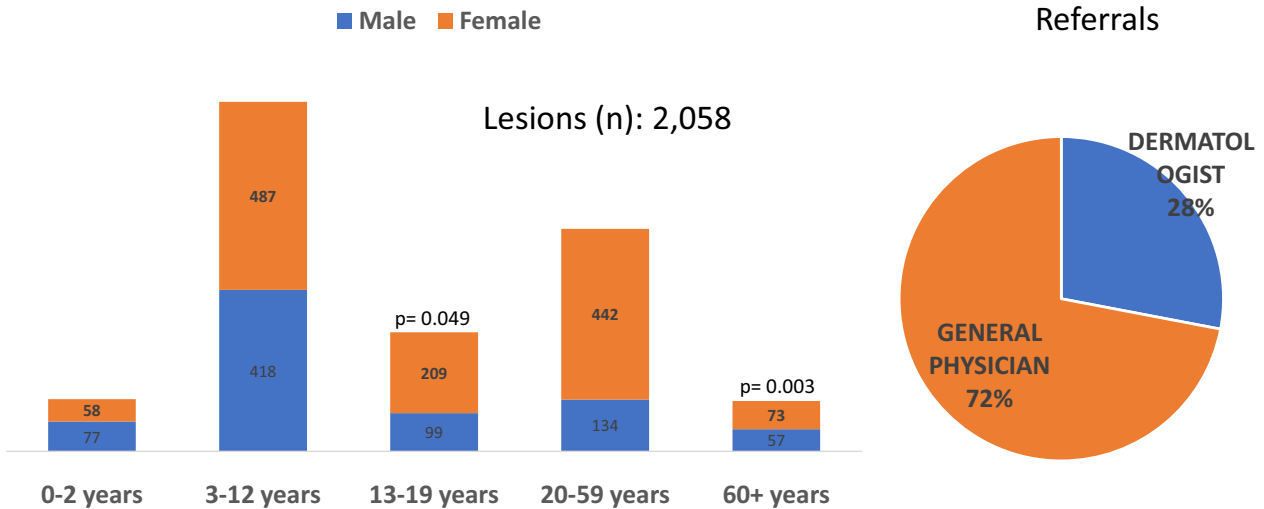


Fig 2. Frequency of atopic dermatitis lesions according to age and sex and referrals made by teledermatologists in the telemedicine project from July 2017 to July 2018 in the city of São Paulo.

Clinical data and treatment

The chronicity of the lesions at the teleconsultation was evaluated. Atopic dermatitis cases were divided in thirds: lasted for 1 year or less, between 1 and 3 years, or 3 or more years until the teleconsultation date. Pruritus was a common symptom, reported in 70% of the patients with atopic dermatitis, and bleeding was present in 25% (Fig 3).

The most common sites affected by atopic dermatitis according to age and sex are shown in Fig 4. The limbs and head/neck regions were the most affected in male and female patients up to aged 19 years. We observed that the same locations were affected among the adult patients, but lesions became more frequent in the trunk, especially in men. We also analyzed the most common treatments prescribed by the teledermatologists. Emollient was the most prescribed treatment (74%). Low-potency corticosteroids were frequently prescribed for atopic dermatitis (56%) and high-potency corticosteroids were recommended for a third of all the atopic dermatitis lesions. Topical calcineurin inhibitors were not used during the project because of their higher cost.

Referrals and accuracy

The teledermatologists referred the patients to a primary care physician in 72% of atopic dermatitis cases. Telemedicine was most efficient for adults (20-59 years) and adolescents (13-19 years), and was used for management of their disease in conjunction with the general physician in 77% and 68% of the cases, respectively. It was less efficient in early life (0-2 years), with 43% efficiency, and it had an

intermediate result for children aged 3 to 12 years and adults aged 60 years and older (54% and 57%, respectively). Biopsies were suggested for only 3 cases. Referrals to in-person dermatologists occurred in 28% of cases (Fig 2). The use of telemedicine reduced the mean waiting time for an in-person specialist visit from 6.7 to 1.5 months during this project (reduction of 78%). Mean waiting time is constantly monitored online by the municipal government, and it is calculated from the patient's referral to a dermatologist until the in-person appointment has occurred. Among the 2058 atopic dermatitis cases, 576 were referrals to dermatologists, and we retrieved 109 cases of them with the final in-person dermatologist diagnosis to compare with the teledermatologists' diagnoses (Table D). Both diagnoses agreed in 92 of 109 cases (84.4%). If we considered similar diagnoses in the spectrum of atopic diseases (eg, pityriasis alba, xerosis, keratosis pilaris, lichen simplex chronicus), the atopic dermatitis accuracy increased to 99 of 109 (90.8%). If we amplified to eczematous diseases, accuracy was 104 of 109 (95.4%).

DISCUSSION

Telemedicine is still an innovation for both patients and physicians in Brazil, and a pioneer project involving a significant number of participants was a challenge that has been overcome. Most of the previously published telemedicine articles focus on skin tumors, such as melanoma or malignant tumors.⁶⁻⁸ However, this telemedicine project included a large cohort of individuals and virtually all the prevalent skin diseases in the population. As

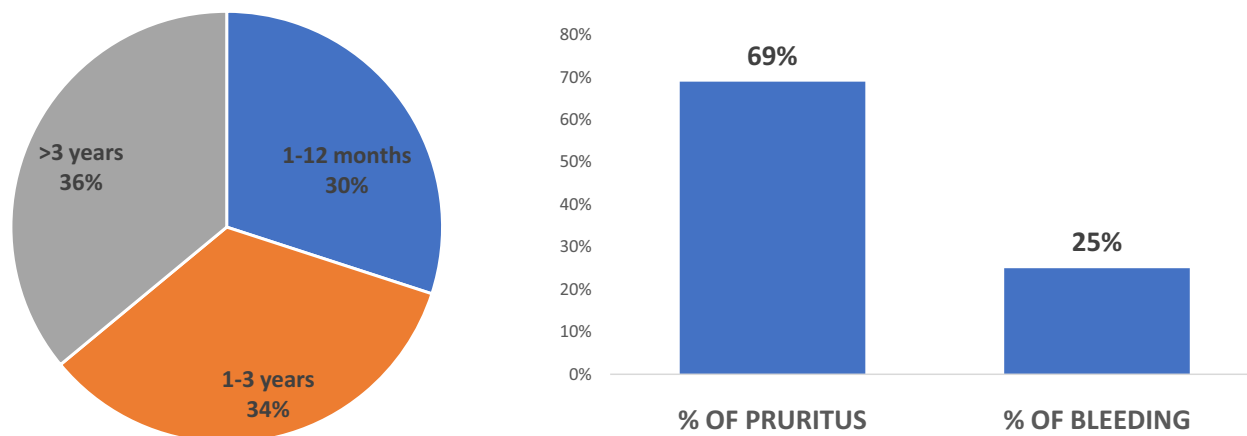


Fig 3. Duration of the lesions and the frequency of pruritus and bleeding in the atopic dermatitis patients who participated in the telemedicine project from July 2017 to July 2018 in the city of São Paulo.

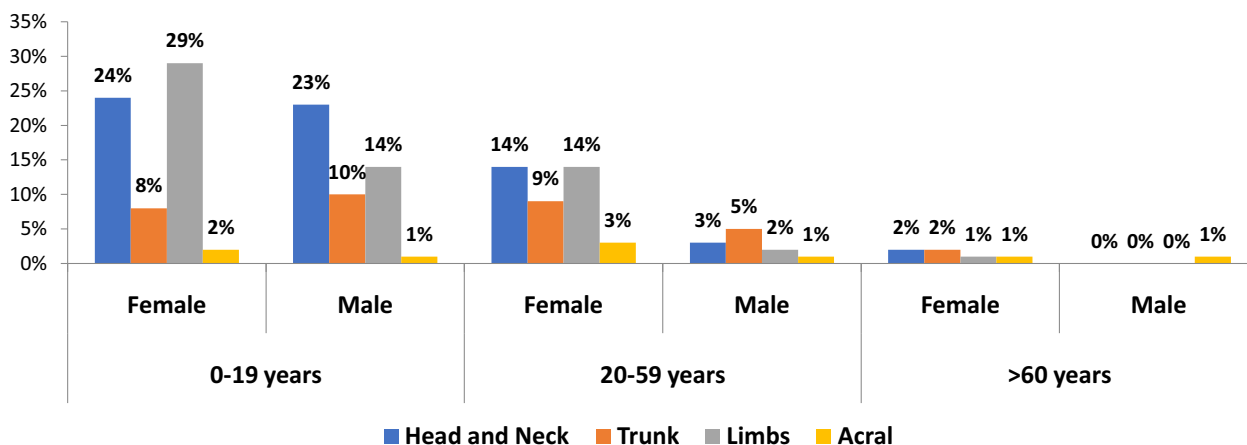


Fig 4. The distribution of atopic dermatitis lesions according to age, sex, and site of affliction for the patients who participated in the telemedicine project from July 2017 to July 2018 in the city of São Paulo.

we assessed those dermatoses, we observed that a high number of individuals were referred to dermatologists because of atopic dermatitis, making it important to be studied in depth.

The frequency of atopic dermatitis (5.3%) was high in our study. According to the literature, it is one of the most common noncommunicable skin diseases, affecting 5% to 20% of children worldwide⁹ and 2% to 8% of adults in most countries.^{3,10} The long duration of this dermatosis can probably be explained by its inherent chronicity, patients' lack of awareness, and difficulty in obtaining an appointment with a medical specialist, a situation that changed during the project.

Although the number of atopic dermatitis lesions was greater in male individuals in the group aged 0 to 2 years, this predominance reversed with age.

However, we have to take into account that the number of total lesions photographed among female patients was much higher than among male patients with increasing age. Even so, atopic dermatitis was significantly more prevalent in female teenagers and in the older male population.

Telemedicine was effective in screening dermatologic diseases in primary care attention.¹¹ Previously, we showed that telemedicine was efficient for triage and management of dermatoses in the pediatric age group.¹² In the present study, the majority of patients with atopic dermatitis did not require an in-person visit with the dermatologist or allergist (72%), presumably because they had mild disease. Patients with more severe atopic dermatitis were probably sent for in-person appointments (28%). This finding highlights the potential of

Table I. Final diagnosis made by in-person dermatologist corresponding to teledermatologists' hypothesis of atopic dermatitis

Group disease	In-person diagnosis	Number (n = 109)
AD spectrum	Atopic dermatitis	92
	Xerosis	4
	Pityriasis alba	1
	Keratosis pilaris	1
	Lichen simplex chronicus	1
Eczematous	Contact dermatitis	5
Other	Erythrasma	1
	Acne	1
	Urticaria	1
	Nail disorders	2

AD, Atopic dermatitis.

telemedicine for the management of atopic dermatitis in the years to come, through the optimization of medical hours and costs, increasing patients' access to specialists, and reducing the waiting time for an appointment, especially in the public system. Another study showed that most cases of atopic dermatitis are mild and can be managed in the primary care setting.¹³ A randomized controlled equivalency clinical trial compared the effectiveness of a telemedicine model for delivering follow-up dermatologic care for atopic dermatitis with that of in-person office visits and concluded that patients' improvement was equivalent in both groups.¹⁴

We observed a complete match between telemedicine and the gold standard in-person diagnosis of atopic dermatitis in 84.4% of the cases, which reached 90.8% and 95.4%, respectively, if the spectrum of atopic skin conditions and all eczematous disorders were considered together. To our knowledge, no previous articles assessing such a high number of individuals have specifically addressed telemedicine accuracy for atopic dermatitis. This is crucial for delivering public health policies that can address or prevent these conditions.

Nevertheless, there are limitations in the use of telemedicine for skin conditions, and it does not aim to replace the in-person visit. There are chances of misdiagnosis, although some articles have shown a high agreement rate between teledermatology and in-person dermatology.^{6,15} That the physician can receive multiple photographs from a patient and is not able to examine the patient as a whole makes the diagnosis more challenging. Besides, some important impressions that may help to corroborate the diagnosis might not be available. However, the impossibility of palpating the lesion was not reported as an issue by teledermatologists, who

became much more confident in telemedicine after working with it.¹⁶ Moreover, our study has limitations. First, a retrospective study such as this can lead to biased results because some important information can be missed or imprecise. Second, accuracy was assessed comparing in-person dermatologists' with teledermatologists' clinical diagnosis and did not include milder or typical cases because those were treated by the primary care physician along with telemedicine. Histopathologic examinations were rarely requested for atopic dermatitis (0.2%) and in such cases were consistent with atopic dermatitis.

In conclusion, atopic dermatitis was the first and second most frequent dermatosis in individuals aged 12 years and younger and in those aged 13 to 19 years, respectively. Recognizing the prevalence and distribution of this common disease is important. Telemedicine proved to be accurate in diagnosing atopic dermatitis and efficient in the management of atopic dermatitis, avoiding the need for an in-person appointment with a specialist and providing proper treatment plans and recommendations for patients within the primary care setting.

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