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Contents lists available at ScienceDirect

Journal of the American Pharmacists Association

journal homepage: [www.japha.org](http://www.japha.org)

## RESEARCH

## Direct-to-consumer, store-and-forward teledermatology with dermoscopy using the pharmacist as patient point-of-contact

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## ARTICLE INFO

## Article history:

Received 19 June 2020

Accepted 22 September 2020

Available online 14 October 2020

## ABSTRACT

**Objective(s):** To evaluate the frequency of nonmelanoma skin cancer (NMSC), NMSC precursors, and melanoma on a store-and-forward dermatology model featuring the pharmacist as the patient's point-of-contact. The secondary objective was to define lesion changes and symptoms perceived by patients (clinical prediction rules by nonexpert observers) that can be predictive of malignancy.

**Methods:** A cross-sectional study of teledermatology consultation was performed. All patients who underwent a teledermatology consultation between September 2018 and March 2020 were included. A patient could have more than 1 lesion per consultation. The object of the study was a defined dermatologic lesion. The differences between the variables were analyzed using a univariate model based on the chi-square test for independent qualitative variables and Fisher exact test in cases when the expected values in any of the cells of a contingency table were less than 5. Statistical significance was set at  $P < 0.05$  (2-tailed).

**Results:** A total of 225 lesions in 218 patients were considered for this study; 53.8% ( $n = 121$ ) of the lesions were classified as benign, 16.4% ( $n = 37$ ) as dubious, 23.1% ( $n = 52$ ) as NMSC precursors, 5.8% ( $n = 13$ ) as NMSC, and 0.9% ( $n = 2$ ) as melanomas. Of the reported clinical lesion changes, spontaneous pain, pruritus, surface texture changes, color changes, or form changes had no statistically significant relationship with the diagnostic group, whereas the presence of spontaneous bleeding ( $P = 0.015$ ) and size changes ( $P = 0.026$ ) were more frequently observed in the “dubious lesion” and “of oncological relevance lesion” groups.

**Conclusion:** This “direct-to-consumer,” store-and-forward teledermatology with dermoscopy model featuring the pharmacist as the patient's point-of-contact is useful for the diagnosis of melanoma, NMSC, and NMSC precursors when backed by a robust dermatology service.

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## Background

There are 2 main teledermatology models: the “store-and-forward” model, wherein the patient's iconography and clinical history are forwarded by a physician to the dermatologist, who reviews the data at a later date and the “live model,” wherein the consultation takes place over

**Disclosure:** The authors declare no relevant conflicts of interest or financial.

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videoconference.<sup>1</sup> Several variations of these models exist; one worth mentioning is the “direct-to-consumer” variation of the store-and-forward model, wherein the patient foregoes the initial evaluation by a physician and sends the data directly to the dermatologist through an application or a Web page.<sup>1</sup>

According to the 2019 global competitiveness report prepared by the World Economic Forum, Spain shares first place in the world for its health care system quality, along with Hong Kong, Japan, and Singapore.<sup>2</sup> This is largely due to its robust public, universal, government-funded health system. To compete with such a system, private health centers must

**Key Points****Background:**

- Telemedicine improves health care accessibility while avoiding unnecessary patient influx to hospitals and other health centers.
- One prominent tele dermatology model is called “store-and-forward,” wherein the patient’s iconography and clinical history are forwarded by a physician to the dermatologist, who reviews the data at a later date and sends back a report.
- Teledermatology with dermoscopy improves accessibility to specialized care, which translates to early skin cancer diagnosis and prognosis.

**Findings:**

- The pharmacist’s background knowledge and the proximity of the pharmacy to the patient makes the pharmacist the ideal candidate for the role of patient point-of-contact.
- A “direct-to-consumer,” store-and-forward tele dermatology with dermoscopy model featuring the pharmacist as the patient’s point-of-contact is useful for the diagnosis of skin cancer when backed by a robust dermatology service.

provide excellence-based and avantgarde care. Telemedicine and, in particular, teledermatology, have been practiced in the Spanish public health care system since 1997. In 2014, 70 health care centers were practicing some form of tele dermatology, 15% of which were practicing dermoscopy. None of these centers were private.<sup>3</sup>

Teledermatology with dermoscopy has been shown to improve the results of an Internet-based skin cancer screening system, as compared with screening systems based on the use of clinical images alone.<sup>4</sup> Both the proximity and reliability of tele dermatology with dermoscopy improve accessibility to specialized care, which can explain the increasing frequency with which thin melanomas (Tis-T1)<sup>5</sup> are identified; this represents an early diagnosis, which is associated with a better prognosis.

*Using the pharmacist as the patient’s point-of-contact*

Since September 2017, we have been employing a “direct-to-consumer,” store-and-forward tele dermatology with dermoscopy model in the private setting at the Viamed Santa Angela de la Cruz Hospital in Seville in collaboration with Bidafarma (Figure 1). Patients can request a teleconsultation at their local pharmacy, where the pharmacist evaluates the lesion on the basis of several exclusion criteria as part of a teleconsultation (e.g., inflammatory nature; the presence of mucosal or pilous regions that do not allow for easy photography). A brief anamnesis, which includes obtaining patient information such as age, sex, solar exposure pattern, reason for consultation, perceived changes, perceived symptoms, duration of the lesion, and lesion location, is done. At least 2 images of each lesion are taken using the 32 GB iPod Touch (Apple

Inc.), 1 in macro mode and 1 with immersion dermoscopy using the Handyscope FotoFinder adaptor (FotoFinder Systems GmbH).

The anamnesis and images are sent to our team of dermatologists through a secure platform and accompanied by a numerical reference. Potentially identifying patient data do not leave the pharmacy.

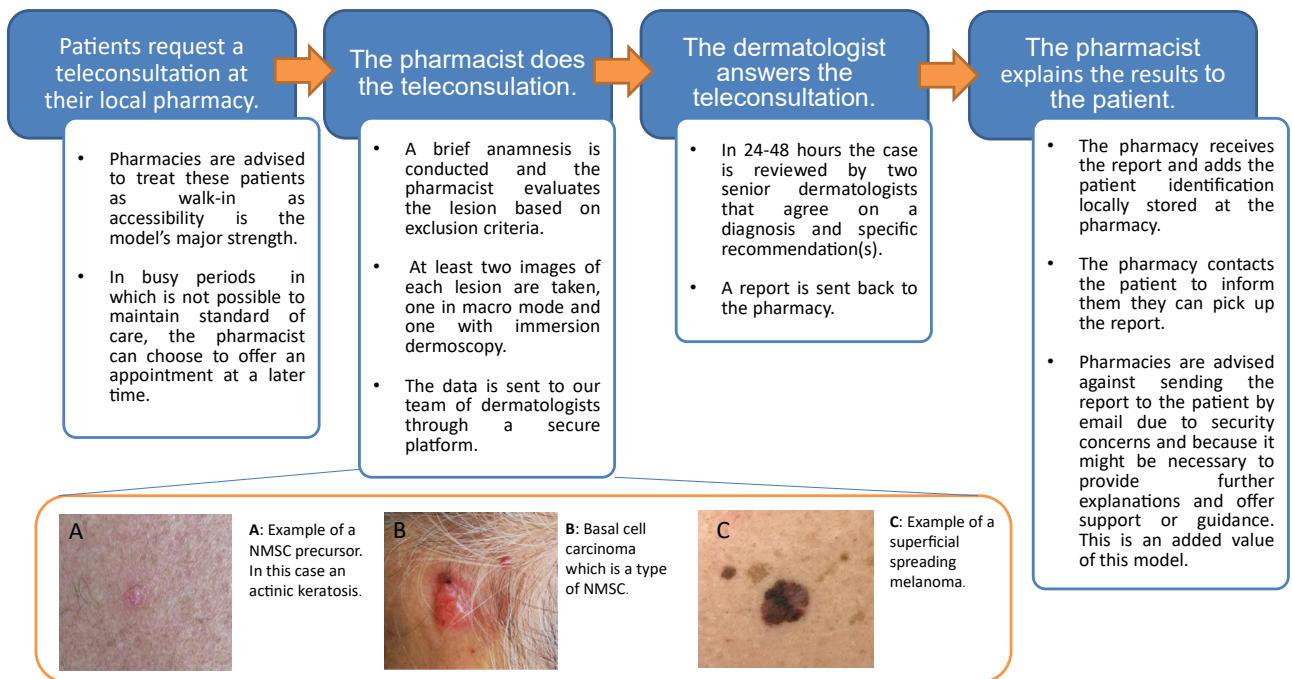
Within 24–48 hours, the case is reviewed by 2 senior dermatologists who agree on a diagnosis or a differential diagnosis and provide specific recommendation(s). The possible lesion classifications are as follows: “benign lesion,” “malignant and premalignant lesion,” and “no diagnosis can be made.” In the case of the last 2 categories (malignant and premalignant and no diagnosis), a recommendation for an in-person consultation is made. A report is sent back to the pharmacy, where the numerical reference is verified, and the pharmacist then identifies and contacts the patient. A final report that replaces the numerical reference with the patient identification is given by the pharmacist to the patient. This report contains the diagnosis and recommendations made by the dermatologist.

To offer this service, at least 1 pharmacist from each pharmacy must attend a training session (1 hour duration), wherein basic dermatologic concepts (tumoral vs inflammatory lesions, common types of skin tumors, and common types of skin cancer) are explained. In this session, the exclusion criteria are discussed, and the correct photography technique, as well as some practical aspects of the imaging and computer system, are explained. The attendees are expected to instruct their colleagues who could not attend the training session. This is important because if the exclusion criteria are not respected or the iconography is not of sufficient quality, the consultation will be rejected by our team of dermatologists.

The honoraria are directly charged to the patient by the pharmacy at the moment of the initial consultation. The value charged to the patient (30€, approximately \$36) is one-third that of a visit with a dermatologist (90€ approximately \$107). If a recommendation for an in-person consultation with a dermatologist is made and the patient visits a member of our team of dermatologists, the full value of the pharmacy teleconsultation is discounted from the dermatologist visitation fee by presenting the original tele dermatology report. The pharmacy and the dermatologists are respectively charged and payed monthly for the number of teleconsultations made. From a business standpoint, excluding the need for a follow-up in-person consultation, the patient does not make any contact with our team of dermatologists, and the pharmacy is seen as the service provider. For the dermatologists, the advantage lies in the fact that by offering the teleconsultation discount, they attract those patients who need a follow-up in-person consultation.

**Objectives**

The objective of the present study was to evaluate the frequency of nonmelanoma skin cancer (NMSC), NMSC precursors, and melanoma on a store-and-forward dermatology model featuring the pharmacist as the patient’s point-of-contact. The secondary objective was to define lesion changes and symptoms perceived by patients (clinical prediction rules by nonexpert observers) that can be predictive of malignity.



**Figure 1.** Teledermatology model workflow. Abbreviation used: NMSC, nonmelanoma skin cancer.

## Methods

We performed a cross-sectional study of teledermatology consultations at the Viamed Santa Angela de la Cruz Hospital in Seville. All patients who underwent a teledermatology consultation between September 2018 and March 2020 were included. A patient could have more than 1 lesion per consultation. The object of the study was a defined dermatologic lesion. Lesions of inflammatory nature, located on mucosa or pilous regions, as well those with insufficient image quality were excluded.

The following variables were considered: patient age, patient sex, patient solar exposure pattern (recreational, work-related, unusual and incidental), reason for consultation (informative purposes, symptomatology onset of pre-existing lesions, presence of changes on pre-existing lesions, recent lesion onset, multiple lesions, evaluation of the possibility of removal), presence of texture changes, presence of color changes, presence of size changes, presence of form changes, temporality of lesion changes (recent and fast changes, slow changes, no changes), the presence of pain, the presence of pruritus, the presence of bleeding, lesion duration (months), and lesion location (face, head and neck except face, torso, upper limbs, lower limbs).

The end point variables were as follows: type of lesion (benign, dubious, NMSC precursor, NMSC, melanoma), whether a treatment recommendation was made, and whether a recommendation was made for an in-person consultation. Lesions were included in the dubious group in cases in which the diagnosis was not clear, which occurred either when more than 1 diagnosis was considered per dermatologist or when there was a lack of concordance between dermatologists in the diagnosis. Cases in which

recommendations for a consult were made for therapeutic reasons or to request diagnostic confirmation were counted as recommendations for in-person consultation. To analyze lesion changes and the perceived symptoms that could be predictive of malignancy, lesion type was aggregated into 1 of the following categories: benign, dubious, and of oncological relevance. This last category included NMSC, melanomas, and NMSC precursors.

Statistical analysis was performed using SPSS for Windows version 26 (IBM Corp, Armonk, NY). The differences between variables were analyzed using a univariate model based on the chi-square test for independent qualitative variables and the Fishers exact test for cases when the expected values in any of the cells of a contingency table were less than 5. Statistical significance was set at  $P < 0.05$  (2-tailed).

## Results

A total of 230 lesions in 224 patients were submitted for teledermatology consultation. Five lesions were excluded from this study, as they fulfilled one of the exclusion criteria. A total of 225 lesions in 218 patients were considered for this study. Most (63.6%,  $n = 143$ ) of the patients were female, and 36.4% ( $n = 82$ ) were male. The mean age ( $\pm$ SD) was 54.43 (18.20) years, with the oldest patient being 101 years and the youngest being 1 year; a total of 7 patients were younger than 18 years, and 3 patients were younger than 14 years. The average lesion duration before the consultation was 20.95 (35.47) months; the earliest reported consultation occurred at 0.5 months from lesion onset, and the latest was 360 months. Patients' reported pattern of sun exposure, consultation motives, and lesion locations are listed in [Table 1](#).

**Table 1**

Frequencies of sun exposure patterns, reasons for consultation, lesion locations, and diagnostics

Variables	Absolute frequency	Relative frequency
<b>Solar exposure pattern</b>		
Work-related	26	11.6
Unusual and incidental	66	29.3
Recreational	133	59.1
Total	225	100.0
<b>Reason for consultation</b>		
Presence of or changes to pre-existing lesions	53	23.6
Information purposes	86	38.2
Recent lesion onset	63	28.0
Presence of multiple lesions	9	4.0
Evaluation of possibility of removal	1	0.4
Symptomatology onset for pre-existing lesions	13	5.8
Total	225	100.0
<b>Lesion location</b>		
Not reported	1	0.4
Head and neck, except face	19	8.4
Face	121	53.8
Upper limbs	13	5.8
Lower limbs	15	6.7
Torso	56	24.9
Total	225	100.0
<b>Diagnosis classification</b>		
Benign	121	53.8
Nonmelanoma skin cancer	13	5.8
Dubious	37	16.4
Melanoma	2	0.9
Nonmelanoma skin cancer precursor	52	23.1
Total	225	100.0

Surface texture changes were reported in 40% of the patients ( $n = 90$ ); 25.8% ( $n = 58$ ) reported color changes, 51.1% ( $n = 115$ ) reported size changes, and 22.7% ( $n = 51$ ) reported form changes. Spontaneous pain was reported for 6.2% ( $n = 14$ ) of the lesions, whereas pruritus was reported in 36.9% ( $n = 83$ ), and spontaneous bleeding was reported in 6.7% ( $n = 15$ ) lesions.

Regarding the diagnosis, 53.8% ( $n = 121$ ) of the lesions were classified as benign, 16.4% ( $n = 37$ ) as dubious, 23.1% ( $n = 52$ ) as NMSC precursors, 5.8% ( $n = 13$ ) as NMSC, and 0.9% ( $n = 2$ ) as melanomas (Table 1). The correlation—or lack thereof—between the lesion changes, patients' perceived symptoms, and diagnosis are listed in Table 2. The reported pattern of sun exposure had no statistically significant relationship with the diagnostic group ( $P > 0.05\%$ ).

A differential diagnosis was considered in 18.2% ( $n = 41$ ) of the lesions. The recommendation for an in-person consultation was made in 53.8% ( $n = 121$ ) of the cases, and a treatment prescription (use of antibiotic cream and antiseptic spray in all cases) was made before this consultation for 3.1% ( $n = 7$ ) of the cases.

## Discussion

The main novelty described in this study is the role of the pharmacist as a point-of-contact for the patient. The obvious advantage of telemedicine is that the doctor and the patient do not need to be in the same place for the consultation to take place. Pharmacy distribution is regulated through different legislations around the world.<sup>6</sup> The proximity constitutes a major advantage in patient care that, in our opinion, has not yet been properly explored. One advantage of the store-and-

forward model over the live model is that the consultation does not need to take place at a specific time; instead, it can be conducted at both the doctor's and the patient's convenience using an intermediary. In store-and-forward models, it is especially important for the point-of-contact to be a health professional because it is necessary to provide accurate patient background information to the dermatologist. With the pharmacist as a point-of-contact for the patient, they might be able to provide additional explanations and offer support and guidance to the patient. The pharmacist has the proper background knowledge to fulfil this role, and the proximity of the pharmacy to the patient makes this model an ideal option for patient consultation. Using the pharmacist as a patient's point of care holds additional importance during the severe acute respiratory syndrome coronavirus 2 (coronavirus disease 2019) pandemic, as it allows for convenient care and avoids unnecessary patient influx to hospitals and other health centers.

From the patient's point of view, this model has 3 advantages and 1 limitation. This model is advantageous as it is lower in cost than a normal dermatology consultation (one-third of the price [30€, approximately \$36]), it is convenient (there is no need to go to a hospital and clinic), and its availability (patients can walk in; there is no need to make an appointment). These advantages translate into a much better accessibility to specialized care, which has been shown to lead to higher rates of early melanoma diagnosis and thus to a better prognosis.<sup>5</sup> The main disadvantage of this direct-to-consumer model is that not all patients can or should be assessed by tele dermatology, and it is not the patient's responsibility to know what situations can and cannot be addressed through these consultations. These design



**Table 2**  
Correlations between the lesion changes, patients' perceived symptoms, and diagnosis

Reported changes and symptoms	Aggregated diagnostic category				P
	Benign	Dubious	Of oncological relevance	Total	
Spontaneous pain	3.3 (4)	10.8 (4)	9.0 (6)	2.7 (14)	0.095 <sup>a</sup>
Pruritus	35.5 (43)	43.2 (16)	35.8 (24)	36.9 (83)	0.69 <sup>b</sup>
Spontaneous bleeding	2.5 (3)	13.5 (5)	10.4 (7)	6.7 (15)	0.015 <sup>a</sup>
Surface texture changes	40.5 (49)	37.8 (14)	40.3 (27)	40 (90)	0.965 <sup>b</sup>
Color changes	29.8 (36)	18.9 (7)	22.4 (15)	6.7 (58)	0.324 <sup>b</sup>
Size changes	49.6 (60)	70.3 (26)	43.3 (29)	51.1 (115)	0.026 <sup>b</sup>
Form changes	19.8 (24)	24.3 (9)	26.9 (18)	22.7 (51)	0.530

Note: Values are given as % (n).

<sup>a</sup> Fisher exact test.

<sup>b</sup> Pearson chi-square test.

constraints are mitigated in 2 ways. First, by having the pharmacist as the point-of-contact, they act as the point of triage. The pharmacist can recommend that the patient request an in-person consultation instead, particularly if there is a lesion or pathology not suitable for teleconsultation. Second, in those cases when an in-person consultation is actually needed (either because a diagnosis could not be made by tele dermatology or because treatment was necessary), there is no overall increase in cost as the price of the teleconsultation is subtracted from the price of an in-person consultation.

Tele dermatology with dermoscopy has been practiced in the Spanish public health care system since 2017 but using the general practitioner as patient's point-of-contact instead of the pharmacist.<sup>4</sup> We are the first to provide a similar service in the private health care setting with the added benefit of having a hybrid "direct-to-consumer" model.

Our series had a predominance of female patients (63.6% female vs 36.4% male); this can be explained by the fact that our study employed a hybrid "direct-to-consumer" approach for our tele dermatology model. It is known that there is a greater use of health services by women in Spain, as they tend to more frequently use preventive and diagnostic services.<sup>7</sup> The age range of our patients (which spanned from 1 year to 101 years, with a total of 7 patients younger than 18 years, and 3 patients younger than 14 years) showed that this model can be applied even among pediatric populations, as long as high-quality clinical and dermoscopy images are made available.

It came to our attention that the average lesion duration before the consultation was 20.95 months (SD 35.47 months); the earliest reported consultation occurred 0.5 months from lesion onset and the latest, 360 months); the use of tele dermatology reportedly reduces wait times and results in earlier assessment and treatment.<sup>8,9</sup> We believe that this finding is explained by the fact that consultation was needed for informative purposes in 38.2% of the cases and to address symptom onset or recent changes to pre-existing lesions in 29.4% of the cases; only 28% of consultations pertained to recent lesion onset. We did not measure the amount of time from the point-of-contact to the dermatologist consult as previous studies do but rather from lesion onset to first medical consultation.

Even when the underlying reason for the consultation was not related to symptomatology onset or recent changes to pre-existing lesions, the data regarding the presence of any kind of symptom or surface changes were recorded. The most frequently reported lesion-related changes were size changes

at 51.1% (n = 115) and texture changes at 40% (n = 90), whereas the most frequently reported symptom was pruritus at 36.9% (n = 83).

Regarding diagnosis, 53.8% of all cases were classified as benign, 29.8% were considered malignant or premalignant, whereas in 16.4% of cases, it was not possible to make a distinction between groups, and they were thus classified as dubious. A total of 13 NMSCs, 2 melanomas, and 52 cases of actinic keratosis were diagnosed over the duration of this study.

From the reported clinical lesion changes, spontaneous pain, pruritus, surface texture changes, color changes, and form changes had no statistically relevant relationships with the diagnostic group. This might be due to the fact that our study was underpowered to detect those differences or because many of these characteristics have been used since 1985 and are regarded as highly sensitive criteria used in self-examination to promote the early detection of melanoma.<sup>10</sup> This high sensitivity does not necessarily correlate with high specificity, thus explaining our results.<sup>11</sup> By contrast, the presence of spontaneous bleeding and size changes were more frequently noted in the dubious and of oncological relevance lesion groups. These findings may be more clinically relevant, but when used in a self-examination setting, particularly in the case of melanomas, they may signify ulceration or a rapid growth phase and can thus be associated with a late diagnosis and a worse prognosis.

Although the reported frequency with which patients reported recreational sun exposure (59.1%) did not have a statistically significant association with any of the diagnostic groups in our study, this finding is indicative of the need for further, more effective education and lifestyle interventions. Furthermore, a differential diagnosis was considered in 18.2% (n = 41) of the lesions. Recommendations for an in-person consultation was made in 53.8% (n = 121) of the cases. Because the recommendation for in-person consultation was made on a per-patient basis and not on a per-lesion basis, the number of recommendations might be overestimated, as some patients might have more than 1 lesion. Finally, the principal limitation of this work is its retrospective nature and that an in-person consultation by an experienced dermatologist is the gold standard of care. This model was designed to be as safe and reliable as possible, and therefore, only tumoral lesions were included. One possible future practice and research avenue is to expand and validate this model for inflammatory lesions.

## Conclusion

This “direct-to-consumer,” store-and-forward tele-dermatology with dermoscopy model featuring the pharmacist as the patient’s point-of-contact is a useful approach for the diagnosis of melanoma, NMSC, and NMSC precursors when backed by a robust dermatology service.

## Acknowledgments

English-language editing of this manuscript was provided by Journal Prep Services.

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