Dermoscopic Photographs Impact Confidence and Management of Remotely Triaged Skin Lesions

Tova Rogers[1]*, Myles Randolph McCrary[1]*, Howa Yeung[1,2], Loren Krueger[1], Suephy C Chen[2,3#]

1 Department of Dermatology, Emory University School of Medicine, Atlanta, Georgia, USA
2 Regional Telehealth Service, VISN 7, Duluth, Georgia, USA
3 Department of Dermatology, Duke University, Durham, North Carolina, USA
*These authors contributed equally to this work.
#All work performed while at Emory University, Atlanta, Georgia, USA

ABSTRACT

Introduction: Improving remote triage is crucial given expansions in tele-dermatology and with limited in-person care during COVID-19. In addition to clinical pictures, dermoscopic images may provide utility for triage.

Objectives: To determine if dermoscopic images enhance confidence, triage accuracy, and triage prioritization for tele-dermatology.

Methods: In this preliminary parallel convergent mixed-methods study, a cohort of dermatologists and residents assessed skin lesions using clinical and dermoscopic images. For each case, participants viewed a clinical image and determined diagnostic category, management, urgency, and decision-making confidence. They subsequently viewed the associated dermoscopy and answered the same questions. A moderated focus group discussion followed to explore perceptions on the role of dermoscopy in tele-dermatology.

Results: Dermoscopy improved recognition of malignancies by 23% and significantly reduced triage urgency measures for non-malignant lesions. Participants endorsed specific utilities of tele-dermoscopy, such as for evaluating pigmented lesions, with limitations including poor image quality.

Conclusions: Dermoscopic images may be useful when remotely triaging skin lesions. Standardized imaging protocols are needed.

Introduction

Tele-dermatology plays an important role in triage of potentially malignant skin lesions. Tele-dermatology has comparable diagnostic accuracy to in-person evaluations, though, study results vary for malignant lesions [1]. The use of dermoscopic images, in addition to clinical images, can improve accuracy, especially for pigmented skin cancers [2-5].

Images are imperative for the remote management of skin lesions. Prior to the COVID-19 pandemic, many primary providers would arrange to have patient images taken by trained in-office personnel, which are then used for store-and-forward tele-dermatology. There is also an increasing demand for patients to submit photographs of their skin problems without needing to go to the primary care office at all. COVID-19 realized the difficulty of patients to have their skin lesions imaged in person. Dermatologists are then faced with using patient-provided images taken with smartphones or computers [6,7]. The quality of these images is variable. Dermoscopic images have become almost universally unavailable. While the social restrictions resulting from the COVID-19 pandemic are loosening, remote patient care has become a possible parallel care paradigm. Thus, to adequately triage patients and maintain high standards of care, innovative means are required to ensure access to high quality images, including assessing the added value of dermoscopy [1,6,8,9].

Objectives

Our preliminary study aims to assess the impact of dermoscopic images on providers abilities to classify and triage skin lesions, and on their confidence in their decision making. We implemented a parallel convergent mixed method design to quantify the utility of dermoscopy for remotely triaging skin lesions and to assess provider' perceptions of dermoscopy as a triage tool in tele-dermatology.

Methods

Study Design and Data Collection

A convergent parallel mixed-methods design was used to collect, analyze, and interpret quantitative and qualitative data. The study was approved by the Institutional Review Board at Emory University and the Atlanta Veterans Affairs Medical Center Research and Development committee. The Veteran Integrated Service Network (VISN) 7 TeleDermatology service serves as a reading hub for the community-based outpatient clinics (CBOCs) in Atlanta as well as for other VISN 7 medical centers Imagers are trained by the tele-dermatology service to take photographs per standard protocol established by the VA National TeleDermatology Service: a forest view, and close-up, and a dermoscopic view are taken for every lesion and rash. There is not mandated specific magnification or lighting. Images are uploaded via VistA Imaging, an FDA-listed Image Management system employed by Department of Veterans Affairs healthcare facilities nationwide. To maintain our imaging quality standards, feedback for image quality is given for each consult (fully satisfactory, satisfactory with suggestions, and unsatisfactory). For the present study, images from tele-dermatology consults received between 12/1-31/2018 were reviewed. Twenty sets of clinical and dermoscopic images were selected as representative of common benign and malignant skin lesions seen in the tele-dermatology clinic. Diagnoses for malignant lesions were confirmed with biopsy. Benign lesions were classified by consensus among tele-dermatology providers. Clinical and dermoscopic images were de-identified and compiled into a digital slide show using Microsoft PowerPoint Version 16.55. High image quality was maintained at 300 dots per inch.

This preliminary study was conducted over a two-day period using Zoom, a video communication platform with a built-in polling function. Participants filled out a demographic survey, including a series of questions relating to their use of dermoscopy in their clinical practices, prior dermoscopic training, and overall confidence in their dermoscopic abilities. They were shown a clinical image of a skin lesion or multiple skin lesions and asked to determine diagnostic category, management decision (reassure versus further in-person management), perceived level of urgency with which further action is required (not urgent, urgent, emergent), and self-rated confidence level in their decision making (range from 0% to 100% confidence in intervals of 10 percentage points) (Supplemental Material, Survey). Diagnostic categories included non-neoplastic (folliculitis, epidermal inclusion cyst, verruca; 3/20 cases), benign neoplastic (actinic keratosis, seborrheic keratosis, blue nevus, sebaceous hyperplasia, dermatofibroma, melanocytic nevus, angioma; 11/20 cases), and malignant neoplastic (melanoma, basal cell carcinoma, squamous cell carcinoma; 6/20 cases). These images are supplied in Supplemental Table 1. Participants were then shown the accompanying dermoscopic image and asked the same questions. This process was repeated for all twenty study sets. On study day two, a moderated group discussion took place in which participants were asked questions pertaining to their perception of the utility of dermoscopic images for triaging skin lesions and if the Covid-19 pandemic has changed these perceptions (Supplemental Material, Debriefing prompts). The discussion was recorded and transcribed verbatim.

Data Analysis

GraphPad Prism 6 (GraphPad Software) was used for statistical analysis and graphic presentation of survey results. Paired t-tests were used to compare differences in confidence

Table 1. Demographics

Characteristics, N (%)	
Completed Survey	22/26 (84.6%)
Status	
Resident	10/26 (38.5%)
Attending	16/26 (61.5%)
Years in practice (Attendings)	
1-5	4/13 (31%)
6-10	4/13 (31%)
11-15	1/13 (8%)
> 15	4/13 (31%)
% Clinical practice using dermoscopy	
< 50%	13/26 (50%)
>/= 50%	13/26 (50%)
# Formal dermoscopy courses	
0	10/22 (45.5%)
1-2	9/22 (40.9%)
3-4	3/22 (13.6%)
Level of confidence in dermoscopy skills	
Not confident	9/22 (40.9%)
Somewhat confident	13/22 (59.1%)
Confident	0

and correct diagnosis before and after revealing dermoscopic images. Survey data were expressed as means with 95% confidence interval. For urgency and management, McNemar's test was used to determine statistical significance in differences between the ratings before and after exposure to dermoscopic images. To test whether confidence was correlated with correct diagnoses, we used a regression analysis over the average self-rated confidence and average percentage of correct diagnoses per provider. Results were considered significant if P resulted < 0.05. For qualitative analysis of the participant comments, 2 study investigators (TR, MRM) independently reviewed and coded the entire transcript from the group discussion. Themes were developed inductively and defined as having at least three study participants having similar responses to the study questions. Investigators consolidated these comments into a list of key themes designed to characterize perceived benefits, potential applications, and shortcomings of dermoscopic images for remotely triaging skin lesions. Discrepancies were resolved by consensus.

Results

Demographics

Twenty-six physicians participated in this preliminary study, including 16 dermatology attendings and 10 residents (Table 1). Attending physicians had a wide spread of years

in practice. Half of survey participants reported using dermoscopy in ≥50% of their clinical practice. Over half (55%) reported having attended at least one formal dermoscopy course. When asked about their confidence in their dermoscopic abilities, 59% of study participants indicated that they were "somewhat confident" using dermoscopy. None of the study participants were "confident" in their dermoscopic abilities.

Survey Results

Using clinical images alone, 45% of physicians (12/26) correctly diagnosed the study cases. (This increased to 53% (14/26) after viewing the associated dermoscopic images (P = 0.02, paired t-test) (Figure 1). The greatest increase was for malignant neoplasms (31% [8/26] versus 54% [14/26], P = 0.0007).

After showing clinical images, 54% (14/26) rated non-neoplastic lesions (ie, inflammatory and infectious) as "non-urgent", which significantly increased to 81% (21/26) after viewing the associated dermoscopic images (P < 0.0001, McNemar test) (Figure 2). There was a trend to reduce urgency for benign neoplastic lesions (from 69% to 78% non-urgent) and increase urgency for malignant neoplastic lesions (from 44% to 58% urgent/emergent) following dermoscopic images. With regards to management decisions, significantly more providers opted to provide reassurance (14/26) rather than interventions (0/26) for non-neoplastic lesions following the addition of dermoscopic images (P < 0.0001). The addition of dermoscopy did not lead to significant changes in management for benign or malignant neoplastic lesions.

We found a 7.6% increase in providers' confidence in their management decisions with dermoscopy (P < 0.0001) (Figure 3). There was also a weak but statistically significant (r^2 = 0.246 P = 0.024) correlation between providers level of confidence and correct diagnoses.

Theme Results

We conducted a thematic analysis of the moderated discussion on the role of dermoscopy for triage during COVID-19 (Table 2). The first theme involved the specific utilities of dermoscopy. Participants endorsed that dermoscopy was useful for suspected malignancy, pigmented lesions, lesions with well-known dermoscopic features, and in conjunction with patient history, and less useful for generalized exanthems. The second theme was image quality. Many voiced that image quality for both clinical and dermoscopic images was critical and often a major limitation. Thirdly, participants commented on accessibility to dermoscopy during the coronavirus pandemic, and also with technological advances and expansions in telehealth. Notably, providers felt that
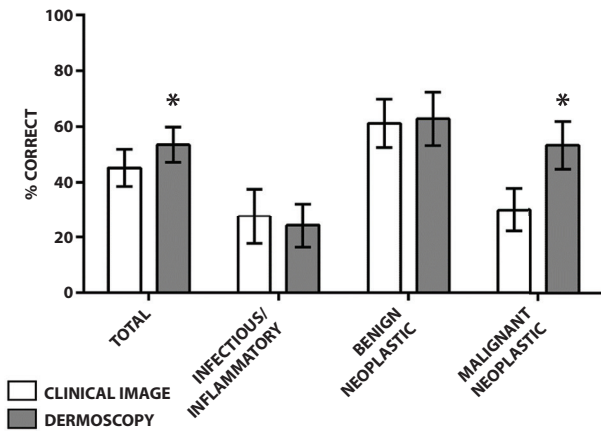
Figure 1. Dermoscopy increases % correct diagnoses for malignant lesions. The percentage of correct diagnoses for all cases, non-neoplastic, benign neoplastic, and malignant neoplastic with clinical images only and following dermoscopic images is shown above. Bar graphs illustrate the means with error bars representing 95% confidence intervals. * indicates P < 0.05 at paired t-test.

Figure 3. Dermoscopy increases confidence in management decisions. The percentage of confidence for all cases, non-neoplastic, benign neoplastic, and malignant neoplastic with clinical images only and following dermoscopic images is shown above. Bar graphs illustrate the means with error bars representing 95% confidence intervals. * indicates P < 0.05 at paired t-test.
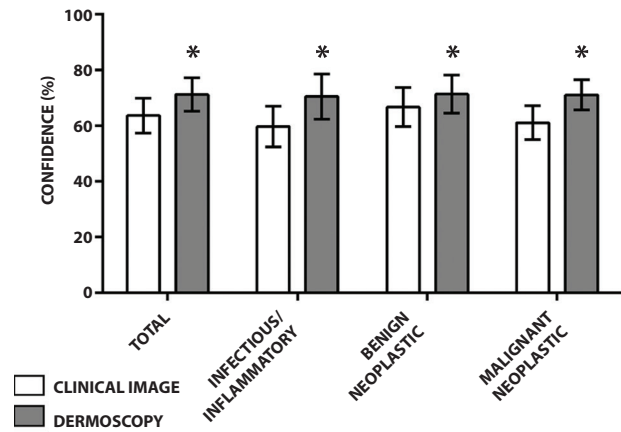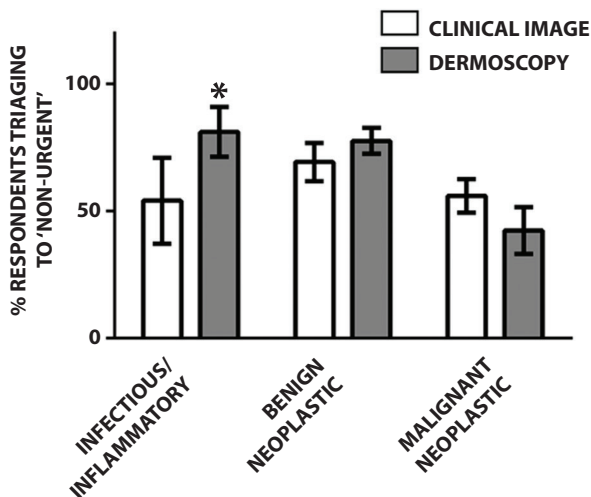

Figure 2. Dermoscopy reduces perceived triage urgency for non-neoplastic lesions. The proportion of respondents that rated non-neoplastic, benign neoplastic, and malignant neoplastic lesions as non-urgent before and after addition of dermoscopy is shown above. Bar graphs illustrate the means. * indicates P < 0.05 at McNemar test.

reduced access to dermoscopy during COVID-19 hampered tele-dermatology efforts. However, there was hesitancy towards direct-to-consumer dermoscopy.

Conclusions

Our preliminary findings demonstrate that dermoscopy can be a useful adjunct when remotely triaging skin lesions. This finding corroborates previous studies that suggest dermoscopic images improve recognition of neoplastic lesions, particularly for pigmented lesions such as melanoma

[1-5,10-13]. Our results indicate that dermoscopy may have additional utilities. Specifically, we found that dermoscopy reduced provider perception of urgency for benign lesions such as verruca (Figure 2). Consequently, a greater proportion of dermatologists in our study opted against prioritizing these patients for in-person evaluation. This is important in the setting of the COVID-19 pandemic, as the risk of viral exposure must be balanced with the benefits of office visits. Additionally, tele-dermoscopy may allow for better resource utilization [14]. The ability to reduce the number of in-person visits allows for the care of a greater volume of patients and prevents unnecessary travel.

Thematic analysis of the moderated discussion revealed that providers feel dermoscopic images are most useful for triaging malignant lesions and pigmented lesions, specifically those with the most common morphological features. Interestingly, despite improving providers' abilities to correctly classify malignant neoplastic lesions (Figure 1), the addition of dermoscopy did not significantly affect urgency scores or management decisions. This may reflect the lack of consensus amongst providers on the perceived urgency for treating slow growing malignancies such as basal cell carcinoma [15].

While training may be a limiting factor for the usefulness of dermoscopic images, study participants also voiced concerns about the impact of image quality. The success of the VISN 7 tele-dermatology program is in part due to imaging protocols that ensure consistently high image quality. This involves staff training, imaging equipment, and additional time—investments that are required for the success of future tele-dermatology efforts [16].

Our moderated discussion also revealed that participants do not find dermoscopy useful for triaging widespread skin

Table 2. Perceptions of dermoscopy for triage in tele-dermatology described by study participants, presented by theme and subtheme with exemplary quotes.

Theme and Subtheme	Exemplary Quotes
Utility of dermoscopy	
Useful for suspected malignancy and pigmented lesions	"Dermoscopy can be very useful for lesions suspicious for malignancy." "(Dermoscopy) has a lot to add for pigmented lesions and neoplasms."
Useful for lesions with common dermoscopic morphologies	"Clear features can increase confidence; more obscure structures are less helpful." "There are certain things that I can trust dermoscopy for, like single lesions with specific findings."
Less useful for rashes (of note, there were no rashes included in the survey)	"Dermoscopy for limited portions of an exanthem, especially without history, can be misleading." "Clinical images are more reassuring and less confusing than dermoscopy for rashes."
Patient history complements dermoscopic images	"I want to know the patient's problem list and how acute this is relative to other comorbidities." "For example, if I see that this patient is immunosuppressed on the primary care note, that will change things."
Importance of image quality	
	"If you have protocols for taking photos outlined, then that is more helpful. For the most part it's going to be patients and nurses taking photos, so we need good protocols and feedback mechanisms in place, so protocols are followed." "The lack of utility is based on both photo quality (such as extreme close ups, blurriness, lighting), as well as not knowing what to take photos of."
Increased accessibility to dermoscopy	
COVID19 limited availability to dermoscopic images	"I felt handicapped [during COVID19] for neoplastic lesions, dermoscopy is crucial for those." "[The transition to telemedicine during COVID19] has made me realize the limitations of webcam and poor-quality images, which makes imaging protocols more important."
Hesitancy for consumer dermoscopy	"I also worry that people might think they can interpret [dermoscopic images], which might be a problem. Even medical students don't get formal training in dermoscopy." "I'm skeptical about this technology in the hands of patients, but there might be utility for our high risk pigmented lesion patients."

eruptions. They feel that it would save time and resources to have primary providers submit dermoscopic images only for appropriate cases. However, having primary providers or patients determine which cases require dermoscopic images is asking them to decipher skin eruptions from discrete skin lesions. In the present study, we included two cases in which field actinic keratoses and field sebaceous hyperplasia were misidentified by the referring primary provider as generalized exanthems (Supplemental Table 1). It has been shown that primary care providers have difficulty diagnosing field actinic keratoses [17]. Accordingly, the tele-dermatology imaging protocol at the VISN 7 Teledermatology service requires clinical and dermoscopic images for every consult. While this requires more time and resources, it eliminates the possibility for this type of error. The ideal imaging protocol is likely dependent on resources available at specific institutions. A previous study of digital imaging for tele-dermatology suggests that standardization should involve a panoramic photo, a close-up with measurements, and a dermoscopic image [18].

Our study participants had a wide and varied range of dermoscopy training and utilization in clinical practice (Table 1). While most (55%) of participants in our survey had training with at least 1 formal dermoscopy course, few dermatology residency programs provide formalized dermoscopy training [19]. In the present study, participants had low self-reported confidence in their dermoscopic abilities, despite some with extensive use in their clinical practice. This may be attributed to the varying utilities of dermoscopy in different contexts, for example, where participants felt dermoscopy was less useful for rashes (Table 2). The addition of dermoscopy, nonetheless, proved useful for correctly triaging benign and malignant skin lesions. These results and others suggest the benefits of dermoscopy could justify a standardized curriculum to be used across residency programs. This educational gap must be addressed so that rising dermatologists are able to confidently use dermoscopy to its full potential [20-23].

Our discussion revealed that providers are hesitant about consumer dermoscopy. There is concern that patients might start interpreting their own images, placing them at risk for mismanagement. This concern has been voiced by others as well [24]. However, studies have indicated that

patient-performed tele-dermoscopy are both desirable for patients and effective [25-27]. For direct-to-patient tele-dermatology to become a viable paradigm, taking dermoscopic images needs to be foolproof and economical. Efforts are underway to address these criteria with user-friendly, affordable dermatoscopes and smart phone attachments [7, 28]. Care must be taken to ensure adequate instruction.

An additional consideration is the rapid and effective classification of dermoscopic images using artificial intelligence (AI). Recent reviews have highlighted dermoscopic image processing for the detection of skin lesions, most notably melanoma [29-33]. The potential for AI-assisted triage using tele-dermoscopy is profound and may allow for decreased costs and improved access to dermatologic care. However, some have noted concerns that the images used to develop or test algorithms is often not reported, and when present, may lack a diversity in patient population [33]. Further research is needed to clarify these issues before AI is integrated into the clinic.

There are several limitations to the present study. The number of survey and discussion participants was small, and composed of providers with various levels of dermoscopic training who were recruited from a single academic institution. Additionally, the number of lesions included was small, and selection bias of representative images may limit interpretation of the results. The study also utilized images from the VISN 7 tele-dermatology program, which serves a large number of fair skinned individuals. Skin lesions in skin of color were underrepresented and could pose a potential pitfall for providers. Future studies should explicitly test the utility of dermoscopy for triaging patients with darker skin. This dataset was also limited to dermatologists and dermatology residents, while primary care providers are increasingly engaged in the interpretation of dermoscopic images [34]. Nonetheless, our pilot data suggests that dermoscopy images should be considered in future tele-dermatology care models, even after the pandemic is over. We encourage future studies to investigate the utility of dermoscopy for tele-dermatology in other populations including those with larger proportions skin of color patients.

References

1. Warshaw EM, Hillman YJ, Greer NL, et al. Teledermatology for diagnosis and management of skin conditions: a systematic review. *J Am Acad Dermatol.* 2011;64(4):759-772. DOI: 10.1016/j.jaad.2010.08.026. PMID: 21036419.

2. Warshaw EM, Lederle FA, Grill JP, et al. Accuracy of teledermatology for nonpigmented neoplasms. *J Am Acad Dermatol.* 2009;60(4):579-588. DOI: 10.1016/j.jaad.2008.11.892. PMID: 19217689.

3. Warshaw EM, Lederle FA, Grill JP, et al. Accuracy of teledermatology for pigmented neoplasms. *J Am Acad Dermatol.* 2009;61(5):753-765. DOI: 10.1016/j.jaad.2009.04.032. PMID: 19679375.

4. Warshaw EM, Gravely AA, Nelson DB. Accuracy of teledermatology/teledermoscopy and clinic-based dermatology for specific categories of skin neoplasms. *J Am Acad Dermatol.* 2010;63(2):348-352. DOI: 10.1016/j.jaad.2009.10.037. PMID: 20633809.

5. Ferrándiz L, Ojeda-Vila T, Corrales A, et al. Internet-based skin cancer screening using clinical images alone or in conjunction with dermoscopic images: A randomized teledermoscopy trial. *J Am Acad Dermatol.* 2017;76(4):676-682. DOI: 10.1016/j.jaad.2016.10.041. PMID: 28089728.

6. Su MY, Das S. Expansion of asynchronous teledermatology during the COVID-19 pandemic. *J Am Acad Dermatol.* 2020;83(6):e471-e472. DOI: 10.1016/j.jaad.2020.08.054. PMID: 32822793. PMCID: PMC7434450.

7. Blum A, Menzies M. Home Dermoscopy During the COVID-19 Pandemic. *Dermatol Pract Concept.* 2020;10(4):e2020091. DOI: 10.5826/dpc.1004a91. PMID: 33150032. PMCID: PMC7588159.

8. Lee KJ, Finnane A, Soyer HP. Recent trends in teledermatology and teledermoscopy. *Dermatol Pract Concept.* 2018;8(3):214-223. DOI: 10.5826/dpc.0803a13. PMID: 30116667. PMCID: PMC6092076.

9. Du Moulin MF, Bullens-Goessens YI, Henquet CJ, et al. The reliability of diagnosis using store-and-forward teledermatology. *J Telemed Telecare.* 2003;9(5):249-52. DOI: 10.1258/135763303769211247. PMID: 14599326.

10. Warshaw EM, Gravely AA, Nelson DB. Reliability of store and forward teledermatology for skin neoplasms. *J Am Acad Dermatol.* 2015;72(3):426-435. DOI:10.1016/j.jaad.2014.11.001. PMID: 25599624.

11. Moreno-Ramirez D, Ferrandiz L, Galdeano R, Camacho FM. Teledermatoscopy as a triage system for pigmented lesions: a pilot study. *Clin Exp Dermatol.* 2006;31(1):13-18. DOI: 10.1111/j.1365-2230.2005.02000.x. PMID: 16309470.

12. Jones OT, Jurascheck LC, van Melle MA, et al. Dermoscopy for melanoma detection and triage in primary care: a systematic review. *BMJ Open.* 2019;9(8):e027529. DOI: 10.1136/bmjopen-2018-027529. PMID: 31434767. PMCID: PMC6707687.

13. Ferrándiz L, Ojeda-Vila T, Corrales A, et al. Impact of dermoscopy on an internet-based skin cancer triage system: Interim results of a randomized study. J Am Acad Dermatol. 2017 Feb;76(2):342-343. doi: 10.1016/j.jaad.2016.02.1165. PMID: 28088994.

14. Lowe A, Atwan A, Mills C. Teledermoscopy as a community based diagnostic test in the era of COVID-19? *Clin Exp Dermatol.* 2021;46(1):173-174. DOI: 10.1111/ced.14399. PMID: 33405282.

15. Coldiron BM, Mellette JR Jr, Hruza GJ, Helm TN, Garcia CA. Addressing overdiagnosis and overtreatment in cancer. *Lancet Oncol.* 2014;15(8):e307. DOI: 10.1016/S1470-2045(14)70295-5. PMID: 24988934.

16. Winkelmann RR, Farberg AS, Glazer AM, et al. Integrating Skin Cancer-Related Technologies into Clinical Practice. *Dermatol Clin.* 2017;35(4):565-576. DOI: 10.1016/j.det.2017.06.018.. PMID: 28886814.

17. Sola-Ortigosa J, Muñoz-Santos C, Masat-Ticó T, Isidro-Ortega J, Guilabert A; Grup d'Estudi de Teledermatologia del Vallès Oriental. The Role of Teledermatology and Teledermoscopy

in the Diagnosis of Actinic Keratosis and Field Cancerization. *J Invest Dermatol*. 2020;140(10):1976-1984.e4. DOI: 10.1016/j.jid.2020.02.013. PMID: 32142799.

18. Piccoli MF, Amorim BD, Wagner HM, Nunes DH. Teledermatology protocol for screening of skin cancer. *An Bras Dermatol*. 2015;90(2):202-10. DOI: 10.1590/abd1806-4841.20153163. PMID: 25830990. PMCID: PMC4371669.

19. Chen YA, Rill J, Seiverling EV. Analysis of dermoscopy teaching modalities in United States dermatology residency programs. *Dermatol Pract Concept*. 2017;7(3):38-43. DOI: 10.5826/dpc.070308. PMID: 29085718: PMCID: PMC5661161.

20. Wang DM, Petitt CE, Goel NS, Ash MM, Mervak JE. Confidence and competency in the use of dermoscopy among new first-year dermatology residents: A repeated-pairs pre-/postassessment study of an online learning module. *J Am Acad Dermatol*. 2021;85(6):1585-1587. DOI: 10.1016/j.jaad.2020.11.028. PMID: 33248068.

21. Patel P, Khanna S, McLellan B, Krishnamurthy K. The need for improved dermoscopy training in residency: a survey of US dermatology residents and program directors. *Dermatol Pract Concept*. 2017;7(2):17-22. DOI: 10.5826/dpc.0702a03. PMID: 28515987. PMCID: PMC5424656.

22. Chevolet I, Hoorens I, Janssens A, et al. A short dermoscopy training increases diagnostic performance in both inexperienced and experienced dermatologists. *Australas J Dermatol*. 2015;56(1):52-55. DOI: 10.1111/ajd.12203. PMID: 25302740.

23. Oldenburg R, Marsch A. Optimizing teledermatology visits for dermatology resident education during the COVID-19 pandemic. *J Am Acad Dermatol*. 2020;82(6):e229. DOI: 10.1016/j.jaad.2020.03.097. PMID: 32283238. PMCID: PMC7146655.

24. Horsham C, Snoswell C, Vagenas D, et al. Is Teledermoscopy Ready to Replace Face-to-Face Examinations for the Early Detection of Skin Cancer? Consumer Views, Technology Acceptance, and Satisfaction with Care. *Dermatology*. 2020;236(2):90-96. DOI: 10.1159/000506154. PMID: 32114570.

25. Kong F, Horsham C, Rayner J, et al. Consumer Preferences for Skin Cancer Screening Using Mobile Teledermoscopy: A Qualitative Study. *Dermatology*. 2020;236(2):97-104. DOI: 10.1159/000505620. PMID: 32126557.

26. Spinks J, Janda M, Soyer HP, Whitty JA. Consumer preferences for teledermoscopy screening to detect melanoma early. *J Telemed Telecare*. 2016;22(1):39-46. DOI: 10.1177/1357633X15586701. PMID: 26026184.

27. Snoswell CL, Whitty JA, Caffery LJ, Loescher LJ, Gillespie N, Janda M. Direct-to-consumer mobile teledermoscopy for skin cancer screening: Preliminary results demonstrating willingness-to-pay in Australia. *J Telemed Telecare*. 2018;24(10):683-689. DOI: 10.1177/1357633X18799582. PMID: 30343653.

28. Goldust M, Zalaudek I, Gupta A, Lallas A, Rudnicka L, Navarini AA. Performing dermoscopy in the COVID-19 pandemic. *Dermatol Ther*. 2020;33(4):e13506. DOI: 10.1111/dth.13506. PMID: 32367660. PMCID: PMC7261992.

29. Magalhaes C, Mendes J, Vardasca R. The role of AI classifiers in skin cancer images. *Skin Res Technol*. 2019;25(5):750-757. DOI: 10.1111/srt.12713. PMID: 31106913.

30. Young AT, Xiong M, Pfau J, Keiser MJ, Wei ML. Artificial Intelligence in Dermatology: A Primer. *J Invest Dermatol*. 2020;140(8):1504-1512. DOI: 10.1016/j.jid.2020.02.026. PMID: 32229141.

31. Goyal M, Knackstedt T, Yan S, Hassanpour S. Artificial intelligence-based image classification methods for diagnosis of skin cancer: Challenges and opportunities. *Comput Biol Med*. 2020;127:104065. DOI: 10.1016/j.compbiomed.2020.104065. PMID: 33246265. PMCID: PMC8290363.

32. Cui X, Wei R, Gong L, et al. Assessing the effectiveness of artificial intelligence methods for melanoma: A retrospective review. *J Am Acad Dermatol*. 2019;81(5):1176-1180. DOI: 10.1016/j.jaad.2019.06.042. PMID: 31255749.

33. Daneshjou R, Smith MP, Sun MD, Rotemberg V, Zou J. Lack of Transparency and Potential Bias in Artificial Intelligence Data Sets and Algorithms: A Scoping Review. *JAMA Dermatol*. 2021;157(11):1362-1369. DOI: 10.1001/jamadermatol.2021.3129. PMID: 34550305.

34. Fee JA, McGrady FP, Rosendahl C, Hart ND. Training Primary Care Physicians in Dermoscopy for Skin Cancer Detection: a Scoping Review. *J Cancer Educ*. 2020;35(4):643-650. DOI: 10.1007/s13187-019-01647-7. PMID: 31792723. PMCID: PMC7363668.