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# Reliability of store and forward teledermatology for skin neoplasms

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**Background:** Teledermatology may be less optimal for skin neoplasms than for rashes.

**Objectives:** We sought to determine agreement for skin neoplasms.

**Methods:** This was a repeated measures study. Each lesion was examined by a clinic dermatologist and a teledermatologist; both generated a primary diagnosis, up to 2 differential diagnoses, and management. Macro images and polarized light dermoscopy images were obtained; for pigmented lesions only, contact immersion dermoscopy image was obtained.

**Results:** There were 3021 lesions in 2152 patients. Of 1685 biopsied lesions, there were 410 basal cell carcinomas (24%), 240 squamous cell carcinomas (14%), and 41 melanomas (2.4%). Agreement was fair to substantial for primary diagnosis (45.7%-80.1%; kappa 0.32-0.62), substantial to almost perfect for aggregated diagnoses (primary plus differential; 78.6%-93.9%; kappa 0.77-0.90), and fair for management (66.7%-86.1%; kappa 0.28-0.41). Diagnostic agreement rates were higher for pigmented lesions (52.8%-93.9%; kappa 0.44-0.90) than nonpigmented lesions (47.7%-87.3%; kappa 0.32-0.86), whereas the reverse was found for management agreement (pigmented: 66.7%-79.8%, kappa 0.19-0.35 vs nonpigmented: 72.0%-86.1%, kappa 0.38-0.41). Agreement rates using macro images were similar to polarized light dermoscopy; contact immersion dermoscopy, however, significantly improved rates for pigmented lesions.

**Limitations:** We studied a homogeneous population.

**Conclusions:** Diagnostic agreement was moderate to almost perfect whereas management agreement was fair. Polarized light dermoscopy increased rates modestly whereas contact immersion dermoscopy significantly increased rates for pigmented lesions. (J Am Acad Dermatol 2015;72:426-35.)

**Key words:** dermoscopy; diagnosis; management; reliability; skin cancer; teledermatology.

Although several small studies have reported reliability (agreement) of teledermatology with in-person examinations, few have focused specifically on skin neoplasms. A recent systematic review on teledermatology<sup>1,2</sup> found that primary diagnostic agreement has only

been assessed in 5 lesion studies<sup>3-7</sup> and 1 dermoscopy pigmented lesion study<sup>8</sup>; the weighted average for these 6 studies (n = 708 lesions) was 62.3%.<sup>1</sup> The weighted average for aggregated diagnostic agreement for 4 studies<sup>4-7</sup> (n = 358 lesions) was similar, 64.4%.<sup>1</sup> Because almost half

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(47%) of all veteran dermatology visits<sup>9</sup> are related to skin neoplasms, evaluation of this subset of dermatologic conditions is critical in this patient population. Previous work by our group reported accuracy (histopathology as gold standard) of store and forward teledermatology as compared with conventional in-person dermatologic examinations for skin neoplasms and found that the diagnostic accuracy of teledermatology was inferior to standard, in-person examinations whereas management accuracy varied by lesion type.<sup>10-12</sup> Interobserver accuracy was also reported.<sup>13,14</sup>

The purpose of this analysis was to compare conventional, in-person dermatology with store and forward teledermatology for skin neoplasms, using the outcomes of agreement for primary diagnosis, aggregated diagnoses, and management.

## METHODS

The Minneapolis Veterans Affairs Medical Center Human Studies Subcommittee in Minnesota provided institutional review board approval for this study. The design of the cross-sectional, repeated measures equivalence study has been reported previously.<sup>10-12</sup>

### Participants and inclusion criteria

Neoplasms were defined as circumscribed lesions. Patients referred to the Minneapolis Veterans Affairs Medical Center Dermatology Clinic for evaluation of a skin neoplasm or patients already enrolled in the dermatology clinic who were undergoing a biopsy of a skin neoplasm were eligible for inclusion. After informed consent was obtained, digital photographs of the lesion(s) and a standardized history were obtained by research staff. A staff dermatologist then completed a clinical assessment that consisted of: (1) a choice of 17 common diagnoses for 1 primary diagnosis and up to 2 differential diagnoses; (2) a choice of 4 basic management plans; (3) pigmentation (yes or no); and (4) level of diagnostic confidence (low, moderate, or high). Clinicians were also allowed to choose "other" for diagnoses and management and hand-write choices.

Additional history could be obtained by the clinical dermatologist in the usual manner of a clinic

encounter and the clinical examination could include all options normally available (eg, palpation, diascopy, dermoscopy).

### Photographs

Research assistants obtained images with up to 3 different cameras. All patients had at least 2 macro images (distance and close-up; digital Nikon Coolpix 4500 with a Nikon SL-1 ring flash [Nikon, Melville, NY] and 1 polarized light image (polarized light dermoscopy [PLD]) (digital Nikon Coolpix 4500 with a 3Gen Dermlite lens attachment [3Gen, San Juan Capistrano, CA]). For lesions greater than 2 mm in height, an additional macro angle shot was obtained. All of the images were obtained in a standardized fashion (distance 640 × 470 pixels; all others at the highest resolution 1600 × 1200 pixels). For

pigmented lesions only, a contact immersion dermoscopy (CID) image (35-mm Minolta X 370 [Minolta, Tokyo, Japan] with a Heine dermphot lens attachment [Heine, Herrsching, Germany]) was also obtained. Previous publications have focused on index lesions.<sup>10,11</sup> The study reported herein includes both index and secondary lesions.

### Image packages

For each patient, a sequence of 2 or 3 images, or "package," was sent to a teledermatologist according to a computer-generated randomization schedule separated by at least 3 weeks, to avoid recall bias. For patients with only nonpigmented lesions, the teledermatologist received a macro package (distance, close-up, and/or angle [if height >2 mm] image of all lesions) and PLD package (macro and PLD images of all lesions). For patients with pigmented lesions, the teledermatologist received a macro package, a PLD package, and a CID package (macro images of all lesions plus CID images of pigmented lesions).

### Teledermatology encounter

For a given patient, 1 of 3 board-certified dermatologists (none of whom served as general clinic dermatologists but all of whom had clinical expertise in dermoscopy and pigmented lesions)<sup>14</sup> was randomly selected to review the electronically transmitted packages of clinical digital photographs

## CAPSULE SUMMARY

- Store-forward teledermatology is being implemented but studies focusing on skin neoplasms are lacking.
- In our series, diagnostic agreement was moderate to almost perfect whereas management agreement was fair.
- Store-forward teledermatology should be used cautiously in evaluating skin neoplasms; contact immersion teledermoscopy should be used whenever possible for pigmented lesions.

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