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Patient photographs taken without instructions are of sufficient quality for clinical decision making in teledermatology

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To the Editor:

The coronavirus disease 2019 (COVID-19) pandemic propelled the adoption of teledermatology, especially store-and-forward teledermatology (SAFTD) involving patient-submitted photographs [1,2]. Although standardized practices for the acquisition of high-quality dermatological photographs in the clinical setting exist [3,4], it is unclear what, if any, instructions are needed for patients to submit clinically useful photos of their skin concerns for SAFTD, particularly given the widespread adoption of smartphones and recent improvements in smartphone camera optics and image processing. Owing to pandemic restrictions on in-person care, our academic medical center implemented direct-to-patient SAFTD for established patients in the form of E-Visits. We then studied whether patient-submitted photographs taken without instructions were sufficient to make clinical decisions. Five experienced teledermatologists at the University of California San Francisco conducted 113 E-Visits between June 2020 and April 2021. During E-Visits, patients were prompted to submit a description of their complaint along with photos of their skin condition without any initial photography instructions. Dermatologists responded asynchronously through the electronic health record (EHR) system and could obtain additional information through chart review and direct patient messaging. Patient-submitted photographs were deemed adequate or inadequate by the dermatologist during the E-Visit as part of clinical care. All photographs were later rated by RK on a 3-point quality scale (0: low, 1: moderate, 2: high) for five characteristics: focus, distribution, projection distance, lighting, and color. Other information, such as the nature of the complaint or prior history, was not accessed during the photo-rating process. Total photo quality score (TPQS) was calculated by adding individual characteristic scores for a maximum of 10. Statistical analyses were performed (GraphPad Prism V.9.3.1) to compare photo quality score with dermatologists' assessment of adequacy and examine predictors of clinical decision-making ability and photograph quality. Five cases in which photography instructions were later provided as part of clinical care and used by patients after initial photographs were deemed inadequate were excluded from outcomes analysis. Study demographics consisted of largely White, non-Hispanic, and privately insured patients. Results are summarized in **Table 1**. Photos were perceived as adequate in 91.2% of cases, with a mean TPQS of 8.0 for adequate photos and 6.5 for inadequate photos. A definitive or differential diagnosis was given in 96.3% of cases and a clinical decision was made in 95.4% of cases. In-person visits were recommended

for 14.8% of E-Visits (9.3% for a procedure and 1.9% owing to inadequate photos). Additional clinical information, obtained in 75.9% of cases, was positively associated with clinical decision-making ability upon univariable regression (Odds ratio=14.7; 95% CI [2.05, 296], P=0.019). Lack of focus/blurriness, present in 60% of cases with inadequate photos versus 7.8% with adequate photos, was significantly associated with photograph inadequacy by Fisher's exact test (P<0.001). Increased age was associated with lower TPQS upon both univariable regression (β=-0.031; 95% CI [-0.047, -0.015], P<0.001) and multivariable regression accounting for primary insurance type and primary problem type (β=-0.032, 95% CI [-0.052, -0.012], P=0.002).

In summary, experienced teledermatologists were able to make a clinical decision in 95% of direct-to-patient SAFTD cases without photography instructions; only 1.9% of cases required an in-person visit because of image inadequacy. Our findings suggest that patient-submitted photographs taken without instructions are of sufficient quality to effectively conduct direct-to-patient SAFTD, likely owing to recent improvements in smartphone camera optics, image processing, and the general public's familiarity with using smartphone cameras. However, older adults may need tailored tools or a more personalized approach for optimal teledermatology care. Our findings are consistent with a study of 40 pediatric teledermatology visits at the Children's Hospital of Philadelphia that reported parent-submitted photographs were rarely inadequate (7.5%) and had high diagnostic concordance (89%) compared with in-person evaluation, with no improvement in diagnostic concordance upon provision of photography instructions [5]. In our study, the most common reason for photograph inadequacy was lack of focus/blurriness, suggesting that teledermatology platforms that request new images upon detecting out-of-focus submissions could improve efficiency [6]. We also found that additional clinical information was positively associated with physicians' decision-making ability. This builds upon a study at Duke University which found that, when dermatologists were asked to rate 1200 patient-submitted images without clinical context, only 62.2% of photos were deemed of sufficient quality and only 55.1% were rated as useful for medical decision-making [7]. Together, these results underscore the importance of gathering a good history and interpreting images within the clinical context when conducting teledermatology. Our study was limited by its small size, urban setting, and patient demographic makeup; further research is necessary to understand how teledermatology may optimally serve broader patient populations.

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Potential conflicts of interest

The authors declare no conflicts of interest.

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Table 1. *E-Visit photograph quality and outcomes analysis.*

Overall photo quality			
Adequate photographs	103/113 (91.2%)		
Inadequate photographs	10/113 (8.8%)		
Mean (±SD) total photo quality score			
Adequate photographs	8.0 (±1.4)		
Inadequate photographs	6.5 (±1.7)		
P-value	0.002		
Mean (±SD) initial photographs submitted	2.3 (±1.3)		
Photo quality characteristics			
	Low	**Moderate**	**High**
Focus			
Inadequate photographs	6/10 (60%)	4/10 (40%)	0/10 (0%)
Adequate photographs	8/103 (7.8%)	59/103 (57.3%)	36/103 (35.0%)
P-value	<0.001		
Distribution			
Inadequate photographs	1/10 (10%)	0/10 (0%)	9/10 (90%)
Adequate photographs	0/103 (0%)	20/103 (19.4%)	83/103 (80.6%)
P-value	0.088		
Projection distance			
Inadequate photographs	0/10 (0%)	4/10 (40%)	6/10 (60%)
Adequate photographs	0/103 (0%)	32/103 (31.1%)	71/103 (68.9%)
P-value	>0.999		
Lighting			
Inadequate photographs	0/10 (0%)	9/10 (90%)	1/10 (10%)
Adequate photographs	2/103 (1.9%)	56/103 (54.4%)	45/103 (43.7%)
P-value	>0.999		
Color			
Inadequate photographs	0/10 (0%)	4/10 (40%)	6/10 (60%)
Adequate photographs	0/103 (0%)	15/103 (14.6%)	88/103 (85.4%)
P-value	>0.999		
Additional clinical information gathered			
From electronic medical record	73/108 (67.6%)		
From electronic communication with patient	26/108 (24.1%)		
From any source	82/108 (75.9%)		
Ability to make diagnosis			
Definitive or differential diagnosis made	104/108 (96.3%)		
Definitive diagnosis made	70/108 (64.8%)		
Diagnostic concordance with in-person visit	39/41 (95%)		
Ability to make clinical decision			
Decision made	103/108 (95.4%)		
Decision not made	5/108 (4.6%)		
In-person visit recommended			
For any reason	16/108 (14.8%)		
For procedure	10/108 (9.3%)		
Due to inadequate photographs	2/108 (1.9%)		

SD, standard deviation.

E-Visit data were collected on the number and adequacy of photographs submitted, additional clinical information gathered (i.e., whether dermatologists asked patients for additional information or incorporated prior medical history into the E-Visit documentation), diagnosis rendered, ability to make a clinical decision (i.e., treat or triage), and in-person follow-up.

Summary statistics are shown. For photo quality analysis, initial photograph submissions were evaluated for all cases (N=113). RK rated patient-submitted photographs without referencing the rest of the E-Visit information on a 3-point quality scale (0: low, 1: moderate, 2: high) for five characteristics: focus, distribution, projection distance, lighting, and color. Total photo quality score (TPQS) was calculated by adding individual characteristic scores for a maximum of 10. The number and percent of adequate and inadequate photographs receiving each individual quality characteristic score are shown. A Fisher's exact test was performed to evaluate the association between photograph inadequacy and a quality

score of 0 (low) for each characteristic. For E-Visit outcomes analysis, five cases in which photography instructions were provided as part of clinical care and used by patients after initial photographs were deemed inadequate were excluded (N=108). In one case in which additional photographs were submitted without instructions, the later set of photographs was used for outcomes analysis. A two-sample two-tailed t-test was performed comparing mean TPQS between cases with adequate versus inadequate photos. The rate of diagnostic concordance, which was determined by comparing the diagnosis at in-person visit with the diagnosis or differential diagnosis at E-Visit, was calculated for any subsequent in-person visits that occurred through June 2021.