

Diagnostic accuracy and photographic quality of inpatient Teledermatology during the COVID-19 pandemic.



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Introduction

Since the COVID-19 pandemic, Teledermatology has been used to review hospitalized patients while reducing risk transmission through face-to-face(FTF) contact. National University Hospital, Singapore, Dermatology department utilized Store-and-Forward Teledermatology as default to review inpatients referrals. A retrospective cross-sectional study was performed in 2020 to review the diagnostic accuracy and photographic quality of inpatient Teledermatology and compare these parameters when clinical history and images were obtained by inpatient Dermatology versus non-Dermatology teams.

Methods

All inpatient Teledermatology referrals in 2020 were reviewed. Clinical history and images were obtained by the primary team for isolated patients(pandemic group) and a Dermatology team representative for non-isolated patients(non-pandemic group). These were uploaded into electronic medical records(EMR) for remote review by the Dermatology team (Figure 1). Images in pandemic and non-pandemic groups were obtained with smartphone cameras; and a combination of smartphone and point-and-shoot(PAS) cameras respectively. Attributes of images were recorded into physician-dependent(photographic views, image properties) and device-dependent(image resolution) domains(Table 1). Each image was graded using an unvalidated grading criteria (Table 1). Diagnoses at the first remote, last inpatient and first outpatient consultations were compared (Table 2).

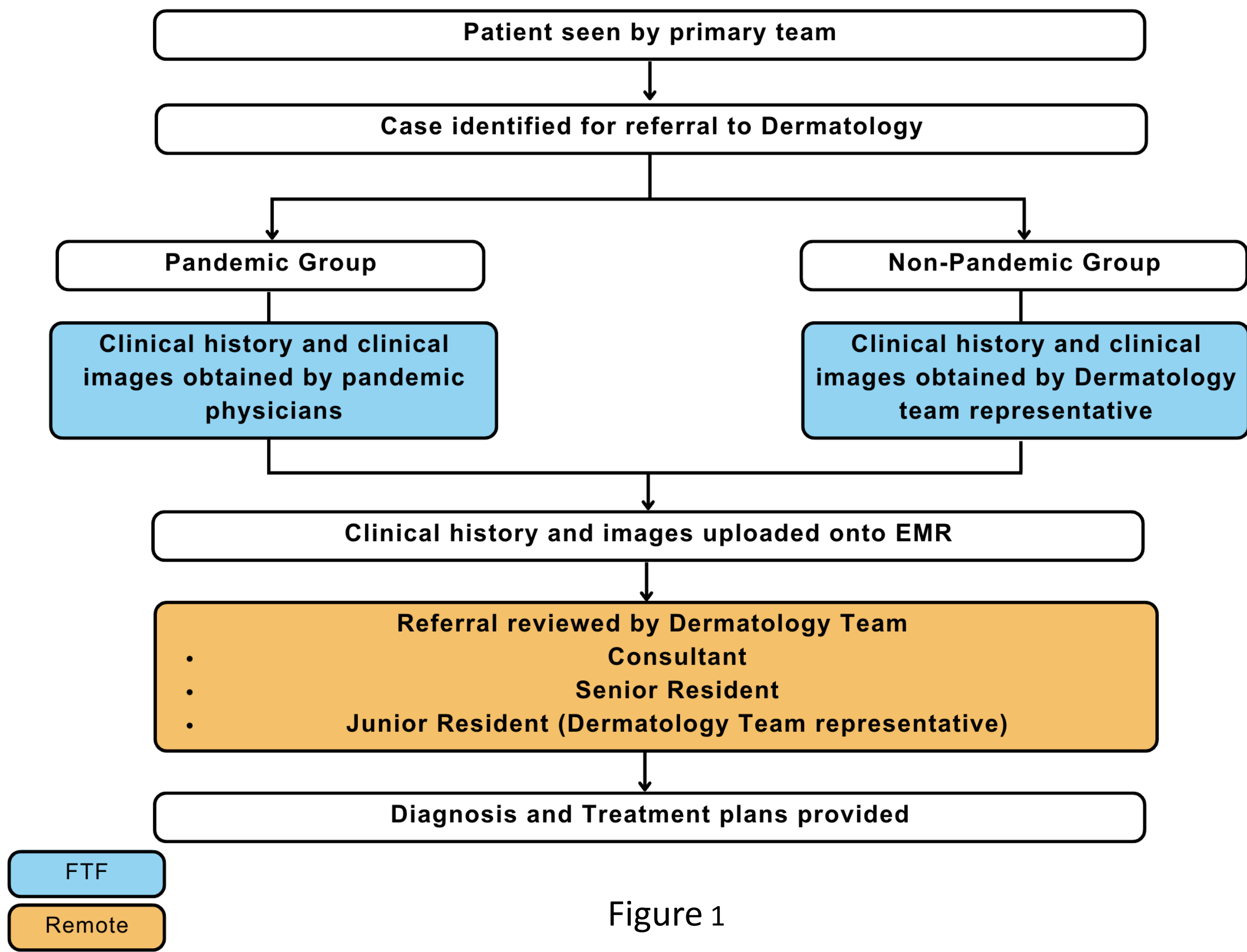


Figure 1

First remote diagnosis	Last inpatient diagnosis	First outpatient diagnosis	Assessment
Atopic dermatitis	Atopic dermatitis	Atopic dermatitis	Diagnosis consistent
Atopic dermatitis	Atopic dermatitis	Psoriasis	Diagnosis revised
Atopic dermatitis	Psoriasis	Psoriasis	Diagnosis revised

Table 2

Domains	Physician-Dependent		Device-Dependent
	Photographic View	Image Property	Image Resolution
Attributes	No. of images	Exposure	Image Resolution
		Well, Over, Under	
	All areas	Focus	
		In, Out	
	Overall View	Noise Correction	
		Acceptable, Excessive	
	Regional View	Camera Flash	
		Used, Not Used	
	Close-up View	White Balance	
		Appropriate, Inappropriate	
	Side View		
	Unaffected side		
Photographic Grading Criteria		Grade	
1) All 5 of the following image attributes present		Good	
Exposure: Well-exposed			
Focus: In focus			
Noise Correction: Acceptable			
Camera flash: Not used			
White balance: Appropriate			
2) At least 1 of the above image attributes absent			
A. Texture of image rash preserved		Acceptable	
B. Texture of image rash lost		Poor	
Image Resolution Grading Criteria		Grade	
< 480x640 (0.3 Megapixels)		Low	

Table 1

Results

Pandemic	Subjects	Images			
	24	133			
Non-Pandemic	Subjects	Images			
	158	866			
	Pandemic	Non-Pandemic	OR	CI	<i>p</i> -value
	(n=24)	(n=158)			
Diagnosis revised	0	7	-		
Physician-Dependent Domains					
Photographic View domain	(n=24)	(n=158)			
Mean no. of images	5.5 (1-12)	5.5 (1-31)			
All involved areas provided	22	123	0.32	[0.07 , 1.43]	0.07
Overall view	7	38	0.77	[0.30 , 2.00]	0.29
Regional view	15	122	2.03	[0.82 , 5.03]	0.06
Close-up view	22	139	0.67	[0.15 , 3.06]	0.30
Side view	8	49	0.90	[0.36 , 2.24]	0.41
Unaffected side	0	0	-		
Image Property Domain	(n=133)	(n=866)			
Exposure					
Well	133	854	-		
Over	0	12			
Under	0	0			
In Focus	133	840	-		
Excessive noise correction	5	25	0.76	[0.29 , 2.02]	0.29
Used camera flash	0	10	-		
Appropriate white balance	133	866	-		
Overall Photographic Grading	(n=133)	(n=866)			
Good	128	824	0.77	[0.30 , 1.97]	0.29
Acceptable	5	23			
Poor	0	19			
Device-Dependent Domains					
Image Resolution Domain	(n=133)	(n=866)			
Low resolution	32	127	0.54	[0.35 , 0.84]	0.003

A total of 182 referrals and 999 images were included in the study. Overall diagnostic revision rate was 3.8%(n=7). Revisions were all from the non-pandemic group. 2(1.3%) revisions followed physical reviews. Overall photographic grade was “Good” in 952(95.3%) images. 159(15.9%) images had low-resolution. No statistical differences between groups were noted in physician-dependent domains(Table 3). Images in non-pandemic group referrals were less likely of low resolution(OR 0.54, 95%CI:0.35-0.84, p-value 0.003).

Changes in clinical impression following investigation results, drug charts or changes in rash morphology were expected outcomes and not specific to Teledermatology. Considering diagnoses revised following a physical review after the initial remote review, inpatient Teledermatology showed good diagnostic accuracy. Non-pandemic group referrals lacked views of all involved skin areas. In both groups, referrals lacked provision of overall views. Nonetheless, diagnostic accuracy remained high. Comprehensive photographic views are important to assess areas of involvement and for longitudinal comparison.^{2,3} Lack of these views might have been supplemented by verbal reports describing the true extent of rash involvement by the Dermatology team representative and the dermatologist’s ability to mentally picture overall rash extent with a summation of multiple regional views. Adequate technical know-how is needed to obtain quality images. Presence of camera artificial intelligence(AI) likely contributed to quality images. While AI compensated for environmental factors and improved image quality, over-compensation, especially in low-light environments, is detrimental.⁴ Generally, NUH wards are well-lit. In settings with low ambient light, the photographer’s ability to optimize environmental factors for quality images is important. Low-resolution images may be unusable despite having good photographic grading if over-pixelated when enlarged. Digital zoom functions in smartphone cameras may reduce image resolution.⁵ While impractical for physicians to possess PAS cameras solely for Teledermatology, simply moving smartphone cameras nearer to subjects instead of using digital zoom functions can preserve image resolution.

Table 3

Conclusion

Physicians obtaining images in both groups did not receive training in clinical photography. Since majority of images had favourable image properties, it suggests that untrained physician photographers, whether or not dermatologically trained, are still able to obtain images with sufficient quality needed for an accurate diagnosis. Overall, inpatient Teledermatology showed good diagnostic accuracy and helped maintain standard of care whilst minimizing exposure to COVID-19.

References

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