Limited impact of teledermoscopy on referrals to face-to-face dermatology

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Abstract

Background: Teledermoscopy improves teledermatology clinical outcomes, but the practical impact of this and other teleconsultation variables on patient management are unclear. We assessed the impact of these variables, including dermoscopy, on face-to-face (F2F**)** referrals to optimize effort by imagers and dermatologists.

Methods: Using retrospective chart review, we retrieved demographic, consultation, and outcome variables from 377 interfacility teleconsultations sent to San Francisco Veterans Affairs Health Care System (SFVAHCS) between September 2018 to March 2019 from another VA facility and its satellite clinics. Data were analyzed using descriptive statistics and logistic regression models.

Results: Of 377 consults, 20 were excluded due to patient F2F self-referral without teledermatologist recommendation. Analysis of consults showed that age, clinical image, and problem number but not dermoscopy were associated with F2F referral. Analysis of problems contained in consults showed that lesion location and diagnostic category were also associated with F2F referral. Skin cancer history and problems on the head/neck were independently associated with skin growths in multivariate regression.

Conclusions: Teledermoscopy was associated with variables related to neoplasms but did not affect F2F referral rates. Rather than utilize teledermoscopy for all cases, our data suggests that referring sites prioritize teledermoscopy for consultations with variables associated with a likelihood of malignancy.

Keywords: dermoscopy, teledermatology, teledermoscopy, telemedicine

Introduction

Store-and-forward (SAF) teledermatology allows dermatologists the ability to manage or guide care for patients living in remote areas by sharing clinical information on virtual platforms. By allowing dermatologists to triage cases and decide which need further in-person management, teledermatology has been shown to prevent anywhere from two-thirds to one-half of face-to-face (F2F) visits in a variety of clinical settings [1-3]. The dermatoscope is a tool that facilitates the diagnostic process, especially when dealing with skin cancers [4], by enhancing morphologic features through magnification and the use of polarized light [5]. In addition to enhancing sensitivity and specificity, the inclusion of dermoscopic imaging into

Abbreviations

CBOCs	community-based outpatient clinics
DTC	dermoscopic and clinical image teleconsultations
EHR	electronic health record
F2F	face-to-face
HN	head and neck
M	multiple sites
PCP	primary care provider
SFVAHCS	San Francisco Veterans Affairs Health Care System
SAF	store-and-forward

teleconsultations also increases diagnostic confidence [6] and treatment concordance among teledermatologists relative to in-person dermatologists [7].

San Francisco VA Health Care System (SFVAHCS) provides consultative SAF teledermatology services to other VHA facilities and their community-based outpatient clinics (CBOCs) throughout the United States. The process begins when a referring primary care provider (PCP) uses the electronic health record (EHR) to order a teledermatology imaging consult which includes patient history and instructions on anatomic sites to image. Imaging technicians then perform the corresponding imaging, sometimes including dermoscopic imaging, and upload the images along with the PCP's patient history to a new teledermatology reader consult in the EHR. San Francisco VA Health Care System dermatologists then review the mixture of cases with only clinical image teleconsultations (CTC) and with both dermoscopic and clinical image teleconsultations (DTC) to create differential diagnoses, recommend management plans, and suggest disposition recommendations, which can include referral to F2F dermatology clinics.

Although VA technicians are often trained to only include dermoscopic images when specifically instructed by the PCP to do so as part of the teledermatology imaging order, some VA sites have adopted a policy in which dermoscopic images are routinely captured as part of all teledermatology consults. Such images provide additional information that can reassure a dermatologist who otherwise might be uncertain of a diagnosis thus averting a F2F referral for further examination. Dermoscopic images might also increase the sensitivity of the teledermatology examination for conditions such as skin cancers needing histopathological evaluation and leading to increased F2F referrals for further examination and a skin biopsy. For example, the addition of teledermoscopy has been shown to increase diagnostic accuracy and reliability between teledermatologists when evaluating skin malignancies [8,9]. The practice of always including dermoscopy images for teledermatology consults does incur a cost, both in the additional time needed to capture dermoscopic images and in the time needed to read these images in every case, thus the relative value of doing so remains unclear.

To better understand the impact of routine dermoscopic imaging in SAF teledermatology, we compared referral rates to F2F dermatology following teledermatology consultations for cases that did, and did not include dermoscopic images. Because of the ability of the dermatoscope to provide more detailed information about the skin, we hypothesized that dermoscopy would result in fewer in-person referrals within the DTC group compared to the CTC group. Our findings suggest that routine teledermoscopy may not be impactful on F2F referrals, but we do identify other factors that appear to influence F2F referral rates. We suggest an approach for teledermatology imagers to optimally include dermoscopic images into teleconsultations by prioritizing problems of concern for skin growths rather than rashes.

Methods

This project was approved by University of California at San Francisco's Institutional Review Board. Retrospective chart review was utilized to evaluate all SAF teledermatology consultations referred to SFVAHCS from one VA referring facility and its five CBOCs between September 3, 2018 and March 29, 2019; a three-month period of follow-up was used to detect F2F encounters. Cases were excluded if patients self-referred for F2F dermatology evaluation without a formal recommendation from the teledermatology reader.

Demographic, consultation, and outcome variables were retrieved using the EHR at the VA (**Figure 1**). Because individual consultations could be requested for more than one skin-related concern, we documented and reviewed the first problems listed, up to a maximum of three, regardless of total problem number per consult. Problems were localized to one of three possible anatomical regions including the head and neck (HN), trunk and limbs (TL), or multiple (M) sites. Using the leading diagnosis given to each problem by teledermatologists in their

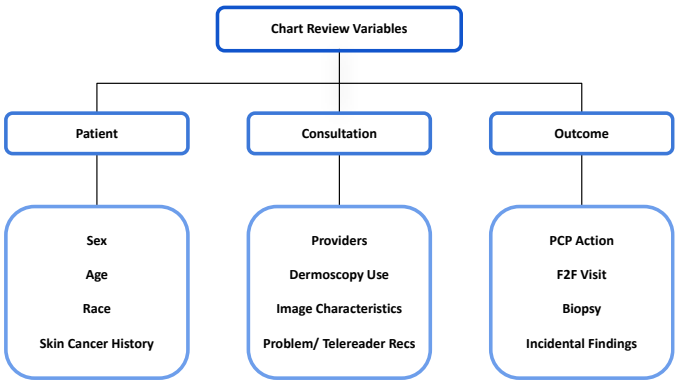

Figure 1. *Chart review variables. List of broad categorizations including patient, consultation, and outcome factors used to organize and capture data during chart review. In this figure, Recs stands for recommendations, PCP stands for primary care provider and F2F for face-to-face.*

differential diagnoses, these problems were additionally classified as growths (neoplastic) or rashes with further subclassification into one of seven diagnostic categories: rashes (inflammatory, infectious) and growths (benign neoplasm, benign melanocytic nevus, seborrheic keratosis, actinic keratosis, or malignant neoplasm). These classifications and subclassifications were modified based on previously published teledermatology studies and for clinical relevance [6].

Characteristics of the cohort, stratified by referral or non-referral to F2F dermatology clinics, were summarized with counts and proportions for categorical variables; continuous variables were described using medians and interquartile ranges. The two groups were compared with chi-squared tests for categorical variables (or Fisher's exact test, where appropriate) and Wilcoxon rank sum tests for continuous variables. Univariate logistic regression analyses were conducted to identify the patient variables that were independently associated with either a growth or rash diagnostic category. Those found to be significant at the $P \leq 0.05$ level in univariate analysis were then included in a multivariable logistic regression model. Because each patient could have more than one dermatological problem and such problems within a patient are likely to be correlated, generalized estimating equations techniques were used for both univariate and multivariable models. Statistical analysis was completed using Stata software (Stata v16.1, College Station, TX).

Results

Of the total 377 teledermatology consultations that were reviewed, twenty met exclusion criteria. Of the remaining 357 consults evaluated in this study, 106 (29.7%) received referral recommendations and 251 (70.3%) did not (**Table 1**). Within the included consults, 254 were found to have one problem, 82 to have two problems, and 21 to have three problems (**Table 1**). Demographic and consultation parameters can be found in Tables 1 and 2. In analysis of consults, the non-referral and referral groups differed by age as well as by number of images and problems included in consults (**Table 1**). Analysis of problems contained in consults showed referral rates differed by anatomical location and diagnostic category (**Table 2**). A total of 481 problems were identified in these consults with 156 (32.4%) in the referral arm. Problems that were referred were more likely to be located on the head/neck and to fall under the growth diagnostic category (**Table 2**).

Of the teleconsultations referred for F2F evaluation, 95 (89.6%) actually presented to F2F visits. These teleconsultations accounted for 126 problems in the growth diagnostic category of which 65 were concerning for malignancy to the telereader. Ultimately, 48 biopsies were conducted during F2F evaluation. Thirty-two of the 48 biopsies were found to be malignant on histopathology: 17 of 29 (58.6%) in the CTC group and 15 of 19 (78.9%) in the DTC group (**Figure 2**).

Though dermoscopy was applied in 118 consults, yielding 35 (29.7%) referrals, its inclusion did not impact referral decisions (P=1.00), (**Table 1**). Referral rates were instead found to differ by age group with a greater proportion of patients 65 years and older receiving recommendations to be seen F2F (33.1%) compared to their younger counterparts (22.6%), (P=0.04). The number of clinical images submitted was inversely associated with rates of referral to F2F evaluation (P=0.005). Lastly, cases containing more

Table 1. *Cohort demographics. Consult-based data expressed as N, (%).*

Patient Characteristic	Total (N=357)	No referral (N=251)		Referral (N=106)		P value
		N	(%)	N	(%)	
Age						0.04
<65 year	115	89	(77.4)	26	(22.6)	
≥65 years	242	162	(66.9)	80	(33.1)	
Male Sex	331	233	(70.4)	98	(29.6)	0.90
Race						0.64
Caucasian	287	202	(70.4)	85	(29.6)	
Non-Caucasian	11	9	(81.8)	2	(18.2)	
Unknown	59	40	(67.8)	19	(32.2)	
History of skin cancer	64	41	(64.1)	23	(35.9)	0.23
Days to completion (median, IQR)		4	(2, 5)	4	(2, 5)	0.82§
Imager						0.45
1	113	75	(66.4)	38	(33.6)	
2	23	15	(65.2)	8	(34.8)	
3	39	30	(76.9)	9	(23.1)	
4	25	15	(60.0)	10	(40.0)	
5	18	13	(72.2)	5	(27.8)	
6	92	65	(70.7)	27	(29.3)	
7	47	38	(80.9)	9	(19.1)	
Telereader						0.72
1	104	75	(72.1)	29	(27.9)	
2	52	39	(75.0)	13	(25.0)	
3	89	62	(69.7)	27	(30.3)	
4	112	75	(67.0)	37	(33.0)	
Image quality						0.64#
Fully satisfactory	336	237	(70.5)	99	(29.5)	
Partially satisfactory	19	12	(63.2)	7	(36.8)	
Unsatisfactory	2	2	(100.0)	0		
Dermoscopy included	118	83	(70.3)	35	(29.7)	1.00
Image number, (median, IQR)						
Clinical		9	(6, 13)	7	(5, 12)	0.005§
Dermoscopic		0	(0, 2)	0	(0, 2)	0.53§
Problem number per consult						0.03
1	254	188	(74.0)	66	(26.0)	
2	82	52	(63.4)	30	(36.6)	
3	21	11	(52.4)	10	(47.6)	

*All P values calculated using chi-square test unless otherwise indicated.
#P-value calculated using Fisher's exact test.
§P-value calculated using Wilcoxon rank sum test.
Percentages are a fraction of No Referral versus Referral.
IQR, interquartile range

problems were also more likely to be referred for F2F care (P=0.03).

Table 2 demonstrates a relationship between referral status and problem-based consults. Problems localized to the head/neck region were more likely to receive a recommendation for referral (P=0.004). There was also a significant difference in referral rates based on diagnostic categories with problems classified as growths having an association with in-person referral (P<0.001). Since concern for

Table 2. *Anatomic location and diagnostic category by consult problem.*

Problem characteristic		Total (N=481)	No referral (N=325) N	(%)	Referral (N=156) N	(%)	P value*
Body location							0.004
	Head/neck	201	124	(38.2)	77	(49.4)	
	Trunk/limbs	226	155	(47.7)	71	(45.5)	
	Multiple	54	46	(14.2)	8	(5.1)	
Diagnosis category							<0.001
	Rash	162	144	(44.3)	18	(11.5)	
	Growth	319	181	(55.7)	138	(88.5)	
Diagnosis subcategory							<0.001
Rash	Inflammatory	133	119	(36.6)	14	(9.0)	
	Infectious	29	25	(7.7)	4	(2.6)	
Growth	Benign neoplasm	51	38	(11.7)	13	(8.3)	
	Benign melanocytic nevus	18	10	(3.1)	8	(5.1)	
	Seborrheic Keratosis	114	88	(27.1)	26	(16.7)	
	Actinic keratosis	61	44	(13.5)	17	(10.9)	
	Malignant neoplasm	75	1	(0.3)	74	(47.4)	

* P values calculated using Chi-square tests.

malignancy is an important consideration for both F2F referral and teledermoscopy use, we explored which teleconsultation variables might be associated with a growth/neoplastic diagnostic category. Older age (OR 1.68, 95% CI 1.09-2.59), skin cancer history (OR 2.51, 95% CI 1.38-4.56), and problem location on the head or neck (OR 2.09, 95% CI 1.42-3.09) were independently associated with growths on univariate analysis of which only the latter two retained this association on multivariable analysis (OR 2.12, 95% CI 1.14-3.93 for skin cancer history; and OR 2.06, 95% CI 1.38-3.07 for head/neck location).

Discussion

One benefit of teledermatology is reducing unnecessary F2F dermatology clinic visits [2,3]. By improving the accuracy and reliability of diagnosis, the dermatoscope can enhance the quality of care delivered through teledermatology and can potentially decrease the need for avoidable or additional dermatology encounters [10,11]. Although the dermatoscope can help teledermatologists recognize benign features to help rule out the need for closer inspection or biopsy, it can also uncover concerning features that need further investigation. This is most true in the evaluation of both pigmented and non-pigmented skin neoplasms for which the dermatoscope increases diagnostic accuracy, specificity, and sensitivity [12-15]. However, since SAF teledermatology imagers typically do not have medical training allowing them to determine when dermoscopy can be useful, they typically either receive instructions from the referring PCP or have a policy in place that instructs them to use dermoscopy indiscriminately for all cases. In this study, we observed surprisingly that dermoscopic images did not impact teledermatologists' recommendations for F2F dermatology care.

We had expected that dermoscopy would reduce the number of F2F referrals as has been previously shown in teledermoscopy studies. In a skin cancer screening system, teleconsultations including dermoscopic imaging resulted in approximately half the number of F2F referrals when compared to those including only clinical images [6]. These results may reflect the narrower focus of using teledermatology for skin tumors as opposed to all skin conditions such as inflammatory diseases for which the dermatoscope's usefulness is still under investigation [16]. In a virtual clinic utilizing teledermoscopy, only 6% of patients needed

additional F2F appointments [17]. In this setting, however, cases referred to dermatology clinic by a PCP were then triaged by a dermatologist to receive either F2F or SAF care. This preliminary evaluation by a dermatologist likely reduced the number of complex teleconsultations seen through SAF teledermatology as these were probably referred to in-person care from the outset. A subsequent study in a similar clinic found a less stark difference, more consistent with our findings; approximately half the patients needed additional in-person visits [18]. In this scenario, all consults were originally referred to SAF care by PCPs similar to the process at SFVAHCS.

Despite the minimal impact dermoscopy effected on referrals, we still found valuable trends in its application. Close to 74% of problems concerning for malignancy referred to F2F dermatology were biopsied with those in the DTC group achieving a higher degree of concordance with histopathology (78.9% versus 58.6% in the CTC group), (**Figure 2**). These results agree with the literature which demonstrates high biopsy rates within referred consults [17,18] and high rates of biopsy-confirmed malignancy [19] with dermoscopy, suggesting that an important benefit of teledermatology is the effective triage for lesions when malignancy is a possibility.

We secondarily examined the influence of other variables on the decision for referral following teledermatology consultation. We found that referral rates were associated with decreased number of clinical images, increased problem number, lesion location on head and neck, and growth diagnostic category. Additionally, we uncovered a weak association between advanced patient age and referral rates (P=0.04). Further investigation is needed to clarify the nature of this association, which in our study may have been confounded by a greater proportion of older patients in our cohort.

When we searched for the variables associated with a growth diagnostic category, as these lesions would preferentially benefit from additional dermoscopic imaging compared to rashes, our multivariate analysis indicated that neoplasms were correlated with a past medical history of skin cancer and anatomic lesion location on either the head or neck.

As one of the primary reasons for referral is concern for malignancy where biopsy is warranted, we anticipated that predictors of skin cancer would influence F2F referrals. Malignant skin neoplasms often localize to the head or neck [20]. A history or recurrence of one these malignancies increase the risk for another [21,22]. Therefore, our findings regarding problem location and diagnostic category along with history of skin cancer are not surprising. Of these, only skin cancer history and problem location were shown to be associated with a neoplastic process in our multivariate analysis. Of note, recognizing diagnostic categories can still be challenging for trained dermatologists and may be even more difficult for imaging technicians and referring PCPs with limited dermoscopy training.

We also found that a larger number of problems were associated with F2F referral. With a greater number of problems comes a greater chance that at least one will need in-person evaluation. Although the number of clinical images was inversely associated with referrals, the absolute difference between the means is small (referred 7 versus non-referred 9) and highlights the need for high-quality clinical images, which are essential for accurate teledermatology diagnosis and recommendations [23]. Fewer images in the referral group could mean they were of sufficient quality for dermatologists to recognize the need for F2F evaluation. Alternatively, the number of images may have been insufficient to achieve diagnostic confidence, thus, warranting F2F referral. On the other hand, more images in the non-referral group may have increased dermatologists' confidence eliminating the need for F2F assessment.

To improve teledermoscopy application within teledermatology services, we recommend that PCPs restrict requests for dermoscopic imaging to patients who may have a skin growth (neoplasm) including those with history of skin cancer or who have problems located on either the head or neck. These recommendations still need future formal testing and revisions, but after validation may ultimately be useful if incorporated into an imaging algorithm to optimize clinical outcomes.

The generalizability of our results is limited given our study was conducted on teledermatology cases

between two particular VA facilities which, while likely similar to many teledermatology programs, may not be fully representative of all referral and reading sites within or outside of the VA. The retrospective and observational methods used only allow us to identify associations rather than causal relationships between our variables and outcomes of interest. Despite these obstacles, the evaluation of a real-life telehealth system offers insights for further system-based improvement, an indispensable and timely task during the ongoing COVID-19 pandemic. To address the dermatological needs of patients over the last two years, teledermatology services have undergone a dramatic shift and upscale nationwide including at the SFVAHCS [24,25]. Our work, which provides suggestions for the limited use of teledermoscopy, could interest healthcare leaders and teledermatology providers looking to study ways to increase the efficiency of the growing systems where they practice [26]. Ultimately, we believe a more intentional use of this imaging technique by non-dermatologists could result in higher-diagnostic yield teleconsultations and subsequent F2F visits leading to more efficacious teledermatological care while simultaneously reducing in-person exposures during the pandemic.

Conclusion

A more judicious and curtailed utilization of dermoscopic imaging may prevent unnecessary secondary F2F visits as well as minimize the burden of capturing and reviewing teledermatology cases.

Acknowledgements

Drs. Li Zhang and Iryna Lobach served as statistical consultants for initial methodologies and analysis and Dr. Nancy Hills assisted with final data analysis and interpretation. All statisticians mentioned herein form part of the UCSF (University of California, San Francisco) Clinical & Translational Science Institute. D.M. was supported by the Summer Explore Grant obtained through the UCSF Inquiry Funding Office.

Potential conflicts of interest

The authors declare no conflicts of interest.

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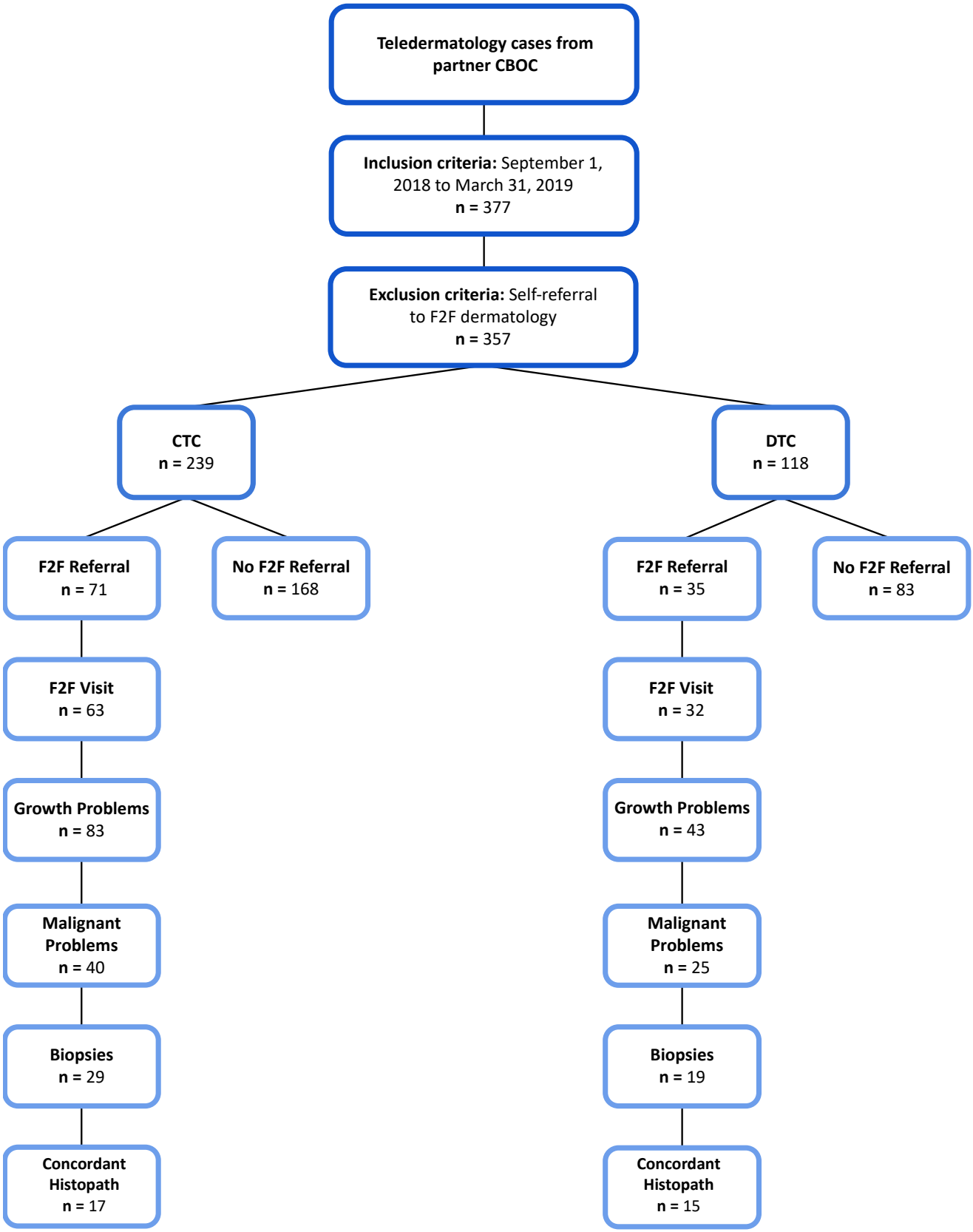
Figure 2. *Case-selection, distribution, and associated outcomes. Summary of charts analyzed during chart review subdivided by image type and showcasing proportion of completed in-person referrals for growths concerning for malignancy with concordant pathology.*



CBOC, community-based outpatient clinic; CTC, clinical teleconsultation; DTC, dermoscopic teleconsultation; F2F means face-to-face; Histopath, histopathology.