Dermatology Reports

https://www.pagepress.org/journals/index.php/dr/index

eISSN 2036-7406

Please cite this article as: Sarfaraz S, Turk T, Lowe SAJ, et al. Teledermatology: Canadian dermatologists' practice patterns, perceived challenges and future recommendations. *Dermatol Rep 2025 [Epub Ahead of Print] doi: 10.4081/dr.2025.10197*

Submitted 23/11/24 - Accepted 27/01/25

Teledermatology: Canadian dermatologists' practice patterns, perceived challenges and future recommendations

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Key words: teledermatology; dermatology; telemedicine; Canada; COVID.

Contributions: SS, TT, conceptualization of the study design, data collection, formal analysis, writing the original manuscript, and review and editing; SL: statistical analysis, writing the original manuscript, and review and editing; LV, conceptualization of the study design; MD, conceptualization of the study design, supervision of the study, revision, and editing of the manuscript. All the authors read and approved the final version of the manuscript and agreed to be accountable for all aspects of the work.

Conflict of interest: the authors declare that they have no competing interests, and all authors confirm accuracy.

Ethics approval and consent to participate: the study design was approved by the University of Alberta Research Ethics Board (Pro00115599). Additionally, participants were reminded that submitting survey answers implied consent.

Availability of data and materials: the datasets generated and/or analyzed during the current study are not publicly available due to confidentiality and data anonymization but are available upon reasonable request from the corresponding author.

Funding: this study was partially funded by a grant from Pfizer Incorporated and administered by the University of Alberta Research Services Office. The funding was allocated to support a research coordinator responsible for overseeing different aspects of a quality improvement project designed to enhance teledermatology practices in Alberta, Canada. The funding organization did not participate in the study design, data collection, data analysis, data interpretation, or any other aspects of conducting the study.

Abstract

The use of teledermatology has increased significantly in recent years. The objective of this study was to determine Canadian dermatologists' and dermatology residents' perspectives on teledermatology. An online survey was created to determine participants' teledermatology practice patterns and their perception of the challenges, education, training, and research in teledermatology. The survey was distributed through the Canadian Dermatology Association and by administrative staff at Canadian Dermatology departments. There were 33 respondents: 66.7% of respondents started using teledermatology during the COVID-19 pandemic, and 93.8% reported that teledermatology accounted for 0-25% of their practice. Convenience, access, and safety were identified as the primary advantages of teledermatology. Teledermatology was mainly utilized for medication monitoring or refills and to assess, manage, or follow up on dermatitis, other chronic inflammatory conditions, and pre-diagnosed dermatologic conditions. Poor photo quality (32.3%) and the inability to conduct physical examinations or accurately diagnose conditions (74.2%) were reported as significant challenges. Respondents recommended education on the medicolegal considerations of teledermatology and research on how teledermatology compares to in-person consultations. Overall, teledermatology offers convenience, access, and improved safety for patients and healthcare professionals. However, addressing challenges related to physical examinations, accurate diagnoses, and photo quality is essential for optimal care delivery.

Introduction

The term teledermatology was coined in 1995 to refer to the provision of dermatologic care through technology.[1] Teledermatology modalities include store-and-forward, live videoconferencing, telephone-based interviewing, and hybrid. Store-and-forward is the most utilized modality and involves patients or primary care physicians forwarding images for a dermatologist to assess and respond to asynchronously.[2–4] Live videoconferencing involves real-time, direct interactions with patients or referring physicians through a webcam or phone camera.[2,5] These modalities are incorporated into several types of practice models, including consultative, triage, direct care, and follow-up.[6,7] Consultative models allow for collaboration between dermatologists and the referring physician, whereby dermatologists assess patients and suggest management options. In the triage model, dermatologists assess severity and determine the need for an in-person evaluation. In the direct model, dermatologists interact directly with patients and

assume clinical responsibility.[7] Software platforms for teledermatology also vary widely and may differ with the provincial and/or local healthcare system.[8]

Teledermatology utilization increased significantly during the COVID-19 pandemic as governments mandated lockdown measures and non-urgent outpatient clinics shut down.[9–11] Reimbursement for teledermatology services, traditionally a barrier to teledermatology, also improved during the pandemic.[2,12] Teledermatology may improve efficiency of triaging and lead to shorter wait times for in-person assessments, with one study showing a 78% reduction in wait times.[11,13] Improved dermatologist, referring physician, and patient satisfaction, as well as improved patient access, have also been reported.[14] While research is ongoing, teledermatology appears to be overall cost-effective, particularly for patients who would otherwise need to travel long distances for appointments or whose dermatologic conditions can be managed by primary care physicians.[15,16]

Teledermatology may be particularly effective for managing common and chronic conditions such as atopic dermatitis (AD), psoriasis, and acne.[2] AD is a chronic inflammatory condition and has the highest disability-adjusted life years amongst skin conditions.[17] Continuity of care is crucial for patients with AD, given its chronic nature. Teledermatology allows for remote monitoring of AD, prevention of disease exacerbations, prompt management of any complication, and empowers patients to self-manage when appropriate.[18,19] Teledermatology can also improve collaboration with primary care physicians, who can manage most AD cases.[20]

While many advantages of teledermatology have been reported, there is a lack of evidence-based, gold-standard guidelines for assessment and management through teledermatology, particularly for chronic dermatologic conditions. The aim of the present study was to conduct a survey of Canadian dermatologists and dermatology resident physicians with the goal of understanding the current practice patterns, advantages, and challenges of teledermatology, including for AD.

Materials and Methods

Survey design and distribution

The survey questions were developed based on a literature review on teledermatology, both generally as well as focusing on AD.[2,11,14,18,21–23] Questions were asked on the participants' general characteristics and practice patterns, as well as their thoughts and opinions regarding the challenges of teledermatology, including education and training. We also asked questions

pertaining to the participants' attitudes toward research and their suggestions for improvement. Additionally, opportunities to ask open-ended questions and make comments were provided at the end of the survey. The survey consisted of a total of 42 questions. Answer formats varied and included yes/no, multiple choice, Likert scale, and short answers. Summation scores were generated for positive perceptions (10-item, α=0.92) and perceived challenges (8-items, α=0.82), with higher scores indicating higher perceived benefits and challenges of teledermatology, respectively. The study design was approved by the University of Alberta Research Ethics Board (Pro00115599).

The survey was created using Google Forms and distributed in English and French. French translation was completed by a professional medical translator. Informed consent was explained. The survey functionality was tested by the research team and subsequently distributed by e-mail to dermatology residents and practicing dermatologists across Canada through the Canadian Dermatology Association member communication emails. Dermatology department administrators at academic institutions across Canada were also contacted to help distribute the survey to their respective residents and staff dermatologists. The survey was open to participants from September 2022 until December 2022. Prior to survey initiation, participants were reminded that submission of the survey implied their consent. Identifying information was not collected. There were no financial incentives for participants to complete the survey. All questions were voluntary.

Statistical analysis

Participant responses were collected and imported automatically to a password-protected Google sheet restricted to the researchers. Descriptive statistics consisted of counts and percentages out of the total number of responses for each question. Medians were also calculated for Likert scale answers. Thematic analysis was conducted for answers to open-ended questions. To determine whether outcomes related to teledermatology use (use versus do not use teledermatology), training (have versus have not received teledermatology training), attitudes (very or highly comfortable, satisfied, and confident using teledermatology), positive perceptions (10-item summation score), and perceived challenges (8-item summation score) varied by participants' characteristics, bivariate associations were tested using Mann-Whitney U test (physician age, years of practice)

and Fisher's exact test (physician gender, title, practice type, and practice location). All descriptive statistics were run using STATA (v16.1), and all bivariate models were two-sided ($p \leq 0.05$).

Results

Participants

Twenty-nine respondents completed the English version of the survey, and four completed the French version, totaling 33 responses (Table 1). 56.3% of respondents were female and 43.8% were male. The majority (66.7%) were 26-49 years old and were staff physicians (66.7%) who had been practicing for 0-4 years (43.8%) in an urban practice (84.6%). The majority of respondents practiced in Central Canada (Quebec, Ontario; 30.3%) and the Prairies (Manitoba, Saskatchewan, Alberta; 42.4%).

Teledermatology practice patterns

Most respondents started using teledermatology during the COVID-19 pandemic (66.7%). 93.8% of respondents reported that teledermatology constituted 0-25% of their practice. Reported advantages of teledermatology during COVID-19 were convenience, access, and safety (Table 2). Most respondents were comfortable using teledermatology. Teledermatology was primarily used for medication monitoring or refills and to assess, manage, or follow dermatitis, chronic inflammatory conditions, or other pre-diagnosed dermatologic conditions. 16.7% of respondents reported that they do not use teledermatology for any conditions. Respondents thought that store-and-forward was the most efficient interaction model (42.4%). 71.9% of respondents interacted directly with their patients. Most respondents (51.9%) used designated platforms (*e.g.*, Zoom™ [San Jose, California] or ConsultDERM™ [Edmonton, Alberta]) to deliver teledermatological care. 50% of respondents were somewhat satisfied, and 26.7% were fairly satisfied with the technological platform they used. 51.2% of respondents reported they were somewhat satisfied with the clinical outcomes of their teledermatology practice.

81.8% of respondents agreed or strongly agreed that teledermatology can increase healthcare access, and 75.8% agreed or strongly agreed teledermatology can increase health equity. 30.3% of respondents neither agreed nor disagreed that teledermatology can lower healthcare costs, and 36.4% agreed or strongly agreed that teledermatology enhances efficiency of care. 39.4% of respondents said they agreed or strongly agreed with the statement "teledermatology can reduce

waiting times." 57.6% of respondents agreed or strongly agreed about the potential to enhance infection control with teledermatology.

With regards to AD, most respondents said they were satisfied with the outcomes of their AD patients (16.1% very satisfied, 19.4% fairly satisfied, and 41.9% somewhat satisfied). 83.9% of respondents provided follow-up care to their AD patients, 64.5% provided prescription refills, 58.1% provided patient education, 51.6% diagnosed AD patients, and 41.9% provided first-visit management (Table 2). Teledermatology was also used to determine patient scoring (*e.g.*, Eczema Area and Severity Index [EASI], etc.) and provide patient and family education.

Teledermatology challenges

Respondents reported the inability to do physical examinations and/or potential for misdiagnosis (74.2%), as well as poor photo quality, to be the biggest challenges of teledermatology (32.3%) (Table 3). Common themes regarding challenges of teledermatology specific to the COVID-19 pandemic included technological barriers (31.3%) and inability to do procedures or follow-up (18.8%). 60.6% of respondents disagreed or were neutral about whether teledermatology can delay access to in-person care. 51.5% of respondents agreed or strongly agreed that teledermatology can increase the risk of confidentiality breaches. 93.9% of respondents agreed or strongly agreed that teledermatology can limit diagnostic accuracy, and 97% agreed or strongly agreed it can limit physical exams. 84.9% of respondents agreed or strongly agreed that teledermatology can impose technological barriers for patients and clinicians, and 65.6% agreed or strongly agreed teledermatology offers lower physician compensation compared to in-person.

Education and training

There was no clear trend on whether respondents thought teledermatology requires specific training. Most respondents did not receive any teledermatology training (53.1%). Most of those (48%) who received training reported that training in residency or through continuing medical education (CME), continuing professional development (CPD), or conferences would all be best. 21.2% of respondents said they would be willing to attend CME or CPD training on teledermatology. Preferred training modalities included workshops, seminars, or conferences. Suggested topics for further training included efficiency, medicolegal considerations, and approaching the physical examination (Table 4). Approximately equivalent numbers of

respondents described teledermatology training during residency as poor (30.3%) and adequate (36.4%), and 33.3% were not sure. Additionally, 78.8% of respondents were not aware of any patient teledermatology education resources.

Research and future development

Most respondents (60.6%) did not know how to describe research in teledermatology. Recommended areas for research included comparison to in-person appointments, as well as patient outcomes and diagnostic accuracy (Table 5). Suggested improvements to teledermatology in the short term centered on accessibility (29.4%) or restricting usage (29.4%; *e.g.*, to specific conditions or for follow-ups only, or not using teledermatology at all). 22.2% of respondents did not know what to suggest for long-term improvements, while others suggested creating standardized platforms and guidelines (22.2%) and providing instructions/education for patients and referring physicians (16.7%). With regard to technological barriers, most respondents suggested enhancing accessibility and usability, especially for patients (50%).

Bivariate associations

The bivariate association between participant characteristics and teledermatology use, training, attitudes, perceptions, and challenges is presented in Table 6. While the majority of outcomes did not vary by physician characteristic, a significantly higher proportion of staff physicians had received training in teledermatology compared to residents (55.0% *vs.* 0.0%, p=0.010). Additionally, the mean age was significantly lower for those who reported being highly confident in using teledermatology for diagnosis and managing their patients compared to those who were less or not confident (40.5 years vs. 50.9 years, p=0.032).

Discussion and Conclusions

This study adds to the literature regarding teledermatology in Canada and indicates that most Canadian dermatologists and dermatology trainees use teledermatology as part of their practice. Most respondents started using teledermatology during the COVID-19 pandemic, a trend that was also observed globally.[24] For instance, 14.1% of dermatologists in the United States used teledermatology before the pandemic, increasing to 96.9% during the pandemic.[25] Convenience, access, and safety were common advantages reported by respondents in our study.

Teledermatology reduced in-person appointments during COVID-19 lockdown measures,[26,27] thereby reducing infection transmission. Common conditions to assess with teledermatology include acne, AD, psoriasis, and COVID-19-related manifestations.[27,28] Challenges identified by our survey respondents included misdiagnosis, lack of physical exams, and poor photo quality. While reimbursement was traditionally a major barrier to teledermatology,[14] this improved with COVID-19 measures and may need to be revisited post-pandemic. Other challenges were similar to what has been reported elsewhere and include technological barriers, inability to do physical exams and/or procedures and/or follow-ups, and security.[2,21] Some challenges are inherent to teledermatology, while others can be addressed by improving teledermatology platforms, enhancing network connectivity, and selecting suitable dermatologic conditions for diagnosis and management through this medium.[2]

Our study results suggest that teledermatology can be used to approach common, stable skin conditions (*e.g.*, dermatitis, acne, psoriasis, rosacea) and to provide follow-up care for other preestablished diagnoses. Several studies have supported the efficacy and utility of teledermatology in acne management,[2,29] and found high rates of patient satisfaction.[30] Additionally, teledermatology can be used to manage psoriasis, particularly for stable patients, and to make medication changes.[18] Indeed, a randomized clinical trial (RCT) for patients with new or previously diagnosed psoriasis found equivalent improvements in disease severity amongst patients treated through teledermatology compared to in-person care.[31] Patients in both groups also had similar treatments, treatment changes, and adverse events.[31] Acne and stable psoriasis can, therefore, be well-managed through teledermatology.

Most of our respondents were satisfied with the clinical outcomes for their patients with AD. 83.9% and 58.1% of respondents in our survey said they provide follow-up care and patient education, respectively, to their AD patients. A Brazilian study reported that both diagnosis and management of AD are efficient when done through teledermatology, particularly for adults and adolescents.[20] While statistical significance was not reported, the authors reported that teledermatology reduced wait times for in-person appointments for AD patients by 78%, and that 72% of the patients assessed through teledermatology could be managed appropriately through primary care.[20] Further, teledermatology appears to be associated with good clinical outcomes for AD patients, with one RCT finding similar improvements in AD severity between patients who received online *versus* in-person follow-up care.[23] Teledermatology may also be helpful in

educating AD patients about behavioral changes, which have been shown to improve symptoms and disease severity.[32] Overall, AD can generally be diagnosed and managed through teledermatology, particularly in cases that are less severe.[2,33]

Training and education in teledermatology are currently not standardized for trainees or staff dermatologists. In a 2011 study, 71% of dermatologists in the United States did not receive training prior to starting teledermatology,[14] whereas in the present study, approximately half of the respondents did not receive any training. This may have been due to the rapid implementation of teledermatology necessitated by the COVID-19 pandemic, as reported by some of our respondents. Even so, 45.5% of our respondents did not think teledermatology requires any specific training. While most respondents (48%) thought that residency training, CME/CPD, and conferences would all provide good teledermatology training, 39.4% said they would not be willing to attend CME or CPD training. At one Canadian academic institution, 62% of staff dermatologists and 91% of dermatology residents felt that teledermatology should be a part of residency training.[34] Our study highlights that efficiency, medicolegal considerations, and physical examination approaches could be additional areas to address in teledermatology training. Many of our respondents were also not aware of the research in teledermatology, and thus exposure to and discussion of teledermatology research may enhance understanding of evidence-based teledermatology practices. Addressing these gaps in teledermatology training and education will be important long-term, as many staff and trainee dermatologists expect to continue providing teledermatological care after the COVID-19 pandemic.[25,34]

Educating referring physicians and/or patients to take high-quality images and navigate teledermatology platforms would enhance the teledermatology experience for both providers and patients.[2,35] In one study, training primary care providers (PCPs) on common skin conditions and image acquisition led to more appropriate dermatology referrals and improved the quality of images attached to referrals.[36] PCPs who were interviewed about their teledermatology experiences reported enhanced access to specialist care and reduced provider stress regarding patient diagnoses. However, other PCPs reported that conventional referrals would have been more efficient than teledermatology.[37] PCPs may also spend more time on teledermatology referrals due to technological factors.[38]

Security and privacy are also relevant factors to consider in the delivery of teledermatology. Clinical advice is increasingly being provided on instant messaging (IM) apps, such as WhatsApp,

due to ease of use, rapid response time, and low cost.[39] Interestingly, 52% of the physicians in the same study did not think of IM as telemedicine, only 19% reported that they knew about ethical guidelines regarding telemedicine, and 43% of participants did not answer the question regarding confirmation of patient consent.[39] The Canadian Medical Protective Association states that privacy legislation extends to text messaging.[40] It is recommended that physicians document clinical advice given through IM in the patient's medical record.[40] Further, the Canadian Medical Association recommends that informed consent also be obtained, either implied or expressed.[41]

To our knowledge, this is the first study to gather the perspectives of Canadian dermatology staff and residents regarding teledermatology practice patterns, challenges, and future steps. However, there are some limitations to this study. The survey was voluntary, and while it was disseminated nationally, there were 33 respondents. Therefore, the study may not accurately represent the perspectives of Canadian dermatology staff or residents. The small sample size also limited the statistical power of our models, which were limited to exploratory non-parametric bivariate methods. Additionally, given that participants were able to answer whichever questions they wished to, some questions had a small number of respondents and thus cannot be used to draw concrete conclusions. Future studies can build on the results of our survey to enhance the teledermatology experience for patients, dermatologists, and dermatology residents.

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Table 1. Demographics and practice patterns of survey respondents.

Characteristic	N (%)
Gender	
Female	18 (56.3)
Male	14 (43.8)
Other	0
Prefer not to say	0
Age (Mean: 44.2, SD: 14.30)	
26-49	20 (66.7)
50-69	8 (26.7)
70-91	2 (6.7)
Title	
Resident	9 (27.3)
Fellow	1 (3.0)
Staff Physician	22 (66.7)
Years of Practice (Mean: 12.8, SD: 14.4)	
0-4	14 (43.8)
5-24	11 (34.4)
25+	7 (21.9)
Type of Practice	
Private – Solo	6 (18.2)
Private – Group	10 (30.3)
Hospital-based	6 (18.2)
University-based	15 (45.5)
Community Health Center	1 (3.0)
Location of Practice	
Urban	28 (84.6)
Rural	2 (6.06)
Suburban	3 (9.09)
Region of Practice	
Atlantic - Newfoundland and Labrador, Prince Edward Island, Nova Scotia, New Brunswick	7 (21.2)
Central - Quebec, Ontario	10 (30.3)
Prairies- Manitoba, Saskatchewan, Alberta	14 (42.4)
West Coast- British Columbia	2 (6.1)
Northern Territories- Nunavut, Northwest Territories, Yukon	0 (0)

N = the number of responses for each answer. Percentages were calculated for each question based on the total number of responses.

Table 2. Teledermatology practice patterns of Canadian dermatologists and dermatology resident survey respondents.

Survey Areas	N (%)
Do you use teledermatology as part of your practice?	
Yes, I have always used it, even before the COVID19 pandemic	4 (12.1)
Yes, I have started using it during the COVID19 pandemic	22 (66.7)
No	7 (21.2)
Were there any advantages of teledermatological services specific to the COVID19 pandemic?	
Convenience/access	57.1
Safety	46.4
Other	7.1
How long have you been practising teledermatology for?	
0-5 years	27 (81.8)
5-10 years	1 (3.0)
10-20 years	3 (9.1)
20+ years	2 (6.1)
How comfortable are you with using teledermatological models including videoconferencing and store-and-forward teledermatology? Store-and-forward teledermatology involves receiving text and images for review, whereas videoconference involves real-time video interactions with patients.	
Very Comfortable	8 (24.2)
Fairly Comfortable	13 (39.4)
Somewhat Comfortable	9 (27.3)
Not Comfortable	2 (6.1)
Not Comfortable at all	1 (3.0)
How much do teledermatological consultations constitute of your practice?	
100%	1 (3.1)
75%-100%	0 (0)
50-75%	0 (0)
25-50%	1 (3.1)
0-25%	30 (93.8)
What are the conditions that you feel can be approached with confidence using teledermatological services?	
Medication monitoring/refill	3 (10.0)
Dermatitis (atopic, seborrheic)	12 (40.0)

Chronic inflammatory conditions (acne, rosacea, psoriasis)	19 (63.3)
Follow-up only for already-established diagnoses	11 (36.7)
Other	2 (6.7)
What conditions do you regularly assess, manage, and follow using teledermatological services?	
Medication monitoring/ refill	5 (16.7)
Dermatitis (atopic, seborrheic)	9 (30.0)
Chronic inflammatory conditions (acne, rosacea, psoriasis)	18 (60.0)
Follow-up only for already-established diagnoses	4 (13.3)
None	5 (16.7)
Other	8 (26.7)
Which teledermatological interaction model do you think is the most efficient?	
Video conferencing	2 (6.1)
Photos storage (store and forward)	14 (42.4)
Hybrid – video conferencing and photo storage	8 (24.2)
Phone calls	5 (15.2)
Other	4 (12.1)
Which teledermatological interaction model do you prefer? Select all options that apply.	
Dermatologist-Referring physician	12 (37.5)
Dermatologist-Patient directly	11 (34.4)
It depends on the case	13 (40.6)
Other	1 (3.1)
Which teledermatological interaction model do you use? Select all options that apply.	
Dermatologist-referring physician	7 (21.9)
Dermatologist to patient directly	23 (71.9)
It depends on the case	4 (12.5)
Other	3 (9.4)
How much do you agree with the following statement: "I plan to use or keep using teledermatology in the future"?	
100%	6 (18.2)
75%-100%	2 (6.1)
50-75%	5 (15.2)
25-50%	3 (9.1)
0-25%	17 (51.5)
How satisfied are you with the clinical outcomes of your teledermatology practice?	

Very Satisfied	6 (19.4)
Fairly Satisfied	3 (9.7)
Somewhat Satisfied	16 (51.2)
Not Satisfied	4 (12.9)
Not Satisfied at all	2 (6.5)
How satisfied are you with the clinical outcomes for patients with atopic dermatitis in your teledermatology practice?	
Very Satisfied	5 (16.1)
Fairly Satisfied	6 (19.4)
Somewhat Satisfied	13 (41.9)
Not Satisfied	7 (22.6)
Not Satisfied at all	0 (0)
What kind of care do you provide for patients with atopic dermatitis in your teledermatology practice? Select all options that apply.	
Diagnosis	16 (51.6)
First visit management	13 (41.9)
Follow-up	26 (83.9)
Prescription refills	20 (64.5)
Patient scoring (EASI, DLQI)	6 (19.4)
Patient education	18 (58.1)
Family education	10 (32.3)
Other, please specify	1 (3.2)
How confident are you with diagnosing and managing patients with atopic dermatitis through teledermatology?	
Very confident	7 (21.9)
Fairly confident	11 (34.4)
Somewhat confident	8 (25.0)
Not confident	5 (15.6)
Not confident at all	1 (3.1)
What teledermatological platform(s) do you use for your teledermatology practice?	
EMR	1 (3.7)
Designated platform i.e., Zoom™, ConsultDERM™, Ontario Telemedicine Network™, Medeo™, Provincial Virtual Care Platform	14 (51.9)
Telephone	10 (37.0)
Telephone and photo	5 (18.5)

Secure email	3 (11.1)
None	4 (14.8)
Other	1 (3.7)
How satisfied are you with the technological platform you use(d) for your teledermatology practice?	
Very Satisfied	3 (10.0)
Fairly Satisfied	8 (26.7)
Somewhat Satisfied	15 (50.0)
Not Satisfied	4 (13.3)
Not Satisfied at all	0 (0)
How satisfied are you with the cost of your teledermatology platform?	
Very Satisfied	6 (25.0)
Fairly Satisfied	10 (41.7)
Somewhat Satisfied	5 (20.8)
Not Satisfied	3 (12.5)
Not Satisfied at all	0 (0)

N = the number of responses for each answer. Percentages were calculated for each question based on the total number of responses.

Table 3. Respondents' opinions and ideas regarding challenges associated with teledermatology.

Survey Areas	**N (%)**
What are the challenges of managing patients using teledermatological services?	
Physical exam/misdiagnosis (limited physical exam, inability to do full exam, body language)	23 (74.2)
Poor efficiency (longer appointment times, need for an in-person follow-up appointment after initial)	6 (19.4)
Poor photo quality	10 (32.3)
Inability to do procedures/ have follow-up	4 (12.9)
Remuneration	1 (3.2)
Technological barriers (connection troubles, patient technological skills, access to devices)	5 (16.1)
Security	1 (3.2)
Other	9 (29.0)
Were there any challenges of teledermatological services specific to the COVID19 pandemic?	
Difficult/ delayed diagnoses	2 (12.5)
Inability to do procedures/ have follow-up	3 (18.8)

Rapid implementation/ Poor platform usability	2 (12.5)
Technological barriers	5 (31.3)
Remuneration	1 (6.3)
Other	3 (18.8)

N = the number of responses for each answer. Percentages were calculated for each question based on the total number of responses.

Table 4. Respondents' opinions and ideas regarding education and training in teledermatology.

Survey Areas	N (%)
Do you think practicing teledermatology requires specific training?	
Yes	18 (54.6)
No	15 (45.5)
Did you receive any teledermatology training prior to starting teledermatological practice? Select all options that apply.	
Yes	3 (9.4)
Yes- during residency	7 (21.9)
Yes- during practice	2 (6.3)
Yes- informally from colleague	5 (15.6)
Yes- from the teledermatology platform company	3 (9.4)
No	17 (53.1)
If yes, what type of training do you think is best?	
Residency Training	3 (12.0)
Continuing Medical Education (CME) or Continuing Professional Development (CPD)	5 (20.0)
Conferences	2 (8.0)
All the above	12 (48.0)
Other, please specify	3 (12.0)
Are you interested in and willing to attend CME (Continuing Medical Education) or CPD (Continuing Professional Development) training on teledermatology?	
Yes, willing to attend	7 (21.2)
Maybe	14 (42.4)
No	13 (39.3)
If yes, is there a specific training modality that you prefer (i.e., seminar, workshop, conference, etc.)?	
Workshop or seminar	12 (75.0)
Conference	3 (18.8)
Other	2 (12.5)
Are there any specific topics that you would want the training to focus on?	
Efficiency	4 (33.3)
Medicolegal considerations	5 (41.7)
Physical examination	2 (16.7)
Other	5 (41.7)
Are you aware of any patient education resources for teledermatology?	
Yes	7 (21.2)

No	26 (78.8)
How would you describe the adequacy of teledermatology management training during residency?	
Poor	10 (30.3)
Adequate	12 (36.4)
Too much	0 (0)
Not sure	11 (33.3)

N = the number of responses for each answer. Percentages were calculated for each question based on the total number of responses.

Table 5. Respondents' opinions and ideas regarding research and future directions for teledermatology.

Survey Area	N (%)
How would you describe research in teledermatology?	
Poor	9 (27.3)
Adequate	4 (12.1)
Too much	0 (0)
I do not know	20 (60.6)
Do you recommend any topics or areas for research regarding teledermatology?	
Outcomes	2 (18.2)
Comparison to in-person appointments	5 (45.5)
Diagnostic accuracy	2 (18.2)
Other	3 (27.3)
What would you change in the short-term to improve patient care using teledermatological services?	
Instructions to patients and referring physicians/practitioners	2 (11.8)
Remuneration	2 (11.8)
Accessibility/ Ease of use	5 (29.4)
Restrict usage/ Not use Teledermatology at all	5 (29.4)
Other	5 (29.4)
What would you change in the long-term to improve patient care using teledermatological services?	
Instructions/education for patients and referring physicians/practitioners	3 (16.7)
Remuneration	1 (5.6)
Standardized platform and guidelines	4 (22.2)
4. Ability to follow-up/ Restrict usage to follow-ups	1 (5.6)
5. Accessibility	2 (11.1)
6. I do not know	4 (22.2)
7. Other	3 (16.7)
How do you think technological barriers with teledermatology could be improved for clinicians and/or patients?	
Improve accessibility and ease of use for patients	8 (50.0)
Improve accessibility and ease of use for physicians	3 (18.8)
Improved training	3 (18.8)
I do not know	2 (12.5)
Other	5 (31.3)

N= the number of responses for each answer. Percentages were calculated for each question based on the total number of responses.

Table 6. Bivariate associations between physician characteristics and teledermatology indicators among Canadian dermatologists (N=33).

	Uses Teledermatology in Practice			**Received Training in Teledermatology**			**Highly Comfortable Using Teledermatology Models**		
Physician Characteristics	**% yes**	**% no**	**p-value***	**% yes**	**% no**	**p-value**	**% yes**	**% no**	**p-value**
Age mean years (SD)	44.1 (14.8)	45.0 (18.9)	0.96	46.1 (16.8)	44.2 (14.2)	0.80	46.2 (16.9)	40.8 (11.7)	0.50
Years Practicing Medicine mean years (SD)	13.3 (15.6)	11.4 (14.4)	0.69	12.7 (15.9)	14.0 (15.3)	1.00	14.8 (16.5)	9.2 (11.9)	0.33
Gender Female (n=15) Male (n=13)	 86.7% 76.9%	 13.3% 23.1%	 0.64	 42.9% 38.5%	 57.1% 61.5%	 1.00	 73.3% 61.5%	 26.7% 38.5%	 0.69
Title Resident (n=9) Staff Physician (n=20)	 77.8% 85.0%	 22.2% 15.0%	 0.63	 **0.0%** **55.0%**	 **100.0%** **45.0%**	 **0.010**	 44.4% 75.0%	 55.6% 25.0%	 0.21
Practice Type Private (n=14) Non-private (n=15)	 85.7% 80.0%	 14.3% 20.0%	 1.00	 57.1% 21.4%	 42.9% 78.6%	 0.12	 78.6% 53.3%	 21.4% 46.7%	 0.25

Practice Location Urban (n=25) Non-urban (n<5)	 80.0% 100.0%	 20.0% 0.0%	 1.00	 41.7% 25.0%	 58.3% 75.0%	 1.00	 60.0% 100.0%	 40.0% 0.0%	 0.27
Table 6 (Cont.)									
	Highly Satisfied with Clinical Outcomes of Teledermatology			**Highly Confident Using Teledermatology for Diagnosis and Patient Management**			**Score of Perceived Benefits of Teledermatology†**		
Physician Characteristics	**% yes**	**% no**	**p-value**	**% yes**	**% no**	**p-value**	**% high score**	**% low score**	**p-value**
Age mean years (SD)	47.6 (18.6)	44.6 (14.2)	0.81	**40.5 (16.5)**	**50.9 (11.8)**	**0.032**	44.7 (19.2)	44.0 (11.7)	0.57
Years Practicing Medicine mean years (SD)	18.4 (20.1)	12.0 (12.9)	0.67	11.8 (17.9)	15.9 (10.8)	0.11	11.1 (18.0)	14.7 (12.6)	0.061
Gender Female (n=15) Male (n=13)	 23.1% 38.5%	 76.9% 61.5%	 0.67	 42.9% 76.9%	 57.1% 23.1%	 0.12	 33.3% 61.5%	 66.7% 38.5%	 0.26

Title Resident (n=9) Staff Physician (n=20)	 12.5% 36.8%	 87.5% 63.2%	 0.36	 66.7% 52.6%	 33.3% 47.4%	 0.69	 66.7% 40.0%	 33.3% 60.0%	 0.25
Practice Type Private (n=14) Non-private (n=15)	 38.5% 21.4%	 61.5% 78.6%	 0.42	 53.9% 60.0%	 46.2% 40.0%	 1.00	 35.7% 60.0%	 64.3% 40.0%	 0.27
Practice Location Urban (n=25) Non-urban (n<5)	 26.1% 50.0%	 73.9% 50.0%	 0.56	 62.5% 25.0%	 37.5% 75.0%	 0.29	 48.0% 50.0%	 52.0% 50.0%	 1.00
Table 6 (Cont.)									
	Score of Perceived Challenges of Teledermatology‡								
Physician Characteristics	**% high score**	**% low score**	**p-value**						
Age mean years (SD)	 44.1 (13.9)	 44.5 (16.8)	 0.79						
Years Practicing Medicine mean years (SD)	 13.1 (13.5)	 12.9 (17.2)	 0.52						

Gender Female (n=15) Male (n=13)	 60.0% 38.5%	 40.0% 61.5%	 0.45						
Title Resident (n=9) Staff Physician (n=20)	 44.4% 50.0%	 55.6% 50.0%	 1.00						
Practice Type Private (n=14) Non-private (n=15)	 35.7% 60.0%	 64.3% 40.0%	 0.27						
Practice Location Urban (n=25) Non-urban (n<5)	 48.0% 50.0%	 52.0% 50.0%	 1.00						
Bold, statistical significance at p≤0.05; *p-value were generated using Mann-Whitney U tests for continuous physician characteristics and Fisher's exact tests for categorical physician characteristics; †10 item summative scale of the perceived benefits of teledermatology (α=0.92); ‡8 item summative scale of the perceived challenges of teledermatology (α=0.82).									