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Implementation and Impact of a Dermoscopy-Enabled Dermatology eConsult Application in Primary Care

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Abstract

Introduction/Objectives: Primary care providers (PCPs) can help fill gaps in access to dermatology care using eConsults to collaborate asynchronously with dermatologists. Many dermatology eConsult programs face challenges with image acquisition, image quality, lack of dermoscopy and complicated, time-consuming workflows that limit primary care acceptance.

Methods: This quality improvement study used the RE-AIM (Reach, Effectiveness, Adoption, Implementation, Maintenance) framework. We introduced a dermoscopy-enabled dermatology eConsult device and application (DermLoop) to PCPs at a statewide Federally Qualified Health Center (FQHC) and compared dermatology referrals during the 9-month periods pre-DermLoop versus post-DermLoop.

Results: Sixty-nine PCPs at 16 practice sites submitted 560 DermLoop eConsults for 526 unique patients. After being trained to use DermLoop PCPs (n = 65) submitted a higher proportion of dermatology referral requests as eConsults rather than face-to-face visit (28.6% vs 17.3%, $P < .001$, r = 0.39). Most DermLoop eConsults (79.8%) allowed patients to avoid a face-to-face visit. DermLoop provided improved image quality and resulted in high PCP-user satisfaction.

Conclusion: Broad adoption of DermLoop eConsults helped provide effective dermatology care to Medicaid-insured and uninsured patients who may otherwise have been unable to obtain care.

Keywords

access to care, underserved communities, health inequities, primary care, program evaluation, quality improvement, dermatology eConsults, dermoscopy, referral and consultation, interprofessional consultation

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Introduction

One in 4 people in the United States (U.S.) is impacted by a skin disease, with total direct costs to the healthcare system exceeding $75 billion.[1] Skin cancers accounted for 5.1% of new cancer cases in 2025[2] and an estimated 1 in 5 people in the U.S. will have skin cancer in their lifetime.[3] The dermatology specialty workforce (an estimated 12 120 practicing dermatologists in the U.S.; 3.7 per 100 000 population) is insufficient in number to meet the need for dermatologic care.[4] In addition, dermatologists are distributed unevenly across the country, with an influx of new dermatologists in areas that already have a high concentration, shortages in less dense areas, and dermatologists more likely to practice in high-income versus low-income and urban versus non-metropolitan or rural zip codes.[4-6] Patients with Medicaid insurance who seek dermatology care are significantly less likely than those with private insurance or Medicare to be able to obtain an appointment with a dermatologist, and wait twice as long to receive care.[7]

Primary care is often the first point of contact for both adult[8] and pediatric[9] patients with skin complaints, with

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some estimates suggesting that approximately two-thirds of dermatology complaints are treated by a healthcare provider other than a dermatologist.[10] Studies have found that between 12% and 37% of patients presenting to their primary care provider (PCP) had at least 1 skin problem.[11-13] However, primary care providers may not be well equipped to accurately diagnose and treat these issues. Training in dermatology is limited for most primary care providers,[14] and studies have shown that diagnoses made by a PCP were concordant with a dermatologist's diagnosis only 40% of the time.[15,16] In an effort to help address this gap, a 2022 consensus statement established standards for PCP education on use of dermoscopy (microscopy of the skin surface) to improve the diagnosis of benign and malignant skin growths.[17] Diagnostic algorithms have been developed[18] that allow non-dermatologists to accurately differentiate between benign and malignant skin lesions with higher sensitivity and specificity, enhanced by brief dermoscopy training.[19]

Algorithms and more robust dermatology education for PCPs may help address education gaps, but traditional educational interventions take years to improve skin lesion diagnostics.[20] Expanded access to dermatologic expertise is also needed to address current gaps in dermatology care. Asynchronous (store-and-forward) telehealth is a scalable tool that expands access to dermatology care, enhances patient satisfaction, and improves efficiency and cost-effectiveness.[21-23] Dermatology electronic consultations (eConsults) are a form of store-and-forward telehealth which enable users to exchange clinical information, transmit digital images, and receive diagnostic and treatment advice from a dermatologist. Literature on dermatology eConsults consistently shows that PCPs can address the majority of patients' complaints in primary care, potentially averting a costly specialist visit.[24,25]

Facing substantial barriers in access to dermatologic care, in 2014 we implemented an eConsult process in a large, multi-site Federally Qualified Health Center (FQHC) in Connecticut. The process utilized "point and shoot" cameras and hand-held dermatoscopes. Dermatoscopes provide high-resolution magnified views with and without polarized light to assist in the diagnosis of various skin conditions including malignancies. Results demonstrated substantial improvements including reduced need for face-to-face (F2F) visits and reduced wait times.[25] However, there were significant limitations including poor image quality and limited utilization by busy PCPs. Use of handheld dermatoscopes with cameras proved to be unwieldy and of limited diagnostic utility. Complex workflows for extracting images from the camera and uploading them to the eConsult were awkward and time-consuming. These challenges reduced utilization and limited specialists' ability to provide diagnoses and treatment recommendations to PCPs.

To address these limitations, we identified a new digital image acquisition tool that utilized a smart device, removable dermatoscope, and a built-in application (app) to streamline the eConsult submission process and improve image quality. We anticipated that enhanced ease of use and higher quality images with dermoscopy would expand PCPs' use of eConsults and would further reduce unnecessary F2F referrals. We utilized a structured implementation framework to capture context-specific results relevant to safety-net practices caring for the uninsured and underinsured.

Methods

Participants and Setting

Community Health Center, Inc. (CHC) is a statewide multi-site FQHC in Connecticut with over 110 000 unduplicated patients, a majority of whom are Medicaid-insured or uninsured. Between 2020 and 2024, its PCPs submitted an average of 3065 dermatology referrals annually. Although the estimated average wait time to see a dermatologist in Connecticut is 47 days,[26] PCPs and referral staff report that Medicaid-insured patients often wait 6 to 12 months for an appointment.

DermLoop (https://www.melatech.io/dermloop) is a mobile device and app for capturing high-quality overview and dermoscopic images of the skin and documenting clinical information to facilitate eConsults with a dermatologist. All PCPs at CHC's 13 primary care sites and 5 large school-based health center sites were offered in-person or virtual training on using DermLoop to submit dermatology eConsults, and a dermatology grand rounds training on differentiating between benign and potentially malignant conditions, which included dermoscopy techniques. Figure 1 shows example dermoscopic images of common conditions.

Approach

We utilized the RE-AIM framework[27] to guide planning, implementation, and evaluation of the new DermLoop tool. Our analysis compared dermatology referrals submitted "pre-DermLoop" (7/10/23-4/10/24) versus "post-DermLoop" (7/10/24-4/10/25). We operationalized each domain of RE-AIM as follows:

- Reach—How many practice sites, PCPs and unique patients were impacted?
- Effectiveness—Did DermLoop help patients avoid an unnecessary face-to-face dermatology visit? Did it help improve image quality?
- Adoption—After DermLoop was introduced, did PCPs send more dermatology referrals as eConsults rather than requesting a face-to-face dermatologist visit?

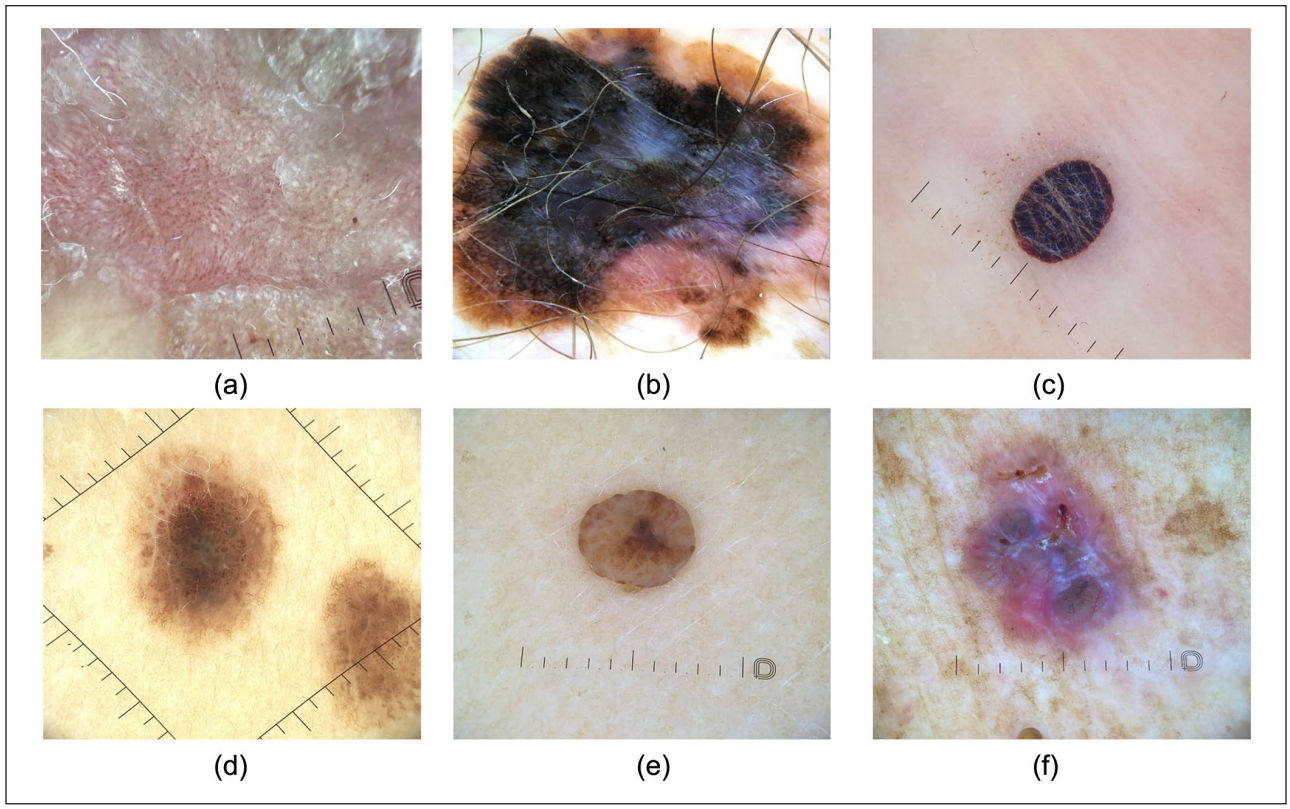

Figure 1. Dermoscopic images of common conditions: (a) dermoscopic image of psoriasis showing dotted vessels, pink background and scale, (b) dermoscopic image of melanoma showing an overall disorganized pattern with a blue-white veil, atypical pigment network, and shiny white structures, (c) dermoscopic image of subcorneal hemorrhage showing rust brown color and cracks in the stratum corneum aiding in differentiation from a melanoma, (d) dermoscopic image of a compound nevus with a mixed globular and reticular pattern, (e) dermoscopic image of an intradermal nevus with a globular pattern with central hyperpigmentation, and (f) dermoscopic image of a basal cell carcinoma with shiny white structures, arborizing vessels, and ulceration.

- Implementation—How was the process rolled out, delivered, and received by users?
- Maintenance—How satisfied were providers with DermLoop after having used it for at least 3 months? Did PCPs continue to utilize DermLoop at consistent rates after implementation?

The primary outcome for the project was the proportion of dermatology referrals submitted as eConsults versus face-to-face consultations. The Institutional Review Board at Community Health Center, Inc. determined that this quality improvement/quality assurance study was exempt from review (11/27/23) and granted approval for secondary analysis of existing data (Protocol #1235, 8/14/25). We followed SQUIRE 2.0 reporting guidelines.[28]

Measures

We obtained data on dermatology referrals and dermatology eConsult requests from CHC's electronic health record and its eConsult platform. An eConsult was considered to have prevented an unnecessary face-to-face visit if the dermatologist indicated that there was no need for a F2F referral or if they recommended further workup by the PCP. Dermatologists were required to choose 1 of 3 "close codes" (PCP management, F2F Visit, Additional workup recommended) in order to complete the eConsult. Dermatology reviewers assessed image quality by rating the images accompanying dermatology eConsults submitted "pre-DermLoop" and "post-DermLoop" on a 3-point Likert-scale ("Good," "Poor," or "Undiagnosable").

We assessed adoption by (1) measuring the number and percentage of PCPs who were trained and used DermLoop to submit at least 1 dermatology eConsult; and (2) for those PCPs who used DermLoop, comparing the proportion of their dermatology referrals submitted as eConsult "pre-DermLoop" (7/10/23-4/10/24) versus "post-DermLoop" (7/10/24-4/10/25). PCPs were excluded from the latter analysis if they had not submitted at least 1 dermatology referral during both periods.

We conducted surveys and obtained written, open-ended feedback from clinical leaders, early adopting "PCP

Champions," and from PCP users following their training. Clinical leaders were asked a set of structured questions to identify site-level barriers and facilitators to use of dermatology eConsults prior to the introduction of DermLoop. PCPs were asked to provide feedback and rate their confidence in ability to use DermLoop in clinical practice following their initial training on a Likert scale from "1—Not at All Confident" to "10—Very Confident." Two additional surveys were distributed to all PCP users to assess overall satisfaction.

Data Analysis

Quantitative data were analyzed in Microsoft Excel and R[29] using descriptive statistics. Differences in eConsult submissions by provider type (physician vs nurse practitioner or physician assistant/associate) were examined using a Mann-Whitney U test. The proportion of dermatology referrals submitted as eConsults pre-DermLoop versus post-DermLoop was compared using a Wilcoxon signed-rank test with alpha level ≤ 0.05 and Wilcoxon effect size calculation, with $r < 0.3$ considered small, .0.3 to 0.5 considered moderate, and $r > 0.5$ considered a large effect size. Qualitative response data were analyzed in Microsoft Excel using deductive thematic analysis.[30]

Results

Reach: During the 9 months following submission of the first DermLoop eConsult, 69 PCPs at 16 practice sites submitted 560 DermLoop eConsults (465 adult [83.0%] and 95 pediatric [17.0%]) on behalf of 526 unique patients. (Table 1). Each PCP submitted 8.1 DermLoop eConsults on average (range 1-30, median = 5.0, SD 7.2, IQR = 9.0). There was no statistically significant difference in number of eConsults submitted by physicians (n = 16, median = 4.5) versus nurse practitioners or physician assistants/associates who used DermLoop (n = 53, median = 6.0; $P = 0.22$). When including PCPs who were trained but did not submit any DermLoop eConsults, nurse practitioners or physician assistants/associates used more DermLoop eConsults after having been trained ($P = .04$).

Fifty-five percent of eConsults were submitted by the PCP with a non-specific diagnosis of rash or disorder of the skin, suggesting that in the majority of cases PCPs were uncertain as to the diagnosis.

Effectiveness: The majority of DermLoop eConsults (n = 447, 79.8%) recommended PCP management (n = 361; 64.5%) or additional workup by the PCP (n = 86; 15.3%) versus F2F referral to a dermatologist (n = 113, 20.2%).

Table 1. Characteristics of DermLoop eConsults (N = 560).

Characteristic	eConsults	
	n	%
Reason for eConsult		
Adult dermatology	465	83.0
Lesion	220	47.3
Rash	245	52.7
Pediatric dermatology	95	17.0
Lesion	24	25.3
Rash	71	74.7
Specialist's recommendation		
Face-to-face visit	113	20.2
PCP management	361	64.5
Additional workup by PCP	86	15.3
Recommendation by eConsult type		
Adult dermatology	465	83.0
Face-to-face visit	91	19.6
PCP management	301	64.7
Additional workup by PCP	73	15.7
Pediatric dermatology	95	17.0
Face-to-face visit	22	23.1
PCP management	60	63.2
Additional workup by PCP	13	13.7

There was a notable improvement in image quality. Among a sample of 50 cases submitted prior to implementing DermLoop, approximately 1/4 (n = 13, 26%) contained "Poor" (n = 11) or "Undiagnosable" (n = 2) images. By comparison, 558 (99.6%) of the cases submitted with DermLoop contained overview, close-up, and/or dermoscopy images that the eConsult dermatologist rated as "good."

Adoption: In total, 96 PCPs were trained to use DermLoop, which represents 88.9% of all PCPs employed at the 18 practice sites. Of these, 65 PCPs submitted at least 1 dermatology referral during both the "pre-DermLoop" and "post-DermLoop" periods. The number of eConsults submitted increased from 336 during the pre-DermLoop period to 556 after DermLoop was implemented. Additionally, the proportion of dermatology referrals submitted as an eConsult instead of a face-to-face consult increased from 17.3% pre-DermLoop (n = 336/1943) to 28.6% (556/1943) after a PCP was trained to use DermLoop ($P < .001$, r = 0.39).

Implementation: Feedback collected from clinical leaders (n = 12) about the eConsult process in use prior to DermLoop characterized submitting a dermatology eConsult as time-consuming, with multiple steps that reduced utilization, and few clinicians using dermoscopy. Long wait times for dermatology visits and lack of dermatologists accepting Medicaid-insured or uninsured

patients in the community were facilitators that encouraged PCPs to submit dermatology eConsults despite flaws in the process.

Following DermLoop training, PCP Champions (n = 14) rated their confidence in ability to use DermLoop as 9.3/10.0 (range: 5-10, SD: 1.3) and expressed high satisfaction with the DermLoop eConsult workflow relative to the prior process. They highlighted the intuitive workflow ("It seems much quicker and easier") and improved photo quality versus the prior process ("Much smoother, better photos, less hassle with upload"), and expressed confidence in the process ("I think it will give better information") and satisfaction with application to practice ("Significantly easier as taking pictures and adding them to the chart was very time-consuming") A PCP summarized their overall impression of the new process: "Much better than before. Previously, you'd have to find the camera. . . take 3 low quality images, take out the [memory] card or find a cable, plug it into the computer, load the images, then upload them to [the electronic health record]. Far too many steps. This is much, much easier."

Maintenance: Thirty-four (49.3%) of the 69 PCPs who had submitted an eConsult completed the post-implementation feedback survey. On average, each had submitted 9.2 eConsults before responding (Min: 1, Max: 28, SD: 7.6). Average likelihood to recommend DermLoop to a colleague (net promoter score) was 9.3/10.0. More than 3/4 of DermLoop users felt that it was much better for submitting eConsults than the prior process and agreed that it helped diagnose and treat more dermatologic problems, was easy to use, and made them more likely to submit dermatology eConsults. The majority of PCPs found all steps of the DermLoop workflow to be "very easy" or "easy," with the most difficult step involving the login process. (Table 2).

PCPs continued using DermLoop eConsults consistently throughout the implementation period, with monthly submission peaking at 100 eConsults in January 2025 and averaging 64.1 eConsults during each full month of implementation (Figure 2).

Discussion and Conclusions

Introducing an app-driven image acquisition tool with built-in dermoscopy led to increased reach, effectiveness, and adoption of dermatology eConsults in a large, multi-site safety-net practice. The new process increased the proportion of dermatology cases that could be managed in primary care and reduced the need for face-to-face dermatology visits for a population of patients whose access to in-person specialty care is extremely limited.

Rates of referral resolution for in-person dermatology care are extremely low for patients cared for in FQHCs. Our previous work demonstrated referral resolution rates of only 11% for in-person dermatology referrals.[25] Under the prior process, eConsult dermatologists were recommending F2F visits for cases which were ultimately benign and did not require biopsy, and many patients no-showed dermatologist appointments and were lost to follow-up. The need to expand the capability of FQHCs to make accurate diagnoses and provide treatment on-site and reduce reliance on F2F dermatology visits was the principal driver for this project.

The improvement we observed in image quality has important implications for clinical practice. Estimates from peer-reviewed literature indicate that between 5% and 20% of images included in teledermatology eConsults are low or poor quality,[31] limiting the efficacy of virtual consultation. Our finding that 25% of dermatology eConsults submitted prior to the present study contained low-quality images is consistent with these studies. The improvement to less than 1% low-quality after implementation not only expands the number of consults that can be effectively reviewed by an eConsult dermatologist, but should also increase PCPs' confidence in the process and willingness to use eConsults.

Improved access to dermatoscopes and dermoscopy training was an important element of this project. Although dermoscopy improves diagnostic accuracy and clinical outcomes,[32-34] primary care providers generally lack access to dermatoscopes and training on how to use them, and the majority report that they do not use them in their daily practice.[35] Skin cancer is the most commonly diagnosed cancer in the U.S.,[36] with demographic-based disparities in time to diagnosis and treatment contributing to more late-stage diagnoses, poorer clinical outcomes, and increased mortality. Dermatoscopes are particularly useful for evaluating potentially malignant skin lesions and likely expanded the ability of the reviewing dermatologist to rule out non-malignant lesions more readily and to better identify and triage lesions needing in-person assessment.

This program may, over time, help reduce disparities in skin cancer outcomes for Hispanic (~39% of patients served in FQHCs in 2023) and Black or African American (~21%) patients.[37] A review of care and outcome disparities for melanoma, the most lethal form of skin cancer, found that melanomas are detected at an earlier stage in non-Hispanic White patients, their mortality is lower, and their survival times are greater than their Hispanic and non-White counterparts.[38] Though skin cancer in darker skinned individuals is associated with higher morbidity and mortality and has a different clinical presentation and risk factors,[39] darker skinned individuals are underrepresented in clinical education and research,[40,41] and medical providers are less confident and competent diagnosing and treating their dermatologic conditions.[42] By improving

Table 2. Satisfaction With DermLoop among Primary Care Provider Users (N = 34).

Question	Average agreement (5.0 = strongly agree)	Agree or strongly agree # (%)
DermLoop is much better for submitting eConsults than the previous process	4.53	29 (85.3)
DermLoop helps me diagnose and treat more of my patients' dermatologic problems	4.34	27 (79.4)
DermLoop is easy to use	4.22	26 (76.5)
Having DermLoop available makes me more likely to submit dermatology eConsults	4.27	27 (79.4)
Question	**Average ease of use (1.0 = very easy)**	**Very easy or easy # (%)**
Setting up an account in DermLoop.us	1.91	25 (73.5)
Logging into DermLoop using the QR code	2.06	23 (67.6)
Using the built-in scanning technology to capture patient information from the electronic health record and begin entering a consult	1.44	30 (88.2)
Capturing photos without the dermatoscope attached	1.47	31 (91.2)
Capturing photos with the dermatoscope attached	1.76	28 (82.4)
Completing the clinical questions and submitting the consult in DermLoop	1.76	27 (79.4)
Submitting a consult request in the electronic health record	1.59	28 (82.4)
Finding the eConsult when it has been answered within the electronic health record	1.44	28 (82.4)
Storing and accessing the device	1.44	31 (91.2)
Charging the device	1.35	31 (91.2)

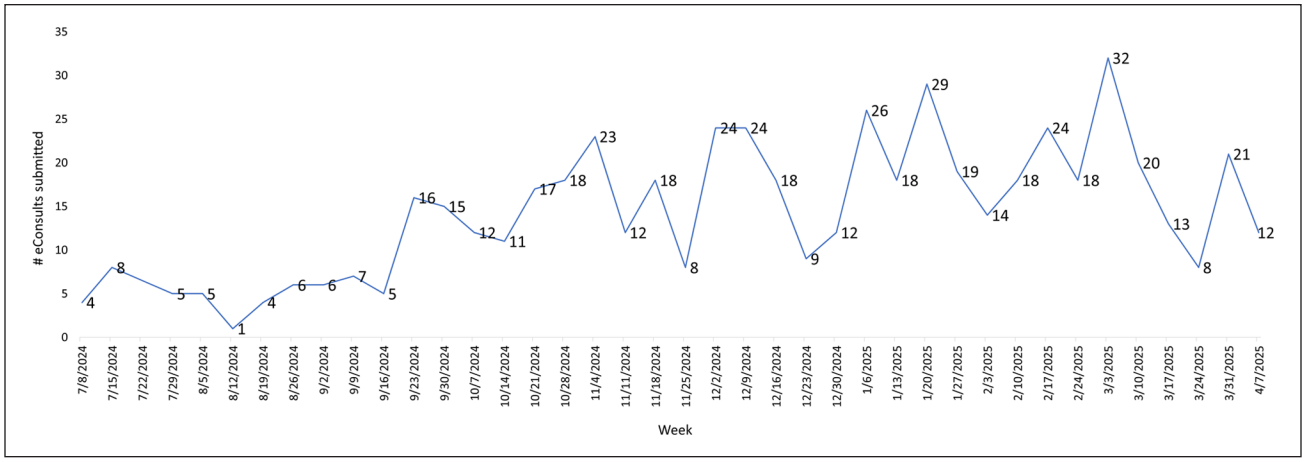

Figure 2. DermLoop eConsult submissions by week (N = 560).
July 2024 data reflect DermLoop eConsults submitted 7/10/24 to 7/31/24 and April 2025 data reflect DermLoop eConsults submitted 4/1/25 to 4/10/25.

access to dermatology assessments in a primary care practice serving a large number of Hispanic and Black/African American patients we are reducing inequality in dermatology outcomes.

Many teledermatology programs focus exclusively on assessment of skin lesions. However, as in our previous study,[25] clinicians in this study used eConsults for rashes (316/560; 56.4%) more than for lesions (244/560, 43.6%). The DermLoop platform supports capturing images and clinical information for rashes as well as lesions and allows for the inclusion of dermatoscopic images which can, in many cases, assist in their evaluation. This is important as studies show that primary care providers diagnose up to one-third of rashes incorrectly.[15]

A 2022 quality improvement study in the United Kingdom demonstrated that providing dermatologists with high-quality images of dermatologic conditions in combination with a telephone consultation facilitated exchange of diagnostic and treatment information, allowing 80% of patients presenting to a primary care clinic with a dermatologic complaint to be treated without referral for a face-to-face dermatology visit.[43] Although we observed an increase in use of eConsults after implementing the new process, the overall rate of use (~30% of

dermatology referrals) remains lower than anticipated and suggests the need for further efforts to increase adoption. While our study did not investigate reasons for non-use, previous efforts to increase eConsult use and other studies exploring this topic suggest that some PCPs perceive eConsults as being overly burdensome, adding additional tasks to an already busy schedule.[44,45] In addition, despite our efforts, a full 10% of clinicians did not receive training in the use of the new process. While DermLoop was found by most to be easy and intuitive to use, some providers with less confidence in using technology found the device challenging, particularly the login process. Further work will explore ways to address these challenges and further increase the use of this important tool.

Limitations

A 2025 systematic review of studies on referrals from primary care to specialty care emphasizes the importance of context when seeking to optimize the referral process.[46] Our study was conducted in a primary care practice where eConsults are used routinely by PCPs, and was intended to be context-specific. Our findings regarding adoption and acceptance may not be generalizable to practices that are new to the concept of eConsults. Likewise, primary care providers face barriers to delivering dermatology care including limited time, increased visit complexity, and limited training on skin exam, dermoscopy, biopsy, and diagnosis.[47] PCPs practicing in different settings may face different barriers to eConsult utilization specific to their unique setting. Both need and willingness to utilize dermatology eConsults may vary by PCPs' individual comfort diagnosing and treating dermatology conditions, using dermoscopy, and incorporating technology-enhanced diagnostic tools into their practice. We were unable to assess whether variations in PCPs' years in practice, age, and prior dermatology experience impacted their eConsult utilization. Although the response rate of 49.3% to the feedback survey was similar to rates reported in the literature,[48] our satisfaction findings may reflect selection bias toward PCPs who were motivated to respond, and do not represent the perspectives of PCPs who chose not to provide feedback.

Conclusions

Image acquisition tools with streamlined workflows and improved image quality offer a promising way to expand the use of eConsults to diagnose and treat dermatologic conditions in primary care, but more work is needed to improve uptake and utilization. With access to dermatology care unlikely to improve in the near future, particularly for medically underserved populations, programs such as this provide an effective means to expand access to care and reduce inequality in healthcare.

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Ethical Considerations

The Institutional Review Board at Community Health Center, Inc. determined that this quality improvement/quality assurance study was exempt from review (11/27/23) and granted approval for secondary analysis of existing data (Protocol #1235, 8/14/25).

Consent to Participate

Not applicable.

Consent for Publication

Not applicable.

Author Contributions

Lauren Bifulco, MPH: Data curation, formal analysis, investigation, methodology, writing – original draft.
Daren R. Anderson, MD: Conceptualization, investigation, methodology, resources, supervision, writing – original draft.
Niels Kvorning Ternov, MD: Investigation, methodology, resources, supervision, writing – review and editing.
Elizabeth V. Seiverling, MD: Investigation, methodology, supervision, writing – review and editing.

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Declaration of Conflicting Interests

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D.R.A. is the President and Founder of ConferMED, a non-profit specialty eConsult network, and the owner of ConferMED PC, a practice group responsible for delivering eConsults to its clients.
N.K.T. is the CEO and founder of MelaTech.
E.V.S. is a consultant for Melatech.

Data Availability Statement

Data are available from the corresponding author, D.R.A., upon reasonable request.

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