

## IN-DEPTH REVIEW

## A Comparative Outcomes Analysis: The Evolution and Growth of a Teledermatology Program to Accommodate High Patient Volumes

Leandra Doan, BS<sup>1</sup>, Marit Kreidel, MD<sup>2,3</sup>, Jeffrey Benabio, MD, MBA<sup>2,4</sup>, Gabriel Hernandez, BS<sup>5</sup>, Walt Engler, BS<sup>6</sup>, Linda Tolbert, MD, JD, EdD, MPH<sup>2,7</sup>

<sup>1</sup> Kaiser Permanente Bernard J. Tyson School of Medicine

<sup>2</sup> Department of Clinical Science, Kaiser Permanente Bernard J. Tyson School of Medicine

<sup>3</sup> Department of Dermatology, Orange County Medical Center, Southern California Permanente Medical Group

<sup>4</sup> Department of Dermatology, San Diego, CA, Southern California Permanente Medical Group

<sup>5</sup> Regional Virtual Medical Center Clinical Operations, Southern California Permanente Medical Group

<sup>6</sup> Strategy, Decision Support & Transformation, Kaiser Permanente Southern California

<sup>7</sup> Department of Dermatology, San Bernardino, CA, Southern California Permanente Medical Group

### ABSTRACT

**Background:** Most teledermatology studies include reviews of programs on a limited scale, whereas there are fewer reports on how to expand a program to accommodate high patient volumes.

**Objective:** To share our insights into the growth and maintenance of a teledermatology program that sees over 100,000 cases a year.

**Methods:** Retrospective review of a teledermatology program between 2015 and 2022. Outcomes were compared between the initial phase from 2015-2017 and the maturation phase from 2018-2022.

**Results:** In 2015, the teledermatology program was piloted in 3 hospital centers and expanded to 10 more centers by 2017. There was a total of 12,385 cases in 2015, which increased to 139,110 cases in 2022. Despite the dramatic increase in number of cases, our program adapted well: the initial phase of program development resulted in 69.2% of concerns being treated remotely, compared to 70.9% of submissions in the later years,  $p < 0.001$ .

**Limitations:** Overall generalizability as this study was performed in a large integrated health system.

**Discussion:** We maintain that the following can help scale a teledermatology program: 1. Communication with all interested parties; 2. Streamlined implementation of technological devices; 3. Training for dermatologists and primary providers; 4. Image guidelines to maintain photo quality.

### INTRODUCTION

Teledermatology refers to the use of technology when delivering remote dermatologic care. There are many models of teledermatology with asynchronous and

November 2023 Volume 7 Issue 6

synchronous options. Many teledermatology programs focus on the use of store-and-forward options, where a provider sends a clinical photo a patient's skin lesion(s) to a dermatologist.<sup>1</sup> In addition, teledermatology has expanded to include direct-to-consumer services, allowing patients to directly communicate with dermatologists in live interactive settings.<sup>2</sup> In many environments, teledermatology have been proven to be an effective means of providing reliable care and broadening access to care with high rates of patient satisfaction.<sup>3</sup>

The COVID-19 pandemic resulted in a huge shift in utilization of teledermatology, as 97% of US dermatologists reported participating in teledermatology workflows.<sup>4</sup> Since then, studies have found that teledermatology use will likely continue post-pandemic, as there is a general consensus that this modality helps increase access to care, reduces costs of transportation, and improves patient triage.<sup>4</sup> Existing literature primarily consists of reviews of teledermatology programs on a limited scale. Our study, focused on the expansion of a large teledermatology program, contributes to the limited existing literature on how to scale a teledermatology program with high patient volumes. Our program has adapted well to the robust number of cases and maintained success, even post-pandemic. Insights from the implementation and growth of our successful teledermatology program over a 7-year period can help inform future developing programs.

## METHODS

We performed a retrospective review of a large integrated health system's teledermatology program between 2015 and 2022. Asynchronous store-and-forward encounters, in which a primary care provider

sends a photo to a dermatologist, and e-visits, in which a patient sends an online message to a dermatologist, were included in this study. We reviewed all materials leading to implementation of the teledermatology program and noted physician workflows between PCPs and dermatologists and quality ratings of photo images.

Considering that years 2015 to 2017 included initiation and implementation of the teledermatology program across thirteen separate hospital centers, this period can be analyzed as the "initial phase" of development. Years 2018 to 2022 were focused on maturation and optimization of the program and can be referred to as the "later phase" of development. Variables such as age ranges of patients, turnaround time between teledermatology photo submission and clinical outcomes, and whether the teledermatology concern was treated remotely or required in-person visits were compared between the two cohorts. Statistical analysis of the data was performed using SPSS Statistics 24.0 (Armonk, New York: IBM; 2016), with statistical significance set at  $p < 0.05$ .

## RESULTS

Kaiser Permanente Southern California (KPSC) is a closed integrated health care system that provides health care to 4.8 million diverse members. Access to dermatologic care is primarily achieved through referrals from primary care providers (PCPs). In 2015, the teledermatology program was piloted in 3 KPSC medical center areas and was implemented in 7 more medical center areas in 2016, and 3 more medical center areas by 2017. The initial development of the teledermatology program relied on clear understanding of present workflows and coordination between

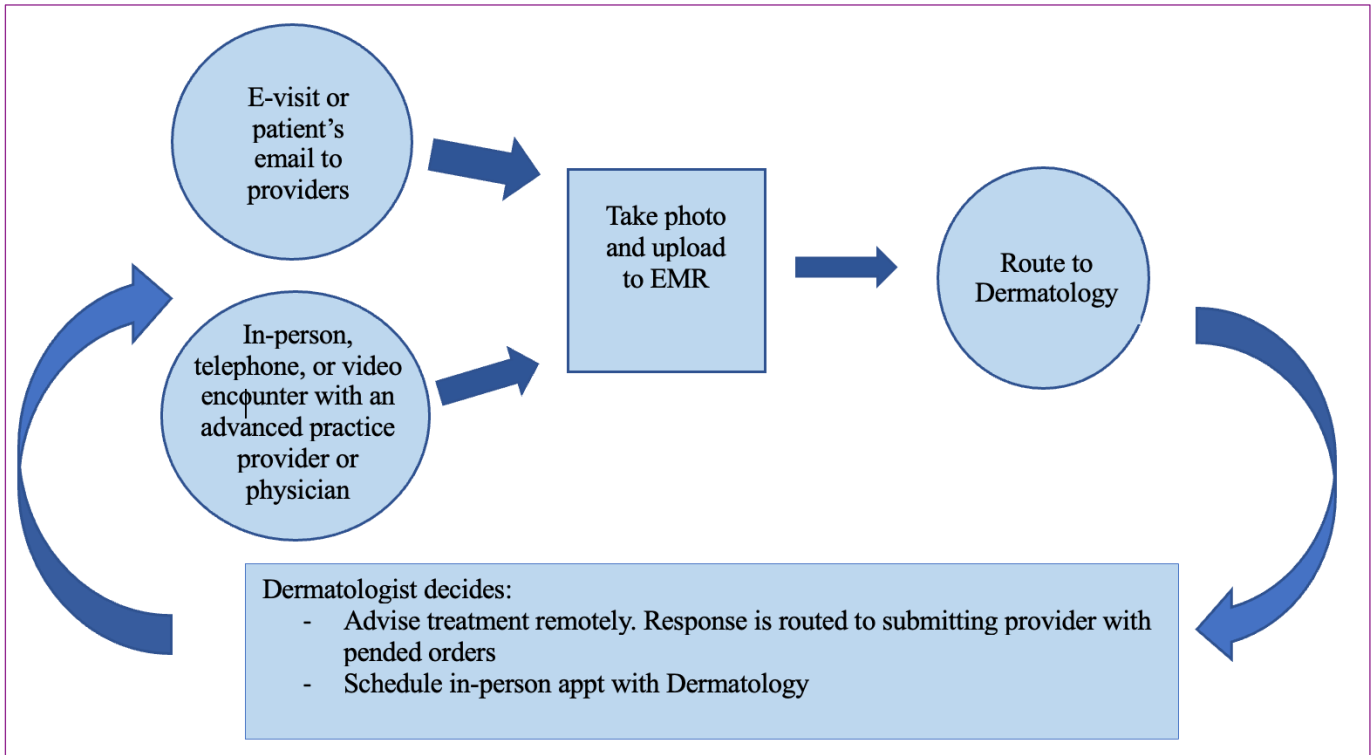
providers and dermatologists (**Figure 1**). Our teledermatology program receives submissions from advanced practice practitioners and physicians in Internal Medicine, Family Medicine, Pediatrics, Urgent Care, and Emergency Medicine.

In our system, the teledermatology service can be initiated in a variety of settings (**Figure 1**). Most often, the initial encounter begins when a PCP determines that they need an opinion from a specialist in Dermatology. This can result from a patient's in-person appointment with a PCP, a video or telephone appointment with a PCP, an Urgent Care/Emergency Medicine visit, or a patient's e-message to their provider. The PCP then takes a photo and uploads it to the electronic medical record (EMR). The PCP then routes the encounter to the teledermatology service. E-visits, or encounters that patients initiate through their online portals, can also result in use of the teledermatology service. E-visits allow patients to send direct messages to a dermatologist or an advanced practice practitioner. The other alternative at this stage includes the PCP placing a referral to Dermatology for an in-person appointment.

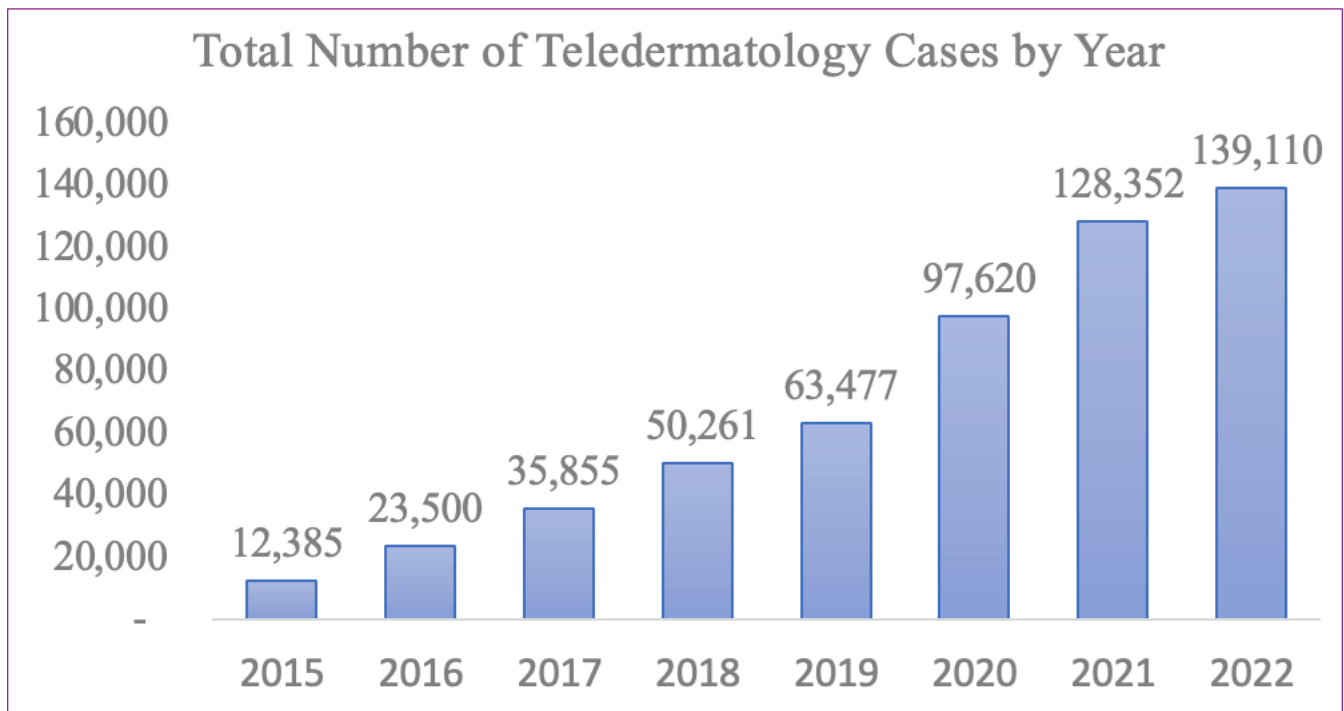
The multiple entry points described above explain why our uniquely robust teledermatology program has such a large number of cases. At no extra cost to our members, patients can easily engage with specialist care from a variety of modalities and receive responses in a timely manner. Once the photo is received by the teledermatology service, it is vetted for photo image quality. A dermatologist then responds to the PCP and patient within 1-2 business days and advises for the following: a remote treatment plan with pending medication orders routed to the PCP or the patient is contacted directly to schedule an in-person visit for further evaluation.

Our teledermatology program adapted to fit the needs of high patient volumes and grew steadily. There was a total of 12,385 cases in 2015, which increased to 139,110 cases in 2022 (**Figure 2**). 88.9% of all teledermatology submissions involved adult patients, while 11.05% involved pediatric concerns. Between 2015 to 2022, nearly 67% of the total teledermatology submissions were read by a dermatologist within 24 hours, 23.5% were read between 24 and 48 hours, and 5.5% of submission were read in over 48 hours. 96.4% of all submitted photos had no image quality concerns. Clinical outcomes included remote treatment plans versus a scheduled in-person dermatology clinic visit for further evaluation. In 2015, 67.4% of cases were treated remotely compared to 73.9% in 2022.

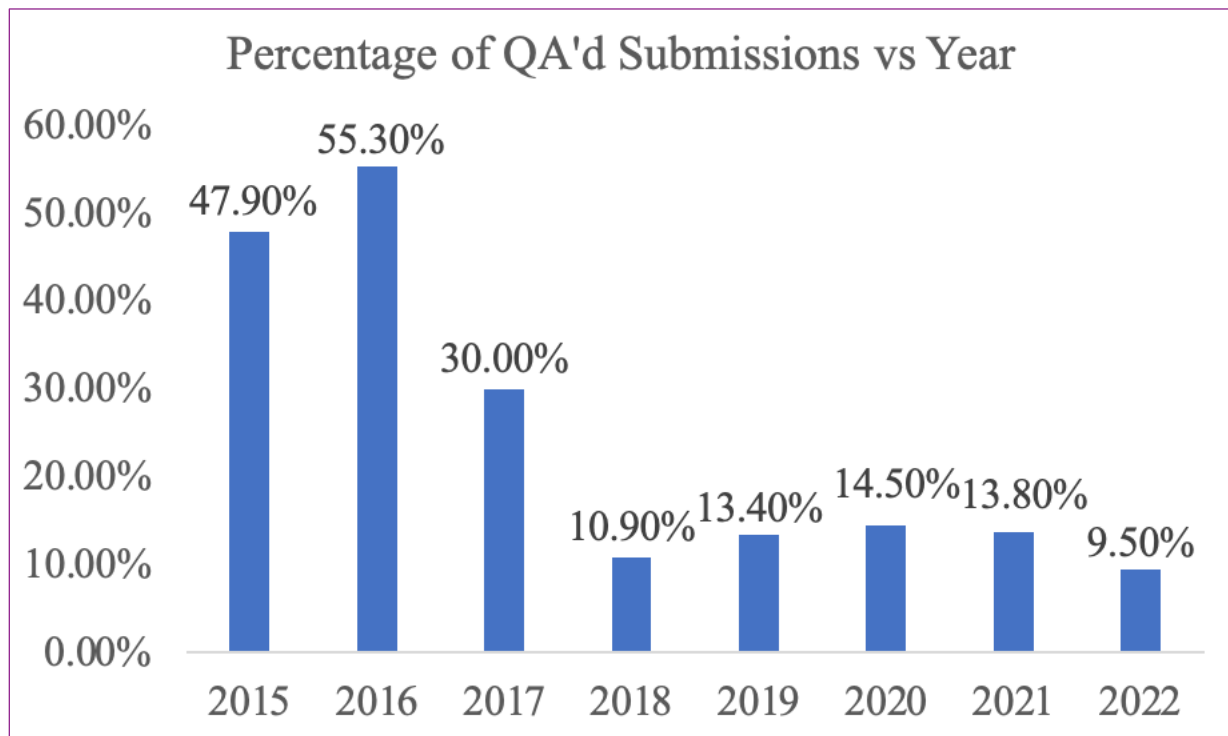
Comparing the initiation phase of the teledermatology program between 2015-2017 to the later maturation phase between 2018-2022 shows improvements and evolution of the program over time (**Table 1**). There were statistically significant differences in patient demographics, as the 2018-2022 cohort had more teledermatology submissions for pediatric patients (11.4% vs 8.8%,  $p < 0.001$ ). Despite the dramatic increase in number of cases, the program maintained its success and even saw a significant increase in remote treatment rates. The initial phase of program development from 2015-2017 resulted in 69.2% of concerns being treated remotely, compared to 70.9% of submissions in the maturation phase of the program from 2018-2022 ( $p < 0.001$ ). Between the two cohorts, the 2018-2022 group had statistically significantly less participation in the QA reversal program (12.3% vs 41.3%,  $p = 0$ ). This trend can be seen in **Figure 3**. This program allows dermatologists to ask for a second opinion from another dermatologist



**Figure 1.** Teledermatology workflow, beginning with a variety of entry points.



**Figure 2.** Bar graph depicting increasing total number of teledermatology cases between 2015 to 2022.



**Figure 3.** Bar graph depicting percentages of teledermatology QA'd submissions between 2015 to 2022, indicating a need for a second dermatologist's opinion.

regarding the teledermatology submission. The significant decrease in QA'd submissions suggests that dermatologists began to feel more confident in their diagnostic reasoning when reading teledermatology submissions over time. Most of the photos that were flagged for the QA reversal program involved pigmented lesions that needed further evaluation to rule out suspicious malignant lesions.

Interestingly, there was a significant difference in turnaround time between submission and clinical outcome. The initial phase of development notably had more dermatologists reading submissions in less than 24 hours (70.3% vs 69.5%,  $p < 0.001$ ). As the teledermatology program expanded in 2018-2022, dermatologists were more likely to assess photos between 24-48 hours of submission (25.2% vs 20.6%,  $p < 0.001$ ). Photo quality ratings also improved with the later phase of development of the

teledermatology program, as the 2018-2022 cohort had a much lower rate of photos being flagged for poor image quality (1.2% vs 4.1%,  $p = 0$ ).

## DISCUSSION

Teledermatology continues to be an evolving field within the field of Dermatology. Our results provide insight to the evolution and optimization of a large-scale robust teledermatology program. We believe the success of this program can be attributed to the following factors: (1) Engagement and communication with all interested parties. This includes collaboration with Dermatology departments, medical site leaders, and workflow consultants. (2) Streamlined implementation of technological devices. One of the main barriers of teledermatology is technological difficulty, such as internet service disruptions, limited photo capabilities

**Table 1.** Comparisons between 2015-2017 cohort and 2018-2022 cohort.

	2015-2017 Cohort (n = 71,740)	2018-2022 Cohort (n = 478,820)	P value
Patient			
Adult Patients	65,427 (91.2)	424,234 (88.6)	< 0.001
Pediatric Patients	6,313 (8.8)	54,106 (11.4)	< 0.001
Clinical Outcomes			
In-person appointment	22,095 (30.8)	139,337 (29.1)	< 0.001
Remote treatment	49,645 (69.2)	339,483 (70.9)	< 0.001
Turnaround Time			
Under 24 hours	50,433 (70.3)	332,779 (69.5)	< 0.001
24-48 hours	14,778 (20.6)	120,662 (25.2)	< 0.001
Over 48 hours	6,478 (9.03)	25,377 (5.3)	< 0.001
Participation in QA Reversal Program			
QA'd Submissions	29,684 (41.3)	59,067 (12.3)	0
Photo Quality Ratings			
Flagged for Poor Image Quality	2,977 (4.1)	5,710 (1.2)	0

on smartphones, and varying levels of digital literacy among patients. Notably both device ownership and broadband internet access correlate with income, age, and education – highlighting disparities in use of tele dermatology that need to be considered.<sup>1</sup> (3) Development of electronic health record (EHR) workflows. A commonly known benefit of tele dermatology is the increased convenience for patients and providers.<sup>5</sup> Avoiding unnecessary in-person visits saves costs of transportation and reduces workload on the provider.<sup>5</sup> Ensuring and optimizing the efficiency of EHR workflows will improve

overall functionality of the tele dermatology program. (4) Training for dermatologists and PCPS. This can be achieved with guidelines and in-person workshops. Both specialists and primary care providers play key roles, and clear communication will be essential to scaling a successful tele dermatology program. (5) Image guidelines to maintain consistent photo quality. Our program asks for two photos per skin concern, one taken close to the lesion for a detailed view and another farther away to assess relative size. Clear instructions and examples were given to the PCPs, nursing staff, and patients. A

previous study from Kaiser Permanente Northern California that reviewed nearly 60,000 teledermatology submissions found that image resolution was the key factor of effectiveness in teledermatology workflows.<sup>6</sup>

Limitations of this study may include overall generalizability. KPSC is an integrated health system that uses one electronic medical record program, while many other health centers may not have the ability to support seamless communication between patients' PCPs and dermatologists. Other health centers may not be as integrated or share electronic health records. For this reason, it may be difficult to coordinate care between PCPs and dermatologists. In addition, there are limitations in the way poor image quality is reported in our health system, likely leading to underreported numbers. Reporting inadequate photos requires a specific code in the EMR, and a large percentage of cases sent for evaluation are due to poor photos. As this is a retrospective study, we also cannot determine definitive causation for changes in practice.

In conclusion, the comparative analysis between the initiation phase of 2015-2017 and the optimization phase of 2018-2022 demonstrate the ability of a teledermatology program to expand and accommodate high patient volumes in a health system. Despite the evident increase in patient cases and workload, our program has shown significant success in adapting to the busy setting. This includes treating both adult and pediatric concerns, demonstrating a significant increase in remote treatment plans as outcomes, and having significantly decreased participation in the QA reversal program that asks for "second opinions" for teledermatology submissions. Our program has had successful outcomes in providing reliable dermatologic care while reducing the number of unnecessary in-person visits.

These results can help guide developing programs and serve as a standard of care for large-scale healthcare systems.

**Conflict of Interest Disclosures:** None

**Funding:** None

**Corresponding Author:**

Leandra Doan, BS  
98 S Los Robles Ave, Pasadena, CA 91101  
Email: [Leandra.I.doan@kp.org](mailto:Leandra.I.doan@kp.org)

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