Quantifying the Cost-Benefit of In-Person Dermatologic Care Versus Teledermatology in Urban and Rural Settings

Travis Jackson[1], Stuti Prajapati[2], Abby Beard[3], Rhea Kodkani[4], Camille Zonfa[5], Fatou Dieng[6], Reyna Moreira-Trochez[7], Kelly Frasier[8]*

[1]University of Missouri School of Medicine, Columbia, MO, United States

[2]St. John's Episcopal Hospital, Far Rockaway, NY, United States

[3]HCA Florida Lawnwood Hospital, Fort Pierce, FL, United States

[4]Drexel University College of Medicine, PA, United States

[5]Wright State University Boonshoft School of Medicine, Dayton, OH, United States

[6]Emory University Goizueta Business School, Atlanta, GA, United States

[7]Rutgers Robert Wood Johnson School of Medicine, NJ, United States

[8]Department of Dermatology, Northwell Health, New Hyde Park, NY, United States

*Corresponding author:

Kelly Frasier, DO, MS
Department of Dermatology, Northwell Health, New Hyde Park, NY, United States, Phone: 3105956882, Email: kellymariefrasier@gmail.com

ABSTRACT

Teledermatology represents a technologically mediated reconfiguration of dermatologic service delivery, offering an alternative to in-person care that varies in clinical utility and economic value across geographic and sociodemographic contexts. In urban settings, where dermatologic specialists are densely concentrated and procedural infrastructure is readily available, in-person visits facilitate higher diagnostic resolution and immediate intervention, particularly for neoplastic and surgically managed conditions. However, the direct and indirect costs associated with in-person care such as patient travel time, missed work, and delayed appointment availability present inconvenient burdens, especially in systems with long wait times or fragmented referral networks. In rural and resource-limited areas, teledermatology offers a mechanism to circumvent geographic isolation and workforce scarcity, with store-and-forward and synchronous models demonstrating high diagnostic concordance for common inflammatory, pigmentary, and infectious dermatoses. Cost-effectiveness is maximized in scenarios involving high-volume, low-complexity consultations, particularly when digital platforms are integrated with interoperable electronic health records and triage protocols that direct patients to in-person care only when necessary. Despite these advantages, limitations persist in the virtual assessment of tactile or morphologically subtle lesions, preoperative planning, and conditions requiring real-

time clinical judgment beyond what static images or brief synchronous interactions can support. Economic outcomes are further shaped by variables such as digital literacy, broadband access, patient age, insurance coverage, and language concordance, which impact the feasibility and acceptability of virtual care. Teledermatology is not a universal substitute for in-person care, but a modality contingent upon alignment with clinical acuity, infrastructural readiness, and patient-specific needs. A stratified cost-benefit analysis incorporating clinical effectiveness, health equity, and system-level resource allocation demonstrates teledermatology offers greatest value when applied to low-complexity conditions, situated within well-integrated health systems, and used in populations where it reduces barriers to timely, appropriate dermatologic evaluation without compromising diagnostic precision or care continuity.

Keywords: Teledermatology, Healthcare System, Dermatopathology, Skin Conditions, Oncology

INTRODUCTION

Reframing Access Through Telemedicine

As the demand for accessible and efficient healthcare grows, telemedicine has emerged as a transformative tool in closing gaps in patient care. Innovative technological advancements have bridged the opportunity for providers to offer consultations, diagnoses, and treatment plans remotely. Teledermatology, a division of telemedicine, virtually diagnoses, monitors and manages dermatologic conditions. Historically, teledermatology has encompassed three distinct modalities: store-and-forward (SAF), real-time (RT)/live video (LV), and hybrid [1]. Through the SAF practice, health practitioners and/or patients capture images using various forms of technology, such as cell phones, and cameras. These photographs are then transmitted to dermatologists to be reviewed asynchronously. In the United States (US), SAF was first used in the mid 90s as a low-cost solution to address healthcare barriers in underserved rural populations in Oregon [2]. This approach allowed providers in Oregon to overcome logistical challenges of distance and specialist availability, enabling earlier evaluations for certain rural populations. Years later, the SAF modality was used more frequently to diagnose rashes and other dermatologic concerns. A study in 2009 reported that more than 80% of skin lesions assessed by pediatric dermatologists through SAF teledermatology were correctly treated [3]. This study highlighted the clinical

reliability of SAF in management of common pediatric dermatologic conditions. Although the SAF practice has its advantages, some practitioners opt to use the RT/LV method of teledermatology.

Real-time (RT)/live video (LV) teledermatology involves assessment of skin conditions through live video appointments between patients and providers using mobile phones, or webcams on devices such as laptops, and tablets. Cross communication among patients, referring physicians and dermatology providers allows both patient and physician education as well as the opportunity for patients to provide additional clinical information to aid in diagnosis [4]. RT/LV teledermatology data has emerged in recent years as a promising alternative to in-person care. High diagnostic accuracy of skin diseases has been observed in board-certified dermatologists utilizing RT/LV teledermatology, with diagnostic concordance rates as high as 83.3% [5]. Hybrid teledermatology (TD) has also been utilized by providers in recent years to incorporate aspects of both RT/LV and SAF. A recent review reported hybrid TD addressed the absence of patient to provider interactions in SAF method, and poor image quality in RT/LV methods of care [6]. Together, these evolving modalities demonstrate the adaptability of teledermatology to overcome in-person care delivery challenges, and support increased access to dermatologic services.

Geographically across the US, most dermatologists are concentrated in urban areas or in metropolitan counties with large academic centers. Recent geographic studies reported the mean dermatologist to population ratio in rural counties is 423 per 100,000 people, and 88% counties have zero dermatologists [7]. This indicates the need for increased access to dermatologic care for patient populations in rural areas with limited resources and access to specialty care. In addition to geographic barriers, there are also several systemic barriers impacting availability of dermatologic services. As urban areas typically have longer wait times, patients may not be able to wait for prolonged periods of time to be seen. In addition to this, many patients may have to make work accommodations or miss work due to financial constraints. This in turn, may increase risk for morbidity and mortality in patients with aggressive and invasive skin diseases [8]. Along with longer wait times, fragmented referral systems are a systemic limitation. The lack of effective information transferred between specialists through referrals often leads to "repeat referrals" to address patient concerns, which may

drive increased healthcare costs [9]. Improving coordination and communication between primary care providers and specialists may bridge this gap. Together, these geographic, systemic, and sociodemographic challenges highlight a need for reform and expansion of dermatologic care access for underserved populations.

Virtual platforms in teledermatology practice may address both systemic and geographic barriers to care in both rural and urban environments. To expand access to dermatologic care, various rural communities in Georgia have implemented teledermatology training programs using smartphones equipped with dermatoscopes to facilitate skin cancer screenings [10]. Furthermore, this training program involves teledermatology sessions including case presentations, discussions, and didactic presentations, attempting to improve communication and understanding between dermatologists and primary care providers. By strengthening these collaborative relationships, primary care providers are more equipped to manage dermatologic concerns at initial point of care. This in turn may prevent repeat referrals and improve the transfer of effective information, leading to a more cost effective process. Sociodemographic barriers may be combated by offering telephone consultations, especially to older populations and those with limited digital literacy. In addition to this, integrating language interpreters into electronic health record (EHR) software, may facilitate virtual visit accessibility to populations where language is a barrier [11]. In addition, some providers have merged the store-and-forward (SAF) modality into EPIC EHR software to address systemic barriers related to wait times and dermatology referrals. Through this methodology, relative to traditional in-person dermatology referrals, the mean wait time to evaluation was reduced from 70 to 0.5 days, and skin disease treatment was reduced from 73.5 to 3.0 days [12]. These findings suggest using innovative measures in teledermatology to address systemic and geographic barriers may lead to a more efficient healthcare system, in terms of diagnosis and treatment duration.

While data suggests teledermatology may address issues in dermatologic care in urban and rural settings, more work is needed to assess its clinical utility, equitable healthcare delivery and economic impact. Traditional in-person care offers procedural advantages such as the ability to perform skin biopsies, dermoscopic evaluation, and full-body examinations. In-person care also allows for direct visual and tactile assessment, which can enhance diagnostic accuracy for complex lesions. However, it also presents burdens for patients and the healthcare system as a whole, including longer wait times, travel requirements, and more. These factors must be weighed carefully in the implementation of teledermatology. Furthermore, extending access through technology outreach and combating geographic and workforce limitations may improve dermatologic access. Infrastructure and system readiness shapes the feasibility of virtual care and bridge success. Sociodemographic influences and feasibility for patient populations in resource limited areas need to be taken into consideration. In an evolving healthcare landscape, the integration of teledermatology may promote a better coordinated and responsive dermatologic care. This literature review aims to evaluate the cost benefit of teledermatology in rural and urban environments in comparison to traditional in-person care.

URBAN SETTINGS

Diagnostic and Procedural Strengths of In-Person Care

In-person dermatology in urban settings offers a range of benefits driven by specialist infrastructure and collaborative potential. Recent studies indicate less than 10% of dermatologists practice in rural areas [7]. With an increased concentration of specialists, patients in urban settings can often access in-person care more easily than individuals in rural settings. In-person encounters allow for real-time evaluations, relying on tactile feedback for accurate diagnosis. Additionally, in-person visits also allow for same day diagnostic procedures such as biopsying lesions saving patients from delayed care, diagnosis and progression of disease. While teledermatology plays an important role in managing low-complexity conditions, it has limited benefit in cases requiring clinical intuition, procedural action, or real-time decision-making. In-person visits allow for an enhanced diagnostic process and promotes continuity of care. In a well-integrated urban system, these advantages make in-person visits more comprehensive and efficient, especially when lesions are challenging morphologically, and triage coordination is required.

While these benefits of in-person care apply to all conditions, they are crucial in diagnosing and managing cutaneous malignancies, where in-person evaluation is often essential to timely and appropriate treatment. Cutaneous malignancies like melanoma and squamous cell carcinoma demand a

precise level of diagnostic and procedural attention, which teledermatology cannot provide. Palpating lesions and assessing depth, texture, and border irregularities is crucial in determining malignant vs benign lesions and the urgency of intervention [13]. Live evaluation allows further diagnostic and real time procedures, such as biopsy and complex surgical planning. The ability for all of these to be coordinated within the same visit dramatically expedites the timeline from diagnosis to treatment. This is essential in treating neoplasms where delays in care can lead to progression of disease. Furthermore, preoperative planning relies on appreciating the lesion's anatomic context and surrounding structures, which must be assessed in person. Additionally, in-person care facilitates easier coordination of dermatopathology, oncology, and other specialist consultations. In all settings, especially in cases of potential neoplasms, teledermatology is not always an adequate substitute to in-person care. Definitive diagnosis through biopsy, expedited interdisciplinary collaboration, and reduced risk of patient loss to follow-up make in-person dermatologic care indispensable for effective management of cutaneous malignancies and complex morphological lesions.

Patient and Systemic Burdens

In an ideal world, patients are empowered with easily accessible in-person dermatologic healthcare access. However, even in urban settings with an increased density of specialists, dermatologic care access is not readily available. Several studies suggest new patients may encounter wait times exceeding 4 weeks to see a dermatologist [14]. In addition to increased wait times, reaching an appointment in urban areas can be difficult. Systemic factors such as traffic, limited parking, and public transportation delays can make it difficult for people to access care. In a recent survey based study, 51% of individuals with missed appointments identified transportation barriers as the primary reason for their absence [15]. For many patients, this may involve missing work, arranging childcare, and navigating other challenges for a singular appointment. These barriers often compound, especially when follow-up requires multiple appointments for accurate diagnosis, treatment, and condition monitoring. Fragmented referral systems, characterized by inefficiency care coordination, patient loss to follow up, and delayed care for potentially serious conditions, can further exacerbate these challenges [16]. Systemic inefficiencies are not only inconvenient, they also lead to worse clinical outcomes, resulting in delayed diagnosis or treatment. Even in resource-

abundant areas like urban settings, the systemic barriers of in-person care can create many obstacles for patients. Recognizing and addressing these access challenges is essential to building a more equitable, efficient, and patient-centered model of dermatologic care.

When implemented in previously described situations, teledermatology reduces barriers to care even in urban settings. For patients with straightforward cases, such as common skin conditions like atopic dermatitis or psoriasis, teledermatology consults can provide quick visits to initiate treatment, monitor progress, or adjust medications. Both asynchronous and synchronous teledermatology modalities offer the benefit of efficiency, particularly in high-volume clinics. This allows for prioritization of in-person appointments for patients requiring procedures or more complex evaluations. When integrated into existing EHR systems, teledermatology allows for smooth transitions between virtual and in-person visits. Teledermatology increases follow-up rates. In recent studies, telehealth visits demonstrated 64% higher odds of completion than in-person appointments [17]. Overall, teledermatology is not a replacement for in person visits, and does accommodate all patients' intricate needs and unique circumstances. However, in urban settings with prolonged wait times and systemic barriers impeding care, teledermatology offers a supplemental care path to a broader patient population without compromising access or timeliness.

RURAL AND UNDERSERVED AREAS: TELEDERMATOLOGY AS A SOLUTION

Addressing Geographic and Workforce Barriers

In urban settings, logistical burdens such as long wait times, transportation challenges, and fragmented referral systems can substantially delay dermatologic care, even when specialists are available. Given fewer than 10% of dermatologists practice in rural locations, patients in these communities face profound geographic isolation and a significant scarcity of specialists [7]. In many rural areas, accessing dermatologic care requires traveling long distances, incurring out-of-pocket costs, missing work, and navigating fragmented referral networks, all of which contribute to delayed diagnosis and treatment. Teledermatology provides a critical pathway to circumvent these hurdles throughremote evaluation, diagnosis, and management without the need for physical travel. Both store-and-forward and synchronous

teledermatology models have high diagnostic concordance, often exceeding 70%, with in-person visits for common inflammatory, pigmentary, and infectious dermatoses [18,19]. Store-and-forward teledermatology, an asynchronous method where digital images and clinical histories are securely captured and transmitted for later specialist review, is particularly effective for high-volume, lower-complexity conditions such as atopic dermatitis, psoriasis, and tinea infections. These lower complexity cases benefit from efficient triage and management without requiring real-time interaction [20]. For cases where dynamic assessment or patient interaction adds clinical value, synchronous video consultations can refine diagnostic accuracy and therapeutic decisions. Together, these teledermatology modalities optimize limited specialist resources, reduce wait times, and facilitate earlier intervention, ultimately improving clinical outcomes for underserved populations.

Enhancing Access Through Technology

Integration with interoperable electronic health records (EHRs) enhances teledermatology's value by providing dermatologists with comprehensive patient histories, previous treatments, laboratory data, and critical inputs for accurate evaluation and continuity of care [21]. Additionally, incorporating structured triage protocols within teledermatology platforms ensures patients with complex, suspicious, or high-risk lesions are directed appropriately to in-person care, while those with low-acuity conditions are managed virtually. This tiered approach increases system efficiency and allows dermatology resources to be more effectively allocated. Such infrastructure mitigates not only the systemic burdens familiar from urban care, such as prolonged wait times and fragmented referrals, but also the unique logistical challenges faced in rural regions. By reducing unnecessary travel and streamlining access to dermatologic expertise, teledermatology promotes improved follow-up adherence and supports better continuity of care. Furthermore, adapting teledermatology platforms to operate in low-bandwidth environments and accommodating multilingual interfaces and culturally sensitive designs increases their usability and acceptability in diverse underserved populations [22,23]. When implemented within digitally integrated health systems supported by triage protocols, teledermatology strategically addresses both geographic and systemic barriers to dermatologic care. It offers a high-value adjunct to in-person evaluation reducing healthcare disparities and enhancing timely, appropriate care in rural and underserved settings.

CLINICAL STRENGTHS AND DIAGNOSTIC LIMITATIONS

Where Teledermatology Works Well

Teledermatology is a transformative modality in dermatologic care. A profound strength of teledermatology is its high diagnostic concordance with in-office evaluations for a range of common dermatologic conditions. In a study evaluating diagnostic concordance for the 20 inflammatory skin conditions, researchers reported a complete agreement rate of 78% between dermatologists and teledermatologists, with a kappa coefficient of 0.743, indicating a statistically substantial agreement between two two groups of dermatologists [24]. Conditions with the highest concordance rates were common inflammatory skin conditions such as acne, psoriasis, and atopic dermatitis. This suggests teledermatology is particularly effective for diagnosing skin conditions exhibiting clear morphological and recognizable visual patterns that can be captured in clinical images. Teledermatology performs optimally when evaluating clinically apparent lesions, but less reliably when treating conditions characterized by subtle, nonspecific findings requiring tactile examination or a patient's medical history.

Additionally, in a study evaluating skin neoplasms via store-and-forward teledermatology, diagnostic agreement ranged from moderate to almost perfect [25]. Notably, concordance for pigmented lesions improved when contact immersion dermoscopy was included alongside the standard macro and polarized light dermoscopy images used to assess all neoplasms. A visualization method enabled a more nuanced interpretation of pigmented lesions, facilitating a better analysis of pigment patterns and vascular structures. This supports the notion teledermatology is an effective means of diagnosis when clinicians can identify distinct neoplastic patterns unique to common dermatoses. Across several studies included in a recent systematic review, diagnostic concordance between pediatric teledermatologists and in-person dermatologists for common dermatologic conditions ranged from 70.1-89% [26]. Higher concordance rates were associated with visually distinct lesions that do not require further evaluation or intervention. In comparison, conditions with lower concordance rates were associated with subtle lesions with overlapping diagnostic features, necessitating further examination beyond the virtual picture. These findings emphasize that teledermatology is an efficient and effective tool for diagnosing common dermatoses, due to the visually

oriented nature of dermatologic evaluation and the high diagnostic concordance for frequently encountered lesions. Thus, in regards to common skin conditions, teledermatology may be a promising alternative to traditional in-person dermatological evaluation.

Beyond diagnosis, teledermatology is effective as a triaging tool for managing low-complexity cases, allowing for enhanced access to care and optimizing resource utilization. Researchers in São Paulo, Brazil, reported 53% of skin lesions could be diagnosed and managed through teledermatology, thereby preventing unnecessary referrals to in-office dermatologists [27]. This allowed dermatologists to focus more on complex conditions such as malignancies or premalignant lesions. Teledermatology in this setting led to a 78% reduction in overall waiting time for visits [27]. These findings reinforce the role of teledermatology as a valuable means of managing routine dermatologic conditions and streamlining diagnoses, therefore enabling in-person dermatology clinics to focus their efforts more effectively on complex or high-acuity cases. The reduction in waiting times not only facilitates quicker diagnosis for complex cases, but also accelerates biopsy scheduling and result turnaround, ultimately contributing to earlier detection and improved patient outcomes. In a retrospective review top diagnoses were dermatitis unspecified and acne, with 68% of these diagnoses managed via e-consultation, thereby eliminating the need for an in-person evaluation [28]. These findings corroborate that lower complexity conditions are often straightforward in diagnosis and management, as they do not require intensive in-person workups. The visible nature and distinctive features of conditions such as dermatitis and acne enable efficient diagnosis and treatment via teledermatology. Due to the feasibility of remote diagnosis management, teledermatology can serve as an effective triage tool, directing in-person dermatologists to patients with higher-risk lesions or more complex cases.

Where Teledermatology Falls Short

Despite these advantages in detecting common skin conditions and triaging lower-complexity cases, teledermatology has notable limitations that should be considered. One major constraint is the inability to appreciate morphological characteristics through a photograph, which highlights the need for an in-office evaluation. In a study examining the causes of diagnostic discordance between teledermatologists and in-person dermatologists, teledermatologist had difficulty distinguishing between actinic damage and telangiectasia and requested further textural information [29]. At the in person follow-up visit, the dermatologist noted no scale or roughness indicating actinic keratosis or squamous cell carcinoma. This implies even with high-quality photography, it can be challenging to appreciate specific characteristics, and palpation can be necessary to diagnose and treat lesions. Teledermatology does not allow for palpation, which is equally important as visual examination in diagnosing dermatological conditions. In a study that included 49 skin cancer lesions, 14.3% were incorrectly diagnosed as alternative skin cancers, and 24.5% could not be assessed and were asked to come into the office for a review due to clinical suspicion [30]. These findings underscore that more nuanced structural cues characterizing skin cancers, such as scaling, erythema, and pigmentation changes, may not be captured due to issues with image quality, lighting, or resolution. While advancements in imaging and technology may address these limitations, in-person evaluation remains the standard for accurately diagnosing vague lesions.

While certain conditions, such as acne and inflammatory skin conditions, were more amenable to a virtual format, 96% of clinical dermatology faculty at Yale's School of Medicine agreed that total skin body examinations should be conducted in person [31]. More comprehensive assessments, such as full-body skin checks, require examinations that involve clinicians palpating to assess firmness and induration, thereby differentiating between benign and malignant lesions. In addition to the challenges faced by the necessity of full-body examinations, capturing high-quality photos of anatomically challenging areas, such as the scalp or back, may be challenging, further reinforcing the need for in-person evaluations. Additionally, a virtual setting often places the responsibility on the patient to identify and highlight areas of concern, which could lead to oversight and bias. In contrast, the head-to-toe approach of full-body skin checks empowers dermatologists to detect clinically subtle yet significant findings.

Teledermatology also presents difficulties in preoperative planning, particularly in the context of Mohs Micrographic surgery. During the COVID-19 pandemic, 68.8% of surveyed Mohs surgeons recognized a role for teledermatology in dermatologic surgery, but only 49.9% planned to continue using it post-pandemic [32]. The physical examination limitation of telemedicine was a large reported factor

leading to these results. During a Mohs preoperative visit, the surgeon assesses a biopsy-proven skin cancer and formulates a treatment plan, discussing various repairs, such as primary closure, skin flaps or grafts, or healing by secondary intention, most appropriate for the skin cancer location. In a telemedicine video visit, image quality can compromise visual assessment and tactile information, making it difficult to assess whether a lesion is fixed to a deeper structure. This often results in a repeat preoperative visit during the in-person visit immediately preceding the surgery, making the telemedicine visit an additive visit rather than a replacement for an in-person preoperative visit. While teledermatology is effective for diagnosing and managing certain dermatoses, it falls short in comprehensive examinations and surgical planning due to limitations in physical examination, image quality, and lesion assessment.

ECONOMIC AND STRUCTURAL VARIABLES

When Teledermatology is Cost-Effective

As telemedicine transforms healthcare, evaluating teledermatology from an economic standpoint reveals both its potential to reduce healthcare expenditures and the structural challenges that shape its implementation. Teledermatology is a cost-effective model of care delivery, particularly in managing high-volume, low-complexity dermatologic conditions such as acne, eczema, and benign lesions. By facilitating remote triage and follow-up, it reduces unnecessary referrals, specialist backlog, and patient travel. Documented implementations in Spain, the United Kingdom, and the United States. Veterans' clinics show teledermatology has saved between $10-$80 per consultation, with one model predicting up to $35 million in national annual savings if only 5% of dermatology visits transition to virtual care [33]. These savings may extend beyond direct costs, offering societal benefits including fewer missed work hours and improved access in geographically isolated communities. In some studies, store-and-forward (SAF) tends to be more cost-effective than Real-time (RT)/live video (LV) teledermatology approaches due to lower infrastructure requirements and scalability associated with SAF models [34]. In underserved urban settings, teledermatology has the potential to lower emergent health services such as emergency room and urgent care visits. A study performed in Philadelphia showed that teledermatology programs not only resulted in a 27% drop in in-person visits, but also a 3.3% decrease in emergency

department utilization [33]. However, cost-effectiveness is less clear for complex conditions like suspected skin cancers. This is because virtual triage of complex lesions may lead to redundant visits or diagnostic delays [35]. Overall, the per-consult cost declines with greater adoption, making teledermatology especially viable when deployed at scale in well-integrated systems.

Infrastructure and System Readiness

Despite its clinical and economic promise, several structural and technological barriers continue to shape who can access teledermatology and how effectively it can be delivered. Key barriers include limited digital literacy among the geriatric population and underserved populations, and disparities in broadband access that hinder reliable video or image sharing. Modalities that allow flexibility, such as switching from video to audio after image upload, can help bridge these divides, particularly in low-bandwidth households [36,37]. Digital literacy gaps and lack of adaptable visit modalities risk excluding vulnerable groups from equitable virtual care. Insurance coverage and EHR integration are also critical to sustainable implementation. During the COVID-19 pandemic, expanded reimbursement policies under Medicare allowed teledermatology to grow rapidly, but reimbursement for asynchronous services remains inconsistent and inadequate across states [38]. Without payment parity, that is equal reimbursement for teledermatology and in-person care, and broader policy support, long-term viability is uncertain. Additionally, lack of EHR interoperability can fragment care, making it difficult to access prior clinical data and maintain continuity across visits [39]. To fully realize the cost and access benefits of teledermatology, targeted investments in broadband infrastructure, health information technology, and equitable reimbursement models are essential.

HEALTH EQUITY AND PATIENT-SPECIFIC FACTORS

Sociodemographic Influences on Access

While teledermatology holds promise for reducing barriers to dermatologic care, several sociodemographic factors impact its accessibility and effectiveness. Patient age, language concordance, and digital literacy are particularly influential in determining teledermatology use and satisfaction. Older adults, for example, often face greater challenges with telehealth due to lower technology proficiency and age related barriers such as hearing impairments [40,41]. These

factors may result in difficulty navigating platforms and dissatisfaction with care. Similarly, patients with limited English proficiency or low digital literacy may struggle to access or benefit from teledermatology services [42]. Addressing these specific barriers, especially for older adults and non-English-speaking patients, is essential to improving equitable access and patient satisfaction with virtual dermatologic care.

Feasibility and Acceptability

The feasibility and acceptability of teledermatology are influenced by patient-specific factors, especially in vulnerable populations, older populations, and resource-limited areas. For virtual dermatologic care to be effective, patients must have reliable internet access, access to compatible devices, and a basic level of digital literacy [43]. Without these elements, patients may struggle to connect with providers or fully participate in their care. These requirements therefore pose significant barriers in underserved communities and among older individuals, who are less likely to possess the necessary resources or familiarity with digital devices [44]. As a result, these factors can limit high-quality virtual dermatologic care. Nonetheless, studies suggest telehealth can still be effective and acceptable in rural and underserved populations when implemented thoughtfully [45]. Tailoring teledermatology models to meet the needs of these populations, by incorporating user-friendly platforms, providing multilingual support, and ensuring access to necessary technology, can improve both the practicality and patient acceptance of virtual dermatologic services.

CONCLUSION

In recent years, teledermatology has emerged as a transformative care modality. Teledermatology offers an alternative and adjunct to traditional in-person care, as it is highly effective at managing visually distinct conditions with clear morphological patterns. These clinically apparent lesions are easier to diagnose via telehealth compared to subtle lesions that may require in-person tactile evaluation. Teledermatology has proven to be highly effective in managing high-volume, low-complexity cases. This, therefore, optimizes resources and specialist time for complex patient scenarios that require in-person care. Studies have demonstrated that teledermatology has the potential to decrease wait times and facilitate timely diagnosis and treatment in low-complexity situations. Economically, teledermatology offers healthcare savings and broader social benefits, including decreased travel burden,

fewer work absences, and expanded access to specialty care in underserved areas. When appropriately implemented into integrated healthcare systems, teledermatology has the potential to save millions in annual healthcare costs. This positions teledermatology as a cost-effective adjunct to in-person care.

While virtual visits have limitations in assessing complex lesions requiring tactile evaluation and comprehensive skin exams, these challenges can be alleviated through triaging patients to in-person visits. When used in clinical scenarios to diagnose and treat common dermatoses or triage patients prior to in-person visits, teledermatology can be an efficient and highly effective adjunct to care. Structural and technological barriers to care continue to be obstacles in today's world. However, targeted interventions such as improving platform usability and offering multilingual language support, among others, can help alleviate these problems. When applied to appropriate clinical situations, teledermatology has the potential to enhance care. Overall teledermatology has the potential to expand care without compromising quality.

ACKNOWLEDGEMENTS

CONFLICTS OF INTEREST

The authors declare that there are no conflicts of interest.

REFERENCES

1. Coates SJ, Kvedar J, Granstein RD. (2015). Teledermatology: from historical perspective to emerging techniques of the modern era: part I: History, rationale, and current practice. J Am Acad Dermatol. 72(4):563-574.

2. Perednia DA, Brown NA. (1995). Teledermatology: one application of telemedicine. Bull Med Libr Assoc. 83(1):42-47.

3. Heffner VA, Lyon VB, Brousseau DC, Holland KE, Yen K. (2009). Store-and-forward teledermatology versus in-person visits: a comparison in pediatric teledermatology clinic. J Am Acad Dermatol. 60(6):956-961.

4. Lamel S, Chambers CJ, Ratnarathorn M, Armstrong AW. (2012). Impact of live interactive teledermatology on diagnosis, disease management, and clinical outcomes. Arch Dermatol. 148(1):61-65.

5. Fujimoto A, Hayashi R, Iguchi S, Abe R. (2024). Can dermatologists reach their full potential in teledermatology? A validation study of diagnostic performance of skin diseases in live video conferencing teledermatology. J Dermatol. 51(7):991-998.

6. Afanasiev OK, Hung DY, Yan S, Huang SJ, Cho BK. (2021). COVID-19: A catalyst for innovative hybrid teledermatology workflows to increase access and improve patient care at a large group practice. J Am Acad Dermatol. 85(1):206-209.

7. Vaidya T, Zubritsky L, Alikhan A, Housholder A. (2018). Socioeconomic and geographic barriers to dermatology care in urban and rural US populations. J Am Acad Dermatol. 78(2):406-408.

8. Capodici A, Noci F, Nuti S, Emdin M, Dalmiani S, Passino C, et al. (2025). Reducing outpatient wait times through telemedicine: a systematic review and quantitative analysis. BMJ Open. 15(1):e088153.

9. Mehrotra A, Forrest CB, Lin CY. Dropping the baton: specialty referrals in the United States. Milbank Q. 2011 Mar;89(1):39-68.

10. Maloney ME, Miranda-Galvis M, Juarez BS, Mamouni K, Odhiambo L, Ibrahim S, et al. (2023). Teledermatology for skin cancer screening in rural Georgia utilizing teledermoscopy and distance learning: An ongoing report. JAAD Int. 11:140-142.

11. Tan-McGrory A, Schwamm LH, Kirwan C, Betancourt JR, Barreto EA. (2022). Addressing virtual care disparities for patients with limited English proficiency. Am J Manag Care. 28(1):36-40.

12. Carter ZA, Goldman S, Anderson K, Li X, Hynan LS, Chong BF, et al. (2017). Creation of an Internal Teledermatology Store-and-Forward System in an Existing Electronic Health Record: A Pilot Study in a Safety-Net Public Health and Hospital System. JAMA Dermatol. 153(7):644-650.

13. Higgins JC, Maher MH, Douglas MS. (2015). Diagnosing Common Benign Skin Tumors. Am Fam Physician. 92(7):601-607.

14. Uhlenhake E, Brodell R, Mostow E. (2009). The dermatology work force: a focus on urban versus rural wait times. J Am Acad Dermatol. 61(1):17-22.

15. Silver D, Blustein J, Weitzman BC. (2012). Transportation to clinic: findings from a pilot clinic-based survey of low-income suburbanites. J Immigr Minor Health. 14(2):350-355.

16. Donohoe MT, Kravitz RL, Wheeler DB, Chandra R, Chen A, Humphries N. (1999). Reasons for outpatient referrals from generalists to specialists. J Gen Intern Med. 14(5):281-286.

17. Cummins MR, Tsalatsanis A, Chaphalkar C, Ivanova J, Ong T, Soni H, et al. (2024). Telemedicine appointments are more likely to be completed than in-person healthcare appointments: a retrospective cohort study. JAMIA Open. 7(3):ooae059.

18. Warshaw EM, Hillman YJ, Greer NL, Hagel EM, MacDonald R, Rutks IR, et al. (2011). Teledermatology for diagnosis and management of skin conditions: a systematic review. J Am Acad Dermatol. 64(4):759-772.

19. Landow SM, Oh DH, Weinstock MA. (2015). Teledermatology Within the Veterans Health Administration, 2002-2014. Telemed J E Health. 21(10):769-773.

20. Lee JJ, English JC 3rd. (2018). Teledermatology: A Review and Update. Am J Clin Dermatol. 19(2):253-260.

21. Armstrong AW, Kwong MW, Ledo L, Nesbitt TS, Shewry SL. (2011). Practice models and challenges in teledermatology: a study of collective experiences from teledermatologists. PLoS One. 6(12):e28687.

22. Zakaria A, Maurer T, Su G, Amerson E. (2019). Impact of teledermatology on the accessibility and efficiency of dermatology care in an urban safety-net hospital: A pre-post analysis. J Am Acad Dermatol. 81(6):1446-1452.

23. Gao JC, Zhang A, Gomolin T, Cabral D, Cline A, Marmon S. (2022). Accessibility of direct-to-consumer teledermatology to underserved populations. J Am Acad Dermatol. 86(3):e133-e134.

24. Giavina-Bianchi M, Sousa R, Cordioli E. (2020). Part I: Accuracy of Teledermatology in Inflammatory Dermatoses. Front Med (Lausanne). 7:585792.

25. Warshaw EM, Gravely AA, Nelson DB. (2015). Reliability of store and forward teledermatology for skin neoplasms. J Am Acad Dermatol. 72(3):426-435.

26. Burshtein J, Buethe MG, Ghias MH, Stein AB, Glick S, Marmon S. (2023). Efficacy, perception, and utilization of pediatric teledermatology: A systematic review. JAAD Int. 12:3-11.

27. Giavina-Bianchi M, Santos AP, Cordioli E. (2020). Teledermatology reduces dermatology referrals and improves access to specialists. EClinicalMedicine. 29-30:100641.

28. Shih A, Riopelle A, Ordan A, Sanchez S, Bhawan J, Lam CS. (2024). Optimizing Dermatological Care Triage in a Safety-Net Hospital: Retrospective Analysis of Diagnoses and In-Person Referrals. South Med J. 117(10):577-581.

29. Lee MS, Stavert R. (2021). Factors Contributing to Diagnostic Discordance Between Store-and-Forward Teledermatology Consultations and In-Person Visits: Case Series. JMIR Dermatol. 4(1):e24820.

30. Patel N, Aboukhatwah N, Esdaile B. (2024). Effectiveness and diagnostic accuracy of teledermatology for the assessment of skin conditions. Australas J Dermatol. 65(4):342-349.

31. Asabor EN, Bunick CG, Cohen JM, Perkins SH. (2021). Patient and physician perspectives on teledermatology at an academic dermatology department amid the COVID-19 pandemic. J Am Acad Dermatol. 84(1):158-161.

32. Maruthur M, Lee E, Dusza S, Nehal K, Rossi A. (2022). Pilot Survey of Adoption of Telemedicine in Mohs Surgery During the COVID-19 Pandemic. Dermatol Surg. 48(2):187-190.

33. Wang RH, Barbieri JS, Nguyen HP, Stavert R, Forman HP, Bolognia JL, et al. (2020). Clinical effectiveness and cost-effectiveness of teledermatology: Where are we now, and what are the barriers to adoption? J Am Acad Dermatol. 83(1):299-307.

34. Chow A, Smith HE, Car LT, Kong JW, Choo KW, Aw AAL, Wong MAME, Apfelbacher C. Teledermatology: an evidence map of systematic reviews. Syst Rev. 2024 Oct 12;13(1):258.

35. López-Liria R, Valverde-Martínez MÁ, López-Villegas A, Bautista-Mesa RJ, Vega-Ramírez FA, Peiró S, et al. (2022). Teledermatology versus Face-to-Face Dermatology: An Analysis of Cost-Effectiveness from Eight Studies from Europe and the United States. Int J Environ Res Public Health. 19(5):2534.

36. Ahuja S, Briggs SM, Collier SM. (2022). Teledermatology in Rural, Underserved, and Isolated Environments: A Review. Curr Dermatol Rep. 11(4):328-335.

37. Maddukuri S, Patel J, Lipoff JB. (2021). Teledermatology Addressing Disparities in Health Care Access: a Review. Curr Dermatol Rep. 10(2):40-47.

38. Lin SK, Deitermann AM, Miller CJ, Garg A, Ungar J, Nguyen HP. (2023). Evolving teledermatology policy and reimbursement landscape in the United States. JAAD Int. 11:200-208.

39. Mehta S, Metko D, Maazi M, Wang OJE, Li MK. (2025). Teledermatology and Virtual Visits for Acne Management: A Review. J Cutan Med Surg. 29(1):63-68.

40. Pasquinelli MM, Patel D, Nguyen R, Fathi J, Khan M, Fernandez K, et al. (2022). Age-based disparities in telehealth use in an urban, underserved population in cancer and pulmonary clinics: A need for policy change. J Am Assoc Nurse Pract. 34(5):731-737.

41. Mao A, Tam L, Xu A, Osborn K, Sheffrin M, Gould C, et al. (2022). Barriers to Telemedicine Video Visits for Older Adults in Independent Living Facilities: Mixed Methods Cross-sectional Needs Assessment. JMIR Aging. 5(2):e34326.

42. Mahtta D, Daher M, Lee MT, Sayani S, Shishehbor M, Virani SS. (2021). Promise and Perils of Telehealth in the Current Era. Curr Cardiol Rep. 23(9):115.

43. Sinha Gregory N, Shukla AP, Noel JJ, Alonso LC, Moxley J, Crawford AJ, et al. (2023). The feasibility, acceptability, and usability of telehealth visits. Front Med (Lausanne). 10:1198096.

44. Santiago S, Lu J. (2023). Patient Satisfaction in Teledermatology: an Updated Review. Curr Dermatol Rep. 12(1):23-26.

45. Butzner M, Cuffee Y. Telehealth Interventions and Outcomes Across Rural Communities in the United States: Narrative Review. J Med Internet Res. 2021 Aug 26;23(8):e29575.