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Teledermatology in Rural, Underserved, and Isolated Environments: A Review

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Abstract

Purpose of Review Summarize the current evidence for teledermatology in rural, underserved, and isolated environments including its use during the current COVID-19 pandemic.

Recent Findings Teledermatology is a reliable and cost-effective tool that can reduce face-to-face visits and improve the timeliness of care for medically underserved populations. Recent studies have shown many additional benefits of teledermatology, including improving patients' health outcomes and increasing local providers' knowledge of dermatologic conditions. Despite these benefits, many low-income and rural populations lack access to digital technology and high-speed internet, limiting the reach of telemedical services.

Summary Overall, barriers in access to care are unique across the globe, and thus teledermatology interventions should address and adapt to the needs of the local patient population. Certain strategies, such as implementing simple, SF models, using standardized TD consult templets, and providing real-time information technology support could potentially mitigate disparities and improve the effectiveness of TD programs in underserved areas.

Keywords Teledermatology · Access to care · Health disparities · COVID-19

Introduction

Dermatology was one of the first telemedicine services to be implemented in 1995 [1], and today, it is one of the most developed specialties for virtual care [2]. During the COVID-19 pandemic, teledermatology (TD) emerged as a crucial tool to promote social distancing and decrease the spread of disease. In fact, a survey of 733 dermatologists found that the use of TD increased from 26 to 75% of all visits in 2020 [3]. Especially for remote and underserved populations, TD is being increasingly used to bridge health disparities and overcome barriers in access to care. Thus, our review highlights the recent literature on the effectiveness, challenges, and best practices of TD for rural USA, low-income, urban USA, and globally underserved communities.

Background

Access to dermatologic care is limited for many populations both in the USA and around the world. A physician needs assessment in the USA calculated that at least one dermatologist is needed for every 30,000 people [4]. Across the globe, many communities fall short of this ratio. It is estimated that three billion people in 345 developing countries lack adequate care for skin diseases [2]. The USA and other high-income countries often have more dermatologists per 100,000 people, but there are still populations (e.g., rural, uninsured/underinsured, racial minorities, and ethnic minorities) with zero dermatologists [5]. Furthermore, dermatologists tend to be concentrated in urban areas, leading to limited access to dermatologic care in geographically isolated areas.

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Socioeconomic status and race also contribute to the distribution of dermatologists in the USA, with fewer dermatologists practicing in African American, Hispanic-American, and American Indian majority counties and areas with low median incomes [5]. This difference in dermatologist density has important implications for health outcomes. A 2012 study showed having a single dermatologist compared to a county with zero dermatologists reduces the melanoma mortality rate by nearly 35% [6].

In areas with few dermatologists, telemedicine has long been thought to be a potential strategy for overcoming access barriers. Research over the past 2 decades has shown that TD is a cost-effective technology that can reduce waiting times, increase provider productivity, and decrease the distance traveled for care. Importantly, some evidence suggests that TD is reliable for the accurate diagnosis and management of skin conditions in all Fitzpatrick skin types [6]. TD also appears to be effective at improving access to care in underserved populations, including people with Medicaid insurance. A 2016 study conducted at underserved clinics in Philadelphia found that 61% of patients who used TD would not have otherwise received dermatologic care [7]. Another study found primary care practices that used TD saw a 64% increase in Medicaid enrollees visiting a dermatologist [8].

Given the recent, dramatic rise in providers using TD, we aim to examine current research on the effectiveness and implementation of TD for medically underserved populations, within the USA and abroad. We will discuss the evidence of different TD modalities in diverse settings, the potential benefits and challenges of TD for both patients and providers, and the current findings on best practices for TD programs.

Overview of Models for Teledermatology Delivery: Rural USA, Urban Underserved USA, and Global Underserved Populations

Teledermatology is often used as an all-encompassing term to describe a variety of virtual modalities for delivering dermatologic care. Each of these modalities can be direct-to-patients or provider-to-provider.

Real-time teledermatology (RTTD) enables interaction via live video or telephone audio. While this model may be more resource-intensive, requiring coordination and technological infrastructure, it also facilitates real-time history taking and discussion of treatments. The store-and-forward (SF) model is asynchronous, allowing for more flexibility as a patient's clinical history and images are sent to a dermatologist, who answers the consultation at a later time. Lastly, hybrid models merge advantageous aspects of both SF and RTTD services. For example, studies on the uptake of TD during the COVID-19 pandemic found that RTTD with stored digital photos was perceived by dermatologists to be the most feasible and accurate model of care [9, 10••]. Modality preferences may be influenced by practice structures and features of the local health care system, including different reimbursement rates for TD models. In addition, the distinctive requirements and benefits of SF and RTTD affect their appropriateness for specific contexts and patient populations.

Common Teledermatology Modalities: Rural USA

Much of the recent literature on TD interventions in rural USA counties has been from the Veterans Health Administration (VHA), which has established one of the most developed TD programs in the world [11]. In 2016, 62 out of 102 active US TD programs were government programs associated with the VHA [12••]. The majority of these programs use SF models, with a minority delivering RTTD [12••]. Most TD services for the American Indian population also operate under the SF model [13]. In highly rural areas, some innovative clinicians use social media platforms for TD, like WhatsApp and Facebook Messenger. In fact, rural dermatologists are more likely than urban dermatologists to deliver remote care via social media, due to the lack of electronic health records [10••].

In order to mitigate existing disparities, providers should select TD modalities that best address the needs of the population they intend to serve. A study comparing RTTD to SF modalities found that veterans who utilized RTTD during the COVID-19 pandemic were younger than SF and face-to-face users (FTF), while the SF modality was used more by patients from rural areas [14••]. Another study showed that only 54% of high-need, high-risk elderly veterans were willing to use video visits for health care. Willing veterans were more likely to be younger, living in socioeconomically advantaged neighborhoods, and be able to use the internet and email [15••]. In rural areas, which often have older patient populations or slower internet connection, the SF model, where patient photos are acquired by trained medical staff to facilitate consultation between PCPs and dermatologists, may be the most effective, as it does not require the patient to have any equipment or technological expertise. Additionally, RTTD can require more internet and high-definition imaging for proper visualization of the skin.

Common Teledermatology Modalities: Urban, Underserved USA

Many disadvantaged, urban populations in the USA also lack high-quality broadband internet access and rely exclusively on mobile devices [16]. Thus, modalities that minimize data throughput may reduce costs and improve quality.

Some have suggested the implementation of models which allow patients to switch from video to audio-only after the skin examination [17].

A recent study compared the efficacy of telephone calls with supplemental uploaded images to a RTTD model in an urban, underserved setting. Interestingly, when patients had the choice, 525 out of 788 chose video visits over telephone visits [18•]. The same study found the average age of patients who chose video visits was significantly lower than those who chose telephone calls [18•]. With age being a predictor of visit preference, maintaining phone calls as a TD modality could maximize the participation of patients of all ages and improve access to care in urban, underprivileged settings. In addition, policies such as equal reimbursement for video and phone visits may encourage more providers to offer audio-only visits as an option [17].

Common Teledermatology Modalities: Global, Underserved

As of 2015, approximately 46% of countries worldwide had implemented a TD service of some type [19]. Countries in North America and Europe have most widely adopted the technology, though low- and middle-income countries (LMICs) carry a disproportionate burden of vulnerable communities [1]. Therefore, focusing on improving TD in LMICs could be an important step towards improving access to care for underserved populations.

A recent international survey discovered that across the globe, 55% of programs used the RTTD method, 48% used the SF method, and 43% used a hybrid SF video model [19]. Some models in China and other areas of the world are incorporating artificial intelligence to assist with the diagnosis and treatment of skin disorders [20]. The possible benefits of this technology are particularly apparent in LMICs with few dermatologists and long travel distances.

As mentioned earlier, certain TD modalities are more or less feasible in different areas of the world depending on access to image-capturing technology, image quality, and internet connectivity. These challenges are profound when looking at underserved populations within LMICs. Furthermore, much of the data on TD in high-income countries has been collected from large-scale studies, while most of the experience of TD in low-income countries has been represented through case studies or pilot programs, typically only examining a few participants over a short period. Future studies should focus on longitudinal data regarding both patients served and participating staff to allow for a greater understanding of best practices for TD in these settings.

Overview of Effectiveness and Benefits: Teledermatology for Rural USA, Urban Underserved USA, and Global Underserved Populations

Recent literature, as outlined below, has documented the effectiveness of TD for diagnosing and treating skin conditions among people in rural and underserved settings. These interventions can expand the reach of limited providers, spare patients long travel journeys, and reduce the time to treat patients with the greatest clinical need.

Effectiveness and Benefits: Teledermatology for Rural Populations in the USA

In conducting this review, we found a dearth of large-scale TD studies in rural areas other than those affiliated with the VHA. Furthermore, many of the VHA studies do not examine rural and urban veterans separately, limiting our ability to analyze the impact of TD specifically on rural veterans.

However, studies looking at all veterans have shown that TD is a reliable way to diagnose and manage skin conditions [21], including malignant melanomas [22]. In a 2019 study, TD significantly decreased the overall percentage of FTF visits, leading to reduced costs for both patients and providers [23]. Similar results were shown in a TD study focused on rural veterans, which found that as the number of TD encounters increased, the number of FTF dermatology visits decreased, suggesting TD helps patients avoid in-person appointments [24••]. Moreover, a study on pre-operative Mohs surgery consults for all veterans, discovered that TD saved each patient 163 min, 145 miles, and 60 dollars [25]. Overall, TD is a highly valuable and impactful technology for veterans and VA clinics, especially in rural settings.

Effectiveness and Benefits: Teledermatology for Urban, Underserved Populations in the USA

Recent studies conducted in low-income urban contexts have also demonstrated the effectiveness of TD. For example, a retrospective review of 3285 consultations in a safety-net health care system found high rates of diagnostic and management concordance between FTF and SF encounters [26]. Other recent studies have suggested that diagnostic accuracy can be improved by providing PCPs with a dermatoscope [27•] and giving teleconsultants access to patients' complete medical records [28].

TD can also reduce avoidable urgent care or emergency room visits in underserved urban communities. A SF program in Philadelphia decreased FTF dermatology visits by 27% and emergency room visits by 3%, saving $10.00–$52.65 per consult [29]. This change in the workflow can be beneficial in busy, safety-net hospitals, as it allows dermatologists to evaluate more cases per hour [30•]. Furthermore, a TD study that incorporated a formalized education program for PCPs found that their confidence in diagnosing and managing dermatology conditions significantly improved, as did their levels of diagnostic and management concordance with dermatologists [31•]. These outcomes highlight the potential for education and enhanced training to reduce the referral burden on teleconsultants and improve the diagnosis and treatment of skin conditions.

Looking at racial and ethnic minorities living below the federal poverty level, patients who received care through a SF program had a no-show rate of 24% compared to 84% in a group receiving in-person care [27•]. In the same study, 10 patients diagnosed by TD with suspicious neoplasm were lost to follow-up, despite extensive outreach [27•]. Although TD may improve no-show rates and enhance access to specialists in urban, underserved environments, it is not a panacea for this population, as facilitating the follow-up of patients is still a challenge. Additional support, such as transportation vouchers and telephone reminders, may be needed to ensure that urban, underserved communities receive necessary dermatologic care [32].

Effectiveness and Benefits: Teledermatology for Global, Underserved Populations

The advantages of TD have also been examined in studies looking at underserved populations across the globe. In rural Brazil, a country with one of the most developed TD practices, FTF and TD consults had roughly 80% diagnostic concordance to histopathologic diagnosis [33]. Another study in Brazil found that TD allowed two-thirds of patients to avoid in-person visits [34]. Similar values were found in rural Spain, where a TD program saved patients and providers 1496 working hours, 786 travel hours, 8280 dollars, and 51.3 km in distance traveled [35]. In addition, large-scale, cost-effectiveness analyses have pointed to the extensive societal savings TD can bring to areas with limited dermatologic care [36, 37]. In French Guiana, a TD service for remote areas allowed 92% of patients who required teleconsult to be managed in local clinics [38]. Other benefits include reductions in carbon emissions [39] and improvements in the knowledge and management of dermatology conditions by regional healthcare workers [40].

Overview of Timeliness of Care: Teledermatology for Rural USA, Urban USA, and Global Underserved Populations

TD can also significantly decrease wait times for appointments and time to treatment, helping improve access to care for vulnerable populations. Melanoma and non-melanoma skin cancer mortality is higher for rural patients, ethnic minorities, the uninsured, and those with lower incomes, partially due to delayed diagnosis and treatment [41]. Thus, improving the timeliness of dermatologic care for these populations may reduce health disparities.

Timeliness of Care: Teledermatology for Rural Populations in the USA

In a retrospective chart review of TD consultations at the Providence Veterans Affairs Medical Center, dermatologists completed 84–99% of all teleconsultations within 1 week after referral, and 69% of referring providers prescribed the recommended medications within 7 days [23]. The study focusing on pre-operative Mohs surgery consults found that TD decreased the time to treatment by 2 weeks and increased the percentage of lesions treated within 60 days [25]. Dermatologists have even reported being able to detect and treat melanomas earlier in a study focusing on the use of TD for rural veterans [24••].

Timeliness of Care: Teledermatology for Urban, Underserved Populations in the USA

Even in areas with a high dermatologist density, TD improves the timeliness of dermatologic care with high levels of provider satisfaction [7, 27•, 30•]. Studies looking at the impact of TD platforms on safety-net healthcare systems found that the wait times for FTF appointments decreased by almost half [26, 27•]. More significant reductions were seen when comparing the time to evaluation between FTF care and SF TD [27•, 42]. In certain studies, TD has even decreased the median time to treatment from 74 to 3 days [42] and reduced the waiting times for new patients from 85 to 7 days [30•].

Timeliness of Care: Teledermatology for Global, Underserved Populations

Reductions in wait times have also been found following the implementation of TD programs in LMICs [40, 43, 44]. Remarkably, in a WhatsApp discussion group of 80

Argentinian dermatologists and one American psoriasis specialist, 79% of questions were answered by the specialist within 5 min and significant improvements were seen in patient outcomes [44]. Additionally, in a pilot SF program in Mali, the average time to receive the dermatologist's response was 32 h [40]. Another study found that the time to diagnosis was 50% longer for TD cases that required a FTF visit with a dermatologist, highlighting the timeliness of virtual care when used alone [43].

Overview of Best Practices and Barriers: Teledermatology for Rural USA, Urban USA, and Global Underserved Populations

Despite the many benefits of TD, there are major obstacles to its widespread use, especially among populations with the greatest need for remote care. In high-income countries, concerns about TD often center around patient privacy and reimbursement issues, while in LMICs, implementation barriers are related to limited resources, underdeveloped infrastructure, and lack of technical expertise [45]. More specifically, with the digital divide, access to virtual care is not equal across location, age, race, ethnicity, and income. In 2019, 31% of people residing in rural areas of the USA lacked access to a computer and 37% lacked broadband internet [46]. In the same year, 27% of people in urban areas lacked access to a computer and 25% lacked access to broadband internet [46]. Furthermore, the ratio of Medicare beneficiaries lacking digital access to telemedicine is higher among patients over 85 years of age, communities of color, and those of low socioeconomic status [47].

Implementation of Best Practices and Barriers: Teledermatology for Rural Populations in the USA

While there are certainly patient-related factors limiting the adoption of TD, there are also operational factors impeding the use of TD in primary care clinics. A recent study on the perceptions of TD among rural PCPs found concerns related to the accuracy of SF models, despite the plethora of research showing high levels of diagnostic concordance between FTF visits and remote care [48]. Education on the clinical effectiveness of TD may dispel such fears and improve the uptake of TD in rural settings. Furthermore, the majority of concerns in this study were related to the time required to master TD technology, establish digital links between primary care providers and consultants, and submit a TD consult [48]. A previous study focusing on rural veterans suggested that TD programs can improve provider satisfaction by prioritizing simple workflows, effective communication between PCPs and dermatologists, and fast turnaround times [49]. More recent studies, as outlined below, support that increasing funding and diversifying healthcare staffing may also improve the efficacy of TD programs.

One study that looked at the effects of funding on a large-scale TD initiative for rural veterans found that the use of TD increased at a faster rate at sites where dermatologists were paid to read consults, compared to non-funded sites [24••]. Furthermore, funded sites were more likely to serve patients who were more remotely located, consistent with the program's goals of serving rural patients [24••]. In this study, communication between dermatologists and PCPs was the most commonly reported implementation facilitator, while understaffing was the most commonly reported implementation barrier [24••]. Overall, additional health care staffing and funding may be required if TD usage continues to expand.

Implementation of Best Practices and Barriers: Teledermatology for Urban, Underserved Populations in the USA

A clinic in San Diego that provides free care to urban, underserved communities discussed the necessity of having information technology staff members to set up calls and resolve technical difficulties when using RTTD [50]. This was essential to conducting successful visits, especially for patients with low digital literacy who were logging into a visit for the first time [50]. Furthermore, remote access to interpreters was necessary for communication with non-English-speaking patients [50]. Another study in an urban, underserved setting found that automating PCP processes with standardized TD consult forms improved management concordance between PCPs and dermatologists by 117% and reduced FTF referrals by 15% [51••]. Future research should focus on determining the minimum amount of data required for standardized templates to remain effective, in order to reduce PCP workload.

Earlier studies have cited barriers specific to TD interventions in disadvantaged, urban communities, such as pharmacy restrictions and limited resources to perform basic dermatologic interventions in busy community clinics [52]. A paper looking at telemedicine perceptions in African American and Latino patients found concerns were primarily related to having less privacy and interaction with the physician [53]. It is important to consider these challenges and perspectives when using telemedicine with groups disproportionately affected by lower access to healthcare.

Implementation of Best Practices and Barriers: Teledermatology for Global, Underserved Populations

The implementation and maintenance of TD initiatives alone can cost a substantial amount of time and money, contributing to the inconsistent uptake of the technology in LMICs [2]. Furthermore, the success of TD programs is limited in areas where a lack of available treatments may prevent healthcare workers from acting on recommendations. In communities plagued by widespread, deadly health conditions, it can be challenging to advocate for non-fatal chronic illnesses, including dermatologic conditions, despite their impact on quality of life [54]. Oftentimes, healthcare workers in frontline facilities focus their resources on programs relating to the prevention of fatal diseases such as tuberculosis, malaria, and HIV/AIDS [40].

Conclusion

All in all, recent studies support that TD is an accurate tool for diagnosing and managing skin conditions, allowing it to improve the timeliness of care and reduce the distance needed to travel in resource-limited communities. Other benefits of TD include its ability to decrease the costs of healthcare and improve local providers' knowledge of dermatologic conditions. However, there are significant barriers to the extensive use of TD, particularly in low-income and rural communities. In order to be most effective, TD programs should be tailored to the challenges faced by the local community. For example, patients lacking access to high-speed internet and digital technology may benefit more from SF models facilitated by local clinic providers, than RTTD models. Moreover, reducing the steps to connect, providing simple instructions, and offering audio-only calls may help patients with low technology literacy effectively use RTTD [18•, 55]. In contrast, in populations where technology is not a limiting factor, there is some evidence that RTTD models with video visits and supplemental uploaded images may optimize patient preferences for direct interaction with providers and dermatologists' ability to accurately diagnose and treat skin conditions [9, 10••, 18•].

In summary, the literature reviewed in this study suggests that all TD programs, regardless of setting, may benefit from increased funding, additional healthcare staffing, and formalized education programs. In some rural environments, educating PCPs on the diagnostic accuracy of TD may improve the adoption of the technology [48], and in urban, underserved environments, some patients may require additional outreach and support for follow-up, in-person care [27•]. Future efforts should focus on increasing the reach of existing telehealth networks and developing simple, inexpensive platforms that minimize data usage and streamline the consult submission for referring providers.

Compliance with Ethical Standards

Conflicts of Interest The authors declare no competing interests.

Human and Animal Rights All reported studies/experiments with human or animal subjects performed by the authors have been previously published and complied with all applicable ethical standards (including the Helsinki declaration and its amendments, institutional/national research committee standards, and international/national/institutional guidelines).

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