Clinical interventions aimed at expanding access to dermatologic care

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Abstract

In the United States access to healthcare continues to be a major issue. Although "top down" public policy approaches hold promise for expanding access, a lack of political consensus has hindered progress. A review of the literature was conducted to investigate the efficacy of clinical interventions aimed at expanding access to care from the "bottom up." The greatest improvements in access to care over the past decade have harnessed teledermatology, shared care, appointment scheduling strategies, and team-based care. Optimization of these approaches will require additional population-based, dermatology-specific research. It is clear that dermatologists, using a "bottom up approach," can significantly expand access to care in their communities in a manner that is economically viable and maintains quality of care and patient satisfaction.

Keywords: dermatology, access to care, efficiency, teledermatology, shared care, appointments, scheduling, team-based care

Introduction

Improving access to health care is a major issue across the globe and is rooted in ethical goals. [1-3]. Most physicians choose their career because of a desire to help others, and the underserved among us need our help [4,5]. Although free and low-cost clinics provide care to patients in some countries, the vast majority do not offer dermatology services [6,7]. Mandated care in emergency rooms has provided

Abbreviations:

ABCD criteria	Acronym describing characteristics of a skin lesion: asymmetry, borders, color, diameter
AHT	Average handling time
DTC	Direct to consumer
INDERMA	Instituto de dermatología y cirugia de piel
EHR	Electronic health record
ICC	Intermediate care clinic
IQR	Interquartile range
LPN	Licensed practical nurse
MA	Medical assistant
MPC	Mean provider consensus
NHS	National health service
NP	Nurse practitioner
PA	Physician assistant
PCP	Primary care physician
PICC	Patient initiated care consultation
PLC	Pigmented lesion clinic
RCA	Regular clinic appointment
RN	Registered nurse
SAF	Store-and-forward
SFT	Store-and-forward teledermatology
SMA	Shared medical appointment
TBC	Team-based care
TTR	Time to response
UAT	Urgent access tract
UCC	Urgent care clinic
VA	Veterans administration
WT	Waikato teledermatology

free care to those who remain uninsured, but preventive care, follow-up care, early treatment, and dermatologic care are difficult to provide in this setting.

Solutions to expand access to health care may be described as "top down" or "bottom up." "Top down" solutions describe public policy enacted by federal and state governments to increase access to health care. "Bottom up" solutions describe clinical interventions physicians can take to expand their services to a greater number of patients. Examples of "top down" solutions include subsidies for primary care clinics in underserved areas, scholarships or debt forgiveness programs for medical students in exchange for working in an underserved area, or incentives for physicians to work in free clinics such as protection from malpractice. More recently, some governments have effectively expanded access by passing laws that require payment for teledermatology at in-office visit rates [8].

Although political gridlock may stymie "top down" solutions, some dermatologists have attempted "bottom up" approaches to address problems of access to care. A review of the "access to care" literature was performed and the following attempts at expanding access to care were identified. These attempts included the provision of care in underserved areas through "store and forward" teledermatology, the establishment of outreach clinics, and the training of dermatologists with a commitment to rural or inner-city practice. Other interventions aimed to provide dermatologic care to greater numbers of patients through shared care, appointment scheduling strategies, and team-based medical care.

Methods

A comprehensive review of the published literature pertaining to access to dermatologic care was performed with the Embase and PubMed databases. Two independent reviews of the literature were conducted via the following methods. Embase was searched using the following search terms: (dermatology OR teledermatology) AND (health care access OR access to care). PubMed was searched using the following MeSH terms: (access to health care AND dermatology). The process of the review is outlined in **Figure 1**, along with exclusion and inclusion criteria. Search results from Embase and PubMed yielded 701 distinct articles. An additional 10 papers were added to the review by a subject matter expert. Exclusion criteria eliminated papers that were published prior to 2000, were not published in the English language, or did not contain primary source material. Inclusion criteria required that papers had to 1) describe a clinical intervention aimed at expanding access to dermatologic care, and 2) measure the clinical intervention's effect on patient access. After reviewing the literature by these methods the remaining papers were organized into four categories for qualitative synthesis, as they are presented in the following results section. The diversity of clinical interventions and strategies used to measure the efficacy of these interventions precluded a quantitative synthesis or meta-analysis from being performed. Finally, articles that were excluded from the review because they lacked a measured clinical intervention but that provided information related to the feasibility of the various clinical interventions were included in the discussion section.

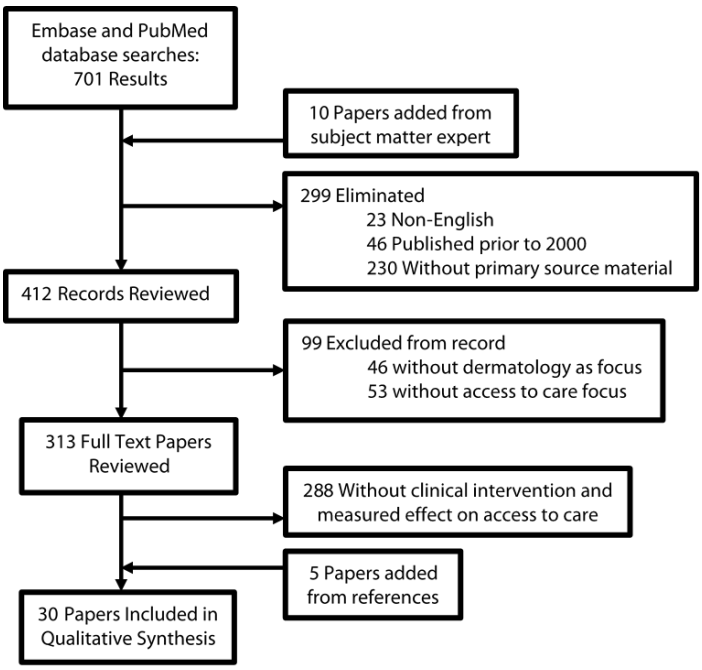

Figure 1. *Literature review methods with description of exclusion and inclusion criteria.*

Results

Clinical interventions affecting access to care are organized into four categories and are summarized in Table 1.

Teledermatology

Store-and-forward teleconsultation facilitates expedited access to initial evaluation by a dermatologist [9-20]. For patients that ultimately need an in-person appointment, teledermatology acts as a more efficient conduit to face-to-face care, reducing the waiting time from referral to initial face-to-face visit [9,11,13,14,16,18,20,21]. Biopsies and surgeries for lesions needing investigation or excision can occur faster via a teledermatology referral process [14].

In a public safety-net hospital setting in Texas, teledermatology increased the percentage of consults that received dermatologist evaluation from 64% to 83% [12]. Teledermatology consultation through primary care physicians (PCPs) drastically increased the number of patients who accessed dermatologic care in 11 underserved clinics in Philadelphia; 61% of consults would have otherwise failed to receive dermatology input [19]. In a large California Medicaid managed care plan, it has also contributed to an increase in the percentage of Medicaid enrollees able to access care, especially for the newly enrolled [22].

Shared care

Liu et al. measured the efficacy of two algorithm-based acne treatment plans used by primary care physicians (PCPs). The plans only involved initiation of topical treatments and eliminated 40% of referrals, decreased average delay-to-treatment by 28.6 days, shortened average wait time by 5 days, and decreased the no-show rate by 13%. Adding oral antibiotics to the algorithm eliminated an additional 32% of cases, further decreased average delay-to-treatment by 0.7 days, shortened wait time by four more days, and decreased the no-show rate by an additional 11% [23].

McFarland et al. found an education and skills program to greatly expand the scope of practice of PCPs. Consequently, these PCPs increased the frequency with which they could effectively and safely do punch biopsies, shave biopsies, electrocautery, and excisions, increasing the percentage of patients who had their dermatologic care provided at their local clinic from 39% to 85% ($P<0.01$), [24]. Similarly, a study in England by Salisbury et al. found one PCP with special interest in dermatology to provide adequate dermatologic care with average wait times 40 days fewer than those of the local hospital dermatology clinic [25].

Appointment scheduling strategies

Rapid access clinics have expanded access to dermatologic care in three different settings. First, Anderson et al. found that a rapid access clinic—in which patients (with or without referral) were able to successfully schedule an appointment anytime between two weeks ahead of time to the same day of the appointment—was able to provide care in an area in which a clinic's new and established appointments had to be scheduled four and two months ahead of time, respectively [26]. Next, Lipworth et al. reported that a pigmented lesion clinic at Massachusetts General Hospital was able to provide appointments for patients at high risk for melanoma and educated them to recognize early signs with care within 7 days of appointment request compared to a mean wait time of 73.4 days in the community [27]. Most recently, Jayakumar et al. described how urgent and intermediate care clinics at the University of Pennsylvania were able to provide care in three and 36 days, respectively, compared to a 45 day wait time for routine care. Patients were triaged into the urgent, intermediate, and routine care clinics based on information from referring providers [28].

Knackstedt et al. found shared medical appointments (SMAs), during which a group of patients with similar conditions share an appointment, for preoperative Mohs surgery consultations to increase average attendance from 6 to 7.1 per 90-minute clinic session [29]. Prior to that, Sidorsky et al. measured an increase in the rate of dermatology patient visits by 1004 additional visits per year, a rate of increase greater than experienced by any other medical specialty. The majority of these visits were for routine skin checkups but also included evaluations for single lesions, nonsurgical facial rejuvenation, or teenage acne [30].

Siddiqui et al. showed that non-attendance rates for appointments scheduled by the patient online were much lower (6.9%) than for those scheduled by traditional means (17-31%), [31]. Cronin et al. studied the effect a system that algorithmically generates double-booking recommendations based on patients' histories of missed appointments. They discovered that clinic sessions for patients randomized to the "Smart-Booking" group yielded more patient visits (15.7 versus. 15.2 visits, P=0.014) without physicians feeling busier [32].

Khoury et al. found that patients with well-controlled psoriasis randomized to a patient-initiated care consultation group—in which they had annually scheduled consultations but were able to initiate a visit sooner if needed—requested 63% fewer consultations than the traditional group that attended follow-up appointments every 12-16 weeks (P=0.001) and had significantly fewer no-shows (P=0.003), [33]. By analyzing different combinations of 28 clinical interventions at 18 clinics, Rouppe van der Voort et al. determined that clinics were able to decrease average wait time by 55% from 47 to 21 days. The most frequently adopted interventions included: not allowing patients to cancel sessions within 6 weeks of a scheduled appointment, proactively filling empty slots by daily scanning, introducing patient-initiated care consultations, combining diagnostic appointments, performing more follow-up by telephone, having no personal pager during sessions, and delegating activities to nurses, nurse practitioners (NPs), physician assistants (PAs), or medical assistants [34].

Team-based care

Over 12 months, Nambudiri et al. found that medical scribes allowed dermatologists to cut the amount of time spent on documentation in half from 6.1 to 3.0 minutes of documentation per patient, which could allow dermatologists to care for more patients per clinical session [35]. Kindley et al. demonstrated a 30% increase in patient visits completed over an 8-month period with the addition of a second LPN/RN to a dermatologist's clinic team [36].

O'Brien et al. measured the combined effect of 5 clinical interventions at a dermatology clinic in a safety net health system. Over almost 3.5 years, the clinic began (1) discharging patients with stable, low-acuity skin problems from clinic to follow-up with their PCPs, (2) changing scheduling templates by establishing goal numbers of new and established patients per clinic to increase schedule consistency, (3) hiring one additional nurse and extending work shifts of support staff, (4) designating a resident and nurse to perform biopsies for the whole clinic, and (5) hiring a PA. The combined effect was a drastic decrease in wait times for new and established patients from 377 to 48 days and 95 to 34 days, respectively, despite a 10% increase in referrals to the clinic over this time period [37].

Discussion

Delivering care to underserved areas

Teledermatology

Teledermatology has been shown to provide clinically useful images that can be reliably interpreted in all Fitzpatrick skin types while saving patients time and money for travel to the doctor [38-46]. It is particularly helpful in underserved populations [44,47,48]. Although our results unanimously demonstrate that teledermatology improves access to dermatologic care in various settings, there are a number of barriers to provision of these services to underserved populations. These include: 1) teledermatology care is not reimbursed in all states; 2) the cost of initiating technology is high; and 3) primary care physicians in rural areas seeing large numbers of patients may choose not to initiate a teledermatology referral.

Finally, direct-to-consumer (DTC) teledermatology offers a method of providing care to underserved individuals with access to the internet. Of course, patients need a credit card and problems have been identified that relate to oversight of DTC teledermatology. In a study of 62 clinical encounters at 16 DTC sites, 42 (68%) patients were assigned a clinician without any choice. Only 16 (26%) of physicians disclosed information about their licensure. In many circumstances, relevant adverse effects or pregnancy risks were ignored and primary care physicians did not receive consultative reports [49].

Local outreach clinics
Individual dermatologists may choose to regularly dedicate time to serve in inner city or rural clinics as volunteers or with minimal reimbursement [50,51]. Universities value these services since the health care of all citizens is often part of their mission. For example, at the University of Mississippi School of Medicine all 13 providers who practice in Jackson rotate through a rural clinic in the underserved Mississippi Delta, whereas one physician practices full-time in another rural, underserved area of the state [52].

Delivering a greater volume of dermatologic care
Shared care
In the United States, for example, a growing primary care access problem in rural areas has been demonstrated by Association of American Medical College (AAMC) data [53]. In fact, by 2025 the demand for primary care physicians will exceed supply and cause a national shortage. At the same time, the supply of nurse practitioners and physician assistants in primary care is expected to exceed demand [54]. With proper education, their skills can be harnessed to care for common skin problems. In fact, skin disease accounts for one-eighth of primary care visits and shared care models for dermatological disease are a natural extension of current practice [55]. Acne in particular remains a common indication for referral to a dermatologist despite good diagnostic concordance between patients, PCPs, and dermatologists [56,57]. Logical treatment algorithms for acne are found in both the primary care and dermatology literature [58-60].

Of course, quality must be maintained in shared care. In one acne study, 42.3% dermatologist-treated patients remained acne free, whereas only 28% pediatrician-treated patients were acne-free [61]. Thus, dermatologists will continue to play an important role in treating acne. Shared care that empowers primary care practices to manage common skin conditions with a plan for continuous quality improvement is an important component of any plan to improve overall access while reducing wait times [23].

Appointment scheduling strategies
The establishment of rapid access clinics represent the most thoroughly studied appointment scheduling strategy in dermatology. Relationships with primary care practices are built to enable triage of patients into urgent, intermediate, and routine care tracks. SMAs may be helpful in efficiently educating patients. Educational benefits attributed to SMAs are likely owing to longer patient contact (20-40 minutes plus an optional, brief individual consultation) when compared to individual appointments (10-20 minutes). In addition, SMA visits often involve presentations with audio/visual aids to improve patient comprehension [29,62,63]. Since the 1990s, this model of practice has been tested in several fields of medicine and it has generally demonstrated significant improvement in the quality of care, patient satisfaction, and practice efficiency [29,64]. It is even possible for four SMAs per week, each focused on a separate dermatologic illness, to produce an increase yearly profit of $209,132 [30].

Patient-initiated care consultations require patients to schedule their new appointment when needed rather than scheduling appointments at a specific interval when the visit may not be needed. Smart-Booking algorithms used in this system require staff training [32]. Online scheduling of appointments can be quickly utilized by some patients, but the option to schedule by phone should still be available.

Team-based care
In the team-based care (TBC) model, individuals with various levels of training work in concert to improve efficiency without sacrificing quality of care. Physician assistants and nurse practitioners can be trained to provide protocol-based care for their own panel of patients. The American Academy of Dermatology DermCare™ team approach to advanced practice providers (APPs) is an attempt to codify this supervision [65]. Having a dermatologist in the hallway with PAs and NPs allows immediate support and educational feedback that is difficult if these providers are staffing a distant clinic. New APPs should be assigned a single mentoring provider to take personal responsibility for that provider's training; this strategy avoids the diffusion of responsibility that occurs when all pre-existing providers at a clinic jointly assume the role of supervisor [66].

Team-based care is economically viable. Physician assistants in dermatology practices were able to generate revenue that was three-to-five times greater than their average annual income [67]. The ratio of billings generated to gross income for an experienced PA ranged from 3:1 to 6:1, with a first-year PA's ratio at a minimum of 2:1 [68]. Other medical specialties have demonstrated that adding APPs increased physician efficiency, decreased visit length, increased number of patients seen, and decreased wait time [69-74].

Of course, the team is bigger than just physicians and APPs. Team-based care also involves restructuring nursing schedules, expanding the roles of medical assistants and licensed practical nurses (LPNs), and using scribes to assist in Electronic Health Record (EHR) documentation. These physician "helpers" can also deliver primary education "scripts" after the dermatologist leaves the room to solidify patient knowledge about their condition, such as use of moisturizers for eczema patients, proper application of tretinoin, and reinforcement of proper medication use. By delegating various tasks to their medical assistants, the Cleveland Clinic demonstrated a 20% increase in productivity, a 23% increase in gross patient revenue, a significant increase in patient and physician satisfaction, and an addition of four patients per half-day schedule in a primary care setting [75].

Conclusion

Dermatologists can expand access to care in underserved areas through telemedicine and rural outreach clinics. In addition, training residents whose life goal is to practice in rural areas will positively influence this endeavor. When wait times indicate a local access to care problem, efforts to increase efficiency through shared care, appointment scheduling strategies, and team-based care can be instituted. Evidence supports the cost effectiveness of these approaches and each can be implemented from the "bottom up." Each dermatologist should consider the options that best suits their own unique access issues. Of course, we would not recommend that any dermatologist or group of dermatologists incorporate all these programs at once; doing so might dilute efforts to effect substantial change in any one area. Population-based, dermatology-specific research in these areas is required for us to better judge the impact of these efforts in the future.

Potential conflicts of interest

The authors declare no conflicts of interests.

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Table 1. *Clinical interventions with measured outcomes associated with access to dermatologic care.*

Reference (Year), Country	Objective	Methods or Intervention	Results	Conclusion
TELEDERMATOLOGY (13 Results)				
Carter et al (2017), [12], USA	To develop a store-and-forward (SAF) workflow within the Epic system, assess its effectiveness in improving access to care, and validate its reliability	Electronic consults were independently evaluated by 2 dermatologists, who provided diagnoses and treatment plans to primary care physicians (PCPs). Results were compared with in-person referrals from May to December 2013 from the same clinic (a community outpatient clinic in a safety-net public hospital system)	79 teledermatology consults were placed by 6 PCPs from an outpatient clinic between May and December 2014. Teledermatology reduced median time to evaluation from 70.0 days to 0.5 days and median time to treatment from 73.5 days to 3.0 days compared with in-person dermatology visits. A greater percentage of patients (83.3%) were evaluated by a dermatologist through either teledermatology or in-person during the 2014 study period compared with the previous year (64.2%). PCPs followed management recommendations 93% of the time	Epic-based SAF teledermatology can improve access to dermatologic care in a public safety-net hospital setting
Chansky et al (2017), [11], USA	To evaluate the effect that a store-and-forward teledermatology triage system in an underserved clinic has on expanding access, reducing time to dermatologist evaluation, and optimizing use of in-person appointments in a resource-limited setting	Retrospective evaluation of all teledermatology consultations submitted at an underserved clinic in Philadelphia from January 1, 2014 to July 1, 2016	Mean (1.4 days) and median (6.3 hours) wait times to teledermatology response by an attending dermatologist was significantly shorter than time to next dermatology clinic (14.4 days), ($P<0.0001$). 42 (70%) of 60 cases were triaged by dermatologists as sufficiently managed by teledermatology alone, reducing mean time to evaluation in clinic by 12.9 days. The teletriage system saved an average of 1.4 of 8 appointments per month, increasing in-person appointment availability by 18%	Teledermatology is an effective triage system in a resource-limited community health clinic, improving access to dermatologic care by shortening wait times, allocating in-person appointments based on acuity and complexity, and providing an opportunity for volunteer dermatologists to have an impact on the health of an underserved population
Naka et al (2017), [20], USA	To evaluate the impact of implementing a teledermatology consultation program with dermoscopy on a statewide scale, focusing on access to care and	Descriptive retrospective cohort study of 2385 dermatology referrals from primary care from June 2014 through November 2015. There were 2 comparison groups: patients referred to dermatology during the 6 months before implementation of eConsults	Before implementation, only 139 (11%) of 1258 referrals resulted in a confirmed appointment with a median wait time of 77 days. After implementation, 499 (44%) of 1127 consults were sent electronically; of those, 16% required a face-to-face visit with a median wait time of 28	eConsults increase access to dermatologic care and reduce wait times for patients receiving medical care at community health centers. Implementing dermoscopy into

	skin cancer screening for medically underserved populations	and patients referred during the 6-month period after eConsult implementation	days. Overall consult volume remained stable pre- and post-eConsult implementation	teledermatology could increase access to skin cancer screening and treatment for medically disadvantaged populations
Nelson et al (2016), [19], USA	To determine the impact of teledermatology on outpatient diagnosis, management, and access to dermatologic care in a resource-poor primary care setting	Prospective study of store-and-forward teledermatology consults submitted between January and November 2013 from 11 underserved clinics in Philadelphia to the University of Pennsylvania using mobile devices and the internet. Diagnostic and management concordance between PCPs and dermatologists, time to consult completion, anticipated level of dermatology input in the absence of dermatology, and number of consults managed with teledermatology alone were assessed	Diagnoses and management plans of PCPs and dermatologists were fully concordant for 22% and 23% of conditions, respectively. Median time to consult completion was 14 (IQR 3-28 hours). At least 61% of consults would not otherwise have received dermatology input, and 77% of consults were managed with teledermatology alone	Teledermatology is an innovative and impactful modality for delivering dermatologic care to outpatients in resource-poor primary care settings
Raugi et al (2016), [18], USA	To assess the impact of the implementation of store-and-forward teledermatology on access to face-to-face dermatology at the Mann-Grandstaff Spokane VA Medical Center	Completed requests for dermatology and teledermatology consultation originating from the Spokane main facility from January 1, 2012 through June 30, 2013 were obtained. The numbers of consult requests and wait times for care for overall dermatology, face-to-face dermatology, and teledermatology were compared across the baseline, transition, and intervention periods	Within 6 months of implementation, the total number of requests for dermatology services increased by 40%. Access to face-to-face dermatology care improved, with a decrease in the duration of the interval between consultation request and consultation completion from a mean of 64.2 days to 20.3 days; overall access to dermatology (teledermatology and face-to-face dermatology) care improved with a decrease in the duration of the same from a mean of 61.2 days to 10.3 days	Implementation of a teledermatology program at the Mann-Grandstaff Spokane VA Medical Center improved access to face-to-face dermatology care
Sharma et al (2016), [17], USA	To determine if teledermatology can be used as a means to improve access to inpatient dermatology care	Prospective two-phase pilot study at two academic hospitals comparing time needed to complete inpatient consultations after resident dermatologists initially evaluated patients, called average handling time (AHT), and time needed to respond to the primary team, called time to response (TTR), with and without teledermatology	The mean AHT with use of teledermatology was 26.9 minutes compared to the baseline AHT of 43.5 minutes, a 16.6 minute reduction (P=0.004). 10 of 25 consultations were sufficiently answered by teledermatology alone and had a mean TTR of 273.3 minutes compared to the baseline TTR of 405.7 minutes,	Teledermatology can improve access to inpatient dermatology care by reducing the time required by dermatologists to complete inpatient consultations and by decreasing the time needed for a primary team to receive a

			a 132.4 minute reduction (P=0.032)	response from an inpatient dermatology consultation
Uscher-Pines et al (2016), [22], USA	To evaluate the effect of teledermatology on the number of Medicaid enrollees who received dermatology care	Claims data from a large California Medicaid managed care plan that began offering teledermatology as a covered service in April 2012 were analyzed. Rates of dermatology visits by patients affiliated with primary care practices that referred patients to teledermatology and those that did not were compared. Data were collected from April 1, 2012 through December 31, 2014	In a model adjusted for age, sex, race/ethnicity, and time enrolled from the period before teledermatology to the period after, the percentage of Medicaid enrollees with 1 or more visits with a dermatologist (including in-person and teledermatology visits) grew from 1.2 to 1.9% in teledermatology user practices and from 1.2% to 1.5% in nonuser practices, yielding a statistically significant growth rate difference of 63.8% versus 20.5%	Teledermatology improved access to dermatologic care among Medicaid enrollees and played an especially important role for the newly enrolled
Bezalel et al (2015), [16], USA	To evaluate the effect of implementation of store-and-forward teledermatology (SFT) on patient access in a Veterans Affairs dermatology clinic	Retrospective study of clinical database for percentage of no-shows, average new and established patient wait times, capacity, and percentage of new patients being seen within 30 days. Variables were compared for 2 time intervals—January 1 through May 31, 2012 (when SFT was not being heavily used) and January 1 through May 31, 2013 (when SFT was fully implemented)	There was a significant decrease in the percentage of no-shows (7.91% to 6.16%, P<0.002) and new patient wait times (32.9 days to 9.75 days, P<0.001) between the two time periods. No significant decrease was found for established patient wait times (4.14 days to 1.49 days, P=0.37) or clinic capacity, defined as the sum of appointment slots allocated to a given clinic or location (1612.6 to 1722.8, P=0.29). No statistical difference was found for change in capacity across the two time intervals	SFT may improve patient access to main dermatology clinics by decreasing the percentage of no-shows and the average wait time for new patients
McGoey et al (2015), [15], New Zealand	To evaluate the value of a store-and-forward teledermatology network and its effect on patient access to dermatologic services in a country in which dermatologists are scarce, especially in its public health system	Retrospective review of the first 12 months of Waikato Teledermatology (WT), a low-cost, store-and-forward teledermatology network. Specialist response time, referral metrics, patient diagnosis and progress reports from the network's database were determined	Mean and median dermatologist response time to consultations from general practitioner were 2.07 hours. Referrals were categorized as tumors (56.8%) and rashes (43.2%), including inflammatory dermatoses (51.9%), infection (18.1%), uncertain (16.5%), miscellaneous (7.5%), and of environmental origin (6%). Of 30 tumors biopsied, 9 were melanomas and 3 were basal cell carcinomas. Response times are in comparison to	WT effectively and acceptably expanded patient access to dermatologic care in a health care system of mixed public and private health care services

			routine wait times for an initial appointment of 4 months in the public sector and 1 to 6 months in the private sector in New Zealand	
Hsiao et al (2008), [14], USA	To measure the time intervals in which skin cancer patients referred conventionally or by store-and-forward teledermatology were evaluated, diagnosed, and treated	A retrospective chart review of patients over a 4.5 year period who were treated for skin cancer in a VA medical center's dermatologic surgery clinics as a result of conventional or teledermatology referral from 3 remote primary care clinics	For teledermatology and conventional referrals, respectively, mean time intervals for initial consult completion were 4 and 48 days (P<0.0001), for biopsy were 38 and 57 days (P=0.034), and for surgery were 104 and 125 days (P=0.006)	Access to timely skin cancer management via teledermatology can be achieved with shorter times to evaluation, diagnosis, and treatment
Moreno-Ramirez et al (2007), [13], Spain	To evaluate the ability of a store-and-forward teledermatology system to triage patients with skin cancer	A multicenter, longitudinal, 4-phase, descriptive and evaluation study of a referred sample of 2009 patients through teleconsultation between March 2004 and July 2005. Waiting intervals for teledermatology compared to a letter referral system were measured. The study population included patients with circumscribed lesions with one of the following: changes in ABCD criteria, recent history, multiple melanocytic lesions, symptoms, or application or surgical treatment and concern about moles	Teleconsultation reports were available to the PCP in a mean time of 61.06 hours. Subsequent mean waiting intervals to attend clinic were 12.31 days through teledermatology. Mean wait times were 88.62 days for the traditional letter referral system	Store-and-forward teledermatology can expedite and expand access for routine management of patient referrals in skin cancer and pigmented lesion clinics
Klaz et al (2005), [10], USA	To assess the clinical efficiency of a pilot store-and-forward teledermatology service implemented in primary clinics	A multi-center prospective uncontrolled cohort pilot trial was conducted over a 6 month time period in which PCPs referred patients to dermatologists using text email with digital photographs, and patient wait times and patient satisfaction were measured	Over 6 months, 435 patients were processed by store-and-forward teledermatology. The average patient wait time was 65 working hours, which was a 50% shorter wait time compared to time required to see a local dermatologist for a face-to-face appointment. 89% of patients rated their satisfaction level with the service as high or very high	Store-and-forward teledermatology services can increase access to care by increasing efficiency, reducing wait times, and maintaining patient satisfaction
Whited et al (2002), [9], USA	To determine if a store-and-forward teledermatology consult system resulted in shorter wait times from referral date to date of initial	Patients were randomized to either a teledermatology consultation or usual care. Time to initial definitive intervention was measured and defined as the time between the referral date and the date the patient was scheduled for a clinic visit (for	Patients benefiting from teledermatology reached a time to initial definitive intervention significantly sooner than did those who randomized to usual care (median 41 days versus 127 days, P=0.0001)	Significantly shorter wait times to initial definitive intervention can be achieved using a teledermatology consult system when compared to

	intervention when compared to a traditional referral process	patients whose consultant requested a clinic-based evaluation) or the time between the referral date and the date the consult was answered by the consultant (if a clinic visit was not required)		traditional consult modalities
INTERNATIONAL OUTREACH (2 Results)				
Lipoff et al (2017), [76], USA and Guatemala	To assess the effectiveness of a dermatology global health outreach and residency partnership program between the University of Pennsylvania and Guatemala	Review of patient visits at multiple outreach clinics established by a partnership between the University of Pennsylvania and the Instituto de Dermatología y Cirugia de Piel (INDERMA) surrounding Lake Atitlán, a rural area in Guatemala that is home to an indigenous Mayan population with limited access to care	Over 3 years, 8 clinic sites supported 1046 patient encounters. Common diagnoses included atopic dermatitis, scabies, verruca vulgaris, and acne, while rare diagnoses included anhidrotic ectodermal dysplasia, xeroderma pigmentosum, and lamellar ichthyosis. 57 procedures were performed. Over the counter medications and compounded prescriptions were provided by Penn and INDERMA, and medications were donated to a local pharmacy for patients to receive throughout the year	With adequate funding, it is possible to connect 2 international dermatology programs while working to increase access to care for particularly underserved communities through outreach clinics. Notably, long term goals of the partnership include establishment of telemedicine to connect local Guatemalan dermatologists to isolated communities
Rao et al (2014), [77], USA and Dominican Republic	To determine the efficacy of a privately organized dermatology mission to the Dominican Republic	In April of 2013, a 2 day clinic was arranged in an area with access to acute care at a nearby hospital but without access to basic skin care. A volunteer team was assembled that included a dermatopathologist, 2 bilingual medical assistants, a surgical assistant, a high school student, and 2 local persons who served as translators	During a 2 day mission, 279 patients were evaluated and treated. 24 patients required a surgical procedure (e.g. biopsy, excision). Conditions that were most common included eczema (29%), dermatophytosis (15%), acne (12%), dyspigmentation (10%), folliculitis (6%), and psoriasis (6%)	With adequate resources and support from the local community, short-term, privately organized dermatology missions can be successful in providing care to developing countries that lack access to basic dermatologic care
SHARED CARE (3 Results)				
Liu et al (2016), [23], USA	To model the effect of algorithm-based acne treatment by PCPs on referral patterns and costs	Retrospective chart review of 253 referrals from PCPs to dermatologists for acne from January 2014 through March 2015. No-show rate, diagnostic concordance between PCPs and dermatologists, treatment at the time of referral, and treatment by a dermatologist were ascertained; 2 treatment	Algorithm A reduced initial referrals in 72 of 150 cases (48.0%), eliminated referrals in 60 of 150 cases (40%), and reduced average delay-to-treatment by 28.6 days, resulting in a cost savings of $20.28 per patient, reduction of wait time by 5 days per patient, and decreased the no-show rate by 13%.	Algorithm-based treatment of acne by PCPs eliminates unnecessary appointments, reduces wait time for treatment, lowers costs, and reduces patient no-shows

		algorithms were modeled—initiation of topical treatments by PCPs (algorithm A) and initiation of topical treatments and oral antibiotics by PCPs (algorithm B)—to identify the most effective referral patterns and costs	Algorithm B reduced initial referrals in 130 of 150 cases (86.7%), eliminated referrals in 108 of 150 cases (72%), and reduced average delay-to-treatment by 27.9 days, resulting in a cost savings of $35.68 per patient, shortened wait time by 9 days per patient, and decreased no-show rate by 24%	
McFarland et al (2012), [24], USA	To evaluate the impact of implementation of an education and skills program in a teledermatology project for rural veterans	A teledermatology program aimed at training primary care providers and imaging technicians was implemented with the following five components: (1) initial training, (2) continuing education, (3) developing patient care plans, (4) basic surgery skills training, (5) competency assessments. After 1 year, analysis of changes in clinical practice patterns from baseline was performed	Primary care providers greatly expanded their scope of practice to include punch biopsies (94%), excisions (94%), shave biopsies (88%), and electrocautery (76%). The mean number of procedures performed increased from 14.7/month (mostly liquid nitrogen procedures) to 20.5/month (including biopsies and excisions, P=0.01). By the end of the first year of implementation, significantly fewer veterans were referred to distant facilities or private fee-for-service physicians (15% versus 61% at baseline) and the percentage who had their dermatology care provided at their local clinic by trained VA providers increased from 39% to 85% (P<0.01)	Education and skills programs in a teledermatology project can increase the scope of dermatology practice of rural providers so that underserved patient populations have better access to dermatologic care in areas were dermatologists are scarce
Salisbury et al (2005), [25], England	To assess the accessibility of a PCP with special interest in skin problems compared with a hospital dermatology clinic	Adult patients with non-urgent skin problems that were referred to a hospital dermatology clinic were randomized in a 2:1 ratio to receive care by a PCP with special interest in dermatology or usual hospital outpatient care	The PCP with special interest dermatology service was more accessible with average wait times 40 days fewer than those of the hospital dermatology clinic	The PCP with special interest dermatology service was more accessible than hospital outpatient care while achieving similar levels of patient satisfaction and clinical outcomes
APPOINTMENT SCHEDULING STRAGETIES (10 Results)				
Jayakumar et al (2018), [28], USA	To describe rapid access clinics' operations, referral patterns, and distributions of diagnoses at the University of Pennsylvania	Retrospective review of dermatology consult order and appointment data for an urgent care clinic (UCC), an intermediate care clinic (ICC), and a routine care clinic to determine the number of orders, consult appointments, and follow-up appointments; appointment wait times; and	The median wait times for UCC, ICC, and routine care appointments were 3 days, 36 days, and 45 days, respectively (P<0.001). The proportion of referrals originating from subspecialists varied among UCC (47.6%), ICC (20.2%), and routine care (15.8%),	Dermatology rapid access clinics within an academic medical center can reduce wait times for higher acuity patients while maintaining patient satisfaction

		frequencies of diagnoses in referring provider and consult appointments. Criteria for a UCC appointment included the following high-risk features: immunocompromised status, acute skin condition, vesicular or blistering eruption, suspected severe drug reaction, or suspicious mole. Press Ganey patient satisfaction ratings were also analyzed	(P<0.001). Distributions of diagnoses differed among UCC, ICC, and routine care. Ratings for most satisfaction metrics were similar across clinic settings	
Khoury et al (2018), [33], Denmark	To determine the impact of patient-initiated care consultation (PICC) for patients with psoriasis in a dermatology outpatient clinic	A prospective randomized controlled trial including patients with well-controlled psoriasis on systemic treatment randomized to either (1) a PICC group, in which they participated in one annual consultation with a dermatologists but were able to initiate earlier consultations when needed or (2) a routine care group, in which they participated in a consultation every 12-16 weeks	Patient adherence and safety with treatment monitoring were equal between the groups. Patients in the PICC group requested 63% fewer consultations with a dermatologist (P=0.001) and were significantly better at attending consultations than was the control group (P=0.003). Further, the lower number of consultations within the PICC group did not lead to a higher number of helpline phone calls	When compared with routine care, PICC offers additional clinical benefits of reducing no-shows and unnecessary clinic visits while maintaining levels of patient adherence and safety. The authors associate the fewer missed clinic visits to reduced wait times and increased access to care
O'Brien et al (2016), [37], USA	To evaluate interventions aimed at decreasing patient wait times	Retrospective analysis of the following interventions: (1) discharging patients with stable, low-acuity skin problems (e.g. mild acne) from clinic to follow-up with their PCPs; (2) changing scheduling templates by establishing goal numbers of new and established patients per clinic to increase schedule consistency; (3) hiring 1 additional licensed vocational nurse and extending work shifts of support staff so that sufficient staffing was available throughout the clinic duration; (4) designating a resident and nurse to perform biopsies for the whole clinic to limit clinic delays; and, after 1 year, (5) hiring a PA to support increasing clinic patient volume and maintaining short wait times	From May 2012 to September 2015, the interventions led to a decrease in wait times for new and established patients from 377 to 48 days and from 95 to 34 days, respectively, despite a 10% increase in patient referrals over this time period	Targeted interventions in staffing and patient scheduling can decrease and maintain lower wait times, resulting in expedient access to dermatologic care in a safety net health system

Cronin et al (2014), [32], USA	To determine if algorithmically generated double-booking recommendations can increase patient volume per clinical session without increasing the burden on physicians	Sessions were randomly assigned (1) to "Smart-Booking", an algorithm that generates double-booking recommendations using a missed appointment (no-shows + same-day cancellations) predictive model or (2) to a control arm where usual booking rules applied. Average number and variance of arrived patients per session were measured	257 sessions were randomized to Smart-Booking and 262 sessions to control booking. The mean number of arrived patients per session was higher in the Smart-Booking intervention arm than the control (15.7 versus 15.2, P=0.014). Physicians reported being similarly busy in each study arm	Using individual physician assumptions and predictive modeling, algorithmically generated double-booking recommendations of dermatology clinical sessions can increase the number of arrived patients without overburdening physicians
Knackstedt et al (2014), [29], USA	To create a shared medical appointment (SMA) model for the preoperative consultation visit of Mohs micrographic surgery and to evaluate patient satisfaction and patient per provider hour rates for SMAs compared with conventional appointments	A pilot SMA was implemented. Patient satisfaction was assessed via a 13-question survey over a 6-month period, and attendance was analyzed and compared with conventional appointment attendance	Over a 6-month period, SMA attendance averaged 7 to 8 patients (mean 7.1; range 5-10) per 90-minute period compared to 6 patients that are scheduled in the conventional appointment format for the same time period. Patients found the SMA model useful (84.7%) and would attend another SMA in the future (80.6%)	SMAs can be successfully used for Mohs preoperative consultation visit with high patient satisfaction while increasing the number of patients seen over a given time period
Siddiqui et al (2013), [31], USA	To examine attendance rates of appointments made on the internet for rural and urban dermatology clinics	Retrospective cross-sectional study of appointment records made over a 6-month period (October 1, 2011 to March 31, 2012) on ZocDoc.com for 3 dermatology clinics located outside Houston, Texas	Non-attendance rates appointments that were scheduled online were much lower (6.9%) than non-attendance rates for appointments at dermatology clinics through traditional means (e.g. in person, by phone), which have been reported to range from 17 to 31%	Appointments made online are more likely to have lower non-attendance rates than appointments made through traditional means, yielding more patients seen in a clinic day and expanded access to care
Lipworth et al (2011), [27], USA	To evaluate the ability of an urgent access track (UAT) embedded within a pigmented lesion clinic to provide improved access to care for early melanoma detection	Retrospective review of patient records from the Massachusetts General Hospital Pigmented Lesion Clinic (PLC) and its associated UAT over a 21-month study period. All patients in the PLC are considered to be high risk for melanoma and have been educated to recognize signs of early melanoma	Compared to a mean wait time of 73.4 days for dermatology consultations in the community of the authors, the UAT granted patients access to urgent visits for concerns about new or changing cutaneous lesions or systemic symptoms within 7 days of appointment request. UAT visits were more than 4 times as likely to yield	Analysis of the UAT strategy suggests that UATs have potential to detect melanomas at earlier stages and improve access to care for early melanoma detection among high risk patients

			a diagnosis of melanoma and 25 times more likely to yield a diagnosis of metastatic melanoma compared with routine track visits	
Rouppe van der Voort et al (2010), [34], The Netherlands	To assess whether delays to outpatient specialty care can be solved by improving the way supply and demand are matched	Analysis of interventions applied by 18 clinics using the model of "advanced access" and the effects of the interventions on their delays. Some of the most widely adopted interventions included: forbidding canceling sessions within 6 weeks, proactively filling empty slots by daily scanning, introducing patient-initiated-follow-up appointments, combining diagnostic appointments, performing more follow-up by telephone, having no personal pager during sessions, and delegating medical activities to nurse, NP, PA, or medical assistant	The clinics applied different combinations of 28 interventions aimed at improving the way supply is organized and at reducing unnecessary demand. 14 of 18 clinics showed statistically significant improvements. Their average wait time decreased 55% from 47 to 21 days	Delays in outpatient specialty care can be shorted by improving the way supply and demand are matched using different combinations of 28 interventions in the way that clinics operate
Sidorsky et al (2010), [30], USA	To evaluate the ability for shared medical appointments to expand access to dermatologic care	Calculation of the difference between hourly adjusted census levels and profit between shared medical appointments (SMAs) and mean provider census (MPC) for regular clinic appointments (RCAs)	All dermatology SMAs produced significantly greater differences in hourly adjusted census levels and profit in comparison between SMAs and MPC for RCAs than the respective measures in all other departments (i.e. plastic surgery, gastroenterology, oral health, orthopedic surgery), ($P<0.001$). Over 16 months, 175 dermatological SMAs were conducted. 130 were routine skin checkups, and the others included evaluation for a single lesion, nonsurgical facial rejuvenation, or teenage acne. During this time period the mean difference in census per hour between SMAs and MPC for RCAs was 7.68 patients, which, over the time frame of this study, represents an increase in the rate of dermatology appointments by 1004 appointments per year	SMAs can significantly increase access to care in dermatology when used for routine skin checkups, evaluation of a single lesion, nonsurgical facial rejuvenation, or teenage acne. In addition, these SMAs appear to be more productive and profitable in dermatology than in several other medical specialties

Anderson et al (2007), [26], USA	To assess the impact of the Hershey access clinic, a clinic using advanced or open access scheduling, on patient access and satisfaction	Analysis of a patient questionnaire, patient waiting times, and number of missed appointments after the third year of implementation of the Hershey access clinic. The clinic was in operation one afternoon per week and saw a maximum of 90 patients. Patients were allowed to schedule appointments no sooner than 2 weeks before the open access clinic. Patients who called on the day of the access clinic before 2:00PM were guaranteed an appointment that same day, as long as the maximum of 90 patients had not yet been reached	Over a course of 4 consecutive access clinics, 92 patients (72%) waited 30 minutes or fewer and 27 patients (23%) waited over 30 minutes before being seen. Only 1 patient waited more than 90 minutes. 114 patients (95%) strongly agreed that they were satisfied with the clinic. Waiting times for new and return patient visits at the traditional dermatology clinic remained 4 months and 2 months for new and return patient visits, respectively, despite 3 years of the access clinic. The no-show rate was 10% for both the Hershey access clinic and the traditional dermatology clinic	Open access clinics can provide expedited access to dermatologic care in which patients schedule appointments on the day of or no more than 2 weeks prior to the appointment; however, access clinics may not decrease waiting times at nearby traditional dermatology clinics
TEAM-BASED CARE (2 Results)				
Nambudiri et al (2017), [35], USA	To evaluate the impact of medical scribes on dermatologist documentation time	A 12-month quality improvement pilot program of scribe implementation in which 12 dermatologists received scribe support in 19 weekly half-day general dermatology sessions across 3 clinical sites beginning February 2016	Across 690 pre-scribe time-audited encounters, dermatologists averaged 6.1 minutes of clinical documentation per patient and 75 minutes of documentation per half-day session. Across 695 post-scribe visits, physician documentation time significantly decreased, averaging 3.0 minutes per patient and 36 minutes per session (3.2 fewer minutes per patient encounter; 95% CI, 2.66-3.63; P<0.001). There was a 7.7% increase in revenue comparing each physician's scribe-supported session to unsupported session in the last quarters of 2016 to 2015, respectively, which more than offset the cost of the scribes	Scribes enable dermatologists to achieve real-time documentation, thereby improving physician efficiency and allowing physicians to care for more patients during each clinical session
Kindley et al (2015), [36], USA	To evaluate changes in efficiency and cost-effectiveness with the addition of an LPN/RN	Analysis of the result of one dermatologist at an academic medical institution adding six patient slots to each half day of clinic in exchange for a second LPN/RN. Data was collected over 8 months, with the physician having 1 assistant during the first 4 months and 2 assistants during the second 4 months	There was a 30% increase in completed patient visits, a 39% increase in wRVUs, and a 33% increase in gross payments received with an annual increase of $144,492 in payments	Adding a second LPN/RN to a dermatologist's clinic team can yield a significant increase in completed patient visits, expanding access to dermatologic care