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TELEDERMATOLOGY (D OH, SECTION EDITOR)

Inpatient Teledermatology: a Review

Joseph Mocharnuk[1] · Trevor Lockard[3] · Corey Georgesen[4] · Joseph C English[2]

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Abstract

Purpose of Review Inpatient teledermatology is a rapidly growing field with significant potential to add value and streamline patient care. This review summarizes the current literature on inpatient teledermatology, primarily focusing on its diagnostic and clinical management utility as compared to live dermatologic evaluation.

Recent Findings The COVID-19 pandemic has accelerated the adoption of inpatient teledermatology, which has been shown to be comparable to live hospitalist evaluation for triage, diagnosis, and management of hospitalized patients for a wide variety of conditions. Despite its comparative cost-effectiveness and recent changes in reimbursement practices, inpatient teledermatology still lacks sufficient reimbursement incentive for widespread implementation.

Summary Inpatient teledermatology is an effective, efficient, accurate, and cost-effective means of managing the hospital burden of skin disease, especially in areas where access to dermatologic care is limited. It is essential that dermatologists and referring providers comprehend the use and potential pitfalls of inpatient teledermatology to effectively incorporate it into hospital practice.

Keywords Teledermatology · Store-and-forward teledermatology · Inpatient teledermatology · Dermatology hospitalists · Inpatient teledermatologist

Introduction

Inpatient dermatology is demonstrated to have a significant impact on the care of hospitalized patients with dermatologic conditions and cutaneous manifestations of systemic disease; nonetheless, it remains an underutilized resource in the face of growing demand for hospital-based expertise regarding the recognition and management of skin disorders [1]. A 2014 study aimed at assessing the national burden of adult inpatient dermatology patients reviewed 644,320 hospitalizations primarily related to skin disease, which cost the healthcare system over $5 billion. Furthermore, skin disease is diagnosed in 1 in 8 hospitalized adults, suggesting a significant need for dermatologic expertise on the frontlines of medical care [2]. Meanwhile, hospital discharge rates for dermatology-specific conditions have been increasing on the order of ~ 3% annually in recent years [3].

To help address this need, the Society of Dermatology Hospitalists designated the role of the dermatology hospitalist in 2009 [4]. As of 2017, their membership roster included 145 individuals, and inpatient dermatology has gradually emerged as its own distinct subspecialty [5]. Meanwhile, there has been a proliferation of studies highlighting the value of their services to both patients and health care systems in alleviating the burden (and associated costs) of skin disease [6].

Despite the growing ranks of trained hospitalist dermatologists, their numbers are still insufficient to meet the burden of inpatient skin disease at the 6090 hospitals in the USA [7]. Only 40% of general dermatologists reported performing inpatient consults, and 14% spent less than one hour a week in active hospital consultations in 2009 [8]. Furthermore, most dermatologists remain geographically concentrated in urban areas, and a majority of those who perform inpatient

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✉ Joseph C English
englishjc@upmc.edu

1 School of Medicine, University of Pittsburgh, Wexford, PA 15090, USA

2 Department of Dermatology, University of Pittsburgh, Wexford, PA 15090, USA

3 School of Medicine, University of Nebraska, Lincoln, USA

4 Department of Dermatology, University of Nebraska, Lincoln, USA

consults are employed at academic medical centers. The urban/rural practice divide among dermatologists is further exacerbated by market forces driving younger trainees to practice in metropolitan areas with great procedural and elective cosmetic demands, though the exact breakdown of general, medical, and cosmetic dermatologists in urban vs. rural locales is difficult to ascertain [9]. This trend puts rural hospitals (whose access to community dermatologists is already significantly limited) at greater risk of shortages in inpatient dermatologic care [10–12, 13•, 14].

Inpatient Teledermatology (IPTD)

In light of these challenges and limitations, teledermatology has emerged as a powerful tool in the armamentarium of the inpatient dermatologist. Several studies have demonstrated the use of teledermatology as a triage tool to assist academic dermatology hospitalists with managing their inpatient services [11, 15, 16••]. Because most studies are conducted at tertiary centers, some authors caveat that their findings on the efficacy of ITPD may not be generalizable to community hospitals [17]. Though seen mostly as a triage mechanism still requiring in-person visits [18], studies have noted full inpatient teledermatology consultation is also effective for urban and rural areas with no access to a dermatologic specialist [19••].

As outlined in a 2014 paper, if IPTD is to be fully adopted in hospitals across the USA, its potential to improve care efficiency, cost-effectiveness, and access must be validated [20]. Therefore, the primary purpose of this review is to investigate the current literature on IPTD with a particular focus on the utility of store-and-forward teledermatology (SAFT) for diagnosis and management of skin disease as compared to face-to-face consultation. Given that most teledermatology research focuses on outpatient settings, extrapolation of SAFT research to inpatient settings may be indicated and is noted where necessary.

IPTD: Background

Inpatient teledermatology, a burgeoning field with a small but growing body of literature (only 27 articles available on PubMed at the beginning of 2022) on its history and clinical uses, was developed to address the inpatient burden of skin disease and to improve hospitalized patients' access to dermatologic care. Though teledermatology is still considered underutilized, 55% of physician members of the Society for Dermatology Hospitalists report using teledermatology for both inpatient and outpatient consultations, with approximately 65% of respondents stating that they thought inpatient teledermatology could be best used to triage consults before assessing patients in person [10]. However, most inpatient dermatologists work at academic institutions in major urban settings, creating a significant gap in dermatologic care for some populations, especially those served by rural hospitals [13•]. While the promise of IPTD has yet to be fully realized, IPTD with SAFT offers a viable means for ameliorating healthcare access inequities [19••, 21]. Concerns about the diminished efficacy of IPTD relative to face-to-face visits for the diagnosis and management of skin disease are largely unfounded, with several survey studies demonstrating consistent patient and provider satisfaction with outpatient and inpatient teledermatology consultation [21, 22].

IPTD: COVID

Beginning in the spring of 2020, the COVID-19 pandemic accelerated the widespread adoption of teledermatology as hospitals sought to minimize viral transmission from in-person visits [23]. Many services considered to be non-essential were either discontinued or adapted to a virtual format, and previously underutilized electronic medical record applications for virtual and electronic visits quickly gained traction with providers [23]. Some hospitals in the USA as well as internationally (e.g., Singapore, Saudi Arabia) transitioned their dermatology visits to virtual encounters through teledermatology platforms [16••, 22, 23, 24•, 25, 26]. This switch was largely successful, with one study recognizing that the transition helped preserve scarce personal protective equipment (PPE) in the early months of the pandemic and spurred providers to work more efficiently and collaboratively [24•]. Teledermatology has become an essential, established tool for the outpatient and inpatient dermatologist during the current pandemic environment and beyond [27]

IPTD: Mechanism of Action

There are two primary forms of teledermatology practice: real-time videoconferencing (synchronous) and store-and-forward teledermatology (SAFT). Some dermatologists have also used hybrid teledermatology, a combination of these two approaches. SAFT is a form of asynchronous medicine consisting of a digital image upload by a non-dermatologist practitioner for later analysis and interpretation by a dermatologist. Overall, SAFT is the more popular of the two teledermatology approaches [28]. Its dominance in outpatient settings is attributable to lower cost, greater flexibility in the coordination of care (i.e., the patient, primary provider, and consulting dermatologist need not be available at the same time), and its capitalization on advances in digital technology, including near-ubiquitous cell phone usage, improvements in and ease of digital photography, and widespread access to the internet, allowing for seamless uploading of

high-resolution images of skin disease [29]. These benefits extend to inpatient teledermatology practice, as well.

For maximum effectiveness of SAFT care, it is recommended that the dermatologist providing diagnostic and treatment recommendations also follow-up through a phone conversation with the referring hospital provider and consultation notes appended to the patient's electronic medical record [17]. In previous studies, SAFT has been shown to not only decrease time to diagnosis and treatment but also reduce the number of unwarranted clinic-based follow-up visits without compromising the quality of care and while also improving patient access to outpatient and IPTD [24•, 30, 31].

IPTD: Accuracy

While teledermatology is comparably accurate to live dermatologic care in the outpatient setting, diagnostic and management accuracy is perhaps even more critical in inpatient settings, where patients are often treated for emergent and potentially life-threatening conditions [11]. Though live, in-person evaluation remains the gold standard for dermatologic care [18, 32], teledermatology can play an important and sometimes vital role. However, several factors can hinder accurate teledermatologic care, including technology failures, poor photographic technique, and missing patient history, all of which may contribute to diagnostic and management discrepancies between teledermatologists and their live dermatologist counterparts [33]. Some studies have questioned the accuracy of teledermatology on the grounds that it may miss crucial details when a patient's skin is incompletely or improperly photographed (i.e., incidental melanoma) [34, 35]. Though these concerns are worth considering, others have found that store-and-forward inpatient teledermatology using only smartphone cameras is comparable to face-to-face care, and in one illustrative example, staff members at the Singapore General Hospital who did not have any formal photographic training were able to achieve an 89.2% diagnostic concordance between inpatient SAFT and live dermatologic examination [26, 35]. Even where teledermatologic consultations are not perfectly accurate, they are substantially better than if patients were to receive no dermatology consultation at all, as supported by the frequent diagnostic, management substitution and accretion when patients are referred to the care of dermatologists after first being evaluated by non-dermatology physicians [36, 37]. Patients with complex medical dermatologic conditions and severe adverse cutaneous reactions can receive appropriate diagnostic, therapeutic management and appropriate triage (i.e., burn unit) from IPTD without a live interaction [19••, 38–40, 41•]. Live consultative dermatologists agree more frequently with inpatient teledermatologists than they do with hospitalists, and multiple studies have demonstrated that teledermatology concurs with the gold standard diagnosis and treatment of face-to-face dermatology between 81 and 88% of the time [15, 17, 35].

IPTD: Effectiveness

In addition to being an accurate means of patient evaluation, teledermatology is also demonstrably effective in inpatient settings and, as previously mentioned, is of significant value in rural areas with no access to dermatologic care [13•]. Several studies have illustrated a high degree of diagnostic, evaluative, and management concordance of various skin conditions (e.g., psoriasis, atopic dermatitis) between teledermatology and in-person consultation, while others have illustrated that teledermatology may be equally, if not more, effective in the management of certain skin diseases [42].

A recent prospective cohort analysis of 27 dermatology hospitalists at large, urban tertiary care centers exhibited a high degree of interrater reliability between in-person and teledermatology assessment in terms of differential diagnosis, laboratory evaluation decisions, imaging decisions, and treatment, albeit with a lower degree of agreement in biopsy decisions and follow-up planning [16••].

IPTD: Cost-effectiveness

Teledermatology holds significant promise for cost reduction. A systematic review of eleven studies yielded nine that found store-and-forward teledermatology to be more cost-effective than face-to-face dermatology consultation and two which found it to be equivalent to the cost of face-to-face consultations [29]. However, savings per patient ranged from $2.39 to $261 and mostly stemmed from regained time and increased productivity rather than through a direct reduction in the cost of care [30, 43, 44]. Given this data, institutional practices and policies will play a key role in determining how cost-effective the implementation of SAFT can be. While more specific research is needed regarding inpatient SAFT's impact on hospital costs, inpatient dermatology has been shown to decrease discharge by 2.64 days and to decrease readmissions by tenfold [36]. One study illustrated that inpatient dermatology evaluation for presumed cellulitis decreased patients' hospital stay by an average of 2.1 days and estimated that such reductions could save the US healthcare system $210 million annually [45]. Another noted early inpatient dermatology intervention can reduce cost by decreasing antibiotic use [46]. These can be extrapolated to ITPD, but studies are lacking. However, Georgesen et al. [19••] demonstrated that antibiotic misuse occurred in 76% of inpatients initially thought to have cellulitis (no monetary savings discussed) and that the use of inpatient teledermatology consulted for SJS/TEN saved $32,000 by

avoiding unnecessary ambulance transfer to academic burn centers due to incorrect hospital team diagnosis [41•].

IPTD: Efficiency

Aside from its potential to improve access to care, teledermatology can also make for more efficient diagnosis and management of skin disease. A retrospective analysis comparing 11,586 patients at Zuckerberg San Francisco General Hospital divided into two cohorts, those admitted prior to the implementation of teledermatology services and those admitted after the implementation of teledermatology, saw significant decreases in patient waiting times, increases in total cases evaluated per month, and increases in the number of cases evaluated per dermatologist-hour with the introduction of teledermatology [47•]. Additionally, after the implementation of teledermatology services, 61.8% of consults were managed without a clinic visit [47•]. Similarly, a prospective study from 2014 highlighted the potential use of teledermatology as a triage tool to bifurcate cases into non-urgent cases versus emergent cases requiring immediate in-person consultation [15]. This analysis noted substantial concordance in the decision of in-person dermatologists and teledermatologists to biopsy skin lesions. Furthermore, teledermatologists were able to triage 60% of consultations to be seen the next day or later and, on average, were able to triage 10% of patients to be seen as outpatients after discharge. These studies effectively demonstrate the capacity for teledermatology to streamline patient access by at least improving clinical workflow efficiency [15].

IPTD: Quality

The accuracy of IPTD has already been established, but its quality beyond diagnostic utility should also be considered. In 2017, the American Telemedicine Association (ATA) published teledermatology guidelines to ensure quality service and patient care [48]. The ATA recommends HIPAA-compliant information security, sufficient technological specifications, and proper photographic techniques in addition to a thorough patient history for optimal use and results [48]. In practice, these guidelines have been effective in quality assurance, as surveys of patients, providers, and consulting teledermatologists have revealed consistently high satisfaction with inpatient teledermatology [21, 22].

To ensure quality inpatient teledermatology care, adequate training for both referring staff and the dermatologist consultant is needed. Just 47% of US dermatology residencies include training in teledermatology. Even despite lack of training for younger dermatology residents, they a a group are more comfortable managing patients via teledermatology then seasoned dermatologists [49, 50]. Though quality standards for teledermatology have been implemented, additional telemedicine training for physicians will enable further improvements.

IPTD: Outcomes

Inpatient dermatology has shown to improve outcomes for inpatients admitted for cellulitis [45, 46, 51]. An important and glaring finding was that cellulits was misdiagnosed, ranging from 30 to 74% of the time. IPTD had identified misdiagnosis in 89.3% of 103 presumed cellulitis referrals [19••]. A similarly high rate of misdiagnosis among non-dermatologist referring providers (Table 1) as compared to both inpatient dermatology and IPTD consultation has been seen in conditions including SJS/TEN, leg ulcers, erythroderma, vasculitis, and VZV. Both live consulting dermatologists and teledermatologists have demonstrated improved inpatient care simply by making the correct diagnosis (as demonstrated by improved patient outcomes). Thus, the lack of dermatologic education among non-dermatology healthcare providers should be of concern to our specialty, especially in hospitalists employed at community hospitals who seem to have less diagnostic acumen and experience than their urban, academic hospitalist counterparts.

Table 1 Outcomes of inpatient teledermatology versus dermatologist hospitalist (live) evaluation for various skin conditions

Condition	% Cases in which inpatient teledermatologist changed the diagnosis from a primary care team	% Cases in which dermatology hospitalist changed the diagnosis from a primary care team
Cellulitis/abscess	89.3% [19••]	30–74% [5, 45, 46, 51]
SJS/TEN	97% [41•]	71.6% [55]
Leg ulcers	86.4% [52]	45% [56]
Erythroderma	78.8% [53]	*No data available
Vasculitis	89% [54]	33% (includes vasculopathy) [5]
VZV	82% [54]	42% (includes other viral exanthemas) [5]
Immunobullous disease (i.e., pemphigus vulgaris and bullous pemphigoid)	84.9% [54]	100% [17]

IPTD: Other Uses

Beyond direct clinical use, store-and-forward teledermatology is also well suited to clinical education. An analysis of internists providing patient care in a Midwestern hospital demonstrates the need for education and training of internal medicine physicians in the identification of dermatologic conditions [38]. Programs such as those at UPMC Mercy Hospital in Pittsburgh, Pennsylvania, are pioneering education of internists through expert teledermatologist consultation via UPMC's teledermatology platform [39]. Among resident dermatologists, teledermatology as a teaching tool can provide significant educational benefit, as diagnostic concordance between dermatology residents and attendings was found to be fully concordant only 53% of the time [40]. For many residency programs, teledermatology is a required component of the curriculum; however, the ACGME has not codified this as a requirement for all training institutions [57]. Both dermatology residents and medical students agree that teledermatology education benefits their medical knowledge, diagnostic capabilities, and confidence in patient management. However, they report a much lower satisfaction rate with its utility in improving professionalism and interpersonal communication [58]. Inpatient teledermatology as an educational tool is, therefore, best suited for the development and reinforcement of clinical knowledge in combination with other educational modalities.

IPTD: Advantages and Disadvantages

As summarized in Table 2, teledermatology has unique advantages and disadvantages. Because it does not require the patient and provider to be physically present or concurrently available, teledermatology provides faster and more cost-effective care [19••, 41•]. It increases access to dermatologic expertise for hospitals without or with dermatologic hospitalists and, as previously mentioned, can be useful for patient triage [11, 15, 19••, 20, 59]. Real hospital cases can effectively be used for the education of dermatology residents and even the referring primary care team [39, 58]. Furthermore, in the circumstances such as the current pandemic, where physical face-to-face exposure carries inherent risk, teledermatology is a safe, effective alternative to an in-person consultation.

On the contrary, teledermatology requires access to secure technology capable of capturing and transmitting high-quality photographs. Additionally, in cases where patient history is sparse or in which physical palpation would significantly aid diagnosis, teledermatology may be a suboptimal approach [34, 58]. For some complex patient populations, prior face-to-face experience seems to be required to conduct a remote evaluation in a high-quality manner, including full-body skin exams, so as not to miss potentially life-altering diagnoses [34, 60]. Reimbursement for teledermatologic consultation is currently insufficient to incentivize care [61]. Additionally, states vary in whether they allow a physician licensed in another state to practice without additional certification. To improve interstate care, states have passed legislation to join membership as part of the Interstate Medical Licensure Compact, which currently includes 29 states and Guam [62].

IPTD Reimbursement

Recently approved Current Procedural Terminology (CPT) codes for electronic (SAFT or asynchronous) consultations have laid the groundwork for more widespread use [63]. These codes include the following: 99451 for when the provider, a consultant, spends five or more minutes evaluating a patient's medical condition via various electronic media and prepares a written report for the referring provider; 99452 for when the provider, a treating or requesting physician or other qualified healthcare professional, spends 30 min providing healthcare information about a patient to a consultant via various electronic media; and 99446 for when a consulting physician performs a 5–10 min consult via telephone, internet, or electronic health record (EHR) and provides a verbal and written report to the requesting physician/qualified healthcare provider (addenda are 99447 for 11–20 min consult, 99448 for 21–30 min, and 99449 for 31 or more). The new CPT codes 99451–99452 and 99446–99449 have payment ranges from about $18 to about $73, depending on the time involved. Interprofessional services provided under these codes can only be billed by

Table 2 Advantages and Disadvantages of Inpatient Teledermatology

Advantages	Disadvantages
Faster, cost-effective care	**Underutilization in part due to provider skepticism**
Increased access to care, especially in resource-limited areas	**Requires access to good-quality technology**
Useful for patient triage prior to admission or before transfer	**Possible limited patient history and no palpation or physical exam maneuvers**
Shorter hospital stays and lower odds of readmission	**May miss incidental lesions if no full-body exam is done**
Cases can later be used for education	**Reimbursement is at best poor**
No risk of disease exposure of or to the patient	**State licensure requirements vary and may prevent interstate consultations**

qualified Medicare practitioners, and the patient's verbal consent must be noted in the patient's medical record given that these services will be performed when the beneficiary is not present, and cost-sharing will apply [61, 64]. These codes can be used for outpatient and inpatient e-Consults. Neither 99451/2 nor 99446/9 accounts for billing differences based on the degree of medical decision-making, and codes 99451/2 also fail to account for differing amounts of time spent by the provider. Reimbursement for the most complex code, 99449, is roughly on par with that of the least complex office visit [61]. In order to be compensated a more reasonable amount and to cover overhead (administrative, IT costs), UPMC developed service contracts based on hospital bed size and set fee per number of consults per month. For synchronous (virtual) teledermatology, COVID has prompted emergency use authorization for in-person office visit CPT codes 99211–99215 with a 95 modifier for outpatient and 99251–99255 with 95 modifier for inpatient virtual or synchronous telemedicine consults. Although synchronous teledermatology, with reimbursement similar to in-person visits, due to its inherent inefficiency and lack of popularity, prevents any gain when compared to SAFT. Representation of teledermatologists at governmental organizations (CMS) to increase the 99451/99446 codes physician fee will be crucial for advancing inpatient teledermatology in rural and community hospitals nationwide.

Conclusion

The field of inpatient teledermatology has emerged from a growing need for dermatologic expertise in the hospital setting. While there is plenty of evidence to support the need for dermatologic care within hospitals and even of inpatient SAFT as a potential solution, there is still comparatively low adoption of this approach. IPTD is an effective, accurate, and cost-saving resource available for patients and health care systems alike. However, barriers to implementation remain, including the potential for misdiagnosis without full-body skin exams or due to inadequate photo quality, as well as reimbursement concerns stemming from the poor regulatory structure and limited interstate licensure opportunities. Despite these shortcomings, inpatient teledermatology is rapidly emerging as a method for improving patient outcomes in areas where access to a dermatologist hospitalist care is limited. Its use and adoption are expected to continue significantly benefiting patients in the future.

Compliance with Ethical Standards

Conflict of Interest The authors declare no competing interests.

Human and Animal Rights and Informed Consent 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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